

# The Impact of Inequality on The Effectiveness of a Country's Education

*William R. DiPietro*

Professor of Economics

Daemen College

Email: wdpietr@daemen.edu

## ABSTRACT

*The degree of income inequality prevailing in society matters on fairness and equity grounds. However, income inequality may also have a decided impact on the effectiveness of educational institutions, and, operating through this channel, have consequences for economic growth. This paper uses cross country regression analysis for the year 2003 to assess the potential effect of income inequality, along with three other variables, corruption, age dependency, and political rights, on school effectiveness, as measured by mean country literacy test scores of fifteen year old students on various subjects and aptitudes. The results suggest that higher levels of country income inequality, corruption, and age dependency have a negative impact on country school educational effectiveness, while greater political rights have a positive effect.*

*The augmentation and development of human capital is important for economic growth, and is becoming even more so with the appearance and spread of the knowledge economy. Greater human capital increases productivity by increasing the overall productivity of people, by increasing their adaptively to alternative forms of production, and by awakening and honing their facility for invention and innovation.*

*Society's primary process for producing and developing human capital is education. Human capital differs between nations due to differences in the extent and quality of educational institutions. The OECD Programme for International Student Assessment (PISA) has recently collected data on literacy test scores of fifteen year old students in schools in different countries. In 2003, PISA provides mean literacy scores for forty one different countries (mainly OECD countries). This sets up the possibility of using cross country study to seek reasons for differences in educational outcomes between nations. The purpose of this paper is to use cross country regression analysis to look at four possible*

*determinants of educational effectiveness. The variables are inequality, corruption, age dependency, and political rights.*

*The organization of the paper is as follows. Section I highlights some current relevant literature. Section II discusses the model. Section III identifies the variables and their sources. Section IV reports the results of the cross country regressions, and section V concludes.*

## I. RECENT LITERATURE

Looking at country characteristics that might determine educational outcomes is important, because student performance is important for the economy.

Hanushek and Kimko (Hanushek and Kimko 200) in their article and Barro (Barro 2001) in his article empirically demonstrate that human capital, as measured by student performance, matters with regard to differential growth rates between nations.

Various aspects of the student performance production function have been considered including school resources, institutional structure, and family background factors.

Employing as measures of school quality test scores on various dimensions of students cognitive abilities, such as reading literacy, problem solving, and scientific understanding, Lee and Barro (Lee and Barro 2001) empirically investigate the effect of family factors and school resource use on school educational quality. They use data from the International Association for the Evaluation of Educational Achievement and the International Assessment of Educational Progress, and compile a panel data set containing two hundred fourteen observations based on test scores for students from different age groups and various years for many as fifty eight countries. They find that both family factors such as parental income and parental education, and school resource input variables, such as pupil-teach ratios, and average teacher salary, are important for student performance.

Looking at test scores in math and science of two hundred fifty thousand students from thirty nine countries, Wobmann (Wobmann 2003), in his empirical analysis, discovers that, even though student performance is not influenced by the amount of educational resources, institutional structure that provides favorable incentives for student performance is very relevant. He finds that acting together a series of institutional factors including such items as school autonomy, parental interest, teacher control over teaching methods, and the degree of educational competition from the private sector, have a marked effect on student performance.

The uniqueness of present study is that it focuses on country income inequality and other country characteristics that are likely, behind the scenes, to be instrumental in determining the levels of the various inputs into the student performance production function that have been discussed by others and in determining the efficacy of these inputs within the student performance production function.

II. THE MODEL: THEORETICAL RATIONALE FOR THE HYPOTHESIZED RELATIONSHIPS BETWEEN EDUCATIONAL PERFORMANCE, INCOME INEQUALITY, CORRUPTION, AGE DEPENDENCY AND POLITICAL RIGHTS

The model considered here is a simple single equation school effectiveness model. The basic idea is that country educational performance depends on income inequality and other country characteristics. Besides inequality, the three country characteristics considered in the paper are corruption, age dependency and political rights. Equation (1) shows the simple equation with its associated partial derivatives.

$$(1) Y = f(X_1; X_2, X_3, X_4) \quad \delta Y / \delta X_1 > 0, \delta Y / \delta X_2 > 0, \delta Y / \delta X_3 > 0, \delta Y / \delta X_4 < 0$$

The left hand side variable, Y, represents some measure of school effectiveness in imparting competencies and abilities to students. In this study, the mean PISA country literacy test scores for various subjects and abilities are used. The variables X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub>, and X<sub>4</sub> are, respectively, measures of income inequality, corruption, age dependency, and political rights.

It is predicted that greater income inequality will reduce outcomes performance of students from schooling. The bias in the educational process in providing better education for the rich than for the poor, and, its associated distortion of the use of educational resources away from students with the greatest capability (a misallocation of educational resources), is likely to be greater the higher the income inequality in society. In addition, greater inequality in the distribution of income is apt to dampen the incentives for the poor to invest their time, energy, and resources into education and into educational achievement. This occurs because the perception by the poor of the extent of upward mobility, if not the reality of the degree of upward mobility, falls with greater income inequality.

Corruption is expected to negatively affect student performance for at least two reasons. First, to the extent that corruption prevails in society it pervades all of society's institutions including educational institutions. Corruption, in a detrimental way, will impact the way schools are run. In particular, with greater corruption, student performance outcomes per dollar invested in education is likely to be lower, as some of the flow of money moving into education will be siphoned off in the form of corruption, and as teachers and school administrators engage in more lax behavior. Second, corruption dampens student incentives and student motivation to invest in educational human capital. Corrupt activities provide an alternative to legitimate activities. To the extent corruption is pervasive and lucrative it provides a viable option to legitimate pursuits.

Just like corruption, it is anticipated that the effect of age dependency on educational outcomes will also be negative. Families that are more strapped with dependents will be less able to provide resources for their children and severely limited in the use resources to gain desired education results for their children through political avenues.

The last variable is political rights. Theoretically, it is anticipated that political rights will certainly matter with regard to educational outcomes. Pressure by the general population to improve the quality and extent of education of the poor, to lower the disparity in education between the rich and the poor, and by such means to enhance the overall quality of education, can only be exerted to the extent that the masses of the people have a political voice. Thus, average educational performance of students in a country is expected to be positively related to the extent of political rights.

### III. THE DATA SOURCES FOR THE VARIABLES

The data on mean country test scores for 2003 for mathematical literacy (MATH), reading literacy (READING), scientific literacy (SCIENCE), mathematical change and relationships literacy (RELATION), mathematical quantity literacy (QUANTITY), mathematical uncertainty literacy (UNCERTAIN), and problem solving literacy (PROBSOL) are taken from the 2003 Programme for International Student Assessment (PISA 2003). The mean country PISA scores are based on tests administered to somewhere between four thousand five hundred and ten thousand students (fifteen years old) per country.

The measure for country income inequality (INEQUALITY) is the Gini coefficient. The Gini values are abstracted from the Wikipedia web site on (Wikipedia 2007). The site has two country listings of the Gini coefficients. The first is based on United Nations numbers and the second on Central Intelligence Agency figures. As the Gini numbers come out with a substantial lag, are not available for every year, and are generally not available for the same year for different countries, the Gini values for different countries are for various years.

The measure of corruption (CORRUPTION) is a simple modification of Transparency International's corruption perception index for 2003 (Transparency International 2007). Transparency International uses surveys to assess the perceptions of businessmen and other groups. The corruption perception index varies from zero to ten with higher values indicating less perceived corruption. In order for higher values to indicate greater corruption, the variable labeled CORRUPTION in the paper is ten minus Transparency International's corruption perception index for 2003.

The last two variables are age dependency (AGEDEPEND) and political rights (POLRIGHTS).

The age dependency ratio is used for age dependency (AGEDEPEND). The age dependency ratio, by definition, is the ratio of dependents, consisting of people younger than fifteen and older than sixty four years of age, to the working population. The data for this variable is taken from the World Bank 2005 CD-ROM (World Bank 2005).

The political rights variable (POLRIGHTS) used in the paper is based on the political rights index of Freedom House (Freedom House 2007). They score countries from one to seven with a value of one signifying most free and a value of seven least free. So that higher levels of the political rights variable do indicate greater political rights, the variable called POLRIGHTS in the paper is seven minus Freedom House's political rights index.

IV. CROSS COUNTRY REGRESSIONS OF MEAN PISA LITERACY SCORES ON COUNTRY CHARACTERISTICS

Table I (A) shows cross country regressions of the average PISA scores for each of the three subjects of math, reading, and science on inequality as measured by the United Nations Gini coefficients, and Table II (B) portrays the regression results for the exact same specification for the four competencies, math relationships (RELATION), math quantity (QYANTITY), math uncertainty (UNCERTAIN), and problem solving (PROBSOL).

TABLE I (A)  
CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR SUBJECTS ON INEQUALITY

	MATH	READING	SCIENCE
CONSTANT	651.88 (17.36) *	598.85 (19.27) *	616.86 (19.85) *
INEQUALITY	-4.92 (-4.59) *	-3.46 (-3.90) *	-3.78 (-4.26) *
RSQ	.389	.315	.355
N	35	35	35

TABLE I (B)  
CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR MATH COMPETENCIESS ON INEQUALITY

	RELATION	QUANTITY	UNCERTAIN	PROBSOL
CONSTANT	656.38 (18.29) *	668.29 (15.56) *	636.09 (17.34) *	653.33 (16.90) *
INEQUALITY	-5.02 (-4.90) *	-5.49 (-4.48) *	-4.41 (-4.22) *	-4.95 (-4.49) *
RSQ	.422	.378	.350	.379
N	35	35	35	35

The set-up for the tables is as follows. The first column of a table lists the independent variables. Each of the subsequent columns shows the results of a single regression run. The first row identifies the independent variable in the equation, the second to last row shows the r-squared values, and the last row tells the number of countries entering the equation. The topmost value in the heart of the table is the estimated coefficient. Underneath the estimated coefficient in parenthesis is the individual t-statistic. Asterisks under the individual t-statistics single out the degree of significance of a variable in an equation. A lone asterisk under the individual t-statistic identifies a variable significant at the one percent level of significance or better in an equation, double asterisks, a variable that is significant at the five percent level or better in an equation, and triple asterisks, a variable that is significant at the ten percent level or better in an equation.

The results lend strong support to the hypothesis that income inequality in a country is detrimental to a country's schools effectiveness in developing student skills. In every one of the seven equations contained in tables I (A) and I (B), inequality is negative and significant at the one percent level of significance.<sup>1</sup> As a single explanatory variable, inequality accounts for from over thirty one percent (READING) to over forty two percent (RELATION) of the cross country variation in average student scores. The impact indicated by the estimated coefficients of income inequality is quite substantial. Looking at the reading equation, the smallest estimated coefficient on inequality in tables I (A) and I (B), indicates that a one point rise in a country's Gini coefficient, which varies from zero to one hundred, leads to close to a three and a half point reduction in average reading scores for a country.

The regressions of table I (A) and table I (B) are re-run adding corruption as an additional explanatory variable. The results are shown in tables II (A) and II (B). Adding corruption jumps the r-squared values in the equations. Corruption is negative and significant at the one percent level of significance in every equation. The estimated coefficient on corruption in the reading equation implies that a one point increase in a country's corruption index (with a range between one and ten), causes somewhat over a ten point reduction in average reading scores in a country. The inequality variable remains negative and significant at the one percent level of significance or better in every one of the seven equations.

---

<sup>1</sup> Because of missing values for country Gini coefficients, the forty one countries for which mean literacy scores are available from Pisa studies is whittled down to thirty five. The thirty five countries entering the equations are Australia, Austria, Belgium, Brazil, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, Indonesia, Ireland, Italy, Japan, South Korea, Latvia, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Slovak Republic, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, United States, and Uruguay

TABLE II (A)  
 CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR SUBJECTS  
 ON INEQUALITY AND CORRUPTION

	MATH	READING	SCIENCE
CONSTANT	643.20 (20.76) *	591.20 (24.08) *	611.39 (21.65) *
INEQUALITY	-3.41 (-3.56) *	-2.11 (-2.78) *	-2.81 (-3.23) *
CORRUPTION	-11.51 (-4.08) *	-10.26 (-4.49) *	-7.34 (-2.86) *
RSQ	.599	.587	.486
N	35	35	35

TABLE II (B)  
 CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR MATH  
 COMPETENCISS ON INEQUALITY AND CORRUPTION

	RELATION	QUANTITY	UNCERTAIN	PROBSOL
CONSTANT	648.47 (21.49) *	658.95 (18.14) *	626.59 (22.40) *	644.98 (19.66) *
INEQUALITY	-3.63 (-3.90) *	-3.85 (-3.43) *	-2.74 (-3.18) *	-3.48 (-3.44) *
CORRUPTION	-10.60 (-3.86) *	-12.53 (-3.79) *	-12.74 (-5.00) *	-11.19 (-3.75) *
RSQ	.605	.571	.635	.568
N	35	35	35	35

The third set of tables, table III (A) and table III (B), adds age dependency. As anticipated, the sign of the age dependency ratio (AGEDEPEND) is negative. A family that needs to support a greater number of dependents, as captured by a higher value for the age dependency ratio, is more financially and emotionally challenged, and less able to expend as much resources on a per child basis on the upbringing and development of individual children in the family. The variable is significant at the one percent level of significance or better in all of the seven student score equations. With the addition of the age dependency variable, the two other variables, inequality and corruption, continue to have their theoretically expected negative signs, and except for inequality in the reading equation (in which it is significant at the five percent level of significance), both variables are significant at the one percent level of significance or better in every one of the equations.

TABLE III (A)  
CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR SUBJECTS  
ON INEQUALITY, CORRUPTION, AND AGE DEPENDENCY

	MATH	READING	SCIENCE
CONSTANT	866.61 (17.71) *	734.65 (16.64) *	797.61 (16.75) *
INEQUALITY	-2.56 (-3.50) *	-1.56 (-2.37) **	-2.11 (-2.96) *
CORRUPTION	-14.13 (-6.54) *	-11.94 (-6.13) *	-9.52 (-4.53) *
AGEDEPEND	-504.44 (-5.17) *	-324.04 (-3.68) *	-420.67 (-4.43) *
RSQ	.785	.713	.685
N	35	35	35



TABLE III (B)  
 CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR MATH  
 COMPETENCIES ON INEQUALITY, CORRUPTION, AND AGE DEPENDENCY

	RELATION	QUANTITY	UNCERTAIN	PROBSOL
CONSTANT	864.99 (18.08) *	906.16 (15.11) *	819.37 (17.89) *	883.24 (17.16) *
INEQUALITY	-2.81 (-3.93) *	-2.91 (-3.25) *	-2.01 (-2.94) *	-2.57 (-3.35) *
CORRUPTION	-13.14 (-6.23) *	-15.43 (-5.83) *	-15.00 (-7.42) *	-13.99 (-6.16) *
AGEDEPEND	-489.10 (-5.13) *	-588.42 (-4.67) *	-435.48 (-4.77) *	-538.21 (-5.25) *
RSQ	.787	.748	.789	.772
N	35	35	35	35

The last set of tables, tables IV (A) and IV (B), adds an index of political rights (POLRIGHTS) to the cross country average student scores regression equations. As expected, greater political rights are associated with higher average student scores for both the subjects (table IV (A)) and the competencies (Table IV (B)). The variable is significant at the five percent level of significance or better in all of the equations. The three other variables, inequality, corruption, and age dependency maintain their negative signs and are significant at the five percent level or better in every equation.

TABLE IV (A)  
 CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR SUBJECTS  
 ON INEQUALITY, CORRUPTION, AGE DEPENDENCY, AND POLITICAL RIGHTS

	MATH	READING	SCIENCE
CONSTANT	821.83 (16.03) *	671.95 (16.28) *	757.16 (15.03) *
INEQUALITY	-1.97 (-2.63) **	-.744 (-1.23)	-1.58 (-2.14) **
CORRUPTION	-13.28 (-6.35) *	-10.75 (-6.38) *	-8.75 (-4.26) *
AGEDEPEND	-552.56 (-5.78) *	-391.41 (-5.09) *	-464.13 (-4.95) *
POLRIGHTS	8.26 (2.08) **	11.57 (3.62) *	7.46 (1.91) ***
RSQ	.812	.800	.720
N	35	35	35

Tables I (A) and (B) through IV (A) and (B) were also run using the Gini coefficient numbers for the Central Intelligence Agency in place of the United Nations numbers. The results were similar.

TABLE IV (B)  
 CROSS COUNTRY REGRESSIONS OF PISA 2003 AVERAGE COUNTRY SCORES FOR MATH  
 COMPETENCIES ON INEQUALITY, CORRUPTION, AGE DEPENDENCY, AND POLITICAL  
 RIGHTS

	RELATION	QUANTITY	UNCERTAIN	PROBSOL
CONSTANT	817.93 (16.51) *	850.85 (13.57) *	774.57 (16.32) *	829.97 (15.72) *
INEQUALITY	-2.19 (-3.03) *	-2.18 (-2.38) **	-1.42 (-2.05) **	-1.88 (-2.44) **
CORRUPTION	-12.25 (-6.06) *	-14.38 (-5.62) *	-14.15 (-7.30) *	-12.97 (-6.02) *
AGEDEPEND	-539.67 (-5.85) *	-617.85 (-5.29) *	-483.62 (-5.47) *	-595.45 (-6.05) *
POLRIGHTS	8.69 (2.26) **	10.21 (2.10) **	8.27 (2.25) **	9.83 (2.40) **
RSQ	.818	.781	.820	.808
N	35	35	35	35

## V. CONCLUSION

The results of the cross country regression analysis suggest that a country's income inequality has a negative impact on a country's school effectiveness. Whether used in isolation in a simple regression, or in combination with other variables in a multiple regression, mean student scores of fifteen year olds in math literacy, reading literacy, science literacy, math change and relationships literacy, math quantity literacy, math uncertainty literacy, and overall problem solving literacy, fall with increases in inequality as measured by a country's Gini coefficient. Thus, the use of political measures to lower income inequality in society is not just beneficial to society on equity grounds alone, but may also be desirable because it leads to enhanced economic performance brought about by improvement in human capital due to greater educational effectiveness.

Similarly, corruption and age dependency appear to have a negative and statistically significant effect on school effectiveness, while political rights appear to have a positive effect.

Just as with modifications in the degree of income inequality in society, there are potential twofold gains for society from policies designed to change any of these variables in the appropriate direction. Reducing corruption bolsters production by releasing resources from nonproductive corrupt activities to productive legitimate activities, but also augments production by its upward effect on human capital. Lowering the burden on families by policies designed to reduce the age dependency ratio, not only benefits family welfare directly, but additionally provides a positive boost for the economy by its increase in school effectiveness. Social change to improve political rights, a good thing per se is potentially productivity augmenting because of its uplifting effect on human capital.

#### REFERENCES

Barro, Robert J. (2001). "Human Capital and Growth", *American Economic Review, Papers and Proceedings*, 91, pp. 12-17.

Case, Anne and Deaton, Angus (1999). "School Inputs and Educational Outcomes in South Africa," *The Quarterly Journal of Economics*, 114(3), pp.1047-1084.

Freedom House (2007), 2003 Political Rights Index, August 2007,  
<http://www.freedomhouse.org/uploads/fiw/fiwallscores.xls>.

Hanushek, Eric and Kimko, Dennis (2000). "Schooling, Labor-Force Quality, and the Growth of Nations", 3, pp. 671-718.

Lee, Jong-Wha and Barro, Robert J. (2001). "Schooling Quality in a Cross-Section of Countries," *Economica*, 68(272), pp. 465-488.

PISA (2007), OECD Programme for International Student Assessment, August 2007,  
<http://pisacountry.acer.edu.au/>.

Transparency International (2007), Home Page, August 2007 <http://www.transparency.org>. The data on the 2003 Corruption Perceptions Index is readily available at  
<http://www.armeniaforeignministry.com/doc/id/cpi2003.pressrelease.en.pdf>.

Wikipedia (2007), The Free Encyclopedia, List of Countries by Income Equality, August 2007,  
[http://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_income\\_equality](http://en.wikipedia.org/wiki/List_of_countries_by_income_equality).

Wobman, Ludger (2003). "Schooling Resources, Educational Institutions and Student Performance: the International Evidence", *Oxford Bulletin of Economics and Statistics*, 65(2) pp. 117-170.

World Bank (2005), *World Development Indicators on CD-ROM*. World Bank:USA.