The Rise of Inequality, the Decline of the Middle Class, and Educational Outcomes

by

Greg Thorson
University of Redlands

Abstract
Today much of the developed world is simultaneously experiencing large increases in economic inequality and severe erosions in the size of the middle class (Pressman, 2007; Birdsall, Graham, & Pettinato, 2000). Recent research has demonstrated that this decline of the middle class and rise in inequality can have significant social impact, including increases in violence, mental illness, and declining health (Wilkinson & Pickett, 2010) while also eroding social cohesion and promoting class conflict (Stiglitz, 2012).

In this paper, I examine the impact that the decline in the middle class and rising inequality has had on educational outcomes. Drawing upon data provided by the International Cross-Time, Cross-System Education Data for Researchers (XTXS), I find that economic inequality has large, statistically significant effects on student academic achievement. In my examination of the effects of inequality on reading, math, and science PISA and TIMSS scores, I find that countries with higher levels of economic inequality experience lower average student performance on these tests. The effect sizes are large. Economic inequality has larger effects on student performance on these tests than does a country's GDP per capita, level of educational spending, and aggregate pupil-teacher ratios.

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NOTE: This is an early working draft of the paper. Please feel free to offer me comments, criticisms, and/or suggestions by emailing me at greg_thorson@redlands.edu. Thanks!

The societal benefits of the establishment of a large and prosperous middle class have long been appreciated. Writing in Book IV, Aristotle claimed that virtue is to be found between the extremes of wealth and poverty. He goes on to argue that a state can only endure when the middle class either holds the power of government or is a necessary partner in the ruling political coalition.

Recent research has provided further evidence that there are large demonstrable benefits for countries having strong middle classes. Recent work has found that the presence of a strong middle class can positively impact the economic success of countries (Easterly, 2001), make countries more democratic (Barro, 1999), and enhance a country's political stability (Huber, Rueschemeyer, & Stephens, 1993).

Alternatively, the decline of the middle class and rise in inequality can have strong negative social impacts, including increases in violence, mental illness, and declining health (Wilkinson & Pickett, 2010) while also eroding social cohesion and promoting class conflict (Stiglitz, 2012).

Developing and maintaining a strong middle class has been difficult in modern society. Today much of the developed world is simultaneously experiencing large increases in economic inequality and severe erosions in the size of the middle class (Pressman, 2007; Birdsall, Graham, & Pettinato, 2000) . Countries have experienced varying rates of declines in the size of their middle classes. For example, some scholars have found that the decline in the middle class has been more pronounced in the United States than in other countries (Foster & Wolfson, 2010;

Stiglitz, 2012). This particular change has produced profound changes in the makeup of the political parties in the United States. (Abamowitz & Teixeira, 2009).

Scholars have adopted varying techniques to both define the middle class as well as measure changes in its composition (Gigliarano & Mosler, 2009; Foster & Wolfson, 2010; Levy & R, 1983). These measurement challenges have presented formidable challenges to the advancement of this literature.

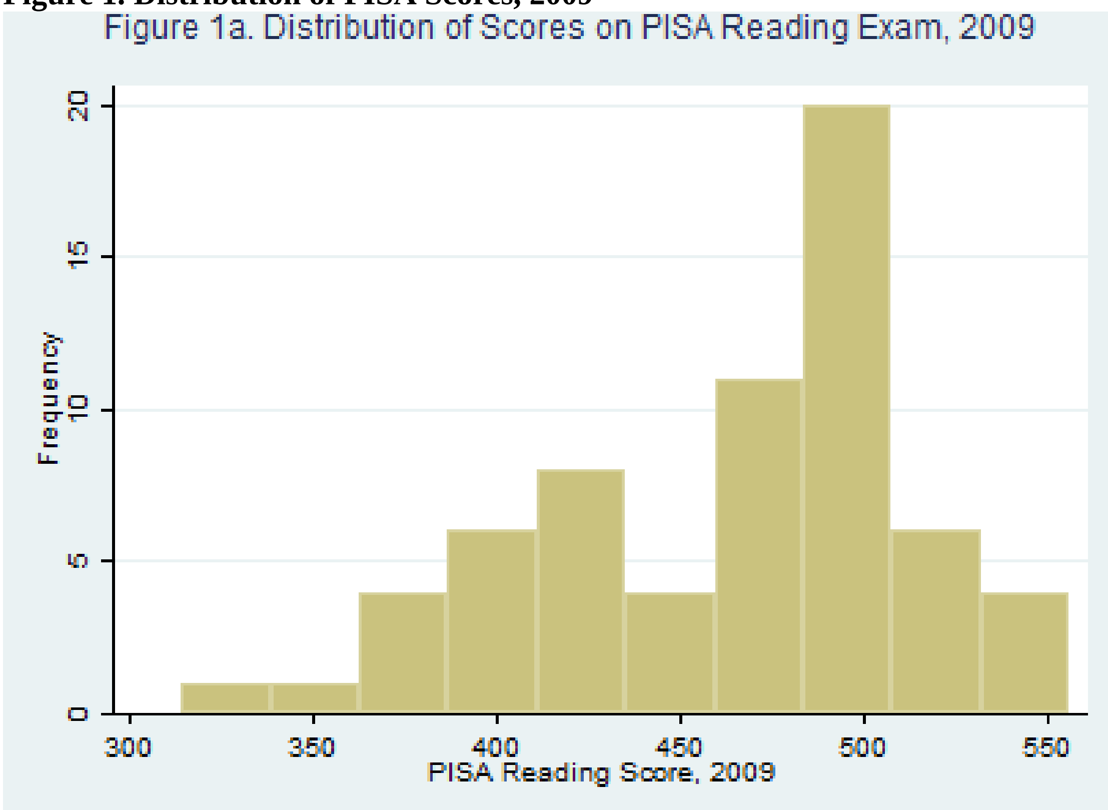
In this paper, I examine the impact that the decline in the middle class and rising inequality has had on educational outcomes. Recent research has found widening achievement gaps between the rich and the poor (Reardon, 2011), as well as an overall decline in educational mobility since the 1930s ((Hout & Janus, 2011).

In this paper, I examine how a country's economic inequality affects its educational outcomes as measured by international standardized tests. The data source is the International Cross-Time, Cross-System Education Data for Researchers (XTXS) found at http://www.intledstatsdatabase.org/. XTXS contains a wide variety of data for up to 232 education systems. It includes not only international standardized test results, but also extensive data on economic, population, health, and political characteristics provided by a number of sources including the World Bank, UNESCO, and the OECD. Some of the data go back as far as the 1970s.

My primary independent variable is inequality. My measure of inequality is the income share of a country that is held by the highest 10%. I use the results from two widely-recognized international tests, the Program for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) as my dependent variables. I also introduce several important control variables, such as the GDP per capita, public expenditures on education, and pupil-teacher ratios. All data are available in the XTXS dataset.

Figure 1 shows the distribution of PISA scores in reading, math, and science. A total of 65 countries participated in the 2009 PISA testing cycle. The distribution of scores on each test demonstrates a negative skew. The median scores were slightly higher in science (491) and math (487) than reading (481). Countries that scored highly on the PISA include South Korea, Finland, Singapore, Hong Kong, Canada, and Switzerland. Country medians on the various PISA exams ranged from 314 to 600.

Figure 1. Distribution of PISA Scores, 2009



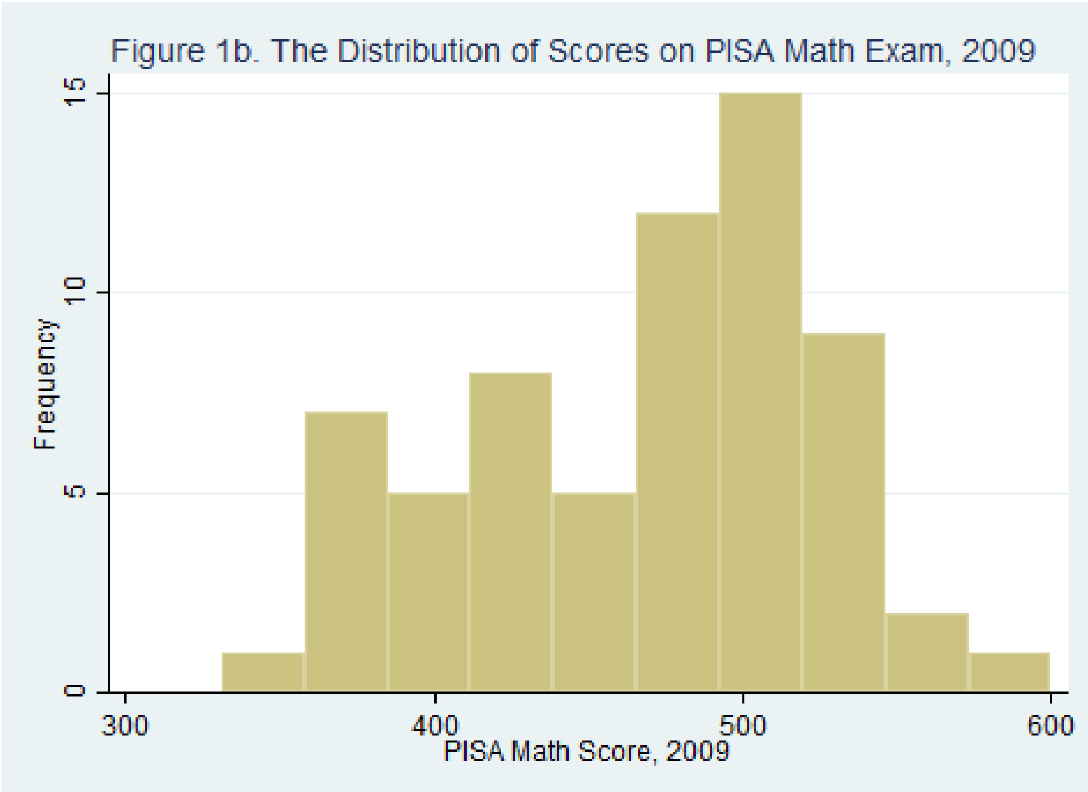


Figure 1b. The Distribution of Scores on PISA Math Exam, 2009
Frequency
0
5
10
15
300
400
500
600
PISA Math Score, 2009

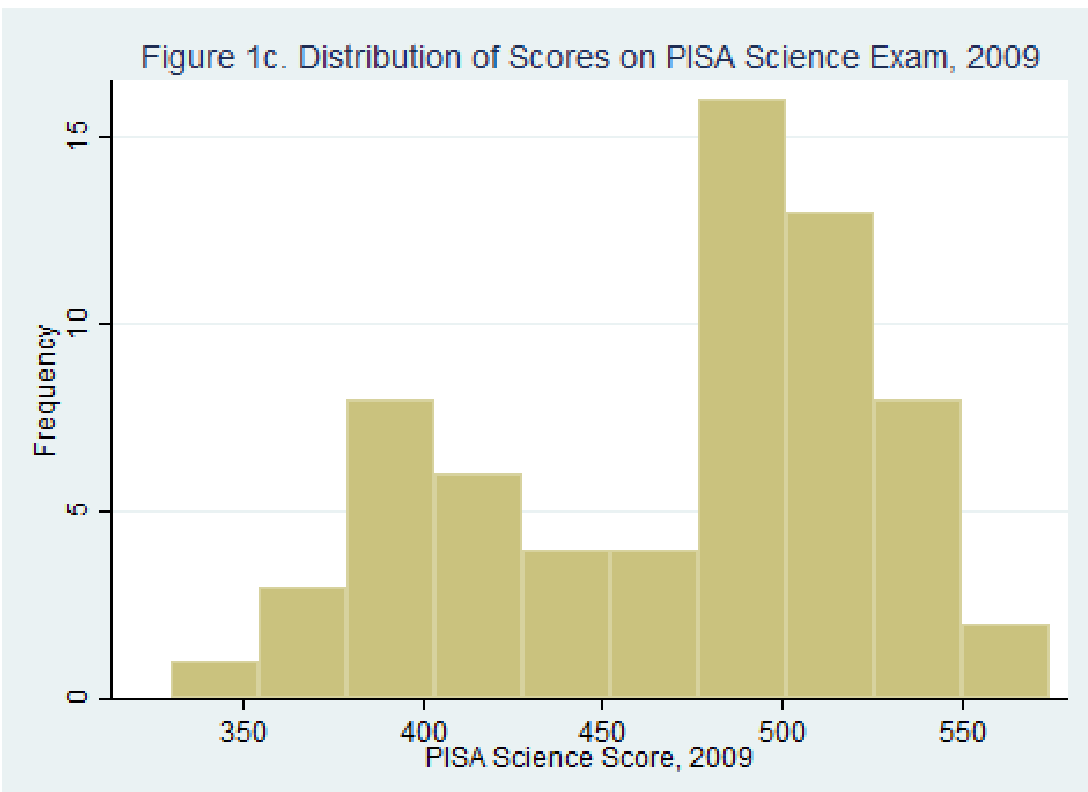
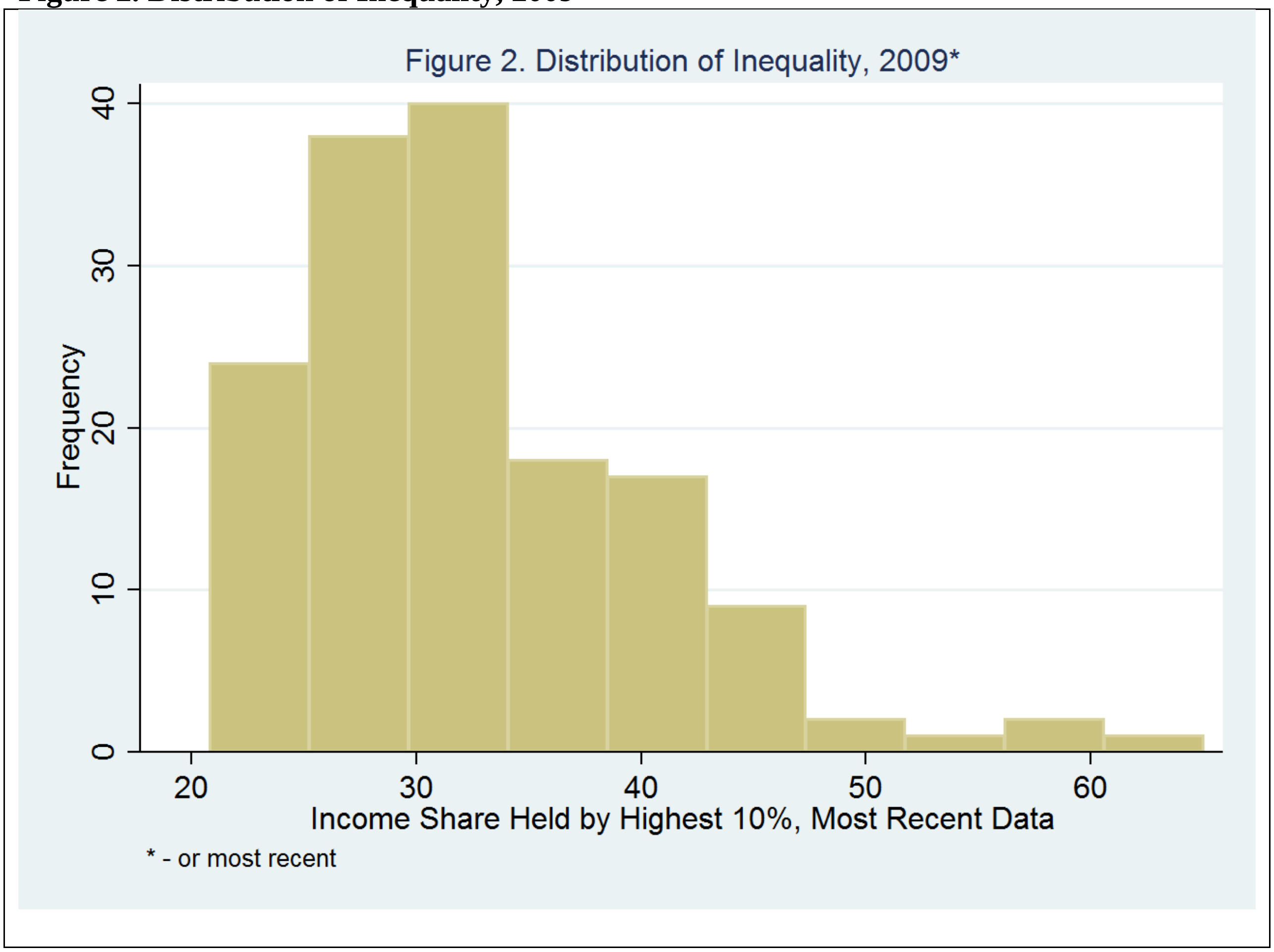


Figure 1c. Distribution of Scores on PISA Science Exam, 2009
Frequency
0
5
10
15
350
400
450
500
550
PISA Science Score, 2009

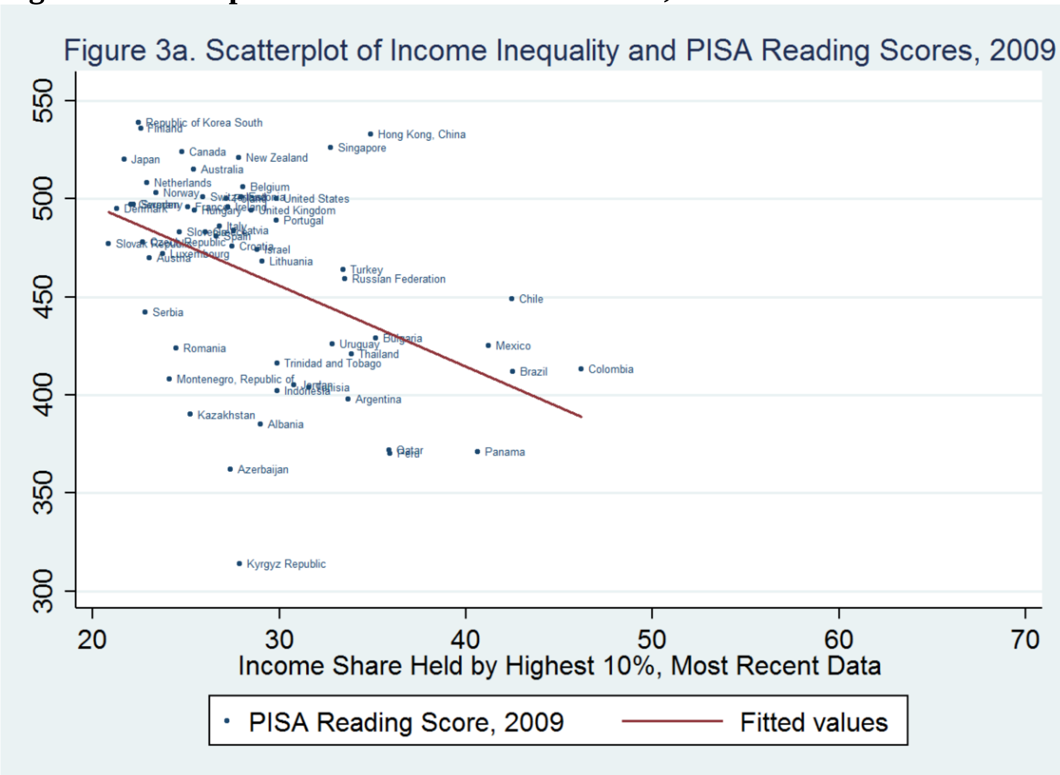
While there are many different ways to measure a country's inequality, this study uses the level of income held by the highest 10% in each country. Figure 2 shows a histogram of the distribution of this measure of inequality. Using this measure, the countries with the lowest levels of inequality are the Slovak Republic, Denmark, Japan, Belarus, and Germany. The median level of income held by the highest 10% is 30.8%. The range of inequality in the entire sample is 20.8% to 65%.

Figure 2. Distribution of Inequality, 2009



Does the level of inequality in a country affect educational outcomes such as PISA scores? Figure 3 presents a simple bivariate scatterplot of inequality and PISA readings scores. A negative correlations appears in all three graphs (best fit lines are presented in Table 3).

Figure 3. Scatterplot of Income and PISA Scores, 2009



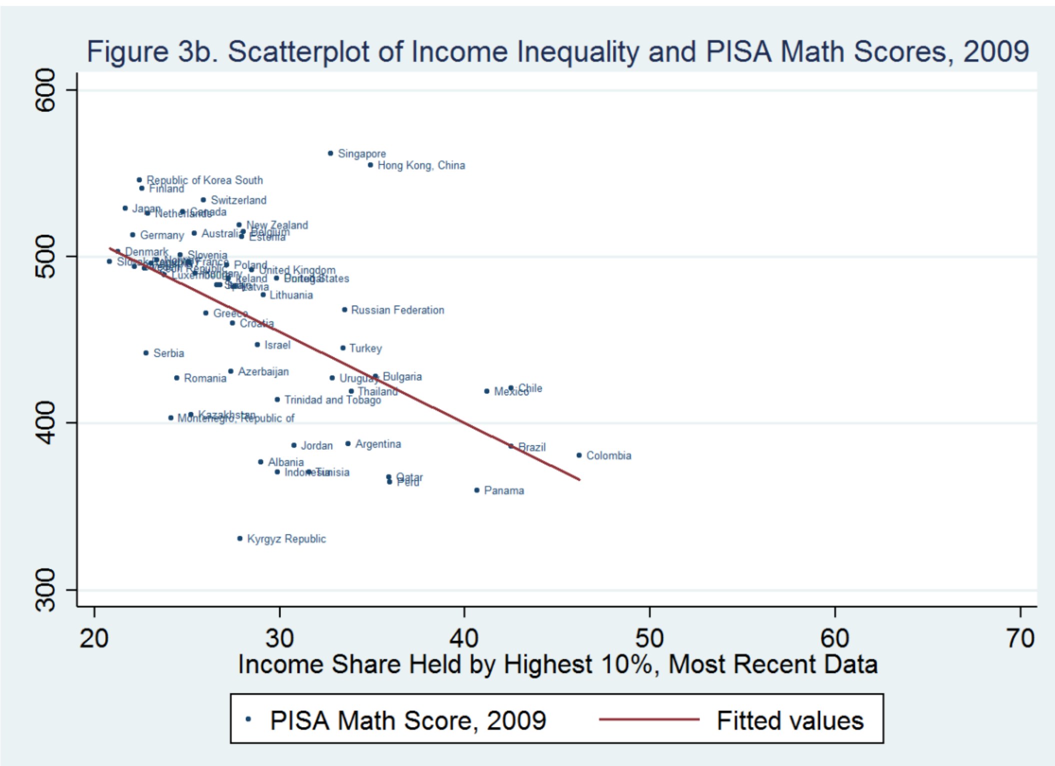
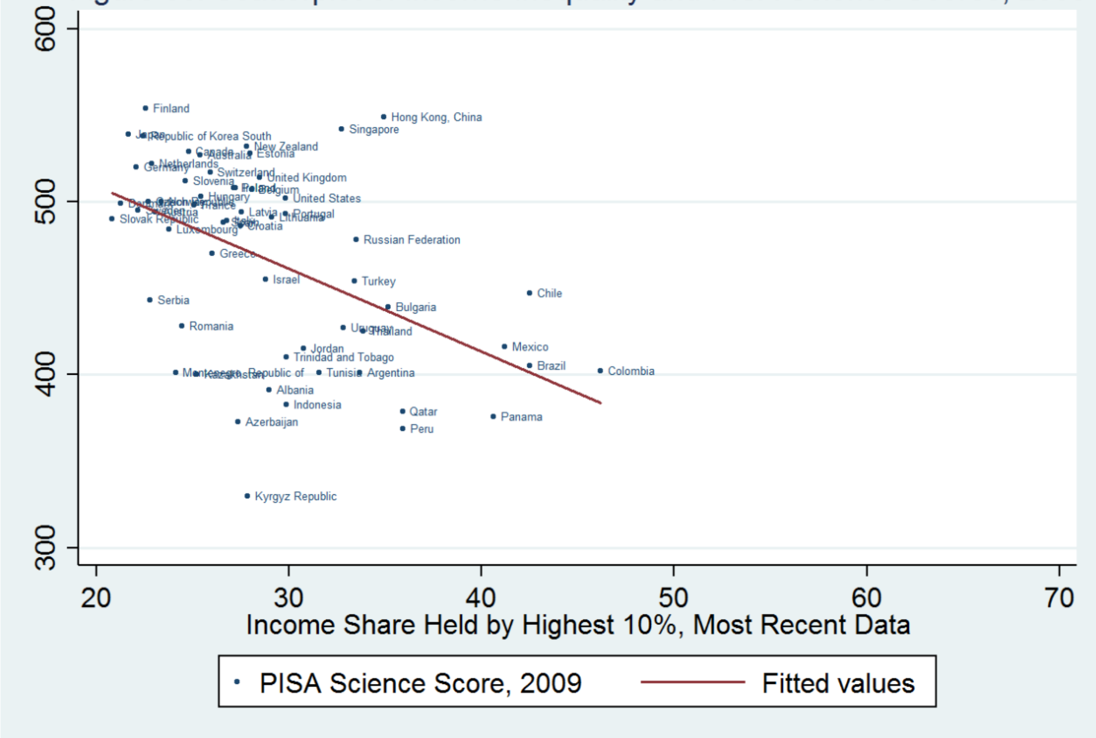


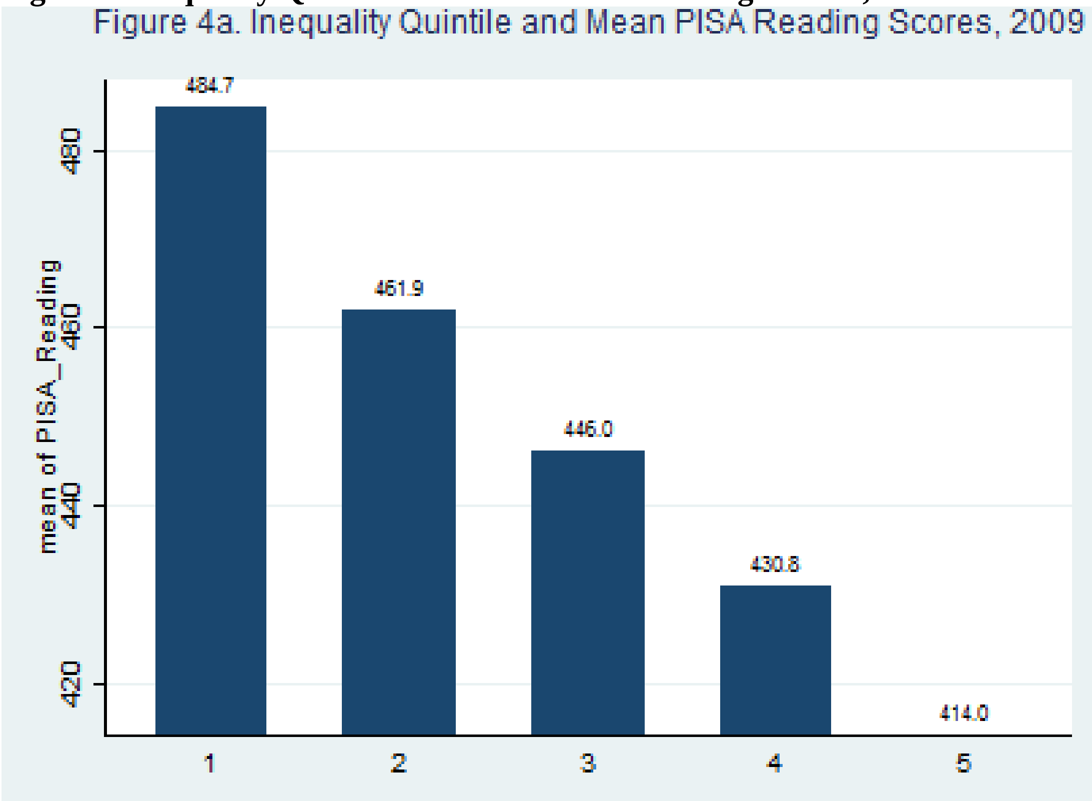
Figure 3c. Scatterplot of Income Inequality and PISA Science Scores, 2009

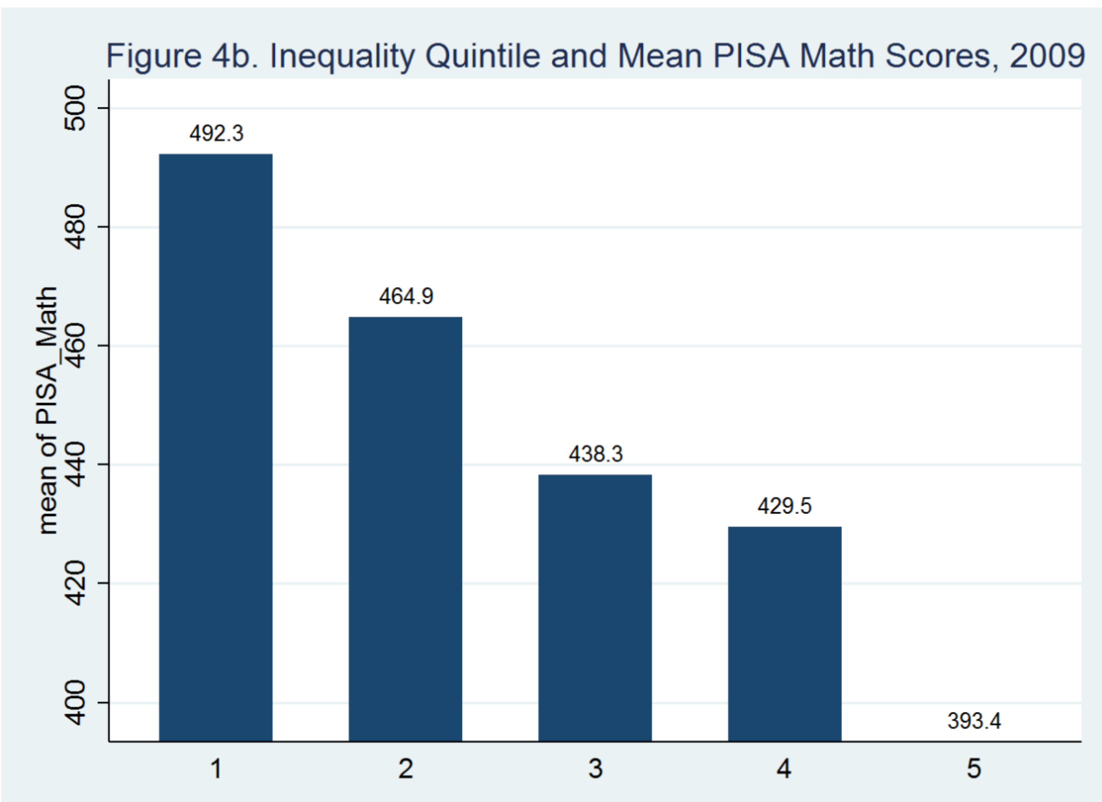


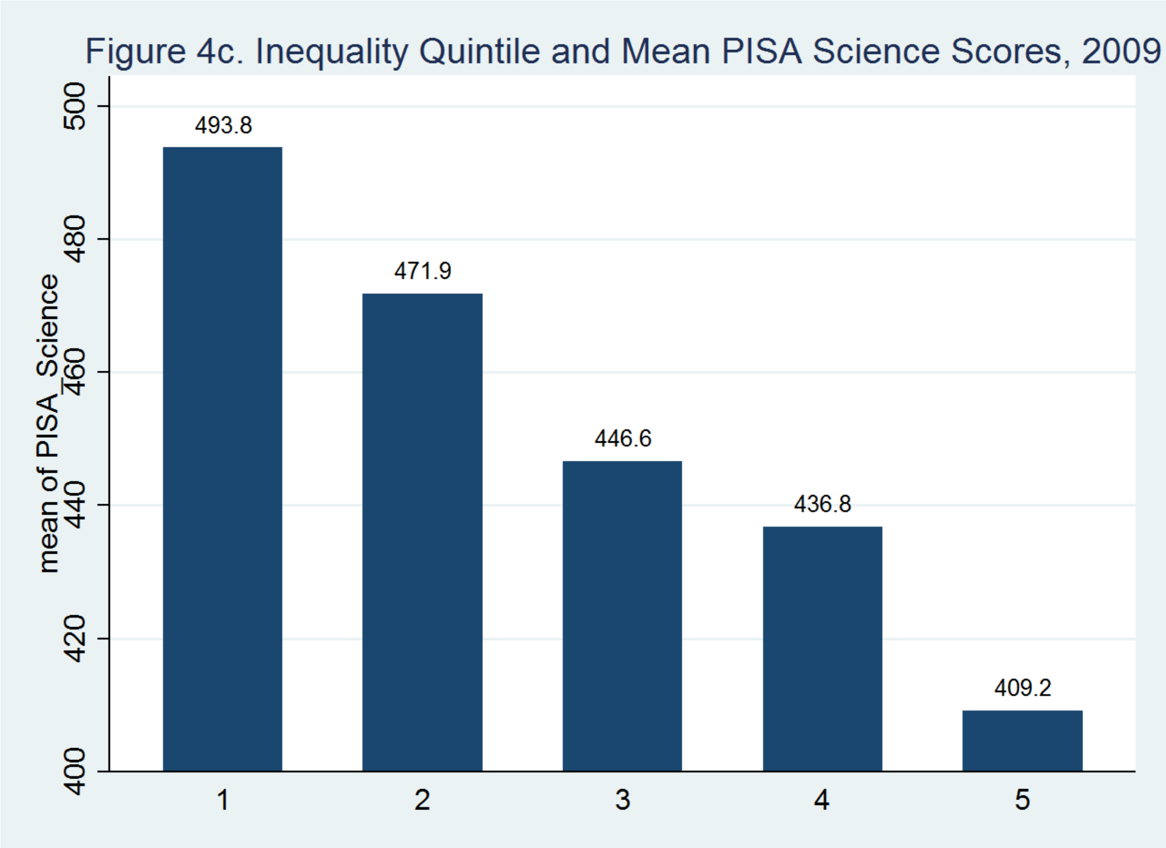
The impact of inequality appears remarkably similar across all PISA tests. As inequality increases, a country's PISA test scores decline markedly.

How large are these effects? Figure 4 presents average PISA scores for each quintile of inequality. The effects of inequality on PISA scores in reading, math, and science appear to be substantial, negative, and quite linear.

Figure 4. Inequality Quintiles and Mean PISA Readings Scores, 2009







Yet are these differences statistically significant? Will the effects lessen or disappear when important control variables are introduced into the model? Table 1 addresses some of these important questions. First we see in each of the bivariate models (Model 1) that increased inequality lowers PISA reading scores. For each percent of income earned by the top 10% of wage earners, the aggregate PISA reading score declines by about 4.1 points.

When a country's GDP per capita is introduced, we see that both the effects of inequality and a country's wealth are statistically significant. Wealth appears to increase overall PISA reading scores. Meanwhile, the effect sizes of inequality on PISA scores are lessened compared to the bivariate model but remain statistically significant.

The relationship between inequality and PISA reading scores holds even when we introduce statistical controls for both education spending and pupil-teacher ratios. The overall percent of GDP spent on education falls just short of meeting traditional standards of statistical significance, while the pupil-teacher ratio variable is statistically significant although in the opposite direction as hypothesized. In each model, however, the effect of inequality on PISA reading scores is both strong and statistically significant.

Table 1. Factors Predicting PISA Reading Scores, 2009

	Model 1	Model 2	Model 3	Model 4
Inequality10	-4.120	-2.581	-2.492	-3.791
	(3.95)**	(2.47)*	(2.38)*	(3.16)**
GDP_Per_Capita		0.001	0.001	0.001
		(3.56)**	(2.89)**	(2.95)**
Educ_Spending			8.854	8.838
			(1.82)	(1.87)
TeacherRatio_Sec				3.130
				(2.06)*
_cons	579.235	510.042	472.087	469.436
	(18.92)**	(15.01)**	(10.77)**	(11.02)**
R^2	0.21	0.36	0.40	0.44
N	59	59	57	57

* p<0.05; ** p<0.01

How do the effect sizes of inequality compare to others in Model 4? Table 2 displays the standardized betas for each of the variables found in Model 4. Standardized betas are frequently used by researchers to compare the effect sizes of competing variables in a model. In simplest terms, standardized betas represent the amount of change in the dependent variable, measured in standard deviations, that would be produced by a one standard deviation change in each independent variable.

According to Table 2, the effect of inequality is much larger than the effects of a country’s wealth, the amount that it spends on education, or a country’s aggregate pupil-teacher ratio. In summary, the effects of inequality on student performance on the PISA reading test appears to be large, statistically significant, and stable when statistical controls are introduced.

Table 2. Standardized Betas Produced by Full Model – PISA Reading

	Full Model
Inequality10	-.44
GDP_Per_Capita	.34
Educ_Spending	.20
TeacherRatio_Sec	.26
_cons	
R^2	0.44
N	57

* p<0.05; ** p<0.01

The findings for PISA math tests were very similar to those of PISA reading. By comparing the results in Table 3 to Table 2, we can see that the patterns of statistical significance for PISA math scores are similar to that for PISA reading scores. Indeed, the effect sizes of inequality on PISA math scores are actually larger than they are for PISA readings scores (-5.5 v. -4.1 for bivariate model; -5.1 v. -3.8 for full model).

Table 3. Factors Predicting PISA Math Scores, 2009

	Model 1	Model 2	Model 3	Model 4
Inequality10	-5.461 (5.01)**	-3.798 (3.51)**	-3.944 (3.58)**	-5.134 (4.04)**
GDP_Per_Capita		0.001 (3.72)**	0.001 (3.08)**	0.001 (3.12)**
Educ_Spending			4.537 (0.89)	4.522 (0.90)
TeacherRatio_Sec				2.866 (1.77)
_cons	618.616 (19.36)**	543.810 (15.46)**	532.931 (11.56)**	530.504 (11.74)**
R^2	0.31	0.44	0.46	0.49
N	59	59	57	57

* p<0.05; ** p<0.01

Furthermore, Table 4 also shows us that the inequality effects again were more powerful in predicting PISA math scores than were a country's wealth, its education spending, or its pupil-teacher ratio.

Table 4. Standardized Betas Produced by Full Model – PISA Math

	Full Model
Inequality10	-.53
GDP_Per_Capita	.35
Educ_Spending	.09
TeacherRatio_Sec	.21
_cons	
R^2	0.49
N	57

* *p*<0.05; ** *p*<0.01

Table 5 continues the examination using PISA science scores. While the same patterns of statistical significance can be found, the effect sizes are a bit smaller than math but larger than for reading. Table 6 shows that inequality once again has the largest effects on PISA science scores than any of the other variables in Model 4.

Table 5. Factors Predicting PISA Science Scores, 2009

Inequality10	-4.786 (4.35)**	-3.187 (2.89)**	-3.186 (2.87)**	-4.396 (3.44)**
GDP_Per_Capita		0.001 (3.50)**	0.001 (2.81)**	0.001 (2.85)**
Educ_Spending			8.358 (1.62)	8.343 (1.65)
TeacherRatio_Sec				2.915 (1.79)
_cons	604.938 (18.74)**	533.026 (14.83)**	500.609 (10.79)**	498.140 (10.95)**
R^2	0.25	0.38	0.42	0.45
N	59	59	57	57

* *p*<0.05; ** *p*<0.01

Table 6. Standardized Betas Produced by Full Model – PISA Science

Inequality10	-.47
GDP_Per_Capita	.33
Educ_Spending	.18
TeacherRatio_Sec	.22
_cons	
R^2	0.45
N	57

* $p<0.05$; ** $p<0.01$

Is the relationship between inequality and educational outcomes limited to only the PISA exams? To answer this question, I also examined the results of the Trends in International Mathematics and Science Study (TIMSS) exams. Tables 7 through 12 all display the same characteristics as we saw in the PISA findings. For all of the TIMSS exams, whether it is 4th or 8th graders being examined, and regardless of whether the subject matter is math or science, inequality has a large, negative, statistically significant impact on international test scores. For all of the models, the largest impact on any of the models is consistently the inequality variable. The results displayed in these tables suggest that it is highly unlikely that the relationship between inequality and test scores is the result of a random statistical correlation found among nations taking the PISA exams.

Table 7. Factors Predicting TIMSS (8th Grade) Science Scores

Inequality10	-5.168	-4.813	-4.866	-4.873
	(3.64)**	(3.31)**	(3.23)**	(2.97)**
GDP_Per_Capita		0.001	0.000	0.000
		(1.06)	(0.97)	(0.93)
Educ_Spending			2.361	2.374
			(0.30)	(0.29)
TeacherRatio_Sec				0.022
				(0.01)
_cons	623.758	604.509	595.784	595.592
	(14.45)**	(12.92)**	(10.08)**	(9.57)**
R^2	0.28	0.30	0.30	0.30
N	37	37	36	36

* p<0.05; ** p<0.01

Table 8. Standardized Betas Produced by Full Model – TIMSS 8th Grade Science

Inequality10	-.49
GDP_Per_Capita	.15
Educ_Spending	.04
TeacherRatio_Sec	.00
_cons	
R^2	0.30
N	36

* p<0.05; ** p<0.01

Table 9. Factors Predicting TIMSS (8th Grade) Math Scores

Inequality10	-5.358 (3.20)**	-4.812 (2.84)**	-4.839 (2.75)**	-4.434 (2.33)*
GDP_Per_Capita		0.001 (1.39)	0.001 (1.32)	0.001 (1.10)
Educ_Spending			1.807 (0.19)	1.022 (0.11)
TeacherRatio_Sec				-1.252 (0.59)
_cons	615.289 (12.09)**	585.765 (10.74)**	578.425 (8.39)**	589.622 (8.16)**
R^2	0.23	0.27	0.27	0.28
N	37	37	36	36

* $p<0.05$; ** $p<0.01$

Table 8. Standardized Betas Produced by Full Model – TIMSS 8th Grade Math

Inequality10	-.39
GDP_Per_Capita	.18
Educ_Spending	.02
TeacherRatio_Sec	-.10
_cons	
R^2	0.28
N	36

* $p<0.05$; ** $p<0.01$

Table 9. Factors Predicting TIMSS (4th Grade) Science Scores

Inequality10	-7.387 (2.75)**	-6.216 (2.21)*	-6.745 (2.33)*
GDP_Per_Capita		0.001 (1.27)	0.001 (1.36)
Educ_Spending			-10.618 (0.84)
_cons	680.457 (8.92)**	624.538 (7.15)**	688.624 (5.93)**
R^2	0.20	0.24	0.26
N	32	32	32

* p<0.05; ** p<0.01

Table 10. Standardized Betas Produced by Full Model – TIMSS 4th Science

Inequality10	-.41
GDP_Per_Capita	.23
Educ_Spending	-.14
_cons	
R^2	0.26
N	32

* p<0.05; ** p<0.01

Table 11. Factors Predicting TIMSS (4th Grade) Math Scores

	TIMSS_Math_4	TIMSS_Math_4	TIMSS_Math_4
Inequality10	-7.401	-6.271	-6.833
	(2.80)**	(2.26)*	(2.40)*
GDP_Per_Capita		0.001	0.001
		(1.24)	(1.34)
Educ_Spending			-11.265
			(0.91)
_cons	678.158	624.234	692.228
	(9.03)**	(7.25)**	(6.06)**
R^2	0.21	0.25	0.27
N	32	32	32

* p<0.05; ** p<0.01

Table 12. Standardized Betas Produced by Full Model – TIMSS 4th Science Math

Inequality10	-.42
GDP_Per_Capita	.23
Educ_Spending	-.15
_cons	
R^2	0.27
N	32

* p<0.05; ** p<0.01

To summarize, there is growing evidence that economic inequality frequently produces very harmful social, political, and as this study suggests, educational effects. Nevertheless, it can be politically difficult for a nation to combat growing inequality.

In future iterations of this paper, I will develop a stronger theoretical foundation for both the primary hypotheses that are tested as well as those used as statistical controls. In addition, I will develop in more detail the mechanism by which economic inequality can be harmful to children.

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