Education and Income Inequality Reconsidered:
A Cross-Country Analysis of Data from 1960-2000

Eunju Kim*

Abstract: Recent comparative inequality studies have addressed not only income but also other dimensions such as education and health inequality. Education has been believed to play a critical role in the nexus of inequality and growth. This study examines whether education distribution has an effect on income inequality. It empirically analyzes the relationship between education inequality and income inequality using quinquennial panel data from 100 countries for 1960-2000. The results show that education inequality and income inequality have a nonlinear, inverted-U-shaped relationship. This relationship appeared more consistently in developing countries. These findings suggest that educational opportunities should be more equally provided for better income distribution, especially in developing countries.

Keywords: education inequality, income inequality, education Gini, comparative inequality studies, panel analysis

INTRODUCTION

Income inequality and its effect on economic outcomes have been major sources of concern for many scholars. Some argue that income inequality is actually favorable to economic growth, since it can work as a conduit for capital accumulation and investment (Forbes, 2000). Others argue that reducing inequality promotes economic growth for two reasons: (1) inequality tends to promote a higher level of redistribution in

democratic societies, which in turn could reduce the incentives for investment (Alesina & Rodrik, 1994; Perotti, 1992; Persson & Tabellini, 1994), and (2) imperfect capital markets with inequality will prevent human capital accumulation by the poor majority (Galor & Zeira, 1993, Perotti, 1996).

A recent attempt to reconcile these two schools of thought argues that the relationship between inequality and growth is not linear. Rather, in the early stages of development, physical capital accumulation is the primary source of economic growth, and inequality enhances growth by channeling resources to individuals whose marginal propensity to save is higher. But in later stages of development, physical capital is replaced by human capital as the engine of growth, and increasing equality reduces credit constraints on human capital accumulation and thus can prompt the growth process. Therefore, inequality is accompanied by growth in developing countries, while greater equality is accompanied by growth in developed countries (Galor & Moav, 2006).

Education also seems to play a critical role in the nexus of inequality and growth. As Deininger and Squire (1996) noted, lack of financial credit constrains educational investment and weakens the poor. It is also argued that constraints on borrowing to pay for education are the main reason that income inequality is negatively related to economic growth (Checchi, 2003). These studies suggest that inequality affects economic growth through an interaction between imperfect credit markets, asset inequality, and human capital accumulation (Castelló & Doménech, 2002).

Many governments invest in education, especially primary education, since it has been recommended as an effective policy tool for reducing poverty and income inequality (Nielsen, 1994; Sylwester, 2002). However, following the rapid expansion of school enrollment in developing countries, there has been disillusionment with the apparent failure of education to provide the expected rapid results (Hall & Midgley, 2004). As a result, early optimism about education as a social policy instrument diminished. In addition, educational expenditure by developing countries slowed in the 1980s due to structural adjustment programs introduced by the World Bank and International Monetary Fund, which made economic liberalization (for example through privatization or deregulation) a condition of new loans and encouraged govern-ments to reduce spending on education and social programs.

However, international efforts in the 1990s, such as Education for All and the World Summit for Children, focused attention on basic education again. These efforts continued in the Millennium Development Goals (MDGs), which emphasized universal primary education and other forms of social development for poverty reduction. In spite of these efforts, many developing countries are still far from achieving universal primary education, especially in South Asia and sub-Saharan Africa. Even though the MDG targets for primary education have been relatively well achieved overall,

education inequality between and within nations has emerged as a major policy issue in the international development community. Therefore, further studies on education for development are critically needed.

Most such studies have focused on the relationship between educational attainment and economic growth at the macro level. Few have examined the relationship between education distribution and income distribution, and no obvious conclusion has been reached on the relationship between education and income inequality. This study aims to provide some empirical evidence by analyzing the relationship between education and income inequality. It examines whether education inequality affects income inequality by analyzing panel data from 100 developed and developing countries.

This article presents a review of previous studies on inequality, focusing on education and income inequality, explains the data and research methods used in this study, and then examines the relationship between education inequality and income inequality. It concludes with a brief discussion on policy implications, especially for developing countries.

EDUCATION INEQUALITY AND INCOME INEQUALITY

Recent Trends in Comparative Inequality Studies

During the last decades, comparative inequality studies have focused on debates about convergence versus divergence of income inequality across countries. Scholars have examined trends of world income inequality, comparing within-nation inequalities and between-nation inequalities using various indicators such as the Gini index and Theil's T coefficients. One strand of research argues that inequality across the world has converged in that between-nations income differences have diminished while within-nation inequalities have grown (Goesling, 2001). Another strand suggests that world income inequality has increased, especially during the 1980s (Korzeniewicz & Moran, 1997), and resulted in global inequality between North and South. It has also been asserted that the most developed countries have been converging while the least developed countries diverge (Breedlove & Nolan, 1988).

While these studies focused on income inequality, recent studies have explored additional dimensions of inequality, including education or human capital as well as health. Education inequality has been a special focus since Glomm and Ravikumar (1992), Saint-Paul and Verdier (1993), and Galor and Tsiddon (1997) demonstrated that inequality is mainly determined by the distribution of human capital. Although it has been recognized as a crucial explanatory factor for income inequality, little is yet

known about the effect of education inequality on economic growth and income inequality.

Relationship between Education and Economic Growth and Equality

Regarding the complex relationships between education, economic growth, and inequality, previous studies have focused primarily on educational attainment. A growing number of studies have analyzed the relationship between average educational level and the economic growth rate, arguing that higher educational attainment contributes to economic growth (Cohen & Soto, 2007; Lee & Barro, 2001; Schultz, 1961). This proposition is considered axiomatic in the field of development studies; it led developing countries to invest in education as a prerequisite for economic growth.

There is also evidence that educational attainment affects income inequality. Barro (1999) empirically examined the relationship between educational attainment and income inequality and found that the effects are different for different levels of education, with primary education having statistically significant negative effects on income inequality but higher education having a positive relationship with income inequality. His research is meaningful in that it tries to find implications for how education influences income inequality and implies a nonlinear relationship between two. But it did not show conclusive results in terms of overall educational effects on income inequality.

Other studies found that income inequality negatively affected educational attainment. Filmer and Pritchett (2001) argued that asset poverty reduced school attainment in the poorest 40 percent of the population. Flug and colleagues (1998) found that secondary school enrollments were affected negatively by income inequality. Checchi (2003) also asserted that enrollment rates and measures of income inequality were negatively correlated so that greater income inequality reduced access to school. These studies explored the relationship between educational attainment and income inequality, but they focused only on overall educational attainment, such as years of schooling or enrollment rates.

Multidimensional Inequality: Education Inequality and Income Inequality

Other scholars focused on education inequality across the world. For example, Lopez, Thomas, and Wang (1998) created an educational distribution index that addresses the distribution of human capital in each nation. They attempted to measure education inequality in various countries and then established the education Gini index, a quinquennial data set of 145 countries from 1960 to 2000 (Lopez, Thomas, & Wang, 1998; Thomas, Wang, & Fan 2001, 2002). They also examined the relationship

between education inequality and the GDP growth rate in 85 countries from 1960 to 1990. The results showed that education inequality has a significant negative relationship with GDP per capita growth. This means that more equal education opportunities can contribute to a higher economic growth rate. This research, however, had limited statistical ability to show causality in that it did not control any other explanatory variables that may affect economic growth. Castelló and Doménech (2002) provided further empirical evidence using their human capital inequality indicators. They examined statistical models with many control variables and then argued that human capital inequality has negative effects on economic growth rates indirectly via investment rates.

Another strand of research sought to extend the academic focus toward multidimensional international inequality. Goesling and Baker (2008) developed international inequality studies identifying health and education inequality data for more than 100 countries. They found that income inequality and education inequality have declined since the 1980s while health inequality has increased, showing a U-shaped trend. This is a very important attempt to connect the three dimensions of inequality, but the causality among those different dimensions remains a challenge for future research.

Few studies have scrutinized the direct relationship between education distribution and income distribution. Checchi (2001, 2003), one of the few researchers to focus on this aspect, concluded that the education and income Ginis have a nonlinear relationship (a U-shaped curve) and average human capital has a negative relationship with income inequality. In addition, he examined the relationships between two variables across different regions and concluded that education distribution is statistically significant only for OECD (Organisation for Economic Co-operation and Development) countries, Latin America, and sub-Saharan Africa (Checchi, 2001). However, these results are inconclusive in that they do not confirm whether the relationship can be true only in some specific regions or whether it can be generally applied across the world.

Causality from Education Inequality to Income Inequality

This article analyzes the relationship between education inequality and income inequality. The literature reviewed above suggests that education lowers income inequality because it offers ordinary people the opportunity to participate in economic activity and thus helps reduce the income gap. The relationship between these two dimensions of inequality can be nonlinear, because the effect of education inequality can be different depending on its level. Drawing on Barro's (1999) explanation that primary and secondary education affect income inequality differently, the following hypothesis can be proposed:

> **Hypothesis 1:** Reducing education inequality will reduce income inequality. The two variables may have a nonlinear relationship depending on the level of education inequality.

In addition, the marginal effect of education can be assumed to be different in developed and developing countries, following the logic of Klasen (2002), who found that education affects developing countries more than developed ones because its marginal effect is bigger in developing countries. The structure of inequality can also be considered different in developed and developing countries. For example, as previous studies have suggested, income inequality has converged among developed countries but diverged among developing countries. The relation between education inequality and income inequality might be different in developed and developing countries. Thus, the second hypothesis takes into account the level of economic development:

> **Hypothesis 2:** The effect of education inequality on income inequality may vary depending on the level of economic development.

DATA AND METHODS

Data

This study used panel data from 100 countries for 1960-2000. It employed World Bank education inequality data that measured the education Gini index. Previous studies that tried to measure education inequality only used school enrolment data, but this could not accurately measure education achievement. For example, in developing countries, many students enroll in school but cannot graduate because of financial constraints. Thus, a more accurate measure of education inequality would be final educational achievement rather than simple enrolment rates. A key World Bank study (Thomas, Wang, & Fan 2001) measured education Gini coefficients based on school attainment in the total population over 15 years old and then established a quinquennial panel data set for 1960-2000.[1] As the independent variable is quinquennial, a panel data set was established for this study with five-year time intervals for 1960-2000.[2]

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1. The original authors kindly provided Gini data for education.
2. This includes educational information for 1965, 1970, 1975, 1980, 1985, 1990, 1995, and 2000. Since Barro and Lee's educational attainment data were established in a quinquennial time frame, other data sets apply the same time frame to enable international comparisons. Arguably, it is necessary to consider the long-term effects of education on income, because

The dependent variable for this study is the income Gini index. The statistics most widely used in comparative income inequality research are the Deininger and Squire Data (D&S data), an income inequality index from 135 countries. These data have been used by a number of distinguished studies, but they have also been criticized because a country's Gini coefficient can vary depending on whether it is calculated based on expenditure or income data, net or gross income data, and household or per capita data. Even though they meet three key criteria for high-quality data—coverage of all types of income, coverage of urban and rural areas, and focus on households rather than individuals—the D&S data still need to be used with care. Moreover, it is difficult to conduct panel research with D&S's high-quality data because the number of observations in that category is smaller, 693 out of the total of 2,633 (Galbraith & Kum, 2005).

Useful alternative data for an income Gini are provided by the Estimated Household Income Inequality Data (Galbraith & Kum, 2005), which estimate manufacturing pay inequality based on the Industrial Statistics database published annually by the United Nations Industrial Development Organization.[3] This data set is useful for cross-country comparisons because it includes more than 3,000 Gini data from both developed and developing countries. In addition, it estimates all Gini indexes based on the same analytical unit, household gross income, and thus is more reliable than other data. Thus, this study used the Estimated Household Income Inequality Data to examine educational effects on income inequality for a more consistent estimation.[4]

To find plausible causality between education inequality and income inequality, it is necessary to control other variables that may affect income inequality. According to traditional cross-country inequality studies, income inequality can be explained mainly by factor endowments, such as land, labor and capital resources. Since Atkinson (1997) proposed this, independent variables such as land, skilled labor force, and capital have been used in quantitative inequality studies. According to conventional wisdom, land (measured as arable land per worker) and capital (measured as capital stock per worker) may have a positive relationship with the income Gini index in that physical capital is

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education as well as other factors affect economic outcome over time—for example, 10 or 20 years later. However, this study uses the education Gini, which was measured by school attainment in the total population over 15 years old. Thus, it is a stock variable and can show distribution of education in the whole society cumulatively. Thus, I did not use any lagged education inequality variable in this panel analysis because it already included long-term information on education distribution and thus can be compared with the dependent variable for the same time period.

3. Alternative income Gini data were also kindly provided for this study by the authors.

4. To find more explanation for UTIP inequality data, see Kum (2010).

usually distributed among a relatively small number of people. But human capital (the skilled labor force) has been assumed by traditional inequality studies to reduce income inequality. In this line of thinking, this study used the World Development Indicator of arable land per person (World Bank, 2011). It also used capital stock per worker (Nehru & Dhareshwar, 1993), dividing total capital by the size of the economically active population (15 to 64 years old).[5] To represent human capital, it used skilled labor, measured as the percentage of the population aged 25 or older that had completed a secondary school education. This followed definitions presented in previous studies and was based on Barro and Lee's (2010) education data.

In addition to factor endowments, globalization may also affect income inequality; previous empirical studies proved that trade openness aggravated income Gini controlling other explanatory variables (Spilimbergo, Londoño, & Székely, 1999). Thus, this study employed trade openness, measured as the proportion of exports and imports of total GDP as reported in the Penn World Table 7.1 data set (Heston, Summers, & Aten, 2012).

The level of economic development also has strong correlation with inequality. In cross-country inequality studies, the Kuznets hypothesis of an inverted U-shaped relationship between economic growth and income distribution has long been dominant.[6] Following this tradition, this study included GDP per capita and its squared value as control variables. GDP data also come from the Penn World Table 7.1 data set (Heston, Summers, & Aten, 2012).

To determine a more robust causality, this study also included government social spending as a control variable. It is believed that social programs can transfer more income to the poor and reduce inequality, and thus some studies include social spending to assess its effect on income distribution (Gupta, Davoodi, & Alonso-Terme, 2002). This study included government consumption data from the Penn World Table 7.1 data set (Heston, Summers, & Aten, 2012).[7]

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5. These data are only available until 1990.

6. Some empirical studies criticize the Kuznets curve, arguing that there is a lack of evidence for it, and suggest other functional forms—for example, the inverse of the level of income (Anand & Kanbur, 1993; Bruno, Ravallio, & Squire, 1996; Deininger & Squire, 1998). However, another study found no difference between analyses of inequality controlling GDP and its squared term, like Kuznets, and other functional forms (Spilimbergo, Londoño, & Székely, 1999). This study was not intended to verify the Kuznets curve itself. It used GDP per capita and its squared term as control variables, in line with the traditional approach.

7. Another possibility would be to use government spending on education and health as a control variable. However, missing data, a common problem especially in developing countries, could seriously limit the number of observations. Thus, this study used government spending as the proxy variable for measuring government efforts to address social problems.

Table 1. Basic Statistics

Variable	Observation	Mean	SD	Minimum	Maximum
Dependent variable: income Gini	691	40.65	7.00	20.06	64.25
Independent variable: education Gini	878	48.17	21.25	12.19	99.10
Control variable: GDP per capita (log)	822	8.27	1.27	5.08	10.72
Land—arable land per person (hectares)	846	0.36	0.42	0	3.44
Capital—capital stock per worker (log)	544	11.07	3.06	-2.01	18.23
Human capital—% of population with a secondary education	855	10.42	10.23	0	47.10
Trade openness (% of GDP)	822	56.72	41.72	4.41	339.80
Government consumption (% of GDP)	822	9.76	5.93	0.32	47.45

This study is based on data from 100 developed and developing countries. Table 1 presents basic statistics for the variables used in the study. The appendix provides a full list of countries (table A1) and more details about the definitions of and data sources for dependent, independent, and control variables (table A2).

Methods

A multi-regression analysis can help identify the causal relationship between educational inequality and income inequality. This study began with pooled-OLS regression followed by regression controlling time as a dummy variable. Finally, it carried out panel regression with a fixed-effects model. Especially in cross-country research, it is preferable to use a fixed-effects model for consistent estimation to control unobserved characteristics that might be related to the error term. Pooled-OLS and panel regression equations were as follows:

$$(1)\ \text{Income Gini} = \beta_0 + \beta_1 \text{Edu Gini} + \beta_2 \text{Edu Gini}^2 + \beta_3 \text{GDP} + \beta_4 \text{GDP}^2 + \beta_5 \text{Land} + \beta_6 \text{Capital} + \beta_7 \text{Human Resources} + \beta_8 \text{Openness} + \beta_9 \text{Gov. spending} + e$$

$$(2)\ \text{Income Gini} = \beta_0 + \beta_1 \text{Edu Gini} + \beta_2 \text{Edu Gini}^2 + \beta_3 \text{GDP} + \beta_4 \text{GDP}^2 + \beta_5 \text{Land} + \beta_6 \text{Capital} + \beta_7 \text{Human Resources} + \beta_8 \text{Openness} + \beta_9 \text{Gov. spending} + \beta_{10} \text{Year Dummy} + e$$

$$(3)\ \text{Income Gini}_{it} = \beta_0 + \beta_1 \text{Edu Gini}_{it} + \beta_2 \text{Edu Gini}^2_{it} + \beta_3 \text{GDP}_{it} + \beta_4 \text{GDP}^2_{it} + \beta_5 \text{Landit} + \beta_6 \text{Capital}_{it} + \beta_7 \text{Human Resources}_{it} + \beta_8 \text{Openness}_{it} + \beta_9 \text{Gov. spending}_{it} + u_i + e_{it}$$
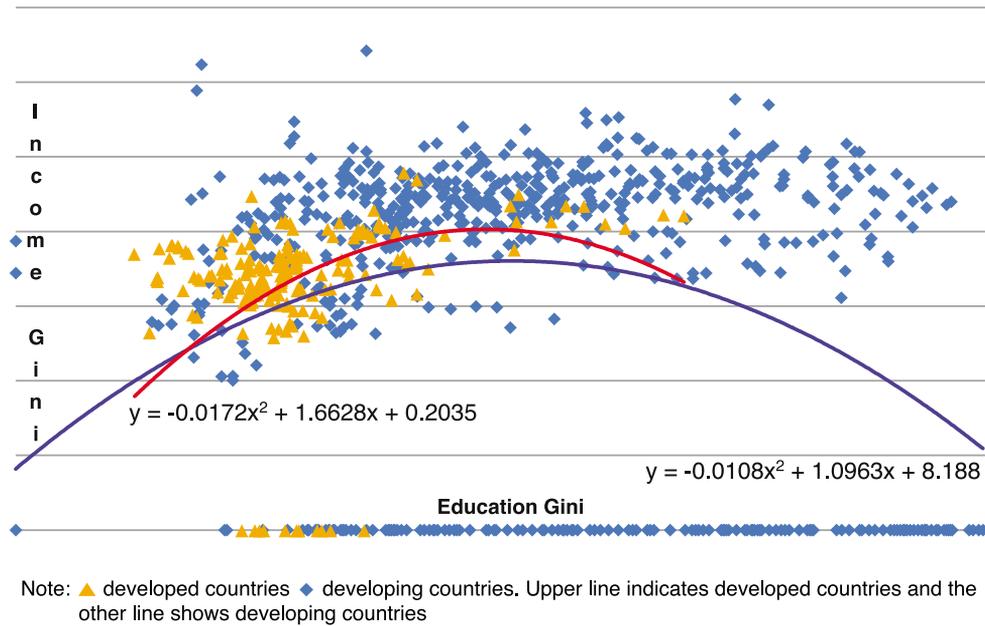
EMPIRICAL ANALYSIS OF EDUCATION AND INCOME INEQUALITY

Correlation between Education and Income Inequality

To find the causality between distribution of education and income, I analyzed cross-country data from 100 countries over 40 years. To begin with, I examined scatter plot and correlation between variables. Correlation results can be found in table A3.

I searched for a basic relationship between education inequality and income inequality in all countries. As figure 1 shows, countries with low education inequality also show low income inequality. Developed countries, which are clustered at the lower left of figure 1, show this trend more clearly. However, the relationship between the two is not linear. It has an inverted U shape, similar to the Kuznets curve. In a simple correlation between education and income inequality, it seems that most countries start with high education inequality but low income inequality (lower right in figure 1); then, education inequality gradually decreases while income inequality increases. Finally, education and income inequality both decrease. This is very similar to the logic of the Kuznets curve that explains the relationship between the level of economic development and income inequality.

Figure 1. Education Gini and Income Gini in Developed and Developing Countries

$$y = -0.0172x^2 + 1.6628x + 0.2035$$

$$y = -0.0108x^2 + 1.0963x + 8.188$$

Education Gini

Note: ▲ developed countries ◆ developing countries. Upper line indicates developed countries and the other line shows developing countries

It is necessary to interpret this figure with caution, because the time effect also needs to be considered. But Barro (1999) and Checci (2001) also confirmed that education attainment or distribution and its effect on inequality can be nonlinear. Thus, based on the correlation presented in the scatter plot, the nonlinear relations between the two Gini indexes can be further examined in the following regression model.

Analysis Results: An Inverted-U-Shaped Relationship

Results of pooled-OLS and panel regression to investigate the effects of education inequality on income inequality are shown in table 2. As discussed, this analysis started from the assumption that the relationship between two inequality dimensions is not simply linear, as shown in figure 1. Thus, the education Gini as well as its squared term were included.

Education and income inequality had a nonlinear and inverted-U-shaped relationship at a statistically significant level in pooled-OLS regression and the panel fixed-effects model. This was confirmed by running simple OLS regression from models 1 to 4 (table 2). Additional analysis considered the panel data structure. Time was controlled as a dummy variable in that the data set was quinquennial from 1960 to 2000. The results of the time-controlled analysis are shown in models 5 to 8 in table 2. They are same as for the simple OLS regression model, suggesting a nonlinear relationship between education and income inequality.

This relationship was consistent when verified with other control variables. Economic development, measured as GDP per capita, was included as a control variable in model 2, and factor endowments—land, capital, and labor force—were included in model 3. Trade openness was included as a proxy variable for the effects of globalization, and government consumption as a proxy variable for government efforts to lessen inequality, in model 4. All these models proved that education and income inequality are related in a nonlinear, inverted-U shape. The results are also consistent when analyzed with all control variables in the time-controlled models (models 6 to 8).

Finally, I analyzed the relationship between the two inequality dimensions using a fixed-effects model to control unobservable characteristics of each nation. In model 10, this also suggested that the two inequalities are related with a nonlinear and inverted-U shape, controlling GDP per capita. However, in the fixed-effects models that added all other control variables (models 11 and 12), only the overall direction was confirmed, and it was not statistically significant.

These results suggest an interesting implication in that the two inequality dimensions present an inverted-U shape similar to the Kuznets curve. The conventional Kuznets curve represents a proposition about the level of economic development and income

Table 2. Effects of Education Inequality on Income Inequality 1960-2000

	Pooled OLS				Pooled OLS (time control)				Panel regression (fixed-effects model)			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Education Gini	0.522*** (0.054)	0.448*** (0.063)	0.251*** (0.089)	0.225*** (0.091)	0.528*** (0.051)	0.372*** (0.059)	0.183** (0.093)	0.164** (0.093)	0.002 (0.072)	0.170** (0.075)	0.033 (0.098)	0.032 (0.098)
Square of education Gini	-0.003*** (0.001)	-0.004*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.003*** (0.000)	-0.003*** (0.001)	-0.002** (0.001)	-0.002** (0.001)	-0.001 (0.001)	-0.002*** (0.001)	-0.000 (0.001)	-0.000 (0.001)
GDP per capita (log)		2.177 (2.414)	14.534*** (3.055)	13.544*** (3.096)		6.756*** (2.307)	15.972*** (3.076)	14.973*** (3.115)		-8.493** (3.888)	-2.391 (5.116)	-3.263 (5.201)
Square of GDP per capita		-0.244* (0.147)	-1.036*** (0.193)	-0.990*** (0.194)		-0.532*** (0.141)	-1.125*** (0.194)	-1.077*** (0.196)		0.496** (0.218)	0.051 (0.299)	0.087 (0.304)
Land (arable land per worker)			-0.372 (0.531)	-0.059 (0.542)			-0.056 (0.532)	0.210 (0.541)			-2.999 (2.526)	-3.509 (2.577)
Capital (capital stock per worker/log)			-0.025 (0.090)	0.034 (0.094)			-0.019 (0.088)	0.034 (0.093)			-0.249 (0.821)	0.130 (0.868)
Human capital (% with secondary education)			0.010 (0.035)	0.004 (0.035)			-0.032 (0.037)	-0.036 (0.037)			0.000 (0.042)	-0.001 (0.042)
Trade openness (% of GDP)				0.017*** (0.007)				0.016** (0.006)				-0.011 (0.011)
Government consumption (% of GDP)				-0.027 (0.041)				-0.026 (0.041)				-0.053 (0.054)
Constant	25.157*** 1.268	29.377*** 9.502	12.381 11.554	-7.864 11.907	23.080*** 1.386	11.688 9.128	-17.300 11.599	-12.823 11.935	42.006*** 1.857	74.161*** 17.407	60.402*** 22.883	62.029*** 22.953
Observation	687	637	426	426	687	637	426	426	687	637	426	426
Countries	100				100				95	89	73	73
Adjusted R-square	0.299	0.382	0.429	0.436	0.379	0.466	0.448	0.453	0.204	0.006	0.302	0.251

Note: Numbers in parentheses represent standard errors. Coefficient values of year dummy variables 5-8 are not reported in this table. The Hausman test verified that the fixed-effects model is more consistent than random effects model. Shaded areas indicate education variables that are statistical significant.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

inequality. Income inequality increases as a national economy develops but decreases after a certain level of economic development (Kuznets, 1955). The same logic would suggest that as education inequality starts to decrease, income inequality grows, but after they pass a certain inflection point, income inequality and education inequality both decrease.

In other words, at the beginning, even though education opportunities are provided to more people, their benefits accrue to only a few people who are able to be educated earlier than others, and thus income inequality could worsen. However, after more people have the opportunity to receive an education, income inequality can decrease as education inequality decreases. I calculated this inflection point with models 8 and 10 and found that the education Gini index at this point was around 41 (in model 8) or 42.5 (in model 10). At these education Gini indexes, people over age 15 had, on average, five or six years of schooling. This suggests that when the average education level for the whole society is equivalent to completion of primary school, income inequality starts to decrease as education inequality decreases.

One reason for caution is that the nonlinear relationship described here starts from the outside and moves toward the zero point on the X axis. This is because for the Gini indexes that were used as independent and dependent variables in this study, higher values represent greater inequality and lower values represent greater equality. This was also shown in figure 1, where in a simple correlation, developing countries are located in the lower right-hand side and developed countries are located in the lower left-hand side, meaning that this inverted-U-shaped curve moves from outward to inward on the X axis.

Regarding the control variables, GDP per capita also had a nonlinear relationship, as it does in the conventional wisdom. This analysis confirmed that the level of economic development and income inequality are related as shown in the Kuznets curve. However, factor endowments showed somewhat different results than expected. Earlier studies assumed that physical capital (such as land and capital stock) aggravated inequality whereas human capital (such as a skilled labor force) ameliorated it. In this model, however, neither physical capital nor human capital had a statistically significant relationship with income inequality. However, trade openness aggravated income inequality at a statistically significant level. Government consumption had a negative relationship with income inequality, but the coefficient values were not statistically significant.[8]

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8. I also considered population to control nation size as in previous comparative studies of economic growth. Additional analysis indicated that education and income inequality have a nonlinear inverted-U shape. However, statistical significance was only valid in the pooled-OLS model, not in the fixed-effects model. Thanks are due to an anonymous reviewer who recommended addressing this issue.

Different Impacts in Developed and Developing Countries

The second hypothesis of this study was that the effect of education inequality on income inequality is different in developed and developing countries. To test this assumption, I divided data into two different groups. Only GDP per capita was included as a control variable, because it is the most crucial control variable and because the number of observations would become too small to analyze, due to missing data, if all other control variables were included. The results are shown in table 3.

In the pooled-OLS model, education and income inequality had a nonlinear, inverted-U-shaped relationship in developing countries at a statistically significant level, but this was not significant in developed countries in either of the pooled-OLS models. In the fixed-effects model, education and income inequality were related at a statistically significant level in both developed and developing countries. This suggests that the relationship between education and income inequality appears more consistently in developing countries. As Klasen (2002) argued, this is because the marginal effect of

Table 3. Effects of Education Inequality by Development Level

	Pooled OLS		Pooled OLS (time control)		Panel regression (fixed-effects model)	
	Developed countries	Developing countries	Developed countries	Developing countries	Developed countries	Developing countries
Education Gini	0.133 (0.214)	0.424*** (0.077)	-0.054 (0.202)	0.400*** (0.073)	0.286* (0.147)	0.188* (0.100)
Square of education Gini	0.000 (0.003)	-0.004*** (0.001)	0.002 (0.003)	-0.003*** (0.001)	-0.005** (0.002)	-0.002*** (0.001)
GDP per capita (log)	-80.286*** (24.906)	-2.070 (3.250)	-33.233 (27.699)	1.039 (3.150)	-88.423*** (14.353)	0.148 (5.442)
Square of GDP per capita	4.151*** (1.283)	0.056 (0.206)	1.396 (1.435)	-0.144** (0.199)	4.640*** (0.738)	-0.035 (0.324)
Constant	418.444*** (119.328)	45.052*** (12.451)	222.153 (132.103)	33.083*** (12.181)	451.506*** (68.684)	41.428* (22.768)
Observation	167	470	167	470	167	470
Countries					19	70
Adjusted R-square	0.174	0.151	0.305	0.116	0.008	0.006

Note: Numbers in parentheses represent standard errors. Coefficient values of the year dummy variable are nor reported in this table. Shaded areas indicate education variables that are statistical significant.
  * $p < 0.1$
 ** $p < 0.05$
*** $p < 0.01$

education inequality is much larger in developing countries. These analyses imply that education inequality has a more visible impact on income inequality in developing countries than in developed countries.

Although it is not discussed in detail in this article, I also ran a pooled-OLS regression controlling time and other variables after dividing developed and developing countries. According to the results, human capital has a negative relationship with income inequality in developing countries at a statistically significant level ($p < 0.01$), while it has a positive relationship in developed countries. In addition, government consumption, which was used as a proxy variable for government efforts to alleviate inequality, also had a negative relationship with income inequality in developing countries at a statistically significant level ($p < 0.1$), while it was insignificant in developed countries. This implies that the effect of human capital for alleviating inequality appears more consistently in developing countries. In addition, if developing countries invest government funds in lessening inequality, the effects are more apparent in developing countries than in developed countries.

These empirical results can suggest policy priorities for developing countries for reducing inequality. Previous studies emphasized the need to increase the average level of educational attainment for economic development. However, this study adds evidence for another important policy priority, the need not only to raise the average education level but also to expand coverage for as many people as possible, because more equal educational opportunity can contribute to a more egalitarian distribution of income.

POST-2015 EDUCATIONAL GOALS

The international development community has recently begun discussing a new development agenda. The time frame for the MDGs ends in 2015, and thus academics and practitioners have been debating new international development goals, the so-called post-2015 agenda. Of the eight MDGs, the second goal is to achieve universal primary education by 2015. Primary education has been emphasized as more attention has been paid to the significance of human development in the MDGs. This goal has almost been met—while the primary school enrollment rate was 82 percent in 1999 across developing countries, it increased to 88 percent in 2004 and 90 percent in 2010, even though its progress has slowed since 2004. However, sub-Saharan Africa's primary enrollment rate is still only 76 percent.

An important issue for the post-2015 agenda is how to establish new education development goals. The scope must be extended to include higher education. Furthermore,

in the post-2015 discussion, it is assumed that structural inequality is the underlying cause of poverty in developing countries. In this sense, this article can suggest policy implications for education and inequality issues for the international development community.

As mentioned earlier, Barro (1999) suggested that income inequality increased as the level of education increased, and that primary education decreased income inequality but secondary education might aggravate it. This proposition should be interpreted cautiously, because it could lead to a misunderstanding, that increasing the level of education can worsen income inequality. However, this study, by addressing distribution of education, can offer a different interpretation. At the earliest stage of development, even though the level of education increases and the distribution of education improves, its benefits may accrue to only a limited strata of society, and thus income inequality cannot be alleviated in the short term. However, in the long term, more equal education distribution can contribute to decreasing income inequality after a country reaches a certain level of development. Therefore, it is important to expand education from the primary level to the secondary and tertiary levels in order to leap up middle-income countries. At the same time, it is crucial to expand educational opportunities to as many people as possible in order to achieve a more equal society.

While recent international efforts and policy goals have concentrated on primary education, future debates on education and development need to focus on secondary and tertiary education. A comparison of expenditures for primary, secondary, and tertiary education across regions and levels of development reveals interesting policy implications for developing countries. As table 4 and figure 2 demonstrate, high-income countries invest more in secondary education than in primary or tertiary education. They spend about 25 percent on primary education, 40 percent on secondary education, and 20 percent on tertiary education. However, developing countries in Latin America

Table 4. Distribution of Educational Expenditures by Region and Development Level (%)

	Developed countries			Latin America (developing only)			East Asia	South Asia		Kenya			Uganda	
	2000	2005	2007	2000	2004	2007	2001	2000	2003	2001	2004	2006	2004	2009
Primary	24.9	25.7	25.3	40.4	37.0	36.9	32.6	46.5	45.4	66.1	62.1	54.1	61.2	55.4
Secondary	40.6	40.1	38.8	34.1	35.1	35.2	33.3	36.1	41.7	19.4	23.4	21.7	17.3	23.5
Tertiary	22.0	22.8	23.3	18.9	18.1	17.0	23.3	18.8	10.3	13.1	12.9	15.4	11.9	11.3

* Source: World Bank (2012). There are no aggregated indicators for sub-Saharan African countries; individual country indicators (Kenya and Uganda) were used to show the trend for the region. Each number shows the percentage among total education expenditure. Other types of education, such as vocational training are excluded.

Figure 2. Educational Expenditure in Developed and Developing Countries
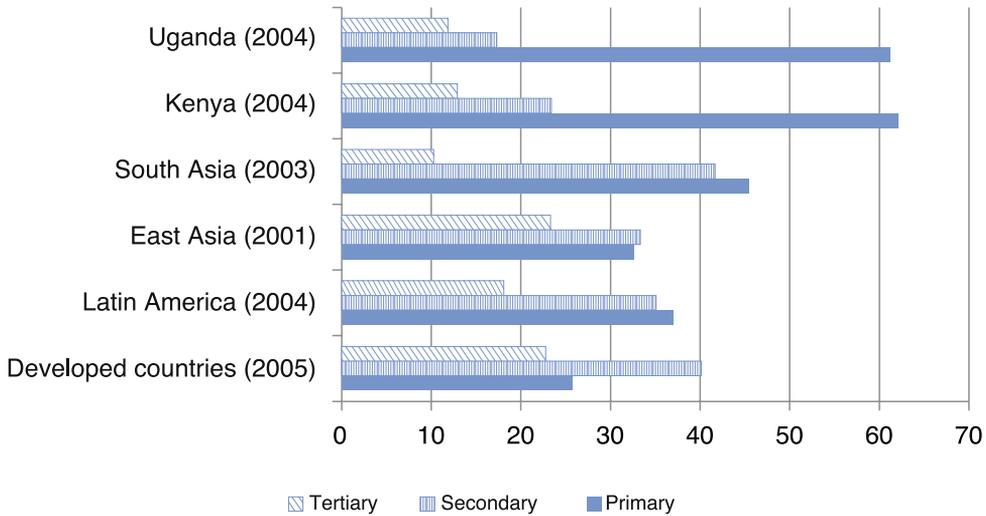
* Source: World Bank (2012).

invest more in primary education, while tertiary education expenditure is lower than in advanced countries. This expenditure trend is more visible in South Asian and sub-Saharan African countries, which spend about 45 or 60 percent of the total education budget on primary education, with lower financial inputs committed to secondary and tertiary education.

This trend was inevitable due to lack of financial capacity in developing countries, but more financial resources should be devoted to higher education, as universal primary education goals are almost met. Therefore, future education goals need to focus more on higher education in developing countries. Post-2015 debates might also address secondary education for training more skilled workers in developing countries. In addition, they should consider how to link secondary education with actual job opportunities, especially in less-developed countries.

CONCLUSION

There have been many debates about economic development and income inequality. A compromise among different arguments would be the conclusion that at the beginning stages of economic development, inequality could prompt development, but after a certain level of development is reached, a more egalitarian society can achieve better

economic development. In this process, it has been assumed that education is a means for improving labor productivity, which can then contribute to economic growth. In other words, a more equal society allows more people to be educated, and they can then participate as skilled workers who ultimately contribute to economic development. In this logical chain, education has been recognized as a mediator between inequality and economic development.

This study used a different approach from previous comparative inequality studies. First, it looked at two dimensions of inequality, education and income, at the same time. Then it examined the causality from education to income inequality. The empirical analysis presented here proves that more equal educational distribution can alleviate income inequality. More interestingly, this relationship has a nonlinear and inverted-U shape similar to the conventional Kuznets curve. Even though income inequality increases as education inequality decreases at the beginning stage, both finally decrease together after reaching a certain inflection point. This suggests that the effect of education appears more conspicuously in developing countries than in developed countries. In sum, the connection between education and income inequality is strong enough to support the conclusion that it is important to provide more equal educational opportunities in order to reduce inequality.

Recent comparative inequality studies have moved their focus from between and within income inequalities toward various inequality dimensions, such as education and health inequality. Along this line, this study contributes to the theory of comparative inequality in that it addresses the relationship between two inequalities—education and income inequality—together, whereas previous studies were unable to do so because of lack of data.

In spite of these new findings, there are some limitations to this study. More awareness is needed of the complex mechanism that relates education to income inequality. Two dimensions of inequality can have a strong correlation, but there can be spurious variables or mediator variables between two. Even though this study controlled a number of variables that affect inequality, drawing on previous theories, changes to the demography or social structure in each county can have an effect on education and income inequality. This study could not fully address this internal mechanism because it focused only on the differences between countries. More dynamic insights could be uncovered by paying attention to education inequality within a country. This remains as a challenge for future comparative education inequality studies.

APPENDIX: COUNTRIES, VARIABLES, AND CORRELATIONS

Table A1. Countries Included in the Study

Developed countries (21)	
Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States	
Developing countries (79)	
Latin America and Caribbean (23)	Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela
East Asia and Pacific (10)	China, Fiji, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, Taiwan
South Asia (5)	Bangladesh, India, Nepal, Pakistan, Sri Lanka
North Africa and Middle East (9)	Algeria, Cyprus, Egypt, Iran, Israel, Jordan, Tunisia, Turkey, Yemen
Sub-Saharan Africa (26)	Botswana, Cameroon, Central African Republic, Democratic Republic of Congo, Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritius, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe
Eastern Europe (6)	Bulgaria, Czechoslovakia, Hungary, Poland, Romania, Yugoslavia

Table A2. Correlations between Variables

	Income Gini	Education Gini	GDP per capita	Land	Capital	Human capital	Trade openness	Government consumption
Income Gini	1.0000							
Education Gini	0.5083*	1.0000						
GDP per capita	-0.5522*	-0.7778*	1.0000					
Land	-0.1480*	0.0157	0.0407	1.000 0				
Capital	-0.2195*	-0.1872*	0.2643*	-0.0399	1.0000			
Human capital	-0.3486*	-0.6644*	0.6586*	0.0889*	0.1688*	1.0000		
Trade openness	0.0861*	-0.0180	0.0739*	-0.2225*	-0.1266*	0.0834*	1.0000	
Government consumption	0.1181*	0.1831*	-0.2859*	0.0745*	-0.2430*	-0.1492*	0.0124	1.0000

* $p < 0.05$

Table A3. Variables: Definitions and Data Sources

Variable	Definition	Source
Dependent variable		
Income Gini	Gini coefficients based on wage income from 1960-2000	Estimated Household Income Inequality Data (Galbraith & Kum, 2005)[a]
Independent variable		
Education Gini	Gini index based on average years of schooling of total population over 15 years old	World Bank education Gini data (Thomas, Wang, & Fan, 2002)[a]
Control variables		
GDP per capita (log)	Real GDP per capita at 2005 constant prices, calculated as a natural logarithm	Penn World Table 7.1 (Heston, Summers, & Aten, 2012)
Land	Arable land per person (hectares)	World Bank (2011)
Capital	Capital stock per worker—total capital divided by economically activate population (15-64 years old)	Nehru and Dhareshwar (1993)
Human capital	Number of people who have completed a secondary education as a proportion of total population age 25 and over	Barro and Lee (2010)
Trade openness	Imports and exports as a proportion of total GDP	Penn World Table 7.1 (Heston, Summers, & Aten, 2012)
Government consumption	Government consumption share of real GDP per capita at 2005 constant prices	Penn World Table 7.1 (Heston, Summers, & Aten, 2012)

[a] Education and income Gini indexes were kindly provided by the original authors.

REFERENCES

Alesina, A., & Rodrik, D. 1994. Distributive politics and economic growth. *Quarterly Journal of Economics*, 109(2): 465-490.

Anand, S., & Kanbur, S. 1993. The Kuznets process and the inequality-development relationship. *Journal of Development Economics*, 40(1): 25-52.

Atkinson, B. 1997. Bringing income distribution in from the cold. *Economic Journal*, 107(441): 297-321.

Barro, R. 1999. *Inequality, growth, and investment* (NBER Working Paper No. 7038). Cambridge, MA: National Bureau of Economic Research.

Barro, R., & Lee, J. W. 2010. *A new data set of educational attainment in the world, 1950-2010* (NBER Working Paper No. 15902). Cambridge, MA: National Bureau of Economic Research.

Breedlove, W., & Nolan, P. 1988. International stratification and inequality 1960-1980. *International Journal of Contemporary Sociology*, 25: 105-123.

Bruno, M., Maritn, R., & Squire, L. 1996. *Equity and growth in developing countries* (Policy Working Paper Series 1563). Washington, DC: World Bank.

Castelló, A., & Doménech, R. 2002. Human capital inequality and economic growth: Some new evidence. *The Economic Journal*, 112 (478): C187-C200.

Checchi, D. 2001. *Education, inequality and income inequality* (Discussion Paper No. DARP 52). London: Distributional Analysis Research Programme, London School of Economics.

Checchi, D. 2003. Inequality in incomes and access to education: A cross-country analysis (1960-95). *LABOUR*, 17(2):153-201.

Cohen, D., & Soto, M. 2007. Growth and human capital: Good data, good results. *Journal of Economic Growth*, 12(1): 51-76.

Deininger, K., & Squire, L. 1996. A new data set measuring income inequality. *World Bank Economic Review*, 10(3): 565-591.

Deininger, K., & Squire, L. 1998. New ways of looking at old issues: Inequality and growth. *Journal of Development Economics*, 57(2): 259-287.

Filmer, D., & Pritchett, L. 2001. Estimating wealth effects without expenditure data—or tears: An application to educational enrollments in states of India. *Demography*, 38(1): 115-132.

Flug, K., Spilimbergo, A., & Wachtenheim, E. 1998. Investment in education: Do economic volatility and credit constraints matter? *Journal of Development Economics*, 55(2): 465-481.

Forbes, K. 2000. A reassessment of the relationship between inequality and growth. *American Economic Review*, 90(4): 869-887.

Galbraith, J., & Kum, H. S. 2005. Estimating the inequality of household incomes: A statistical approach to the creation of a dense and consistent global data set. *Review of Income and Wealth*, 51(1): 115-143.

Galor, O., & Daniel, T. 1997. The distribution of human capital and economic growth. *Journal of Economic Growth*, 2(1): 93-124.

Galor, O., & Moav, O. 2006. Das Human-Kapital: A theory of the demise of the class structure. *Review of Economic Studies*, 73(1): 85-117.

Galor, O., & Zeira, J. 1993. Income distribution and macroeconomics. *Review of Economic Studies*, 60(1): 35-52.

Glomm, G., & Ravikumar B. 1992. Public versus private investment in human capital: Endogenous growth and income inequality. *Journal of Political Economy*, 100(4): 818-834.

Goesling, B. 2001. Changing income inequalities within and between nations: New evidence. *American Sociological Review*, 66(5): 745-761.

Goesling, B., & Baker, D. 2008. Three faces of international inequality. *Research in Social Stratification and Mobility*, 26(2): 183-198.

Gupta, S., Davoodi, H., & Alonso-Terme, R. 2002. Does corruption affect income inequality and poverty? *Economics of Governance*, 3(1): 23-45.

Hall, A., & Midgley, J. 2004. *Social policy for development*. London: Sage.

Heston, A., Summers, R., & Aten, B. 2012. *Penn world table version 7.1*. Philadelphia: Center for International Comparisons of Production, Income and Prices, University of Pennsylvania.

Klasen, S. 2002. Low schooling for girls, slower growth for all? Cross-country evidence on the effect of gender inequality in education on economic development. *World Bank Economic Review*, 16(3): 345-373.

Korzeniewicz, R., & Moran, T. 1997. World-economic trends in the distribution of income, 1965-1992. *American Journal of Sociology*, 102(4):1000-1039.

Kum, H. 2010. Cross-country Variability in Inequality Change. *The Korean Journal of Policy Studies*, 25(1): 1-17.

Kuznets, S. 1955. Economic growth and income inequality. *American Economic Review*, 45(1): 1-28.

Lee, J. W., & Barro, R. 2001. Schooling quality in a cross-section of countries. *Economica*, 68(272): 465-488.

Lopez, R., Thomas, V., & Wang, Y. 1998. *Addressing the education puzzle: The distribution of education and economic reform*. Washington, DC: World Bank.

Nehru, V., & Dhareshwar, A. 1993. A new database on physical capital stock: Sources, methodology and results. *Rivista de Analisis Economico*, 8(1): 37-59.

Nielsen, F. 1994. Income inequality and industrial development: Dualism revisited.

American Sociological Review, 59(5): 654-677.

Perotti, R. 1992. Income distribution, politics, and growth. *American Economic Review*, 82(2): 311-316.

Perotti, R. 1996. Growth, income distribution, and democracy: What the data say. *Journal of Economic Growth*, 1(2): 149-187.

Persson, T., & Tabellini, G. 1994. Is inequality harmful for growth? *American Economic Review*, 84(3): 600-621.

Saint-Paul, G., & Verdier, T. 1993. Education, democracy and growth. *Journal of Development Economics*, 42(2): 399-407.

Schultz, T. 1961. Investment in human capital. *American Economic Review*, 51(1): 1-17.

Spilimbergo, A., Londoño, J., & Székely, M. 1999. Income distribution, factor endowments, and trade openness. *Journal of Development Economics*, 59(1): 77-101.

Sylwester, K. 2002. Can education expenditures reduce income inequality? *Economics of Education Review*, 21(1): 43-52.

Thomas, V., Wang, Y., & Fan. 2001. *Measuring education inequality: Gini coefficients of education* (World Bank Policy Research Working Paper No. 2525). Washington, DC: World Bank.

Thomas, V., Wang, Y., & Fan. 2002. *A new dataset on inequality in education: Gini and Theil indices of schooling for 140 countries, 1960-2000.* Washington, DC: World Bank.

World Bank. 2011. *World development indicators*. http://data.worldbank.org.

World Bank. 2012. *Education statistics*. http://data.worldbank.org.