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Does Educational Inequality Explain Income Inequality Across Countries?

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I. Introduction

Throughout the last decade, countries once considered under-developed have experienced tremendous growth. Although the growth metrics of some countries appear great on paper, unfortunately not everyone in the respective countries has been able to benefit from that growth. Too many times the economic growth of a country has gone to an elite group, while the rest of the people, especially those in rural areas have continued to live in poverty. To illustrate with an example, for the decade of 2000-2010, China's average growth rate has been 10.6%, while its income inequality has remained stagnant, as indicated by a minuscule 0.4 on a scale from 0-100 improvement in its Gini coefficient. Income discrepancies between the rich and the poor have been noted in the developed world as well, from Europe to the United States. This indicates that benefits of economic growth have unfortunately only provided an advantage to a select few, as opposed to having positive spillover effects throughout the country.

Although some degree of inequality is perceived as necessary for a well-functioning economy, extreme inequality is generally a concern to economists due to the negative effects it can have on growth (Champernowne and Cowell, 1998, p.14). Various social ills are attributed to income inequality from diminishing trust in government, to lower life expectancy, higher crime, and lower international test scores (Wilkinson and Pickett, 2009, p. 19). Interestingly, these negative implications of inequality affect everyone in the country not just the least well-off (Wilkinson and Pickett, 2009, p. 181). Besides the philosophical implications of extreme income inequality discussed by John Rawls, that even high income individuals express dislike about living in an unjust world, income disparity's effects carry over to economics as well, impeding efficient market

outcomes. The lower class may have less access to credit, which undermines economic mobility, because they cannot afford an education. Furthermore, polarization might increase as the upper class is more likely to stay in power and adopt policies that solely benefit them through rent-seeking or bribery, while those on the lower end of the income spectrum will likely favor populist policies, and civil unrest might erupt. Thus, the focus of public policy will mostly be on maintaining status quo or redistributionist policy rather than growth and prosperity (Toadaro and Smith, 2012, p. 221). By creating a stratified society, high income inequality can stagnate economic growth.

Many factors have been attributed to growing inequality in income distribution, from rural-urban disparity wage, post-colonialism legacy, to globalization. However, a common denominator which can be assessed across every economy is labor market outcomes. This notion stems from neoclassical theory, which states that income inequality is a consequence of unequal investments in human capital. An appropriate proxy for measuring human capital, as later explained, is education. The premise is that the more time is spent in school, the more human capital a person can accumulate. By having higher human capital, a worker's productivity increases, resulting in higher earnings. According to the wage-schooling model, a worker rationally chooses his/her years of schooling in order to maximize earnings in the labor market (Borjas, 2013, p 242).

Lastly, it is important to note the merits of education, not only as a tool for higher earnings, but sometimes as an end in itself. Education is able to expand a person's capabilities, an important goal of development. It has the ability to empower citizens to be productive members of their country, by increasing civic participation. Specifically,

the gender gap can be narrowed by empowering women to have more opportunities in the labor market. It is also important to note the priority that a government gives to education, particularly which educational cycle is allocated the most money. Spending on college education versus primary education has different impacts on income inequality as will be later explained. By spending more on primary education, the government can provide everyone with a fair chance at being literate, an important end in itself.

This paper investigates whether educational inequality can explain income inequality across countries. It enhances the literature in this topic by utilizing more recent cross-sectional data from 2010, and a novel combination of sociopolitical controls and labor market controls. Assessing income inequality across countries is difficult, because country-specific variables may impact it, such as the degree of meritocracy a country provides. To account for this difficulty, country-specific structural components are controlled for. Specifically, separate regressions which consider a country's level of development are run.

The rest of the paper is organized as follows. The second section of the paper will discuss how this issue is addressed in the literature, and the third will present the theoretical grounds that this paper is based on. The fourth will explain the empirical model, and the fifth presents the results. Finally the sixth section of this paper provides a conclusion and suggests policy recommendations in accordance to the results.

II. Literature Review

The seminal paper in the literature which claimed that there is a positive relationship between income inequality and educational inequality was the Becker and

Chiswick (1966) paper. They argued that different investments in human capital would yield a widespread distribution in earnings. Since there are higher rates of return in the labor market associated with higher schooling, a varied income distribution can be explained by the fact that workers make different choices in regards to education. In the 1960's, when the data for the paper was obtained, the Southern states exhibited greater income inequality than Northern states, and the paper also observed that the variance of education in the South was greater as opposed to the North. This gave rise to the claim that educational inequality positively impacts income inequality.

Nevertheless, as the topic was further studied ambiguity arose. Other researchers have expressed theoretical challenges and, at other times, absence of empirical evidence for this claim. Bhagwati (1973) argued that in the developing world, education is much more likely to be used as a signal of productivity, rather than to build human capital. There appeared to be an excess supply of educated labor, thus jobs that would only require a high school diploma tend to be filled by those that have a master's degree, simply because employers interpret their diploma that they are more productive. In reality, the employees would not use those skills for the job, so the resources spent on education are essentially wasted. To illustrate with an example, this would be someone with a doctorate doing menial clerical work. The final outcome is an absence of demand for high skilled labor, and an excess supply of educated labor. Bhagwati argued that this would have ambiguous effects on income inequality, because even employees with a high amount of schooling may be employed below their levels due to job scarcity, so their earnings would not necessarily be higher. Upon a survey of the literature, Ram (1989) also cautions, that empirical evidence that educational inequality has a clear impact on

income inequality is scant, especially when it comes to Least-Developed-Countries. One particular explanation that he offered had to do with the fact that the rate of return to education may be harder to decipher in the developing countries as compared to the developed ones. Sometimes jobs may be filled on the basis of cronyism and bribery, as opposed to educational achievement.

Empirically, some papers were unable to find a relationship between income inequality and educational inequality (Foldvari and Leewuen, 2011; Checchi, 2004). Their results suggested that the relationship between the two variables is generally insignificant across most models. One of the papers only found a statistically significant relationship, albeit a weak one, for OECD countries, but not for developing countries. (Foldvari and Leewuen, 2011). Checchi (2004) only found the relationship robust for some of the models when average years of attainment is also considered. Surprisingly, the relationship was negative and average years of educational attainment appeared to have a bigger effect than educational inequality on income inequality.

However, other papers have found a robust and positive relationship between educational inequality and income inequality (Gregorio and Lee, 2002; Frankema and Bolt, 2006; Dao, 2013). For example, Frankema and Bolt (2006) defined educational inequality in terms of grade enrollment ratio and found robust results when studying the regions of Latin America and sub-Saharan Africa. Dao (2013) examined access to human capital in a more encompassing manner, as compared to other papers, by considering both education and health investments in the developing countries. Health disparities was measured through access to immunization by the top four quintiles compared to the lower quintile, and Dao's analysis yielded significant results. Gregorio and Lee (2002) found

that social expenditure/GDP was a better predictor of income inequality rather than educational inequality, although educational inequality was significant as well. Social expenditure was measured by the average ratio of general government, social security, and welfare expenditure to GDP. Additionally, Keller (2010), found that increased expenditure per student on primary education significantly reduces income inequality.

Other papers have examined the issue by utilizing access to education, state of the economy, and sociopolitical climate of a country as controls. Since income inequality is contingent on a country's institutions, education may only have a small effect on income inequality. For example, sometimes income inequality can depend on ethnic heterogeneity, type of political regime, and expropriation risk (the risk that an owner has of the government seizing property). Frankema and Bolt (2006) found that the more ethnic groups there are in a country, when interacting with expropriation risk, the higher the income inequality. Wells (2005) found evidence that the Economic Freedom has an important impact on income inequality. This variable captures access to credit, free trade, and whether the property is rightly acquired, as opposed to being obtained through illegal means and whether ownership rights are protected. He also found that interaction effects between secondary school enrollment and economic freedom positively affect income inequality. However, higher secondary school enrollment does not positively impact income inequality in countries with low economic freedom. Wells suggested that this phenomenon is explained by the fact that when a country first opens up to trade, income inequality increases. In countries where a big percentage of a population has less education relative to other workers, their jobs might disappear once a country opens up to trade.

The Kuznets' inverted U effect has been proposed when it comes to explaining income inequality as GNI/capita increases in a country (Kuznets, 1955). Countries are typically believed to go through three stages of development. In the beginning in an agrarian society, income is low, but so is income inequality. However as a country moves to an industrial economy, per-capita income rises but so does income inequality. After a while inequality reaches a peak, and then it decreases even as income per capita continues to grow, as a country moves into its post-industrial stage of development. The end 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 due to most people in a country being illiterate. However, after mandatory schooling is instituted, the wage differential increases, due to the fact that there is a discrepancy between the educated and the non-educated. Yet, over time, this wage differential, and hence inequality, decreases due to the fact that most of the composition of the labor force gains more education. As the labor force becomes more educated, this lowers the disparity of the wage differential. This inverted U- relation has also been investigated with regards to income inequality and average years of education, yielding robust results consistent with the hypothesis (Checchi, 2004).

The consensus across the literature is that there is a theoretical basis to the notion that educational inequality increases income inequality. Nevertheless, empirical results are ambiguous, sometimes finding a positive and significant relationship and other times insignificant results. This paper continues the empirical investigation by examining the relationship between income inequality and educational inequality while controlling for

educational access and quality, the Kuznets' effect, sociopolitical controls, and labor market conditions.

III. Theory

The economic theory that this paper's thesis is based on is human capital theory, along with the Cobb-Douglas Production Function. Human capital refers to "productive investments embodied in human persons, including skills, abilities, ideals, health, and locations, often resulting from expenditures on education, on the job training programs, and medical care" (Todaro and Smith, 2012, p 360). A proxy commonly used to measure human capital is education.

In accordance to human capital theory, the wages earned in the labor market can be estimated as a function of the number of years spent in school. Schooling is believed to increase a worker's productivity through acquiring labor-market relevant skills. However, discrepancy in wages can arise, even though workers acquired the same amount of schooling, due to other factors such as innate ability, quality of schooling, and specialization when it comes to higher education. The assumption of this paper is that years of schooling has a linear and positive impact on wages earned in the labor market.

The Cobb-Douglas Production Function defines real output of a country as the product of physical capital (k), worker effort (l), technological progress (A), and human capital (h):

$$Y_i = Ak_i{}^{a}h_i{}^{1-a}l^{1-a}.$$

Across each country, A and l are assumed to be equal, so that would not cause dispersion in output. However there is variability in human capital and physical capital as captured

by the *i* subscript. Individuals have different human capital due to various educational achievements, and firms throughout each country have different amounts of physical stock due to various acquisitions in machinery/inventory/facilities.

The variance in output of a society can then be expressed as follows:

$$\text{Var}(\ln Y) = a^2 \text{Var}(\ln k_i) + (1-a)^2 \text{Var}(\ln h_i) + 2a(1-a)\text{Cov}(\ln k_i, \ln h_i).$$

Based on this equation, a 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 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 disparity in income.

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 labor-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 labor 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 towards education. In order to look into this, it is necessary to examine how big the size of the government relative to the size of the economy, and then how much of 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 substantial higher quality at the expense of primary education, that 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 labor supply aspect of the occurrences in the labor market. Looking at the demand side is also necessary because even though workers may have different educational achievements, that will not lead to divergent wages in the labor market if there is no demand for educated workers. The skilled laborers 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 labor 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 labor market are zero, so the discrepancy between educated and uneducated workers is higher. Overall, shifts in the demand for labor impact the wage discrepancy by increasing or decreasing the wage disparity between skilled and unskilled workers.

There are multiple factors that affect inequality beyond wages or productivity skills rewarded in the labor market. In fact, various sociopolitical factors can also have an impact on a country's differing levels of income inequality. For example, if female discrimination is prominent in a country, even if women are educated, it is likely that they would be underemployed in the labor market, despite their qualifications. Furthermore, in the developing countries, a high rate of urbanization is likely to lead to more income inequality. One of the reasons for this is because 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 a wage disparity within the city as well, since large scale migration from rural areas leads to the formation of an informal sector where wages are substantially lower due to lack of regulation. The degree of meritocracy of a country further impacts income inequality. If a country's political system can be classified as a meritocracy, then more income can be earned in the labor market as a reward for productivity rather than one group arbitrarily holding it. For example a group might arbitrarily hold it simply because they are the ethnic majority or have political connections rather than merit-based.

From the literature, it appears that the relationship between income inequality and educational inequality can vary for 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 favored 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 in the developing world. Moreover, the developed world is more likely to reward knowledge and skills acquired in school due to job availability. Furthermore, skilled labor 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 cutoffs. The developed group includes high-income countries and upper middle income countries, whereas the developing group includes lower-middle-income and low income countries. [1]

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[1] The World Bank income cutoffs for countries are as follows (2012 GNI/capita):
Low income: $1035 or less;
Lower Middle income- $1036-$4085;
Upper Middle Income-$4086-$12165;
High Income- $12616 or more.

IV. Empirical Model

This study 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:

$$Income\ Gini = B_0 + B_1 EducationalGini + X_1 + X_2 + X_3 + U,$$

where, X_1, X_2, X_3 capture disparities within education, labor market conditions, and sociopolitical controls respectively. Specifically:

$$X_1 = B_2 PrivateEnrollment + B_3 GovernmentSpending/GDP + B_4 EducationSpending/Governmentspending + B_5 TertiarytoPrimaryRatio$$

$$X_2 = B_6 (LnY)^2 + B_7 Unemployment + B_8 ResearchandDevelopment$$

$$X_3 = B_9 EconomicFreedom + B_{10} GenderInequality$$

It should be noted that the above specification is 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 demand for skilled workers in developing countries might mean working in knowledge-based jobs rather than 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.

$$X_1 = B_2 PrivateEnrollment + B_3 TertiarytoPrimaryRatio$$

$$X_2 = B_4 (LnY)^2 + B_5 Manufacturing/GDP$$

$$X_3 = B_6 EconomicFreedom + B_7 GenderInequality + B_8 UrbanPopulation$$

Income Inequality, the dependent variable, is measured through the Gini coefficient. This metric captures the degree at 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 (Todaro and Smith, 2012). 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.[2] Educational Gini examines the inequality of educational achievement in people 25 and over, which are currently in the labor 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 labor force and the number of grades completed by each person are 8, 12, and 16. If the number of years of education completed in this 3-person economy were to be distributed equally, then each person would have the attainment of 12 grades. However, that is not the case. Consequently, what this metric measures is how much the distribution of educational achievement

[2]The formula is provided in the Appendix II.

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 for this is because it creates 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 on 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 enrollment, the percentage of primary and secondary students enrolled in private institutions, is calculated using data from UNESCO. [4] 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

[3] See Appendix II for calculation.
[4] Weighted averages are used when the number of pupils in primary and secondary school are available, otherwise a weight of 0.5 is applied.

calculated using data from the WorldBank to note how many resources are being devoted to education. Furthermore, 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 labor force that is actively seeking to find a job, yet unable to find one. Public and private expenses on Research and Development as a percentage of GDP is 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 the 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 linear effect on income, according to the 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, and 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

credit, labor, and business. It takes values from 1 to 10, and the higher a country scores on this index, the more free it is perceived to be.

Gender Inequality is obtained from the UNDP, and it captures female discrimination in various arenas of the society. Specifically, it includes maternal health, tertiary education attainment, and labor 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, 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 analyzed 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 into account labor market conditions and LnY^2 are used in Model 2. Furthermore, Model 3 is used to assess the sociopolitical 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: Summarizing 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 of Education	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	0-perfect equality 100-perfect inequality	+
Urban Population	Controls for Rural-Urban Inequality and Potential Informal sector	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 percentage in private enrollment, 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 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, 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 the 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 the developing countries compared to the developed countries. The value for the tertiary-primary ratio is also very high for the developing countries. This result is mainly due to the sub Saharan countries which is consistent with previous literature (Keller, 2010). As expected, gender inequality is substantially higher for 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 the 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	69
Economic Freedom	6.42	0.68	4.35	7.42
Gender Inequality	51.87	11.30	25.1	74.7

V. 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.[5]

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

[5] All of the variables are abbreviated in Tables 4 and 5. Please see Appendix III for the full name correspondence.

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 enrollment, 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 to 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.

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 labor 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, consistent with Kuznets' effect[6].

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[7]. Previously, Educational Gini might have been significant simply because it

[6] 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.

[7] The correlation between GenderInequality and EducationalGini is 0.5 and 0.7 in developed and developing countries respectively.

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 a labor 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 for. 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

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 are significant[8]. The second model includes the Educational Gini along with LnY^2, and a labor market control. The percent 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, similar to Model 1.

[8] Since the majority of the labor 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.

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[9]. 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 as to 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

[9] In this data sample there is a correlation -0.284 between income inequality and average years of attainment.

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 the developing countries.

VI. Conclusion

The results indicate that knowledge is more likely to be rewarded in the 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 the 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 fulfill 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 at explaining income inequality rather than inequalities within educational achievement for both the developed and developing countries. Furthermore, Economic Freedom affects inequality

unexpectedly in the 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 of 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 labor 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 enrollment, tertiary/primary spending, education/government spending. Consequently, lagging these variables would enable the researcher to examine the education of the workers currently in the labor force, as for currently enrolled students. As more research is implemented, more of the factors impacting income inequality may be discovered.

Ultimately, this would provide governments with more direction to improve this income inequality.

Appendix

Appendix I

List of developing countries:

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

List of developed countries:

Algeria
Argentina
Australia
Austria
Bahrain
Barbados
Belgium
Botswana
Brazil
Bulgaria
Canada
Chile
China
Colombia
Costa Rica
Croatia
Cuba
Cyprus
Czech Republic
Denmark
Dominican Republic
Ecuador
Estonia
Finland
France
Gabon
Germany
Greece
Hong Kong
Hungary
Iceland
Iran
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kuwait
Latvia
Libya
Lithuania
Luxembourg
Macao
Malaysia
Maldives
Malta
Mauritius
Mexico
Namibia
Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Qatar
Romania
Russia
Saudi Arabia
Serbia
Singapore
Slovakia
Slovenia
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Thailand
Trinidad and Tobago
Tunisia
Turkey
United Arab Emirates
United Kingdom
United States
Uruguay
Venezuela

Appendix II

Formula for calculating Gini coefficient of Education:

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

The n's indicate the percentage of people with the highest level of education completed 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).

Appendix III

Full name for explanatory variables:

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

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