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The Determinants of Income Inequality: The Role of Education

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Abstract

The economics literature reports mixed evidence on the importance of education as a determinant of income inequality. In this document we shed light on the debate by testing this relationship for a sample of developing and developed countries from 1990 to 2014. We control for country specific characteristics including trade openness, unemployment, foreign direct investment, and the share of elderly population. The results of robust panel data estimations unequivocally find that education is negatively and significantly associated with income inequality.

Keywords: education; income inequality; robust estimation.

JEL classification: O1; O15; O57.

1. INTRODUCTION

Income inequality has received substantial attention in the economics literature and other social sciences. Although the phenomenon was observed in the times of David Ricardo, one can argue that formal analysis started with the seminal works of Kuznets (1955) and Kaldor (1960). What factors contribute to income inequality? Why is it persistent? What are the consequences of income inequality? These are some of the questions the economics profession has addressed throughout the years.

In this document, we focus our attention on the role of education as a determinant of income inequality. Mincer (1958), Schultz (1961) and Becker (1962), started the discussion on this front. In general, findings point to a positive effect of education in alleviating inequality. Checchi (2000), Berry and Glaeser (2005), Shapiro (2006), Rodriguez-Pose and Vassilis (2009) and Battistón *et al.* (2014), for example, suggest that the more advanced and effective the educational system of a country, the smaller the spread of income polarization. They

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identify education as one of the core underlying factors in income differences; improving education is one of the main ingredients in a typical recipe for development with equity. This argument follows Williamson (1991), who finds that the accumulation of human capital through education leads to more equal distribution of wealth and robust economic growth[1].

The link between education and income equality is, however, not as straightforward as it seems; a negative relationship is plausible. Becker and Chiswick (1966), Park (1996) and Bourguignon *et al.* (2005) suggest that developments in the sphere of education lead to an increase in income polarization. The argument follows the proposition in Knight and Sabot (1983). The authors analyzed the effect of educational attainment on income distribution recognizing the potential effects of changes in the labor market. Specifically, they argued that as a larger share of the population attains higher levels of education, the supply of labor increases, and the wages of highly educated workers fall in the long-run. Thus, the relationship between educational attainment and income distribution also depends on the supply and demand of labor.[2] The negative contribution of education to equality is also highlighted in Lustig *et al.* (2016) and Campos-Vazquez *et al.* (2014), who allude to the "paradox of progress" and recognize that in early stages of development, and under convexity in the returns to education, it is possible to experience an increase in educational attainment with growing inequality. According to Gasparini *et al.* (2011) this "paradox of progress" has been a constant in Latin America over the years.

Another set of studies finds no significant effect of education on income distribution. Spence (1973), Galor and Tsiddon (1997), Champernowne and Cowell (1998), and Wolf (2004), for instance, suggest that education has no direct effect on income distribution; as education is considered to be a so-called "label". According to the authors, genetic and cognitive abilities are the main characteristics of the labor force rewarded by employers, not so much the level of education.

More recent literature has evaluated how education, defined in a broader sense, influences income inequality. For instance, Andersen (2019) considers an intergenerational framework whereby parent's education affects the scholastic achievement of their children. Children with relatively well-educated parents are more likely to go to college than children with less educated parents. In turn, the higher level of academic attainment results in relatively higher wages. Similarly, Crawford *et al.* (2016) examines how family background influences education. The authors show that young students from poor families are on average less likely to go to a university; the opposite is true for wealthier individuals who earn relatively higher wages. This disparity in educational attainment and wages persists in future generations. Hence, inequality is an intergenerational phenomenon. The findings in Gregg *et al.* (2019) support the intergenerational argument, adding that overall education is not meritocratic as we usually perceive it to be. That is, educational patterns are not only the result of personal effort and persistence, but are also influenced by family and social background. On this latter issue, Rumberger (2010) evaluates how social background affects college completion. The author finds that students from high socioeconomic status are more than six times more likely to complete college than students from a lower social class background. This difference in academic achievement produces differences in young adult earnings. The author also identifies significant differences across gender and ethnicity: for Hispanic males and Asian males and females in the US, background has no effect on the probability of finishing a college career.

The link between educational opportunities and income inequality was also examined in Baliamoune-Lutz and McGillivray (2015). The analysis centers on gender inequality and access to primary and secondary education. Their results suggest that the gap of female to male enrollment in these educational levels is positively associated with lower income for females[3]. Hartmann *et al.* (2017) further studies how access to education affects academic attainment and ultimately income distribution. The framework of analysis considers how the quality of institutions, including educational systems, determines the level of human capital available in society. More efficient institutions produce higher levels of educational attainment, and hence, higher labor productivity. Workers find themselves better positioned to negotiate higher wages and in consequence compress wage inequality. Their results show a negative and significant relationship between inequality and education, however, they find that economic complexity, not education, explains most of the variation in inequality.

Clearly, there is ample opportunity for examining the role of education as a determinant of income inequality. This paper adds to the existing literature by considering a rich data set consisting of 38 countries for the period of 1990-2014, which in contrast to previous studies, namely Eunyoung (2012), Boarini and Strauss (2010), and Tselios (2008), contains a large number of developed countries. In addition to education, we consider economic and social variables including unemployment rate, inflation rate, Foreign Direct Investment (FDI), Gross Domestic Product (GDP) per capita, the share of elderly population, and trade openness. Unemployment and inflation, as factors associated with inequality, have been amply studied in the literature. It is widely recognized that persistent unemployment, especially amongst low-skilled workers, widens the income gap. Similarly, various studies have argued that inflation and inequality are positively related, including Albanesi (2007). The evidence on FDI and inequality is also abundant and for the most part points to a negative impact of inward capital flows on income distribution; see for example Bogliaccini and Egan (2017). A similar result applies to the effect of an aging population on inequality. Goldstein and Lee (2014), for instance, show that a five-year increase in longevity leads to a one to two percent increase in inequality, as measured by the share of wealth held by the top decile of the population. The inclusion of trade openness as a measure of globalization is particularly attractive, as several authors have argued that the increasing pace in globalization during the past few decades has influenced income inequality significantly[4]. Finally, we include GDP per capita to test the Kuznets curve proposition. By controlling for different factors that may contribute to inequality, we seek to identify more precisely the effect of education on the wealth gap, as such, the results of our study should provide more basis for formulating an argument that definitely establishes this relationship.

We do not make any predictions as to what we should find, as the effect of education on income distribution cannot categorically be stated. Our comments and discussion will follow the results of the econometric exercise. The rest of the document is structured as follows: Section 2 presents the data. Section 3 describes the empirical methodology. Results are reported and analyzed in Section 4. Section 5 concludes.

2. INCOME INEQUALITY

Figure no. 1 shows average Gini index (1990-2014) and average enrollment from the Human Development Report (1990-2014) for the 38 countries considered in this exercise. Annex 1 lists the countries we examine. The figure suggests that higher educational levels

are associated with smaller Gini indexes. Countries with low enrollment show the highest levels of inequality; the income gap is much narrower in countries where enrollment is close to 100%. Also, notice that underdeveloped countries report high income inequality whereas developed countries exhibit high enrollment and low levels of inequality.

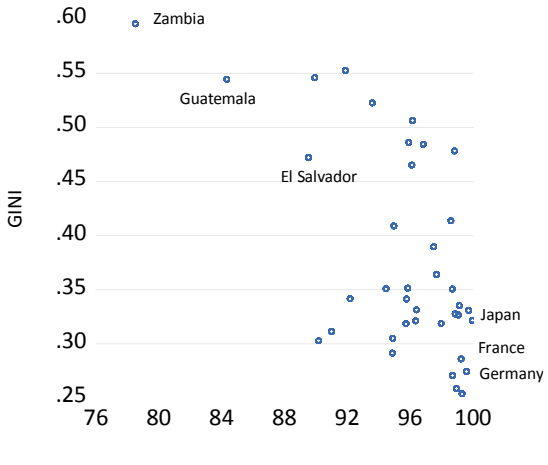

Figure no. 1 – Enrollment and Gini Index. Averages from 1990 to 2014
Sources: United Nations University, World Income Inequality Database (WIID), 2017[5]; Human Development Report (HDR), 2016[6].

Figures no. 2 and no. 3 compare the averages for two periods in time, from 1990 to 2000 and from 2001 to 2014, respectively. We wanted to examine if, graphically, there is evidence of changes in the levels of inequality and education across countries and throughout time. Clearly, countries in the sample experienced an increase in enrollment; while lower levels of enrollment in the 1990s were in the 70% - 80% range; for the 2000s these levels are in the high 80% and low 90%. Also, a decrease in the levels of inequality is perceived. The highest level in the earlier period was close to 0.70 for Zambia; in the latter period the score for this country improves to 0.56. El Salvador shows significant progress in both, enrollment and equality scores, going from 0.50 to 0.44 in the Gini index and from 81% to 95% in enrollment. Overall, in both periods the negative relationship between education and inequality persists.

The graphical evidence showing a decline in income inequality is consistent with the findings in Lustig *et al.* (2016) for the case of Latin America. The authors analyzed seventeen countries from 2000 to 2011 and found that for sixteen of them inequality dropped, the only exception was Honduras. Interestingly, they notice that the global recession of 2008 did not affect the downward trend in the decline of inequality. One would have expected the recession to worsen inequality, as low wage earners have no means to protect against the negative shock, while wealthier individuals may diversify to temper their losses. As a possible explanation for the reduction in inequality the authors point to a reduction in hourly labor income and improvements in government transfers.

While a negative relationship between education and the Gini coefficient is apparent in both periods, we still cannot confidently claim that education is a factor that leads to a decrease in inequality. The econometric exercise that follows will provide definitive evidence.

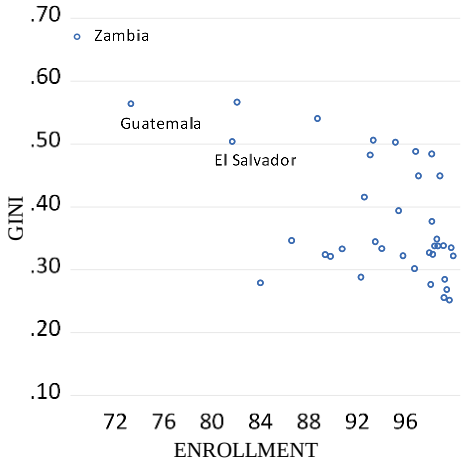

Figure no. 2 – Enrollment and Gini Index. Averages from 1990 to 2000

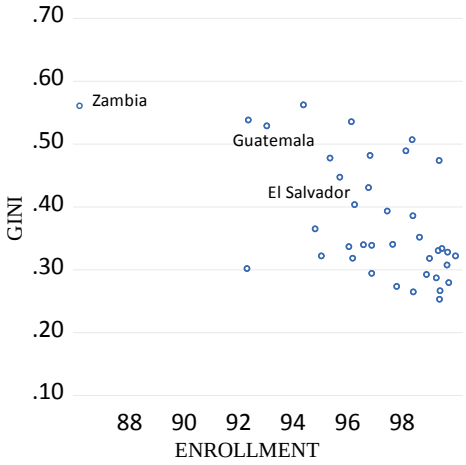

Figure no. 3 – Enrollment and Gini Index. Averages from 2001 to 2014

3. EMPIRICAL EXERCISE: DATA

For the empirical analysis, we assembled a database of 38 countries for the time interval of 1990 – 2014.

Gini index, as a measure of income inequality, was obtained from the World Income Inequality database (WIID 2017) maintained by the United Nations University (UNU-WIDER). It stores information on income inequality for developed, developing, and transition countries (172 countries in total) and provides the most comprehensive set of income inequality statistics available.

As a measure of education, we consider data on adjusted net enrollment rate (primary, both sexes (%)) from the database of World Development Indicators (2017) provided by the World Bank. The variable refers to the total number of students of the official primary school age group who are enrolled in primary or secondary education, expressed as a percentage of the corresponding population.[7]

Data on the unemployment rate (total, % of labor force; modeled ILO estimate) comes from the *World Economic Outlook Database 2017* produced by the International Monetary Fund.[8]

Trade openness is proxy by total trade level as a percentage of GDP from the World Bank database (WB National Accounts data, and OECD National Accounts data files). It is the sum of exports and imports of goods and services measured as a share of gross domestic product.[9]

Data on FDI, GDP per capita, inflation rate, as well as share of elderly population, were obtained from the World Bank *World Development Indicators* database (WDI 2017).[10]

Table no. 1 reports a summary of descriptive statistics for all variables used in this study. The median value of the Gini index is 0.342, which means that 50% of the countries have experienced a Gini coefficient lower than 0.342, and the other 50% a higher coefficient

through the time-frame of 1990-2014. The maximum level of income inequality, Gini of 0.773, corresponds to Zambia in 1991. There is no other country in the sample with a higher Gini index than Zambia between 1991 and 1997. The minimum level of inequality, Gini coefficient of 0.211, was achieved in Sweden in 1995. Notice that Elderly contains the complete number of possible observations, 950.

Table no. 1 – Summary statistics of the data

	Mean	Median	Minimum	Maximum	Std. Dev.	N
Gini	0.379	0.342	0.211	0.773	0.100	932
Enrollment	95.449	97.348	60.008	100.000	6.152	941
GDPpc	18662.57	12196.77	330.22	102910.44	19052.04	949
FDI	18265.59	3307.67	-25093.14	734010.31	50758.84	947
Inflation	28.141	3.783	-4.480	7481.664	272.296	943
Unemployment	7.830	7.200	0.100	27.500	4.218	947
Trade	67.735	60.083	13.753	209.657	32.329	944
Elderly	11.270	12.284	2.676	25.705	5.256	950

4. ESTIMATION RESULTS

The empirical analysis exploits the panel structure of the dataset. The specification for the panel data set is:

$$y_{it} = x_{it}\beta + a_i + \delta_t + u_{it}, \tag{1}$$

where y_{it} refers to the variable measuring income inequality, x_{it} contains the explanatory variables, a_i are random variables drawn along with observables, and δ_t are time-period effects.

We propose three models since the correlations and variance-covariance matrix showed GDP per capita is highly correlated with the share of elderly population. Thus, model M1 includes GDP per capita but not the variable *Elderly*, which is included in model 3, M3. Recognizing that FDI is the variable with the most missing values, we pose a model without this variable, model M2.

$$\ln(Gini_{it}) = \beta_0 + \beta_1 Enroll_{it} + \beta_2 Trade_{it} + \beta_3 Inflation_{it} + \beta_4 Unempl_{it} + \beta_5 \ln(GDPpc_{it}) + \beta_6 \ln(FDI_{it}) + a_i + \delta_t + u_{it} \tag{M1}$$

$$\ln(Gini_{it}) = \beta_7 + \beta_8 Enroll_{it} + \beta_9 Trade_{it} + \beta_{10} Inflation_{it} + \beta_{11} Unempl_{it} + \beta_{12} \ln(GDPpc_{it}) + a_i + \delta_t + u_{it} \tag{M2}$$

$$\ln(Gini_{it}) = \beta_{13} + \beta_{14} Enroll_{it} + \beta_{15} Trade_{it} + \beta_{16} Inflation_{it} + \beta_{17} Unempl_{it} + \beta_{18} \ln(FDI_{it}) + \beta_{19} Elderly_{it} + a_i + \delta_t + u_{it} \tag{M3}$$

Where the dependent variable, *Gini*, is the Gini coefficient, *Enroll* is the adjusted net enrollment rate, *Trade* measures the countries' trade openness (export + import percentage of GDP), *Inflation* is the inflation rate, *Unempl* is the unemployment rate, *GDPpc* is the country's real output per capita, *FDI* refers to foreign direct investment, and *Elderly* is the share of elderly population. Logarithmic transformation was applied when applicable.

Prior to estimating the equations, we determine the appropriate estimator for the variables included in each specification. The selection criteria are based on two assumptions: strict exogeneity and the relationship between the unobserved component a_i and the covariates.

Regarding strict exogeneity, we perform the feedback test based on the following specification:

$$y_{it} = x_{it}\beta + w_{i,t+1}\gamma + a_i + \delta_t + u_{it} \quad (2)$$

where $w_{i,t+1}$ is a subset of x_{it}. Under strict exogeneity, $\gamma = 0$.

Table no. 2 shows the results for the three models using clustered standard errors. We chose STATA to execute all estimations. The results show that most of the covariates are strictly exogenous, however, there is a marginal rejection on inflation, although this is not strong enough to confidently affirm that this variable is not exogenous. As such, all independent variables are considered exogenous.

Table no. 2 – P-values of strict exogeneity test

Variables	Model 1 $H_0: \gamma = 0$	Model 2 $H_0: \gamma = 0$	Model 3 $H_0: \gamma = 0$
Enroll	0.335	0.307	0.468
Trade	0.702	0.960	0.601
Inflation	0.019	0.009	0.029
Unempl	0.333	0.368	0.502
GDPpc	0.692	0.430	-
FDI	0.273	-	0.304
Elderly	-	-	0.493

With respect to modelling the relationship between the unobserved component a_i and the covariates, we pose two possibilities: fixed effects (FE) or random effects (RE). Under a FE environment, an arbitrary correlation between those elements is allowed, whereas under RE, that relationship is considered a random variable in the sample. Formally, following equation (1) RE assumes $Cov(x_{it}, a_i) = 0$ while FE allows for $Cov(x_{it}, a_i) \neq 0$.

To select the appropriate specification we perform a standard Hausman test. The results are presented in Table no. 3. The statistics support RE for Models 1 and 3 and FE for Model 2. Hence, we focus our discussion on columns 2, 3, and 6, which correspond to the RE specification for Models 1 and 3, and the FE specification for Model 2. Three variables are significant: *Enroll*, *Inflation*, and *Unempl*. The coefficient for enrollment is negative and significant in all cases. That means that, as educational attainment rises, inequality decreases. The relationship with inflation is positive, which suggests that, as inflation increases, so does inequality. This results is consistent with basic economic theory: high levels of inflation typically occur during economic crisis, especially in developing countries. Wealthy individuals have the means to insure against inflation, by diversifying. Low income individuals, on the other hand, do not have this alternative. Hence, real income for wealthy individuals does not fall as much as it does for lower income individuals. The result is a wider income gap. A similar rationale can also be applied to unemployment. Low income individuals are typically low productivity workers. During an economic crisis the less productive workers lose their jobs more extensively than higher productivity workers, who are most likely individuals in

higher income levels. Long-term unemployment of the less qualified workers worsen inequality. GDP per capita is also significant in the FE specification with a positive sign. In the context of the Kuznets curve, the result suggests that countries in our sample have not achieved a level of development that allows for improvements in the distribution of income.

For the other variables in the models –*Trade*, *FDI*, *Elderly*- there is not enough evidence to suggest a statistically significant relationship with income inequality. As we stated in the introduction, one variable that was particularly interesting to include in the exercise is the measure of trade openness. We were curious as to what results we would get from this variable since significant discussion has dominated the academic and policy maker circles regarding the effect of globalization on inequality[11]. Our results indicate that, when controlling for other factors, trade openness does not affect income inequality significantly; though we will mention a caveat in the text below.

Table no. 3 – Estimation results

VARIABLES	(1) M1fer lngini	(2) M1rer lngini	(3) M2fer lngini	(4) M2rer lngini	(5) M3fer lngini	(6) M3rer lngini
Enroll	-0.0038**	-0.0037**	-0.0038**	-0.0035**	-0.0031*	-0.0039**
	(0.0016)	(0.0016)	(0.0016)	(0.0017)	(0.0018)	(0.0018)
Trade	-0.0002	-0.0004	-0.0003	-0.0005	-0.0004	-0.0004
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0007)
Inflation	0.0001***	0.0001**	0.0001***	0.0001**	0.0001*	0.0001*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Unempl	0.0067***	0.0054**	0.0070***	0.0055**	0.0047**	0.0053**
	(0.0021)	(0.0022)	(0.0023)	(0.0023)	(0.0023)	(0.0022)
GDPpc	0.0593	0.0173	0.0688*	0.0127		
	(0.0372)	(0.0310)	(0.0392)	(0.0311)		
FDI	0.0001	0.0013			0.0043	0.0025
	(0.0063)	(0.0061)			(0.0062)	(0.0063)
Elderly					0.0060	-0.0085
					(0.0089)	(0.0054)
Intercept	-1.2200***	-0.8647***	-1.3086***	-0.8231**	-0.8410***	-0.6216***
	(0.3494)	(0.3202)	(0.3727)	(0.3281)	(0.2254)	(0.2128)
Observations	866	866	912	912	866	866
R-squared	0.109		0.111		0.097	
Number of id	38	38	38	38	38	38
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Hausman		0.511		0.00546		0.0594

*Note: Clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

One can argue that because the unit of observation is "country", it is likely that there is an unobserved heterogeneity between countries. To address this issue, we instrument a Correlated Random Effects (CRE) specification for Models 1 and 3. CRE can be considered an alternative to the Hausman test. This approach considers the correlation between a_i and $\{x_{it}: t = 1,2,3, \dots, T\}$. Let $\bar{x}_i = T^{-1} \sum_{t=1}^{T} x_{it}$ and define

$$a_i = \alpha + \bar{x}_i\theta + r_i \quad (3)$$

where r_i is assumed to be uncorrelated with x_{it}. From (3), the RE estimation sets $\theta = 0$, while the FE approach estimates θ. Following equation (1), the estimating equation becomes:

$$y_{it} = x_{it}\beta + \alpha + \bar{x}_i\theta + r_i + \delta_t + u_{it} \quad (4)$$

If the null hypothesis $\theta = 0$ is rejected, then the RE assumption is rejected in favor of FE.[12] Table no. 4 reports the results for Models 1 and 3. In both cases at least one of the mean variables results significant, suggesting that FE is the preferred specification. The coefficient for *Enroll* is significant with a sign and magnitude identical to those obtained under the FE estimation in Table no. 3. The qualitative relationship between *Inflation* and *Unempl* and the Gini index does not change. Notice that independently of the specification estimated, *Enroll* consistently reports a negative sign, confirming an inverse association with inequality. This consistency is also observed for the inflation and unemployment variables, tough in their case the relationship with inequality is positive.

Table no. 4 – CRE Estimation results

VARIABLES	Model 1 CRE Gini	Model 3 CRE Gini
Enroll	-0.0038**	-0.0031*
	(0.0016)	(0.0018)
Trade	-0.0002	-0.0004
	(0.0006)	(0.0007)
Inflation	0.0001***	0.0001**
	(0.0000)	(0.0000)
Unempl	0.0067***	0.0047**
	(0.0021)	(0.0023)
GDP	0.0650*	
	(0.0386)	
FDI	0.0009	0.0045
	(0.0063)	(0.0062)
Elderly		0.0059
		(0.0089)
$\overline{Enroll}$	-0.0104*	-0.0047
	(0.0061)	(0.0048)
$\overline{Trade}$	-0.0025*	-0.0016*
	(0.0013)	(0.0010)
$\overline{Inflation}$	-0.0000	0.0001
	(0.0005)	(0.0002)
$\overline{Unempl}$	-0.0088	-0.0006
	(0.0073)	(0.0050)
$\overline{GDP}$	-0.1289***	
	(0.0484)	
$\overline{FDI}$	-0.0222	-0.0232
	(0.0254)	(0.0185)
$\overline{Elderly}$		-0.0333***
		(0.0123)
(Intercept)	1.3400***	0.2933
	(0.4711)	(0.4265)
Time dummies	Yes	Yes
N	866	866

*Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10*

To summarize the results, we find an inverse relationship between education and inequality: the higher the educational attainment, the lower the inequality gap. This result is robust to different specifications and consistent with accepted economic theory: educational attainment enhances labor productivity and allows for higher and more evenly distributed wages. It is worth noticing that the link between education and inequality we identify in this exercise is compatible with findings in recent literature that has considered alternative measures of educational achievement. Specifically, while we employ a standard measure of education, other studies have chosen variables that go beyond enrollment, and capture dimensions that include the effectiveness of educational institutions and access to educational opportunities. Baliamoune-Lutz and McGillivray (2015) and Hartmann *et al.* (2017), for instance, find that education broadly measured contributes to the reduction of inequality: improvements in educational opportunities and more efficient institutions promote a more equitable distribution of income. Hence, our results, along with those found in recent works, confirm that the effect of education on the distribution of income is positive, and that relationship holds independently of how education is measured.

Since the sample includes both, developing and developed countries, this finding also suggests that, even if we assume that returns to education are convex, improvements in education still produce lower levels of income inequality. We can refer to the case of El Salvador as an illustration. In the decade of the 1990s access to education, and hence enrollment, was poor; low educational attainment was associated with high levels of inequality. As enrollment during the early 2000s grew, the Gini index dropped significantly. This experience holds true for two other countries in the sample with very low enrollment: Zambia and Guatemala. In both cases enrollment during the period 1990-2000 was below 75% and the Gini coefficient well above .50; for the latter period improvements in education are associated with a decline in inequality.

The coefficients for inflation and unemployment are also significant and show a direct relationship with inequality. These results are not only consistent with existing literature but also intuitive. As we previously indicated, the effect of inflation can be understood by recognizing that during periods of high inflation, people in the lower income levels cannot protect themselves against the loss of purchasing power; since they do not own financial instruments that would allow them to diversify. Wealthy individuals typically own a portfolio of assets designed to hamper the negative effects of a large increase in inflation. For example, they can purchase foreign currency to retain the purchasing power of their wealth. Poor individuals do not have this option. With respect to unemployment, we can argue that, when firms lay off workers, they start with low-productivity employees who do not have a high level of educational attainment. These workers, who are also the ones with lower wages, find themselves without a source of income, while highly educated workers with relatively high wages retain their jobs. Long-term unemployment of low-skilled workers and the absence of unemployment benefits, especially in developing countries, inevitable widens the income gap. The positive sign for GDP per capita indicates that as income increases so does inequality. This result portrays an environment where income is rising unevenly across the population, which is typical in low- and medium-income economies as suggested by the Kuznets curve.

Three variables report coefficients that are not significant: FDI, Trade, and Elderly. The result for trade is somewhat puzzling. We would have expected to find a significant coefficient and perhaps a positive sign: the more open to trade is an economy, the more

unequal the income distribution. What we identify, however, is that openness is not associated with the degree of income inequality. A possible explanation for the non-significant result is that the measure of trade we use in the present study does not fully capture how specialization and trade may affect income inequality. Specifically, recent literature has focused on economic complexity of exports, rather than on exports and imports, to characterize a country's position in trade. Hartmann *et al.* (2017), for instance, show that countries that produce and export complex products, exhibit lower levels of inequality relative to countries that specialize in simple products. Similarly, Gala *et al.* (2018) conclude that high income countries, those with low levels of inequality, produce and manufacture complex goods; while developing countries, characterized by high levels of inequality, produce and export simple commodities. Hence, the use of a variable that measures economic complexity of exports may produce different results than what we found here. A similar issue may be related to the FDI variable. As stated in Bogliaccini and Egan (2017), disaggregating FDI at the sectorial level results in differentiated effects of investment flows on inequality; with investment in the service sector exhibiting a larger effect on inequality relative to investment in other sectors. The inclusion of alternative measures for these variables is an exercise that we shall pursue in future research.

5. CONCLUSION

The impact of education on the distribution of income has been analyzed extensively in the literature without having achieved a consensus on whether improvements in human capital close the income gap. International institutions such as the World Bank have regarded education as one of the most powerful tools to reduce income inequality. But if no definite empirical evidence exists on the relationship between education and inequality, arguments similar to this cannot be supported. The purpose of our exercise is to add to the literature by examining a rich data set containing developed and developing countries for a relatively large sample period.

Our estimations go beyond the basic specifications controlling for the correlation between country specific effects and the independent variables. We make use of a more robust model, the CRE, to fully capture the interaction across the different terms in the estimating equation. The results from the robust estimations confirm the inverse relationship between educational attainment and income inequality: as the population becomes more educated, the income gap narrows. We also find that inflation and unemployment are positively correlated with income inequality. This is a call for policy makers to take steps to moderate the impact of economic crises on the more vulnerable population, perhaps by providing some type of insurance against these negative shocks. One of results that we find somewhat unanticipated is the corresponding to the variable that captures trade openness. In the last few decades, as globalization accelerated, the argument had been made that trade openness increases income inequality. If this were true, we would have obtained a significant and positive coefficient for trade openness, but we did not. Our results suggest that, when controlling for other factors including macroeconomic conditions and education, globalization itself does not lead to a wider income gap. Clearly, these results would have to be confirmed in future research, perhaps including alternative measures of openness. For now, we conclude confirming that there are gains from a more educated population in terms of producing a more equal distribution of income: growing with equality.

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References

Albanesi, S., 2007. Inflation and Inequality. *Journal of Monetary Economics, 54*(4), 1088-1114. http://dx.doi.org/10.1016/j.jmoneco.2006.02.009

Andersen, T., 2019. Social Background, Education, and Inequality. *Economic Inquiry, 57*(3), 1441-1459. http://dx.doi.org/10.1111/ecin.12778

Baliamoune-Lutz, M., and McGillivray, M., 2015. The Impact of Gender Inequality in Education on Income in Africa and the Middle East. *Economic Modelling, 47*, 1-11. http://dx.doi.org/10.1016/j.econmod.2014.11.031

Battistón, D., Garcia-Domench, C., and Gasparini, L., 2014. Could an increase in education raise income inequality? Evidence for Latin America. *Latin American Journal of Economics, 51*(1), 1-39. http://dx.doi.org/10.7764/LAJE.51.1.1

Becker, G. S., 1962. Investment in Human Capital--A Theoretical Analysis. *Journal of Political Economy, 70*(5), 9-49. http://dx.doi.org/10.1086/258724

Becker, G. S., and Chiswick, B. R., 1966. Economics of Education and Distribution of Earnings. *The American Economic Review, 56*, 358-369.

Berry, C. R., and Glaeser, E. L., 2005. The Divergence of Human Capital Levels across Cities. *Papers in Regional Science, 84*(3), 407-444. http://dx.doi.org/10.1111/j.1435-5957.2005.00047.x

Boarini, R., and Strauss, H., 2010. What Is the Private Return to Tertiary Education? New Evidence from 21 OECD Countries. *OECD Journal: Economic Studies, 1*, 7-31.

Bobbitt-Zeher, D., 2007. The Gender Income Gap and the Role of Education. *Sociology of Education, 80*(1), 1-22. http://dx.doi.org/10.1177/003804070708000101

Bogliaccini, J., and Egan, P., 2017. Foreign Direct Investment and Inequality in Developing Countries: Does Sector Matter? *Economics and Politics, 29*(3), 209-236. http://dx.doi.org/10.1111/ecpo.12098

Bourguignon, F., Ferreira, F. B., and Menéndez, M., 2005. Inequality of Opportunity in Brazil. *Ibero America Institute for Econ. Research (IAI) Discussion Papers, 133*.

Campos-Vazquez, R., Esquivel, G., and Lustig, N., 2014. The Rise and Fall of Income Inequality in Mexico, 1989-2010. In G. Cornia (Ed.), *Falling Inequality in Latin America: Policy Changes and Lessons*: Oxford Scholarship Online. http://dx.doi.org/10.1093/acprof:oso/9780198701804.003.0007

Carnoy, M., 1996. Education and Racial Inequality: The Human Capital Explanation Revisited. *Economics of Education Review, 15*(3), 259-272. http://dx.doi.org/10.1016/0272-7757(96)00014-3

Champernowne, D. G., and Cowell, F. A., 1998. *Economic Inequality and Income Distribution*. Cambridge: Cambridge University Press.

Checchi, D., 2000. Does Educational Achievement Help to Explain Income Inequality? . *Departmental Working Papers, University of Milan, 11*.

Crawford, C., Gregg, P., Macmillan, L., Vignoles, A., and Wyness, G., 2016. Higher Education, Career Opportunities, and Intergenerational Inequality. *Oxford Review of Economic Policy, 32*(4), 553-575. http://dx.doi.org/10.1093/oxrep/grw030

Eunyoung, H., 2012. Globalization, Government Ideology, and Income Inequality in Developing Countries. *The Journal of Politics, 74*(2), 541-557. http://dx.doi.org/10.1017/S0022381611001757

Gala, P., Camargo, J., and Freitas, E., 2018. The Economic Commission for Latin America and the Caribbean (ELAC) was Right: Scale-free Complex Networks and Core-Periphery Patterns in World Trade. *Cambridge Journal of Economics, 42*(3), 633-651. http://dx.doi.org/10.1093/cje/bex057

Galor, O., and Tsiddon, D., 1997. The Distribution of Human Capital and Economic Growth. *Journal of Economic Growth, 2*(1), 93-124. http://dx.doi.org/10.1023/a:1009785714248

Gasparini, L., Galiani, S., Cruces, G., and Acosta, P., 2011. Educational Upgrading and Returns to Skills in Latin America. Evidence from a Supply-Demand Framework. *WB Policy Research Working Paper, 5921*.

Goldstein, J., and Lee, R., 2014. How Large are the Effects of Population Aging on Economic Inequality? *Vienna Yearbook of Population Research / Vienna Institute of Demography, Austrian Academy of Sciences, 12*, 193-209.

Gregg, P., Macmillan, L., and Vittori, C., 2019. Intergenerational Income Mobility: Access to Top Jobs, the low-pay no-pay Cycle and the Role of Education in a Common Framework. *Journal of Population Economics, 32*(2), 501-528. http://dx.doi.org/10.1007/s00148-018-0722-z

Hartmann, D., Guevara, M., Jara-Figueroa, C., Aristaran, M., and Hidalgo, C., 2017. Linking Economic Complexity, Institutions, and Income Inequality. *World Development, 93*, 75-93. http://dx.doi.org/10.1016/j.worlddev.2016.12.020

Kaldor, N., 1960. *Essays on value and distribution*. Glencoe, IL: Free Press.

Knight, J. B., and Sabot, R. H., 1983. Educational Expansion and the Kuznets Effect. *The American Economic Review, 73*, 1132-1136.

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

Lustig, N., Lopez-Calva, L. F., Ortiz-Juarez, E., and Monga, C., 2016. Deconstructing the Decline in Inequality in Latin America. In K. Basu and J. E. Stiglitz (Eds.), *Inequality and Growth: Patterns and Policy: Volume II: Regions and Regularities* (pp. 212-247). London: Palgrave Macmillan UK. http://dx.doi.org/10.1057/9781137554598_7

Mazur, J., 2000. Labor's New Internationalism. *Foreign Affairs, 79*(1), 79-93. http://dx.doi.org/10.2307/20049615

Mincer, J., 1958. Investment in Human Capital and Personal Income Distribution. *Journal of Political Economy, 66*(4), 281-302. http://dx.doi.org/10.1086/258055

Park, K. H., 1996. Educational Expansion and Educational Inequality on Income Distribution. *Economics of Education Review, 15*(1), 51-58. http://dx.doi.org/10.1016/0272-7757(95)00000-3

Rodriguez-Pose, A., and Vassilis, T., 2009. Education and Income Inequality in the Regions of the European Union. *Journal of Regional Science, 49*(3), 411-437. http://dx.doi.org/10.1111/j.1467-9787.2008.00602.x

Rumberger, R., 2010. Education and the Reproduction of Economic Inequality in the United States: An Empirical Investigation. *Economics of Education Review, 29*(2), 246-254. http://dx.doi.org/10.1016/j.econedurev.2009.07.006

Schultz, T. W., 1961. Investment in Human Capital. *The American Economic Review, 51*, 1-17.

Shapiro, J. M., 2006. Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital. *The Review of Economics and Statistics, 88*(2), 324-335. http://dx.doi.org/10.1162/rest.88.2.324

Sianesi, B., and Van Reenen, J., 2003. The Returns to Education: Macroeconomics. *Journal of Economic Surveys, 17*(2), 157-200. http://dx.doi.org/10.1111/1467-6419.00192

Spence, A. M., 1973. Job Market Signaling. *The Quarterly Journal of Economics, 87*(3), 355-374. http://dx.doi.org/10.2307/1882010

Stiglitz, J., 2017. *Globalization and Its Discontents Revisited: Anti-Globalization in the Era of Trump*: W.W. Norton & Company.

Tinbergen, J., 1975. *Income Distribution: Analysis and Policies*. Amsterdam: North-Holland Publishing, Co.

Tselios, V., 2008. Income and Educational Inequalities in The Regions of The European Union: Geographical Spillovers Under Welfare State Restrictions. *Papers in Regional Science, 87*(3), 403-430. http://dx.doi.org/10.1111/j.1435-5957.2008.00191.x

UNDP, 2016. Human Development Report: Human Development for Everyone. http://bit.do/fk8ai.

Williamson, J. G., 1991. *Inequality, Poverty, and History: The Kuznets Memorial*. Oxford: Basil Blackwell.

Wolf, A., 2004. Education and Economic Performance: Simplistic Theories and Their Policy Consequences. *Oxford Review of Economic Policy, 20*(2), 315-333. http://dx.doi.org/10.1093/oxrep/grh018

Wooldridge, J. M., 2010. *Econometric Analysis of Cross-Section and Panel Data*: MIT press.

Wooldridge, J. M., 2016. *Introductory Econometrics: A modern approach* (6th ed.). Boston, MA: Cengage Learning.

ANNEX 1

List of the Countries Included in the Regression Analysis

Argentina, Australia, Belarus, Bulgaria, Columbia, Denmark, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Guatemala, Honduras, Hungary, Indonesia, Ireland, Israel, Italy, Japan, Korean Republic, Mexico, Netherlands, New Zealand, Norway, Paraguay, Peru, Poland, Romania, Spain, Sri Lanka, Sweden, Switzerland, Turkey, United Kingdom, United States, Zambia.

Notes

[1] Sianesi and Van Reenen (2003) survey the literature on education and its impact on macroeconomic performance.

[2] For an ample discussion on the topic refer to Tinbergen (1975).

[3] As it is widely known, wage inequality as determined by gender is a phenomenon that has persisted for decades. See for example Bobbitt-Zeher (2007) and Carnoy (1996).

[4] *"Globalization has increased inequality between and within nations."* – Mazur (2000). Labors New Internationalism, *Foreign Affairs*.

[5] United Nations University UNU-WIDER. World Income Inequality Database (WIID3.4). Retrieved from https://www.wider.unu.edu/database/world-income-inequality-database-wiid34

[6] United Nations Development Program (UNDP), Human Development Report (HDR) 2016. Retrieved from http://hdr.undp.org/en/data

[7] Data obtained from the World Bank Database: http://data.worldbank.org/indicator/SE.PRM.TENR

[8] Data obtained from the International Monetary Fund *World Economic Outlook* Database, October 2016, http://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx

[9] Data obtained from the World Bank Database: http://data.worldbank.org/indicator/NE.TRD.GNFS.ZS

[10] Data obtained from the World Bank Database: http://data.worldbank.org/data-catalog/world-development-indicators

[11] Refer to Stiglitz (2017) for a thorough discussion on how globalization may affect income inequality.

[12] See Wooldridge (2010 and 2016).

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