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INEQUALITY OF EDUCATIONAL OPPORTUNITY IN A CROSS-SECTION OF COUNTRIES. EMPIRICAL ANALYSIS OF 2009 PISA DATA

We provide a measure of inequality of educational opportunity for 72 countries, estimated as a share of the variation in the 2009 PISA test scores that is explained by pre-determined family characteristics. Inequality of opportunity accounts for up to 40 percent of the variation in educational achievement and different measures (for example in math, science, and reading) are highly correlated. Cross-country variation in the inequality of educational opportunity is unrelated to financial indicators, such as expenditure per student or public spending on education as a share of GDP, but depends on pre-school enrollment, overall economic inequality, and the availability of basic medical services. We also document the negative relationship between the inequality of educational opportunity and educational achievement: average educational achievement is lower in countries where family background plays a major role in determining individual progress.

JEL classification: I21, J62, H52
Keywords: equality of opportunity, student performance, family background, equity-efficiency trade-off

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Guess what Coleman's found? Schools make no difference; families make the difference.

S. M. Lipset to D. P. Moynihan, as quoted by Hodgson (1975, p. 22)

Introduction

Almost fifty years ago the famous "Coleman Report" introduced the notion of equality of educational opportunities. Coleman's most controversial finding documented that the main determinant of achievement for US students was their family background. In contrast, the variation in resource levels between schools accounted for little of the variation in academic achievement among students studying in these schools (Coleman, 1966, 1968). This result was confirmed in many studies in different countries over the next four decades (Gamoran, Long, 2006).

In this paper, we provide a measure of inequality of educational opportunity for 72 countries based on the 2009 PISA study. We also explore the determinants of inequality of educational opportunity in a cross-country setting and ask whether there is a trade-off between equity and efficiency in education. We find that inequality of educational opportunity is unrelated to financial indicators, such as expenditure per student or public spending on education as a share of GDP, but does depend on institutional environment, overall economic inequality, and the availability of basic medical services. We also document the negative relationship between inequality of educational opportunities and educational achievement. In countries where family background plays a major role in determining individual progress, average educational achievement is lower.

This paper relates to a growing body of literature on the equality of opportunity. In 2006 the World Development Report documented that big differences in life opportunities for children from different family backgrounds exist to some extent in all countries and that they "lead to wasted human potential and thus to missed development opportunities" (World Bank Report, 2006, p. 2). In a society where children from middle-income and poor families end up with undeveloped talents, the economy is unlikely to be efficient and will miss many potential opportunities for investment and innovation. Thus, equality of opportunity (including educational opportunity) is a crucial ingredient in the pursuit of long-term economic growth.

The rest of this paper proceeds as follows. Section 2 provides the theoretical background of the study and Section 3 describes the data. Section 4 estimates the effect of family background on the educational achievement of students in 72 countries. Section 5 explores the main determinants of inequality of educational opportunity across countries and Section 6 shows that there is no trade-off

between equity and efficiency in education, at least in the sample of countries participating in PISA. Section 7 concludes the paper.

Theoretical Framework

We can think of inequality in achievement as the result of two types of differences: 1) differences in effort, which are subject to individual choice; and, 2) differences in opportunities or circumstances, which lie outside the individual's control. While the first type is regarded as acceptable, the second one is more problematic to justify because it does not reflect the choices or actions of children, but only the inherited circumstances beyond their control. Following Roemer, equality of opportunity would prevail if the outcome of interest (in our case, educational achievement) were independent of circumstances (Roemer, 1998). Equal opportunity does level the playing field and, in principle, every member of society can have the potential to achieve his or her goals. Leaving aside moral and normative arguments, there are many positive studies showing that high inequality of opportunity leads to wasted human capital – the most valuable resource for a country's development.

The empirical literature on the measurement of inequality of opportunity has focused primarily on income or wealth inequality, but, as Ferreira and Gignoux argue, "there is no reason it cannot be adapted to the space of educational achievement" (Ferreira, Gignoux, 2011, p.15). These authors propose to measure inequality of opportunity (IOp) by between-type inequality. The basic model is as follows.

Suppose that educational achievement y is a function of pre-determined circumstances C, effort E, and other environmental characteristics u. Effort is not exogenous, but can also in part depend on family circumstances and other environmental variables v. Thus the model can be written as such:

$$y = f(C, E, u) \qquad (1)$$
$$E = f(C, v) \qquad (2)$$

Under the assumption of a linear relationship between achievement and circumstances, equations (1) and (2) can be written in the following reduced form

$$y_i = \beta C_i + \varepsilon_i \qquad (3),$$

where β captures the overall effect of pre-determined circumstances operating both directly and through effort. This estimation can suffer from omitted variable bias, since some circumstances cannot be observed and included in the model. Thus β cannot be interpreted as the causal effect of pre-determined circumstances on educational achievement. However, if we are interested in the *total* effect of all circumstances on achievement, we can calculate the share of variation in y that is explained by the circumstances, whether they operate directly or indirectly. This leads to the measure of inequality of educational opportunity[3]:

$$IOp_i = \frac{Var(C_i\hat{\beta})}{Var(y_i)} \qquad (4)$$

This measure has a number of advantages over β. First, it is easy to calculate, because it is simply the R^2 of an OLS regression of a test score on a vector of family background and other circumstances. Moreover, if we estimate a multiple regression model (as we do in Section 4) it is hard to choose which of the coefficients can serve as a measure of inequality of opportunity – it becomes a question of "which β is better". Using the R^2 of the regression easily solves this problem.

Second, β may be biased if we omit some important variables or if ε is correlated with *C* (and in both cases, as well). In contrast, the R^2 of the regression yields a valid lower bound for the object of interest, because the only missing variables in (3) are other circumstances. If we add additional variables, R^2 could rise, but not fall.

Third, this measure allows us to use as much information as possible. Different scholars use different measures of inequality of opportunity. For instance, Schultz, Ursprung, and Woessmann (2008) use the number of books in a student's home as a proxy for family background and the coefficient on this variable as a measure of inequality of educational opportunity. Other studies use a parent's education or family income. Although this approach seems reasonable, it nevertheless does not take advantage of the potential that the PISA data provide. Following Ferreira and Gignoux (2011), we include in our regression as many circumstance variables as we can gather from the 2009 PISA database and consider the joint effect of these circumstances.

In the next section we briefly describe the data on which we base our estimation.

[3] See Ferreira and Gignoux (2011) for details and a more rigorous proof.

Data Description

The Programme for International Student Assessment (PISA) is a well-known worldwide study that is conducted by the Organization for Economic Co-operation and Development (OECD). It uses the test results of 15-year-old students to check their knowledge in mathematics, science, and reading. The program began in 2000 and is now repeated every three years in a wide range of countries. We use data from the 2009 PISA study.

In 2009 there were about 516,000 15-years-old students from the 74 nations and territories that participated in the study. Besides test score results, this database contains rich information on the family background of students, such as the educational and occupational status of parents, family size, immigration status, etc. This allows us to estimate the joint effect of family background on the educational achievements of students.

Table 1. Descriptive statistics

	Average	Std. deviation	N
Individual level data			
PISA Math score	461.68	105.33	515,958
PISA Science score	466.10	105.09	515,958
PISA Reading score	460.52	104.22	515,958
Educational level of mother (7 level scale)	3.76	1.77	495,341
Educational level of father (7 level scale)	3.80	1.76	481,968
White collar high-skilled parent	0.48	0.50	515,958
White collar low-skilled parent	0.22	0.41	515,958
Mother working full-time	0.43	0.50	515,958
Father working full-time	0.70	0.46	515,958
Books at home (6 level scale)	2.98	1.44	505,093
Mother at home	0.93	0.25	497,060
Father at home	0.84	0.37	481,953
Brothers at home	0.62	0.49	445,799
Sisters at home	0.57	0.49	437,667
Grandparents at home	0.22	0.41	402,348
Students' country of birth is the country of test	0.94	0.24	507,003
Mothers' country of birth is the country of test	0.86	0.35	503,748
Fathers' country of birth is the country of test	0.87	0.34	500,238
Language at home is the language of test	0.87	0.33	496,104
Female	0.51	0.50	515,956

Country level data			
PISA Math score	459.66	60.38	72
Log GDP per capita	9.77	0.77	71
Education expenditure per student	21.90	6.96	52
Public spending on education, % GDP	4.68	1.46	60
Pupil-teacher ratio	12.93	3.97	54
Pre-school enrollment	103.44	7.60	71
Gini-coefficient	0.37	0.09	64
Total rent, % GDP	4.49	8.72	72
Nursing and midwifery personnel (per 10 thousand population)	61.60	55.94	69

In addition to PISA data at the individual-level, we use country-level data from the World Development Indicators (WDI), UNESCO Educational Statistics, and the World Health Organization database. Table 1 presents descriptive statistics both at the individual and country level.

In the next section we begin our empirical analysis of estimating the effect of family background on educational achievement in all countries for which we have data from the 2009 PISA study.

Family Background and Student Achievement

Our main goal in this section is to calculate the measure of inequality of educational opportunity that is described in the theoretical section. How much of educational achievement is explained by pre-determined circumstances? In order to address this question, we estimate individual level regressions by relating PISA test scores to family background in every country assessed in the study, and compute the share of the variation in test scores that is explained by these characteristics. The regression equation is as follows:

$$Test\ Scores_{ij} = \beta_0 + \beta_1 FatherEdu_{ij} + \beta_2 MotherEdu_{ij} + \beta_3 High\ Skill_{ij} + \beta_4 Low\ Skill_{ij} + \beta_5 FatherFT_{ij} + \beta_6 MotherFT_{ij} + \beta_7 Books_{ij} + \beta_8 X_{ij} + \beta_9 Z_{ij} + \beta_{10} L_{ij} + \beta_{11} Female_{ij} + \varepsilon_{ij}, \quad (5)$$

where $Test\ Scores_{ij}$ is the measure of student achievement in mathematics, science, or reading (we estimate separate equations for each subject); *i* and *j* are indexes referrung to individual and country, respectively. Family background is captured by a number of variables:

- $FatherEdu_{ij}$ and $MotherEdu_{ij}$ are the father's and mother's respective educational level according to the seven-scale ISCED classification.
- $HighSkill_{ij}$ is a dummy variable indicating highest parent educational status (high-skilled white-collar worker). $LowSkill_{ij}$ is a dummy for a low-skilled white-collar worker. Blue-collar workers are left as the comparison group.
- $FatherFT_{ij}$ and $MotherFT_{ij}$ are dummy variables for full-time employment for the father and mother, respectively.
- $Books_{ij}$ is a six-scale measure of the number of books at home.
- X_{ij} is a vector for family structure, precisely a set of dummy variables indicating the presence of a mother, father, brother, sister, and grandparents.
- Z_{ij} is a set of dummy variables capturing immigration status and whether the father and/or mother of the student were born in the country of test.
- L_{ij} is a dummy variable that captures whether the language of the test was the same as the language the student speaks at home.
- $Female_{ij}$ is the dummy variable for female gender.
- ε_{ij} is the error term.

Table 2 presents the results of the estimation of equation (1). To save space, we report results only for four countries that represent typical results in every quartile of the R^2 distribution[4]. The results show that family background has a strong and statistically significant effect on student achievement – a well-documented empirical fact. For every country of study, similar results were shown in terms of the sign and statistical significance of the coefficients, although the magnitude of the effect is different.

[4] Results on the other 68 countries, as well as on the other dependent variables (test scores for science and reading), are available upon request.

Table 2. Test Scores and Family Background

	Dependent variable: *Math Test Score*			
	Colombia	United Kingdom	Sweden	Russian Federation
	(1)	(2)	(3)	(4)
Educational level of mother	4.748***	0.381	0.407	7.328***
	(0.519)	(0.840)	(1.401)	(1.671)
Educational level of father	4.092***	1.278*	4.016***	4.361***
	(0.480)	(0.733)	(1.211)	(1.569)
White-collar high-skilled parent	26.19***	37.91***	37.57***	30.07***
	(2.149)	(3.069)	(5.568)	(3.404)
White-collar low-skilled parent	7.361***	14.41***	11.93**	5.021
	(2.598)	(3.180)	(6.081)	(3.688)
Mother working full-time	0.259	-6.786***	4.907	2.294
	(1.911)	(1.880)	(3.416)	(2.821)
Father working full-time	-4.690***	9.812***	13.14***	6.780**
	(1.757)	(2.526)	(4.464)	(2.987)
Books at home	14.38***	21.13***	18.92***	13.72***
	(0.888)	(0.700)	(1.276)	(0.977)
Mother at home	39.73***	22.26***	22.26***	4.385
	(2.880)	(6.048)	(7.773)	(6.400)
Father at home	8.088***	10.57***	-6.762	10.27***
	(2.116)	(2.475)	(5.247)	(3.240)
Brothers at home	-13.15***	-4.990***	1.129	-4.406*
	(1.862)	(1.895)	(3.413)	(2.543)
Sisters at home	-5.019***	-5.394***	-4.384	-9.074***
	(1.813)	(1.867)	(3.368)	(2.566)
Grandparents at home	-13.04***	-29.96***	-29.03***	-13.04***
	(2.161)	(4.719)	(8.765)	(2.716)
Student's country of birth is the country of test	-1.782	-12.72**	-7.246	0.119
	(10.71)	(5.362)	(9.897)	(5.796)
Mother's country of birth is the country of test	24.94*	-1.485	0.931	2.356
	(13.61)	(4.099)	(5.659)	(4.303)

Father's country of birth is the country of test	29.45***	0.808	7.216	1.403
	(9.246)	(4.054)	(5.393)	(4.146)
Language at home is the language of test	28.61*	30.67***	20.26**	9.105*
	(14.61)	(4.496)	(8.626)	(4.660)
Female	-32.67***	-21.76***	-6.516**	-10.14***
	(1.688)	(1.804)	(3.260)	(2.447)
Constant	239.0***	372.5***	348.6***	334.0***
	(19.84)	(8.858)	(13.32)	(12.43)
Observations	5,450	6,292	2,485	4,173
R-squared	0.340	0.267	0.206	0.157

In 50 out of the 72 countries studied, the educational level of the mother is positive and statistically significant. The educational level of the father is positively significant in 57 countries. The type of job the parents had (high-skilled or low-skilled) is also important in all countries: If one of the parents occupied a high-skilled white-collar job, it raised the child's test scores by 30 points on average, holding the education of parents constant. The type of employment (full-time or part-time) is also significant with respect to test scores, as are the size of the family and immigrant status. The influence of having books at home is statistically significant in 70 countries with an average effect of adding about 15 points to test scores.

Although the study of any particular effect is an interesting topic in and of itself, our main focus is the variation in inequality of educational opportunity across countries. As discussed in Section 2, our proposed measure of inequality of educational opportunity is the R^2 of an OLS regression of a student's test score on a vector of pre-determined circumstances. It provides a lower bound of the total joint effect of inherited rather than controlled circumstances on achievement.

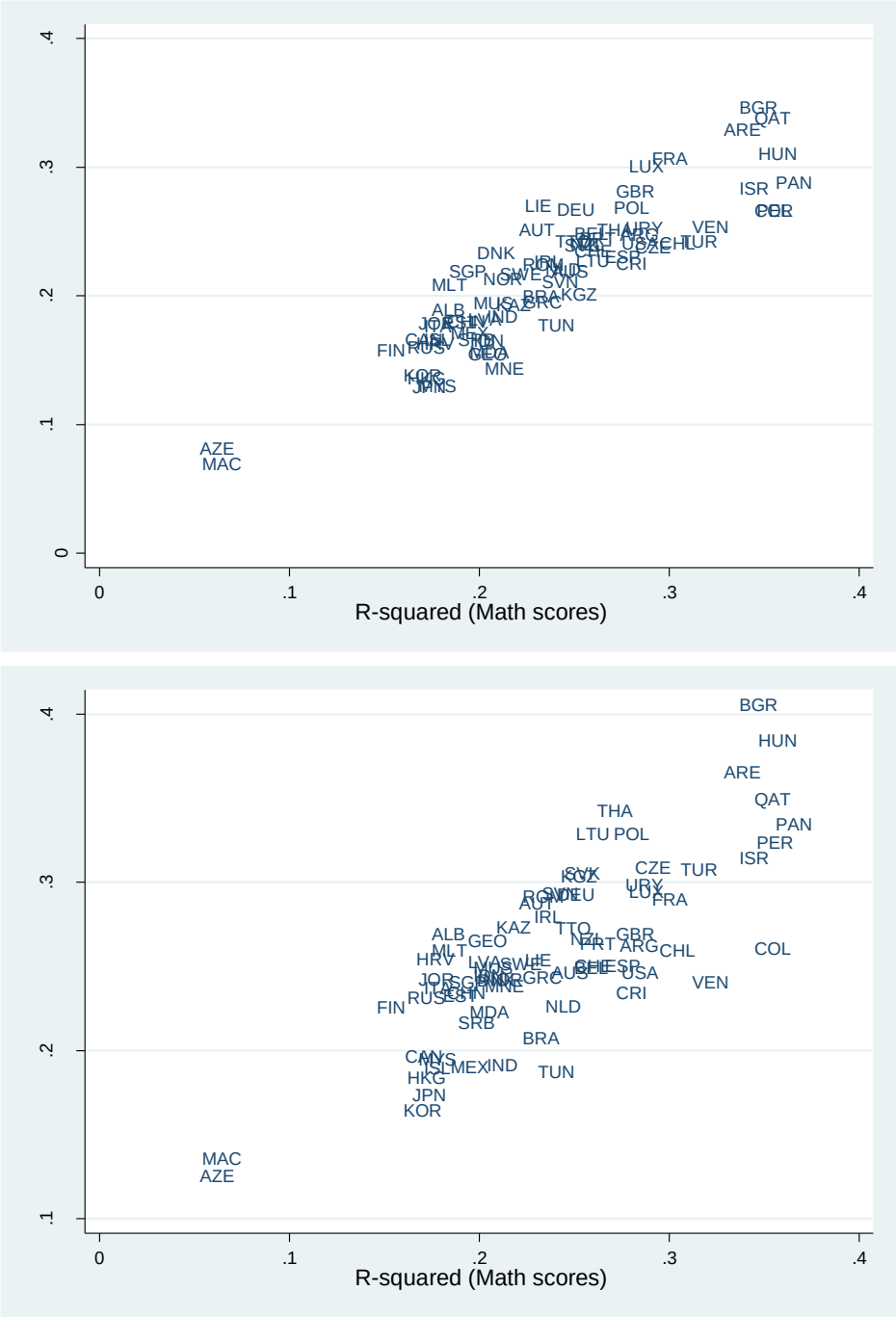
Table 3 reports countries sorted in descending order by R^2 of regression (5). We use three different measures of achievement as dependent variables: test scores in math, science, and reading. Table 3 shows that up to 35% of the math test score variation within the country can be explained by pre-determined family circumstances. The countries with highest inequality of opportunity are Panama, Hungary, Peru, and Colombia. Results for reading test scores indicate that inequality of opportunity could be even higher (up to 40% in Bulgaria).

Table 3. Equality of Educational Opportunity across Countries

Country	Code	R-square math	R-square science	R-square reading
Panama	PAN	0.351	0.289	0.335
Hungary	HUN	0.342	0.311	0.385
Peru	PER	0.341	0.267	0.324
Colombia	COL	0.340	0.267	0.261
Qatar	QAT	0.340	0.339	0.350
Bulgaria	BGR	0.332	0.347	0.406
Israel	ISR	0.332	0.284	0.315
United Arab Emirates	ARE	0.324	0.330	0.366
Venezuela, RB	VEN	0.307	0.254	0.241
Turkey	TUR	0.301	0.243	0.308
Chile	CHL	0.290	0.242	0.260
France	FRA	0.286	0.307	0.290
Czech Republic	CZE	0.277	0.239	0.309
Luxembourg	LUX	0.274	0.301	0.295
Uruguay	URY	0.272	0.253	0.299
United States	USA	0.270	0.242	0.247
Argentina	ARG	0.269	0.248	0.263
Costa Rica	CRI	0.267	0.226	0.235
United Kingdom	GBR	0.267	0.282	0.270
Poland	POL	0.266	0.269	0.329
Spain	ESP	0.261	0.231	0.251
Thailand	THA	0.257	0.252	0.343
Portugal	PRT	0.248	0.245	0.264
Lithuania	LTU	0.246	0.228	0.329
Belgium	BEL	0.245	0.249	0.250
Switzerland	CHE	0.245	0.236	0.251
New Zealand	NZL	0.243	0.241	0.267
Slovak Republic	SVK	0.240	0.240	0.306
Kyrgyz Republic	KGZ	0.238	0.202	0.304
Germany	DEU	0.236	0.268	0.293
Trinidad and Tobago	TTO	0.235	0.243	0.273
Australia	AUS	0.233	0.220	0.247
Netherlands	NLD	0.230	0.221	0.227
Slovenia	SVN	0.228	0.212	0.294
Tunisia	TUN	0.226	0.178	0.188
Ireland	IRL	0.224	0.227	0.280
Liechtenstein	LIE	0.219	0.271	0.254
Brazil	BRA	0.218	0.200	0.208
Greece	GRC	0.218	0.196	0.244
Romania	ROM	0.218	0.225	0.292
Austria	AUT	0.216	0.252	0.288
Sweden	SWE	0.206	0.218	0.252
Kazakhstan	KAZ	0.204	0.194	0.274
India	IND	0.199	0.185	0.192
Montenegro	MNE	0.198	0.144	0.239

Norway	NOR	0.197	0.214	0.243
Denmark	DNK	0.194	0.234	0.242
Indonesia	IDN	0.192	0.166	0.245
Mauritius	MUS	0.192	0.195	0.250
Moldova	MDA	0.190	0.157	0.223
Georgia	GEO	0.189	0.155	0.266
Latvia	LVA	0.189	0.182	0.253
Serbia	SRB	0.184	0.167	0.217
Mexico	MEX	0.180	0.172	0.191
Singapore	SGP	0.179	0.220	0.241
China	CHN	0.178	0.181	0.235
Estonia	EST	0.176	0.180	0.233
Albania	ALB	0.170	0.190	0.270
Malta	MLT	0.170	0.209	0.260
Iceland	ISL	0.166	0.167	0.190
Italy	ITA	0.166	0.177	0.238
Jordan	JOR	0.163	0.179	0.243
Malaysia	MYS	0.163	0.131	0.195
Croatia	HRV	0.162	0.164	0.255
Japan	JPN	0.160	0.130	0.174
Hong Kong SAR, China	HKG	0.157	0.137	0.184
Russian Federation	RUS	0.157	0.161	0.232
Canada	CAN	0.156	0.167	0.197
Korea, Rep.	KOR	0.155	0.139	0.165
Finland	FIN	0.141	0.158	0.226
Macao SAR, China	MAC	0.049	0.070	0.136
Azerbaijan	AZE	0.048	0.082	0.126

All three measures of inequality of educational opportunity are highly correlated. The correlation between inequality of opportunity in math and in science is 0.90, while that between math and reading 0.79. Figures 1 and 2 display this strong linear relationship.



Figures 1 and 2. Correlations between different measures of inequality of opportunity

In the next section, we explore the determinants of cross-country variation in inequality of opportunity and then explore the question of trade-off between efficiency and inequality.

Determinants of Inequality of Educational Opportunity in a Cross-Section of Countries

The average measure of inequality of educational opportunity across countries is 0.23, with minimum level of 0.05 seen in Azerbaijan, a maximum level of 0.35 in Panama, and a standard deviation of 0.06. What factors can explain this variability? Why do some countries achieve a much higher level of equal opportunity than others?

In principle, three groups of factors can account for this variation. First are the features of educational systems. The financing of schools, teacher incentives, tracking rules, and other characteristics can largely affect access to high-quality education for children from different family backgrounds. The second group of factors is purely economic. The level of GDP per capita, distribution of income, and natural-resource endowments can all affect how society provides opportunities to its ordinary members. The third group consists of factors that do not belong to pure economic or pure educational factors, but, nevertheless, play a substantial complementary role. For instance, access to basic medical services for children from different family backgrounds can affect their ability to learn and opportunities to achieve high academic results.

We explore the significance of these factors regressing our measure of inequality of educational opportunity (the R^2 from equation (5) for different countries) on various country characteristics. The results are presented in Tables 4 and 5.

Table 4 explores the effect of educational systems, using as variables the education expenditure per student, public spending on education as percentage of GDP, pupil to teacher ratios, and pre-school enrollment. We gradually add these variables into the regression.

The estimation shows that financial indicators do not have a significant impact on the inequality of educational opportunity. This result is consistent with the finding of Hanushek and Woessman finding there is no relationship between spending on education and student performance (Hanushek and Woesmann, 2011). Pritchett also argues that just increasing spending within the current education system is unlikely to improve student performance, especially in developing countries (Pritchett, 2006). Improving educational performance requires a focus on teacher incentives, institutions, rules, and regulations that set rewards and penalties for the actors. As our analysis shows, these conclusions can be generalized to educational opportunities as well as educational achievement. Purely quantitative financial factors like expenditure per student, public spending on education, or even the number of teachers per student does not affect the equality of educational opportunity.

Table 4. Educational Systems and the Inequality of Educational Opportunity

	Dependent variable: *Inequality of Educational Opportunity (R-square from Regression (1))*			
	(1)	(2)	(3)	(4)
Education expenditure per student	-0.0796	-0.0908	-0.0694	-0.172
	(0.105)	(0.147)	(0.248)	(0.257)
Public spending on education, % of GDP		-0.0843	0.144	0.595
		(0.762)	(1.077)	(1.169)
Pupil-teacher ratio			0.233	0.210
			(0.293)	(0.278)
Pre-school enrollment				2.741**
				(1.275)
Pre-school enrollment squared				-0.0120**
				(0.00548)
Constant	24.60***	25.31***	21.22***	-132.8*
	(2.595)	(3.198)	(5.666)	(73.38)
Observations	52	49	40	39
R-squared	0.011	0.018	0.050	0.142

Along with financial indicators, we include one measure for the institutional environment of secondary education – the availability of pre-primary education. This variable can affect the inequality of educational opportunity in different ways. On the one hand, it can reduce inequality by providing access to pre-school training and compensating for a disadvantaged family background. On the other hand, if pre-school training is itself distributed on the basis of social and economic status, then it can amplify the initial inequalities in family background and lead to more unequal educational opportunities. Based on this logic, Schutz et al (2005) build a theoretical model where the relationship between family-background effects and the enrollment in pre-primary education is non-linear because initially it is the children of relatively well-off families who start attending pre-primary education. Only when a substantial share of children is enrolled in pre-school will there be an equalizing effect of pre-school enrollment. Schutz et al (2008) confirm this theoretical insight empirically and find an inverted U-shape relationship between the effect of family background on achievement and pre-primary school enrollment.

Following this literature, we include a measure of pre-school enrollment and its square to account for possible non-linearity. Column (4) in Table 4 shows that there is indeed an inverted U-shape relationship: Educational opportunities get more unequal with rising pre-school enrollment up

to some level, and beyond this threshold higher pre-school enrollment is associated with more equal educational opportunities.

In Table 5, we estimate similar cross-country regressions with additional right-hand side variables to assess the impact of economic and other factors. In column (1) we add the Gini-coefficient and find that economic inequality is positively related to the inequality of educational opportunity. This finding is consistent with "vicious circle" theories of economic development (World Bank, 2006). In short, high economic inequality is associated with high political inequality. The concentration of income and power in the hands of the few leads to unequal initial opportunities for children from the least well-off segments of society. In turn, these unequal opportunities lead to economic inequality.

Table 5. Determinants of Inequality of Educational Opportunity

	Dependent variable: *Inequality of Educational Opportunity (R-square from Regression (1))*			
	(1)	(2)	(3)	(4)
Pre-school enrollment	3.077***	2.738***	2.774***	2.382***
	(0.827)	(0.740)	(0.764)	(0.827)
Pre-school enrollment squared	-0.0141***	-0.0125***	-0.0127***	-0.0109***
	(0.00377)	(0.00329)	(0.00338)	(0.00372)
Gini-coefficient	0.287***	0.320***	0.331***	0.274**
	(0.107)	(0.111)	(0.104)	(0.111)
Log GDP per capita		1.475*	1.529**	1.759**
		(0.750)	(0.758)	(0.774)
Total rent, % GDP			-0.0503	-0.0360
			(0.116)	(0.116)
Nursing and midwifery personnel (per 10,000 population)				-0.955**
				(0.451)
Constant	-153.3***	-150.8***	-153.5***	-129.2***
	(45.50)	(39.75)	(41.23)	(45.18)
Observations	52	52	52	52
R-squared	0.24	0.27	0.28	0.31

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Our empirical results seem to confirm this theoretical insight, showing that an increase in economic inequality of one standard deviation is associated with an increase in our measure of inequality of educational opportunities by one-third of a standard deviation.

Next we add GDP per capita as a control variable to account for the level of economic development. We find that countries with higher levels of GDP per capita have higher levels of inequality of educational opportunities, although the statistical significance of this result differs depending on the specification.

To account for the effect of possible natural resource endowments, we include the total rents from natural resources as a share of GDP (the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents). The results show no effect of rents from natural resources on educational opportunities.

Finally, we include a measure for the availability of basic medical services for children. We find that the density of nursing and midwifery personnel (per 10,000 individuals) is statistically significantly and negatively correlated with the inequality of educational opportunity. Holding other factors constant, an increase of one standard deviation in the density of nursing and midwifery personnel leads to a decrease of more than 0.2 standard deviations in the inequality of educational opportunity.

This result means that the inequality of opportunity in education is not only a matter of the educational system itself. There are strong complementarities between two sectors – education and health care – that account for human capital production. The availability of basic medical services for children can significantly compensate for possible initial inequalities in family background and thus make educational achievement less dependent on pre-determined birth circumstances.

Equity-Efficiency Tradeoff

Do more equal educational opportunities come at a cost of lower achievement? In other words, is there a tradeoff between educational equity and efficiency? We address this question in a cross-country framework regressing the average PISA test scores in mathematics on our measure of inequality of educational opportunity. The results of this estimation are presented in Table 6.

The inequality of opportunity is statistically significantly and negatively correlated with achievement. It means that higher inequality is associated with lower average achievement. In column (2) we add one control variable – GDP per capita – to account for differences in the level of economic development. The significance of the coefficient of interest is even higher in this specification.

Table 6. Tradeoff between Achievement and Inequality of Educational Opportunity

	Dependent variable: *Average Math Test Scores*		
	(1)	(2)	(3)
Inequality of Educational Opportunity	-2.583**	-2.836***	-2.371***
	(1.006)	(0.926)	(0.781)
Log GDP per capita		52.33***	63.39***
		(7.775)	(4.902)
Constant	516.8***	11.10	-106.7*
	(24.94)	(89.52)	(55.41)
Observations	71	71	67
R-squared	0.07	0.53	0.73

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

An inspection of post-estimation residuals reveals several outlier observations. To ensure that our results are not driven by outliers, we exclude them from the sample and report this estimation in column (3). The coefficient for the inequality of educational opportunity remains statistically significant at the 1% level with a slightly lower coefficient. The magnitude of the effect is still substantial: An increase in inequality of educational opportunity by one standard deviation decreases average test scores in the country by 0.3 standard deviations. The scatter plot for this estimation is shown in Figure 3.

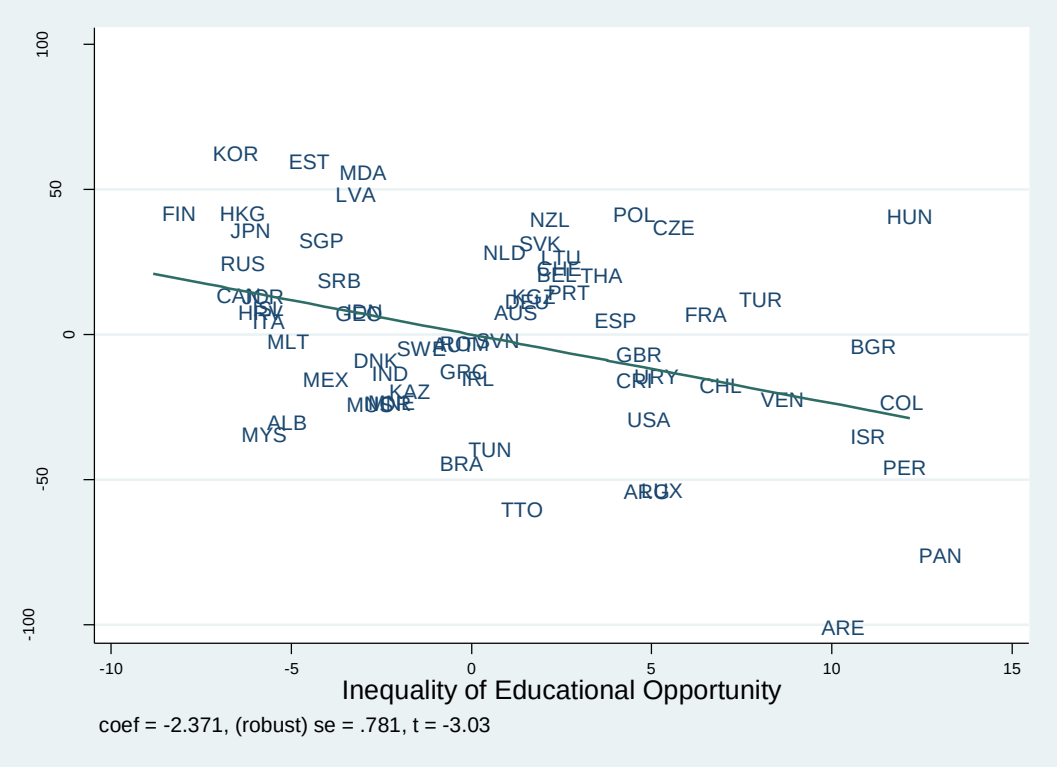


Figure 3. Trade-off between Achievement and Inequality of Educational Opportunity

To some extent, this result contradicts previous findings. For instance, Woessman (2004) finds no relationship between inequality of opportunity and achievement. Other studies find no or very small negative correlation. Of course, this question requires more detail and an in-depth empirical study based on microdata. But until then, we can conclude that, at least in a cross-country setting, there is no trade-off between quality of education and equal opportunities for achievement.

The question regarding equity-efficiency tradeoff is crucial for public policy implications. Our results show that there is at least no contradiction between policies that aim to raise the quality of education and policies that aim to equalize educational opportunities. These goals can complement each other.

Concluding Remarks

In this paper, we make three contributions to the literature on educational opportunities. First, we examine the extent to which pre-determined family variables affect student academic achievement in the sample of 72 countries. We found that these factors account for up to 40 percent of the variation in educational achievement. Their effect is greater in Latin American and Middle

East countries than in Scandinavian and East Asian countries. Second, we explore the determinants of the inequality of educational opportunity across countries. Our main finding is that this is unrelated to financial indicators such as expenditure per student or public spending on education as a share of GDP, but, however, it does depend on preschool enrollment, overall economic inequality, and the availability of basic medical services. Third, we document the negative relationship between the inequality of educational opportunities and educational achievement. In countries where family background plays a major role in determining individual progress, average educational achievement is lower. This result holds even accounting for the level of economic development. Thus, there is no tradeoff between the two types of policies to foster human capital – providing more equal access to education and achieving higher quality of education are not contradictory goals. In fact, both can be relevant policies for countries wishing to acquire higher levels of development.

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