Inequality in Education and Income Across Countries

Alali, Walid Y.

University of Oxford – Economic Department

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Walid Y. Alali

University of Oxford – Economic Department, Manor Road Building,

Oxford OX1 3UQ, United Kingdom

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This paper examines the relationship between educational inequalities to income inequality cross-countries, using Gini Coefficient and Cobb-Douglas (CD) production function. It reinforces the future vision of the literature on this subject by utilising the most recent cross-section data. We create a new combination of controls for both the labour market and socio-political. There are country-specific variables that can have an effect on each of them, and thus make it difficult to assess income inequality across countries. Considering these difficulties, the structural components of each country were controlled. Separate regressions are performed that takes into account the level of country development.

Key Words: Economic Development, Labour, Human Capital & Development, Inequality, Poverty

1. Introduction

Over the past decade, countries that were previously considered underdeveloped have experienced tremendous growth. Although the growth metrics in some countries look impressive on paper, unfortunately not everyone in the countries involved has been able to benefit from this growth. Often, the economic growth of a country went to the elite group, while the rest of the people, especially those living in rural areas, continued to live in poverty. To illustrate with an example, for the decade 2000-2010, the average growth rate in China was 10.6%, while income inequality remained constant, as indicated by 0.4 on a scale of 0-100 improvement in the Gini coefficient. Disparities in income between rich and poor have been observed in the developed world as well, from Europe to the United States. This indicates that

the benefits of economic growth unfortunately have only provided an advantage to a select few, as opposed to positive spillover effects across the country.

The persistence of high and growing income inequality with widespread inequality in access to quality education, nutrition, and health care is one of the defining challenges of our time. Although rapid globalization and technological advancement around the world have brought many opportunities to different segments of society, the advantage is still in favour of the rich. In this context, the unequal distribution of income has become an obstacle to sustainable economic growth. In addition, the unequal distribution of opportunities has given rise to sectors of disadvantaged societies, causing social unrest. Not surprisingly, the extent of inequality, its drivers, and what to do about it is a growing concern for policymakers and researchers. In this framework, the expansion of education is highlighted as an important policy tool to combat high and persistent income inequality. Although economic theories suggest that income distribution is determined by the level and distribution of education (Baker and Chiswick, 1966; Galore and Tseddon, 1997; Glum and Ravikumar, 1992; St. Paul and Verdier, 1993), the empirical literature on various experienced structural frameworks, state samples, control variables, and figures Functional and data definitions, estimation techniques and time periods are inconsistent results. While a large body of empirical literature has supported the vital role of education inequality in income inequality (Park, 1997; Baker and Chiswick, 1966; Ahluwalia, 1976), the contributions of Ram (1989) and Bourguignon et al. (2004) questioned these findings by finding a negative but non-significant effect of education inequality on income inequality.

Although a certain degree of inequality is seen as needful for a well-functioning economy, generally high inequality is a concern for economists because of the negative effects it can have on growth (Champernowne and Cowell, 1998, p.14). Various social ills have been attributed to income inequality from diminishing government trust, low life expectancy, high crime rates, and low international test scores (Wilkinson and Beckett, 2009, p. 19). Interestingly, these effects of negative inequality affect everyone in the country and not just the less affluent (Wilkinson and Beckett, 2009, p. 181). Besides the philosophical effects of extreme income inequality discussed by John Rawls, even high-income individuals express their distaste for living in an unfair world, the effects of income inequality are also transmitted to the economy, hampering market efficiency. Results. The lower class may have less access to credit, which undermines economic mobility because they cannot afford education. Moreover, the polarization may increase as the upper class is more likely to remain in power and adopt policies that benefit them only through the pursuit of rent or bribery, while those at the lower end of income are more likely to prefer populist policies, and civil unrest may result.

break out. Thus, the focus of public policy will often be on maintaining the status quo or policy of redistribution rather than growth and prosperity. By creating a stratified society, inequality of income can stagnate the growth of the economy.

Globalization and technological progress, which are the main reasons for the rise in the skill premium, are likely to be the main drivers of rising and persistent income inequality. Within this framework, while expansions in educational attainment and reductions in educational inequality act as a social equilibrium factor, income inequality is largely determined by the effects of technology (a determinant of demand skilled labour) and education (a determinant of skilled labour supply), on relative wages (Tinbergen, 1975). Globalization, generally approaching the degree of trade openness, is seen as a cause of changing demand for skilled workers. However, empirical work on the link between trade liberalization and inequality is inconclusive. While some studies argue that increased trade openness may reduce income inequality (Reuveny and Li, 2003; Dollar and Kraay, 2004), another line of literature argues the opposite and argues that trade openness is associated with increased income inequality (Easterly, 2005 Milanovic and Squire 2005; Lin, 2007 for Taiwan; Dutt and Mukhopadhyay, 2008). A new trade theory, supporting this second set of empirical studies, suggests that income inequality may rise after trade liberalization because increased imports of new technology increase the demand for and returns to skilled workers. In addition, Goldberg and Pavcnik (2007) surveyed the literature on this issue and showed that globalization worsens income distribution. To this end, while examining the empirical relationship between education and income inequality, one of the aims of this paper is also to incorporate all these factors that are likely to lead to an increase in the skill premium.

Moreover, this paper also aims to address the vicious circle of inequality. Although an equitable distribution of education is vital to reducing persistently high-income inequality, it is not always possible for all segments of society to reap the benefits of education because skills development is prohibitively expensive for the poor (Aghion et al., 1999; Checchi, 2001; Galor and Zeira, 1993). Thus, these two types of inequality accentuate each other, and the circular causal relationship between lack of education and lack of income generates a sustainable inequality trap (Rao, 2006; Bourguignon et al., 2004). However, there is no consensus in the literature on the question of whether income inequality causes human capital inequality or, alternatively, education inequality leads to income inequality. Against this background, this paper attempts to understand the direction of the relationship between education and income inequality.

Finally, it is important to note the advantages of education, not only as a tool for higher gain but sometimes as an end in itself. Education is able to expand a person's capabilities, which is

an important goal of development. It has the potential to empower citizens to be productive members of their country, through increased civic engagement. Especially, the gender gap can be narrowed by enabling women to have more opportunities in the labour market. It is also important to note the priority the government gives to education, particularly the course for which the most money is allocated. Spending on college versus primary education has different effects on income inequality as will be explained later. By increasing expenditure on the primary level of education, the government can provide every individual with a fair chance of being educated, which is an important end in itself. This paper examines whether inequality in education can explain income inequality across countries. It enhances the literature on this topic by making use of the most recent cross-sectional data from 2010, and a new set of social, political, and labour market disciplines. It is difficult to assess income inequality across countries, because country-specific variables may influence it, such as the degree of merit a country provides. To account for this difficulty, country-specific structural components are controlled. Specifically, separate regressions are performed that takes into account the level of development of the country. The rest of the paper is organized as follows. It will discuss how this issue has been addressed in the literature, and provide the theoretical foundations on which this paper is based. We will also explain the experimental model and display the results. Finally, with political proposals and recommendations in accordance with the findings.

2. Literature Review

Park (1996) starts out by examining the inverse-U structure of the Kuznets Curve and bringing about a new interpretation of the curve. In this case, there will be more weight on education variables, particularly focusing on the level of education and income. Throughout the study conducted in this article, Park incorporates the Gini Index as well as income as a measure of the dependent variable run by its models. The education variables used to explain income were separated into four different categories: enrollments at different levels, mean/median years of schooling, rate of return at the different levels, and dispersion of educational attainment. An interesting finding from this paper was the negative effect education inequality and level of schooling have on income distribution when used in conjunction, as explanatory variables. In order for the regression to show a positive effect between the level of schooling and income distribution, the education inequality variable must be removed. The reasoning given for this phenomenon is the high correlation that is present between the level of schooling and the per capita income. Along with a high correlation, there is collinearity between the level of schooling and education inequality. The reason for this collinearity is due to the educational inequality variable already containing a level of schooling within it.

Judson (1998) examines the response of economic growth to the production of human capital through education. Primarily, this paper is concerned with the allocation of educational resources. Judson makes multiple assumptions before constructing his model. It is stated as a fact that years of education yield diminishing marginal returns; thus, investment in primary school has a larger economic return than investment in higher education does. However, this fact does not necessarily hold when returns from secondary education are compared to those from higher education. This claim is informative for our own research. Another interesting technique used in Judson's paper was the allowance for "revelation of talent". Individuals are not all equally talented, so the more talented ones should receive more education as they reveal themselves to be worthwhile investments. This strategy would defeat the aims of our research, as our goal is to reduce inequality, rather than to maximize absolute growth. By including this dimension, Judson creates a model that can be used to determine if a country's allocation of educational resources is efficient or not. After determining efficiency, Judson assesses the relevance of a country's efficiency score.

Sylwester (2002) starts by pointing out an assumption that has been very often overlooked when creating policy to combat education inequality: children from low-income families are actually attending the schools' governments are funding. The main concern highlighted in the article is that although there has been an increased resource allocation towards education, many countries have not seen a difference in their existing, unequal income distribution. In this study, Sylwester divides the countries into OECD and non-OECD and makes a comparison of the results gathered from both. He finds that countries that are part of OECD groups did experience an equalizing effect on their income distribution based on an increase in resource allocation towards education. The same effect was not found in the countries outside of this group. An explanation given for this difference in income convergence stands in the initial overlooked assumption; children who come from lower-income families may have to work in order to support their families and therefore cannot afford to attend school. For many years, it was taken as given in the research of development economists that increasing access to education will certainly reduce inequality. However, more recent literature has shown that this may not hold true in countries with low development from the start. This is because the opportunity cost of attending school is too high, meaning that poor students' tax dollars are sometimes spent on public school while the students themselves cannot afford to take advantage. When this is the case, income inequality actually worsens. We would like to build on this finding by determining if inequality could be decreased if children received more years of education across income brackets.

However, when studying the topic further, ambiguity clearly emerged. Others have expressed theoretical challenges, at other times a lack of empirical evidence for this claim. Bhagwati (1973) dispute that in developing countries, education was most likely used as a signal of productivity, rather than for building human capital. There appears to be an oversupply of educated labour, so jobs that require only a high school diploma tend to be filled by those with master's degrees, simply because employers interpret their degrees as more productive. Employees will not use these skills for the job, so the resources spent on education are essentially wasted. To illustrate with an example, this could be someone with a PhD doing menial clerical work. The result is a lack of demand for highly skilled labour and an increase in the supply of educated labour. Bhagwati dispute that this would have ambiguous implications for income inequality because even employees with a large amount of education may be employed below their standards due to the scarcity of jobs, so their earnings would not necessarily be higher. When scanning the literature, Ram (1989) also cautions that the empirical evidence that education inequality has a clear effect on income inequality is minimal, especially when it comes to the least developed countries. One particular explanation he gave relates to the fact that the return to education rate may be more difficult to decipher in developing countries than in developed countries. Sometimes, jobs could be filled based on bribery and nepotism, as opposed to educational achievement.

Experimentally, some research papers have not been able to find a relationship between income inequality and education inequality (Checchi, 2004). Their results indicated that in most models the relationship between the two variables is not significant generally. Only one paper found a statistically significant relationship, albeit weak, for the countries of OECD, but not for developing countries. Checchi (2004) found the relationship to be strong only for some models when also considering average years of completion. Surprisingly, was a negative relationship and the average years of educational attainment appeared to have a greater effect on education inequality than income inequality. The inverted U effect of Kuznets has been proposed when it comes to explaining income inequality as per capita GNI increases in a country (Kuznets, 1955). It is believed that countries usually go through three stages of development. Initially in an agrarian society, income is low, and so is income inequality. However, when a country moves to the industrial economy, per capita income rises and so does income inequality. After a while, inequality peaks and then decreases even as per capita income continues to grow, as a country moves into a post-industrial stage of development. The result is an inverted parabola. One way to explain this phenomenon is in terms of education (Knight and Sabot, 1983). At first, inequality is low because most people in a country are illiterate. However, after the establishment of compulsory education, the wage differential increases, because there is a disparity between the educated and the uneducated. However,

over time, this wage differential, and thus inequality, decreases because most of the composition of the labour force acquires more education. As the workforce becomes more educated, this reduces the disparity in the wage differential. This inverted relationship concerning income inequality and mean years of education was also investigated, yielding robust results consistent with the hypothesis (Checchi, 2004). The consensus across the literature is that there is a theoretical basis for the concept that inequality in education increases income inequality. However, the empirical results are ambiguous, sometimes finding positive and meaningful correlations and sometimes insignificant results. This paper continues the empirical research by examining the relationship between income inequality and education inequality while controlling for Access to and quality of education, the influence of Kuznets, social and political controls, and labour market conditions.

3. Methodology

Theoretical Approach

There are some papers have found that there is a positive relationship between income inequality and education inequality (Gregorio and Lee, 2002; Frankema and Bolt, 2006). For example, Frankema and Bolt (2006) identified education inequality in terms of classroom enrollment and found strong results when examining regions of 3Latin America and Sub-Saharan Africa. By looking at both education and health investments in developing countries. Health disparities were measured by access to immunization in the first four quintiles compared to the lowest quintile, and Dow's analysis yielded significant results. Gregorio and Lee (2002) found study that social spending/GDP was a much better predictor of income inequality than education inequality, although education inequality was also significant. Social spending was measured by the average ratio of general government spending, social security, and welfare to GDP. In addition, Keeler (2010) found that increased spending per student on primary education significantly reduces income inequality. Other papers examined the issue by making use of 2access to education, the state of the economy, and the social and political climate of a country as controls. Since income inequality depends on state institutions, education may have little effect on income inequality. For example, sometimes income inequality can depend on racial heterogeneity, the type of political system, and the risk of expropriation (the risk of the owner taking possession of property by the government). Frankima and Bolt (2006) found that the more ethnic groups there are in a country when dealing with the risk of expropriation, the greater the income inequality. Wells (2005) finds evidence that economic freedom has an important 2effect on income inequality.

This variable captures access to free trade and credit, proper acquisition of property, rather than illegal means and whether property rights are protected. It was also found that the interaction effects between economic freedom and high school attendance positively affect income inequality. However, high school attendance does not positively affect income inequality in countries with low economic freedom. Wells suggests the fact that when the trade of a country opens up, income inequality increases. In countries where a large proportion of 4the population has less education as compared to other workers, their jobs may disappear once the country opens up to trade. This paper is based on the theory of human capital combined with the Cobb-Douglas production function. Human capital refers to "the productive investments embodied in people, including skills, abilities, ideals, health, and jobs, which often result from spending on education, on-the-job training programs, and medical care. Education is the commonly used means of measuring human capital. According to human capital theory, wages earned in the labour market can be estimated as a function of the number of years spent in school. Education is believed to increase the productivity of workers through the acquisition of skills relevant to the labour market. However, wage disparity can arise, even though workers have the same amount of education, due to other factors such as innate ability, quality of education, and specialization when it comes to higher education. The assumption of this paper is that years of schooling have a linear and positive effect on wages earned in the labour market.

The Cobb-Douglas production function

$$Q(L,K) = A * L^{\beta} * K^{\alpha}$$

In this formula, *Q* is the quantity produced from the inputs *L* and *K*. *L* is the amount of labour expended, which is typically expressed in hours. *K* represents the amount of physical capital input, such as the number of hours for a particular machine, operation, or perhaps factory. *A,* which appears as a lowercase *b* in some versions of this formula, represents the total factor productivity (TFP) that measures the change in output that isn't the result of the inputs. Typically, this change in TFP is the result of an improvement in efficiency or technology. The Greek characters *alpha* and *beta* reflect the output elasticity of the inputs. Output elasticity is the change in the output that results from a change in either labour or physical capital. The Cobb-Douglas production function defines a country's real production as the output of physical capital (K), worker effort (I), technological progress (A), and human capital (H):

$$Y^i = A\, K_i^a\, H_i^{1-a}\, I^{1-a} \qquad (1)$$

In each country, (A) and (1) are assumed to be equal, so that this does not cause the output to be dispersed. However, there is a disparity between human capital and physical capital as is the case by (i) subscript Low. Individuals have different human capital due to different educational achievements, and companies in each country have different amounts of physical stock due to different acquisitions in machinery/inventory/facilities.

$$Var\ (\ln Y)\ = a^2\ Var(\ln K_i) + (1-a)^2\ Var(\ln H_i) + 2a\ (1-a)\ Cov(\ln K_i\ , lnH_i) \qquad (2)$$

Based on this equation, higher variance in human capital should increase the variance in income. Moreover, this effect depends on the parameter (a) of the production function, which represents the elasticity of physical capital and correspondingly, through (1-a), the elasticity of human capital. Thus, according to the Cobb-Douglas production function and human capital theory, it can be hypothesized that the bigger the magnitude of the dispersion in the human capital choices of a population, the greater the dispersion of output and consequently income. If there is a wide variety in the human capital that the workers of the country choose to accumulate, it leads to a greater dispersion of income, hence higher income inequality. Thus, it is plausible that disparity in educational achievement positively impacts income disparity. Educational inequality is quantified through inequality in educational attainment. However, there are other aspects of education that can play a role in affecting income inequality. For example, whether students are enrolled in private education may be a significant factor. This is because typically private schools have more resources, and they can thus equip students with more relevant labour-market skills. Although students in a country may have similar educational achievements, if they were enrolled in different systems they probably have acquired different human capital skills. This would lead to differing productivity in the labour market, and hence it would increase inequality despite equal achievements. Along these lines, the quality of education provided by the public sector is related to how much a government is willing to allocate resources toward education. In order to look into this, it is necessary to examine how big the size of the government is relative to the size of the economy, and then how much government spending is being allocated towards education. Furthermore, it is important to investigate whether the resources are being devoted mostly to primary, secondary, or tertiary education. If governments subsidize tertiary education or prioritize making it of substantially higher quality at the expense of primary education, which might lower social mobility because it does not help disadvantaged students who struggle with finishing their primary education or acquiring a quality primary education. Investigating achievement in isolation would thus be too simplistic and not capture many of the discrepancies relating to the quality/access to education.

Solely examining education only investigates the labour supply aspect of the occurrences in the labour market. Looking at the demand side is also necessary because even though workers may have different educational achievements, which will not lead to divergent wages in the labour market if there is no demand for educated workers. The skilled labourers would likely be filling unskilled jobs and not have the opportunity to apply their higher productivity. Instead, if there is an increase in demand for skilled workers, relative to supply, that would increase their wage and hence increase returns to education. In turn, this would increase the wage differential between skilled and non-skilled workers. The current state of the labour market, specifically unemployment should be taken into account as well. Generally, unemployment is believed to disproportionately affect unskilled workers (Borjas, p. 501). If unemployment is high the unskilled workers' wages in the labour market are zero, so the discrepancy between educated and uneducated workers is higher. Overall, shifts in the demand for labour impact the wage discrepancy by increasing or decreasing the wage disparity between skilled and unskilled workers.

There are many factors that can influence inequality, on the contrary, the professional skills and wages that are rewarded in the labour market. In fact, different social and political factors influence different levels of income inequality in a country. For example, if discrimination against women is prominent in a country, even if the woman is educated, she is likely to be unemployed in the labour market, despite her qualifications. Furthermore, in developing countries, a high rate of urbanization is likely to lead to more income inequality. One of the reasons for this is that it creates a disparity between rural and urban areas. Governments generally allocate more resources to urban areas because that is where the majority of their electorate resides. Additionally, jobs are more likely to be found in urban areas due to agglomeration economies. However, this creates wage disparity within the city as well, since large-scale immigration from rural areas leads to the formation of an informal sector where wages are much lower due to a lack of regulation. The degree of merit in a country affects income inequality. If a country's political system can be categorized as a meritocracy system, then more income can be earned in the labour market as a reward for productivity rather than being held arbitrarily by one group. For example, a group may hold it arbitrarily simply because it is an ethnic majority or has political ties and is not based on merit.

From the literature, it appears that the relationship between income inequality and educational inequality can vary between developed and developing countries. Factors that are believed to increase prosperity and diminish inequality in the developed world, such as free markets may not be as beneficial in developing rather than developed countries. This may be due to the existence of a post-colonialism legacy in the developing world, which would increase income

inequality, as ethnicities favoured by the majority group are more likely to have access to resources. In the context of economics, this would mean that free markets have a different impact on the developing world. Moreover, the developed world is more likely to reward knowledge and skills acquired in school due to job availability. Furthermore, skilled labour may have different meanings in the context of the developing and developed world. If a worker has educational attainment that is above average in the developed world, they might be employed in knowledge-based jobs as opposed to industry, whereas a worker that has educational attainment above average in the developing world may be employed in the industrial sector as opposed to the agrarian one. For all these reasons this study approaches developed and developing countries separately. Countries are thus divided into two groups according to the World Bank income cut-offs. The developed group includes high-income countries and upper-middle-income countries, whereas the developing group includes lower-middle-income and low-income countries (The World Bank income cut-offs for countries are as follows (GNI/capita): Low income: $1035 or less; Lower Middle income- $1036-$4085; Upper Middle Income-$4086-$12165; High Income- $12616 or more).

Empirical Approach

This paper investigates the question of whether educational inequality explains income inequality. It does so empirically through the use of OLS regression. As previously mentioned, developed and developing countries are examined separately through different models due to institutional differences. The general empirical model can be, however, expressed as follows:

$$Income\ Gini = B_0 + B_1 Education\ Gini + X_1 + X_1 + X_1 + U \quad (3)$$

Where, X1, X2, and X3 capture disparities within education, labour market conditions, and socio-political controls respectively. Specifically:

$$X_1 = B_2 PrivateEnrolment + B_3 GovernmentSpending/GDP + B_4 EducationSpending/GovernmentSpending + B_5 TertiarytoPrimary \quad (4)$$

$$X_2 = B_6 (Ln\ Y)^2 + B_7 Unrolment + B_8 Research\&Development \quad (5)$$

$$X_3 = B_9 Economic\ Freedom + B_{10} GenderInequality \quad (6)$$

It should be noted that the above specification applies only to developed countries. When it comes to developing countries X_1, X_2 and X_3 are slightly modified.

Manufacturing/GDP will replace Research and Development in X_2 since the demand for skilled workers in developing countries might mean working in knowledge-based jobs rather than in the manufacturing sector.

Secondly, Urban Population is added to X_3 since urbanization creates a wage disparity as previously explained.

Due to data scarcity for developing countries, GovernmentSpending/GDP, EducationSpending/Government Spending, and Unemployment are dropped from the empirical model.

$$X_1 = B_2 PrivateEnrolment + B_3 TertiarytoPrimaryRatio \quad (5)$$

$$X_2 = B_4 (Ln\ Y)^2 + B_5 Manufacturing/GDP \quad (7)$$

$$X_3 = B_6 Economic\ Freedom + B_7 GenderInequality + B_8 UrbanPopulation \quad (8)$$

Income Inequality, the dependent variable, is measured through the Gini coefficient. This metric captures the degree to which the income distribution of a country deviates from perfect equality, where 0 represents perfect equality, that is every segment of the population has an equal portion of income (e.g. the poorest 20% of the population holds 20% of income available, the poorest 40% of the population 40% of the income, etc.). On the other hand, 100 represents perfect inequality, where all of the income goes to one household. Although, not a perfect measure it is widely used because it has four highly desirable properties, namely anonymity, scale independence, population independence, and the transfer principle. The Gini Coefficient is obtained from the World Income Inequality Database, where it is constructed based on household surveys. The year from which it is collected is either 2010, or the most recent available year if no data was available for 2010.

The metric used to measure educational inequality is the Gini coefficient of education which is calculated from the Barro-Lee (2010) dataset. The formula for calculating Gini coefficient of education is:

$$G = n_0 + \frac{n_2 x_2 (n_2+n_3)+n_3 x_3 (n_1+n_2)}{n_1 x_1+n_2 (x_1+x_2)+n_3 (x_1+x_2+x_3)} \quad (9)$$

The n's indicate the percentage of people with the highest level of education completed, for no schooling (n_0), primary (n_1), secondary (n_2), and tertiary (n_3). The X's refer to the average year of education completed in primary (X_1), secondary (X_2), and tertiary (X_3).

The Gini coefficient of Education in the example is 14.81 because:

$n_0 = 0$

$n_1 = n_2 = n_3 = 1/3$

$X_1 = 8 = \frac{3*8}{3}$ (since all 3 people completed primary);

$X_2 = 8 = \frac{2*12}{3}$ (since only 2 people completed secondary);

$X_3 = 5.33 = \frac{16}{3}$ (since only 1 person has completed primary).

Educational Gini examines the inequality of educational achievement in people 25 and over, which are currently in the labour force. This metric was calculated using the formula presented in the Castello and Domenech (2002) paper, and it compares the distribution of grades completed with a perfectly equal distribution. To illustrate with a simple example, suppose that there is an economy with three people in the labour force and the number of grades completed by each person is 8, 12, and 16. If the number of years of education completed in this 3-person economy was to be distributed equally, then each person would have the attainment of 12 grades. However, that is not the case. Consequently, what this metric measure is how much the distribution of educational achievement deviates from an equal distribution. In this example, the Gini coefficient is 14.81[3]. The more the actual distribution of grades differs from perfect equality, the higher the Gini coefficient.

A disadvantage of this measure is that it is level-dependent, meaning that it depends on the average years of school completed. This metric tends to be higher in countries where a bigger share of the population has no schooling. The reason is to create a big gap between people with zero years of schooling and those that have completed higher education (i.e. 16 years of schooling). The gap between people who completed primary schooling and no schooling is 8, whereas the gap for workers who completed secondary education but not tertiary education is 4. The gap is very prominent when someone has no schooling so it makes the discrepancy bigger, thus causing a higher Educational Gini, as that person's level of accumulated education is only 0. This can also be seen in the Educational Gini formula as the percentage of people without schooling is added to the formula, thus assigning the number special importance. In fact, Frankema and Bolt (2006) find a correlation of 0.96 between the Educational Gini and the share of the working age population without schooling for their Latin America and Sub-Saharan Africa sample. Private enrolment, the percentage of primary and secondary students enrolled in private institutions, is calculated using data from UNESCO (Weighted averages are used when the number of pupils in primary and secondary school is available, otherwise, a weight of 0.5 is applied). This metric addresses access/quality of schooling. Government spending as a percentage of GDP is obtained from the World Bank in order to take into account the different sizes of government throughout countries. Educational spending as a percentage of government spending is calculated using data from World Bank to note how many resources are being devoted to education. Furthermore, the Tertiary to Primary Ratio quantifies which educational cycle is being allocated more resources, by calculating the ratio of money spent per student in tertiary education to the money spent per student in primary education. These latter two variables capture the public sector's commitment to education and in turn, they can also be a proxy for the ease of access to education.

Statistics on unemployment are also collected from the World Bank. This is defined as the percentage of the labour force that is actively seeking to find a job, yet unable to find one. Public and private expenses for Research and Development as a percentage of GDP are also obtained from the World Bank for the developed countries. It refers to work undertaken with the purpose of expanding knowledge. As previously mentioned, the percentage of GDP that comes from manufacturing is used instead of Research and Development for developing countries. Additionally, GDP-per-capita in 2005 constant dollars is collected from the World Bank. The natural log of this metric is taken to capture diminishing returns. Moreover, the square of this variable is used since per capita income is expected to have a parabolic rather than a linear effect on income, according to Kuznets' inverted U-hypothesis. The Economic Freedom Index by the Frasier Institute is used as a proxy attempting to measure the degree

of meritocracy in a country, the extent to which property is rightly acquired and protected, as well as the extent to which individuals have the right to engage in voluntary transactions, are taken into account. The Economic Freedom Index incorporates the size of government, openness to trade, access to sound money and credit, legal structure and security of property rights, as well as regulation of cred labour, and business. It takes values from 1 to 10, and the higher a country scores on this free it is perceived to be.

Gender Inequality is obtained from the UNDP, and it captures female discrimination in various arenas of society. Specifically, it includes maternal health, tertiary education attainment, and labour market participation of women. This index takes values from 0, which means complete equality, and no discrimination, to 100 which means complete inequality, thus complete discrimination. Lastly, Urban Population measures the percentage of the total population of a country residing in urban areas. This value is obtained from the World Bank. An urban area is defined according to each country's national statistics, though it typically encompasses a community with a population of more than 2000 residents.

Table 1 summarizes the variables included, their purpose for including them, the modality of measurement, and their expected effect on income inequality. Ideally, all of these variables should be included in the same econometric model together to control for income inequality. However, that is not feasible due to degrees of freedom issues. Four separate models are thus analysed in order to account for various aspects of income inequality beyond the realm of educational inequality. In Models 1-3, variables are grouped together in accordance to the specific area that impacts inequality which they control for. Variables which take into account educational access or quality are included in Model 1, whereas only the variables which take labour into account labour market conditions and LnY^2 are used in Model 2. Furthermore, Model 3 is used to assess the socio-political climate of a country. Model 4 instead includes at least one of the variables from each of the models 1-3 in order to get a more complete picture of controls for income inequality given the existing degrees of freedom restrictions.

Table 1: Summarising the Dependent and Explanatory Variables

Variable	Reason for Including It	Modality of Measurement	Expected Sign
Income Gini	Dependent Variable	0-perfect equality 100-perfect inequality	N/A
Educational Gini	Main Explanatory Variable	0-perfect equality 100-perfect inequality	+
Private Enrollment	Controls for Access/Quality	0-no students enrolled in private school (primary and secondary) 100-all students enrolled in private school (primary and secondary)	+
Government Spending/GDP	Controls for Size of Government	0-no government Spending 100- government spending equals GDP	?
Education Spending/Government Spending	Controls for Government Dedication to Education	0-no government spending allocated to education 100-all government spending allocated to education	?
Tertiary/Primary Ratio	Controls for Equity within Education	0- no spending on Tertiary <1 more spending towards primary as opposed to tertiary =1 equal spending on primary and tertiary >1 more spending on tertiary as opposed to primary	+
Unemployment	Controls for Labor Demand	0-no unemployment 100-everyone is unemployed	+
Research and Development Spending/GDP	Controls for Demand for Skilled Workers in Developed Countries	0- no spending towards Research and Development 100-All spending towards Research and development	+
Manufacturing/GDP	Controls for Demand for Skilled Workers in Developing Countries	0-no portion of GDP comes from manufacturing 100-all of GDP comes from manufacturing	+
$(LnY)^2$	Controls for Kuznets' Effect	GDP/ capita in 2005 constant $	(+) Developing Countries - Developed Countries
Gender Inequality	Controls for Female Discrimination Controls for Rural-Urban Inequality and Potential Informal sector	0-perfect equality 100-perfect inequality 0- none of the country's population resides in an urban area 100- all of the country's population resides in an urban area	+
Economic Freedom	Controls for the Degree of Meritocracy within a Country	1- least free 10-most free	-

Data for this study is collected for the year 2010. However, in the case of Income Gini, the most recent year available prior to 2010 is used, when data for 2010 is not available. The same method is applied to the percentage of private enrolment, the percentage of spending that goes towards research and development, unemployment, and government spending as part of GDP spending. The sample for developing countries includes 58 countries, while the sample for developed countries has 81 countries (see Appendix I for a complete list). The developing sample includes some of sub-Saharan Africa, Eastern Europe, South Asia, East Asia, Central Asia, and the Middle East. These are countries classified as low-income and lower-middle income by the World Bank. When it comes to the group of developed countries they generally are OECD countries such as Canada, Australia, the United States, and Western Europe. However, it also includes some sub-Saharan countries, such as Botswana and South Africa, some of South America, Central Europe, Eastern Europe, and East Asia. This is because this group includes both upper-middle-income and high-income countries, as classified by the World Bank.

Table 2 presents descriptive statistics for the variables used in this study. The mean Income Gini for the developed countries is 37.32, whereas it is 40.57 for the developing countries. Based on this data, it appears that developing countries have only a slightly higher income inequality. However, the Educational Gini for developing countries is substantially higher, 41.22, as opposed to 19.67 for the developed countries. Moreover, there is more variability in educational inequality in developing countries compared to developed countries. The value for the tertiary-primary ratio is also very high for developing countries. This result is mainly due to the sub-Saharan countries which are consistent with previous literature (Keller, 2010). As expected, gender inequality is substantially higher in developing countries (M=51.87, SD=11.30), as opposed to developed countries (M=26.21, SD=15.13). Interestingly, there does not seem to be a very substantial difference between the Economic Freedom Index in developed countries (M=7.18, SD=0.73) and developing countries (M=6.42, SD=0.68).

Table 2: Descriptive Statistics Developed Countries (Developed Countries)

Variable	Mean (M)	Standard Deviation (SD)	Minimum	Maximum
Income Gini	37.32	8.97	24.24	63.14
Education Gini	19.67	9.64	5.12	43.25
PrivateEnrollment	15.87	18.38	0	96.09
Government Spending/GDP	30.56	9.81	10.8	52.46
EducationSpending/ GovernmentSpending	17.53	5.59	7.80	34.75
Tertiary-Primary Ratio	2.14	3.79	0.56	4.35
$(LnY)^2$	90.09	17.98	63.09	127.54
Unemployment	8.63	5.01	0.3	24.7
Research and Development/GDP	1.27	1.06	0.051	4.35
Economic Freedom	7.18	0.73	4.07	8.9
Gender Inequality	26.21	15.13	4.5	68.2

Table 3: Descriptive Statistics Developing Countries (Developing Countries)

Variable	Mean (M)	Standard Deviation (SD)	Minimum	Maximum
Income Gini	40.57	7.287	25.62	57.49
Education Gini	41.22	20.58	6.53	82.23
PrivateEnrollment	13.05	15.40	0	74.92
Tertiary-Primary Ratio	17.67	46.47	0.41	284.53
$(LnY)^2$	45.86	10.60	25.16	69.36
Manufacturing/GDP	27.11	11.42	5	75.38
Urban Population	40.32	15.88	11	6
Economic Freedom	6.4	0.68	4.35	7.42
Gender Inequality	51.87	11.30	25.1	74.7

4. Results

Table 4 below shows the results for the developed countries, in terms of the four regression analyses. Robust standard errors were used in STATA to correct for heteroscedasticity. The dependent variable is the Income Gini and t-statistics are reported in parenthesis (All of the variables are abbreviated in Tables 4 and 5. Please see Appendix III for the full name correspondence).

Table 4: Developed Countries Regression Results

Variable	Model 1	Model 2	Model 3	Model 4
EdGini	0.306	0.248	0.121	0.239
	(2.54)**	(1.91)*	(1.00)	(1.59)
PrivateEnrol.	0.049			
	(0.94)			
Gov/GDP	-0.220			
	(-1.46)			
Ed/Gov	0.211			
	(0.60)			
T/P	0.857			0.509
	(5.39)***			(0.44)
$(LnY)^2$		-0.156	-0.134	-0.071
		(-2.57)**	(-2.08)**	(-0.71)
Unemployment		0.140		0.253
		(0.47)		(1.36)
R&D		-0.968		
		(0.37)		
EF			0.0620	
			(0.05)	
Gender Ineq.			0.213	0.262
			(1.94)*	(1.84)*
R^2	0.460	0.291	0.437	0.514
F	24.34***	7.08***	11.36***	8.72***
N	52	70	72	51

*indicates significance at the 0.1 level
**indicates significance at the 0.05 level
***indicates significance at the 0.01 level

Ed/GOV= Education Spending/ Government Spending; EdGini= Educational Gini EF= Economic Freedom
GenderIneq= Gender Inequality; Gov/GDP=Government spending/GDP
Manufacturing=Manufacturing/GDP; PrivateEnrol=Private Enrollment
R&D=Research and Development T/P= Tertiary spending per student/ Primary
spending per student; Urban= Urban Population

In Model 1, Income Gini is regressed as a function of educational inequality and other controls that account for discrepancies in education, such as the commitment of the public sector to education, private enrolments, and comparison of resource allocation between tertiary and primary students. Overall, this model is a good fit as it is able to explain 46.0% of the variability in income inequality. The coefficient for Educational Gini is positive and significant and impacts income inequality as would be expected in accordance with human capital theory. The ratio of spending per student on tertiary education as compared to primary education is also significant, and it positively impacts income inequality as well. This indicates that when tertiary education is prioritized over primary education it has negative implications in terms of income inequality (To check for Kuznets' Effect, both LnY and LnY^2 were used in the same model, but they were both insignificant for both developed and developing countries regressions).

Model 2 is not as strong of a predictor of income inequality as it only accounts for 29.1% of the variance. Educational Gini behaves as expected, namely positive and significant. The two labour market controls, Research and Development/GDP and unemployment, are both statistically insignificant. On the other hand, LnY^2 has a negative coefficient which is significant, and consistent with Kuznets' effect (To check for Kuznets' Effect, both LnY and LnY^2 were used in the same model, but they were both insignificant for both developed and developing countries regressions).

In Model 3, where Educational Gini, LnY^2, and sociopolitical controls are used, Educational Gini loses its significance. Nevertheless, Gender Inequality is positive and statistically significant. Interestingly, once Gender Inequality is used in the regression analysis, the Educational Gini becomes insignificant. This suggests that there is a co-movement between the two variables, which needs to be further investigated in future research (The correlation between genderInequality and EducationalGini is 0.5 and 0.7 in developed and developing countries respectively). Previously, Educational Gini might have been significant simply because it was accounting for gender discrepancies. Economic Freedom is not statistically significant. Lastly, the coefficient for LnY^2 is negative, as expected with countries at the upper end of the income spectrum.

In Model 4, all of the previously significant variables were used in the regression, due to degrees of freedom limitations. Unemployment is used as well, in order to include labour market control in the final model, although it previously did not reach significance. The R^2 is high, though most of the coefficients are insignificant which is indicative of multicollinearity. In fact, the only coefficient which remains significant is Gender Inequality, whose coefficient

is 0.262, meaning that as gender inequality increases by 1, income inequality increases by 0.262.

The OLS regression results for the sample of developing countries are presented in Table 5. Similar to Table 4, income inequality is the dependent variable, t-statistics are provided in the parenthesis, and heteroscedasticity is once again corrected. Overall these models are not as good fits as the ones for the developed countries as indicated by the lower R^2.

Table 5: Developing Countries Regression Results

Variable	Model 1	Model 2	Model 3	Model 4
EdGini	-0.040	-0.0044	-0.167	-0.0211
	(-0.60)	(-0.08)	(-2.14)**	(-0.27)
PrivatEnrol.	0.0751			
	(0.90)			
T/P	0.019			0.0227
	(1.55)			(1.44)
$(LnY)^2$		0.057	0.056	0.253
		(0.47)	(0.42)	(2.39)**
Manufacturing		0.071		
		(0.85)		
EF			2.809	6.23
			(1.56)	(2.59)**
GenderIneq.			0.474	0.374
			(3.52)***	(2.65)**
Urban			0.011	
			(0.16)	
R^2	0.0406	0.025	0.216	0.330
F	1.25	0.62	2.86**	4.75***
N	39	58	55	39

*indicates significance at the 0.1 level
**indicates significance at the 0.05 level
***indicates significance at the 0.01 level

Ed/GOV= Education Spending/ Government Spending; EdGini= Educational Gini EF= Economic Freedom
GenderIneq= Gender Inequality; Gov/GDP=Government spending/GDP
Manufacturing=Manufacturing/GDP; PrivateEnrol=Private Enrollment
R&D=Research and Development spending per student; T/P= Tertiary spending per student/ Primary
Urban= Urban Population

The first model predicts income inequality as a function of Educational Gini and other controls for discrepancies in education. Due to missing data, Government Expenditure/GDP and Education Expenditure/Government Expenditure are dropped from the model. This model is not a good fit as indicated by the low R^2, and the fact that none of the coefficients is significant

(Since the majority of the labour force in developing countries may not have tertiary education, the ratio of spending per student on secondary to primary schooling was substituted for the tertiary to primary spending per student, however, the coefficient was not significant). The second model includes the Educational Gini along with LnY^2, and labour market control. The percentage of manufacturing that comes from GDP, and the LnY^2 are not significant. Overall this model is not significant at explaining the variability in income inequality, it is similar to Model 1.

Model 3 includes the sociopolitical controls, LnY^2, and Educational Gini as its variables. This model is a better fit than the previous one. Educational Gini is statistically significant but has a negative coefficient, which is counterintuitive to human capital theory. However, this negative coefficient may be due to the fact that average years of attainment and income inequality have an inverse relationship (In this data sample there is a correlation of -0.284 between income inequality and average years of attainment). Since Educational Gini is calculated using average years of attainment, this creates the possibility of a third variable effect which is causing this negative relationship. Similar to the model for developed countries, gender inequality is once again a significant variable which positively impacts income inequality. This metric constantly performs as one of the best predictors at explaining income inequality. On the other hand, Urban Population, the variable unique to developing countries, is not statistically significant.

Parallel to the analysis for developing countries, Model 4 combines all models by including at least one variable from each of the previous models. So far this model is the best fit when compared to previous ones. The coefficient for LnY^2 is significant and positive, which supports Kuznets' inverted parabola, though inequality does rise at an increasing rate. This relationship indicates that there are structural differences in how an increase in per-capita income impacts income inequality across countries. Economic Freedom, which is used to capture the degree of meritocracy in a country is positive, which is different from what was hypothesized. It has a coefficient of 6.23 and the reason why it has a bigger magnitude than other coefficients is due to the way it is scaled.

Economic Freedom is measured on a scale from 1-10, whereas Income Gini is measured on a scale from 1-100. This coefficient indicates that for this sample, as Economic Freedom increases by 1, income inequality increases by 6.23. A possible explanation for this positive relationship may be that once a country opens to trade it adversely affects the middle class. Wells (2005) finds similar results with Economic Freedom. Once again, Gender Inequality is significant in this model, while Educational Gini is no longer significant. It seems difficult to capture the exact causes of income inequality in developing countries.

5. Conclusion

The results indicate that knowledge is more likely to be rewarded in developed rather than developing countries, as shown by a significant and positive coefficient for Educational Gini. This can be due to a variety of factors, from brain drain in developing countries, or simply due to already existing institutions which affect income inequality, thus masking the effect of Educational Gini. Furthermore, once Gender Inequality is added to the regression for both developed and developing countries, the coefficient for Educational Gini changes in magnitude and significance, suggesting that there is a co-movement between these two variables. There could be gender disparities within educational achievement. For example, women might be expected to fulfil traditional gender roles instead of getting an education, causing them to stop their education earlier as opposed to men. Additionally, they may be less motivated to obtain an education as they would anticipate difficulty finding a job despite their educational achievements. Gender Inequality is overall a more robust metric for explaining income inequality rather than inequalities within educational achievement for both developed and developing countries. Furthermore, Economic Freedom affects inequality unexpectedly in developing countries, suggesting that free markets may not function as well due to structural inequalities. It is possible that the upper class is the only one that benefits from free market operations due to already existing social structures such as class, tribes, and castes. Profits might be generated by those in power thus amplifying the effect of their already-existing wealth. Additionally, the middle class can be adversely affected once a country opens up to trade if they work in an industry where the goods are replaced by imports. This study also confirms Kuznets' inverted U, as LnY^2 affects income inequality negatively in the developed world and positively in the developing world. Income inequality appears to be a very complex topic, and educational inequality can only explain a minimal amount in developed countries, while almost none in developing countries.

Policy recommendations should acknowledge that systematic discrimination against women increases income inequality. Since women are generally half of the population in most economies, if such a substantial portion of the population is denied access to resources, then that would clearly lead to more income inequality. Although this policy would be especially hard to execute in countries that have conservative attitudes towards gender roles, countries should be aware that gender inequality and income inequality are strongly related. The ratio of Tertiary spending per student to Primary spending per student is another significant finding in terms of explaining income inequality in developed countries. Consequently, it is also recommended to increase spending per student in primary education relative to tertiary education. This would make the educational system itself more fair and equitable, as

governments should recognize that if primary schools are of substantially different quality from one another, that will hinder social mobility and education would fail to bring ameliorating effects on income inequality.

In regards to future research, further study of the relationship between gender inequality and income inequality would be appropriate in order to see how exactly gender inequality interacts with income inequality and educational inequality. It should be checked whether it is the case that women have unequal access to education, and thus less potential for higher earnings, or whether they are discriminated against in the labour market, despite having equal accomplishments in education. For example, women can be less likely to be hired or can be paid a lower wage despite similar productivity. Feedback effects should also be investigated since it is plausible that income inequality impacts educational inequality because those in the upper class are likely to have more access to education. Other controls for income inequality could also be considered in the developing world since the ones used explained less of the variability in income inequality than the controls used for developed countries. Identifying a metric that captures meritocracy better than Economic Freedom would also enrich this topic. Finally, future papers should explore lagging the research and development variable since it takes time to see the value of research and development in a society and the consequent demand for those types of jobs. Other variables that could be lagged would be private enrolments, tertiary/primary spending, and education/government spending. Consequently, lagging these variables would enable the researcher to examine the education of the workers currently in the labour force, as for currently enrolled students. As more research is implemented, more of the factors impacting income inequality may be discovered.

List of developing countries

Albania	Fiji	Mali Niger Pakistan	Senegal
Armenia	Gambia	Mauritania	Sierra
Bangladesh	Ghana	Moldova	Leone
Belize	Guatemala	Mongolia	Sri Lanka
Benin	Guyana	Morocco	Sudan
Bolivia	Honduras	Mozambique	Swaziland
Burundi	India	Nepal	Syria
Cambodia	Indonesia	Nicaragua	Tajikistan
Cameroon	Kenya	Niger	Togo
Central Africa	Kyrgyzstan	Pakistan	Uganda
Congo	Lao	Papua New Guinea	Ukraine
Cote d'Ivore	Lesotho	Paraguay	Vietnam
Democratic Republic of Congo	Liberia	Philippines	Yemen
Egypt	Malawi	Rwanda	Zambia
El Salvador			Zimbabwe

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