Universidad del País Vasco
Euskal Herriko Unibertsitatea

MASTER DISSERTATION

Submitted for the Degree

MASTER IN ECONOMICS: EMPIRICAL APPLICATIONS AND POLICY

Inequality of opportunity in education

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September 2012

ABSTRACT

This study computes educational inequality of opportunity level for the 65 countries that participate in PISA tests. First of all, I adapt the structural model proposed by Fleurbaey and Schokkaert (2009) to educational and real data. Secondly, I select 12 relevant variables that explain the variance in the students' achievements, and then, estimate their coefficients. These variables are classified as effort and circumstances variables. To conclude I measure the inequality of opportunity grade of 65 countries. The chosen inequality measure is the variance, and they are adjusted so that the measures are comparable across countries. This study shows that most countries with highest inequality of opportunity degree coincide with countries with lowest average marks, and most countries with lowest inequality degree are likely to have higher average scores. So it suggests that the inequality of opportunity level and the students' achievements are negatively correlated. Countries with highest inequality of opportunity level are mostly countries from South America, Eastern Europe and Asia. On the contrary, countries with lowest unfair inequality degree are those from North America, Western Europe and Oceania.

ACKNOWLEDGEMENT

Thanks to Casilda Lasso de la Vega, my supervisor, who has guided me throughout the entire research process by suggesting helpful research papers, and motivating, inspiring and supporting me all the time.

I would like to say a big thanks to Ainara Gonzalez de San Roman who has helped me with the PISA's dataset as well as the Stata program and econometric issues.

I am grateful to Petr Mariel for his advices in econometric matters.

My final words go to my family and friends who always motivate and encourage me towards my objectives.

CONTENTS

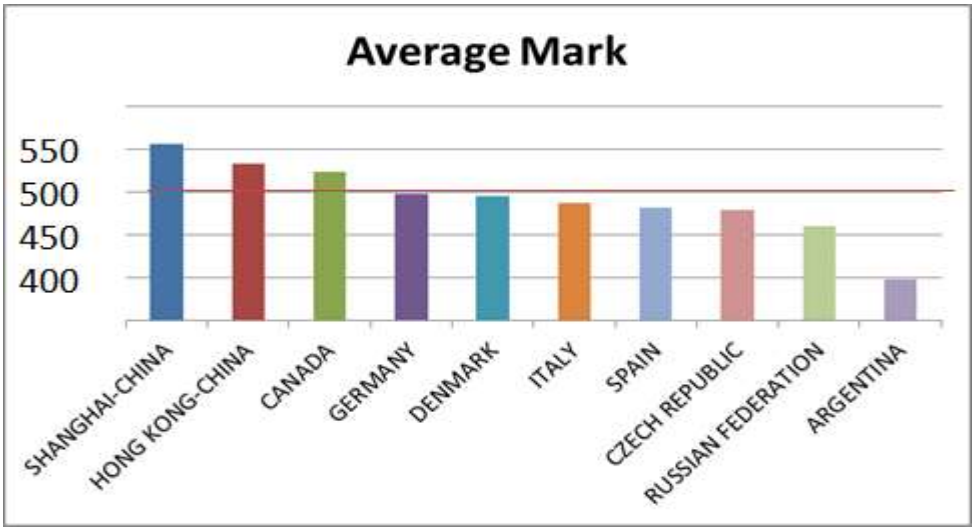
1. INTRODUCTION

Education is usually considered an indicator of well-being since it might stimulate the capacity of innovation and development, productivity and economic growth, as well as the overall health status of a country.

For this reason, educational inequalities across countries should yield a significant position in policy-makers' programs. Differences are, in principle, undesirable since they indicate that an unfavorable social group exists. Accordingly, policy-makers aim to identify the best educational systems as well as their determinants in order to reduce those existent inequalities.

Program for International Student Assessment (PISA) has been evaluating 15-year-old students of participating countries since 2000. The results have put in evidence the differences in the achievements among students from different countries. The average score of OECD (Organization for Economic Cooperation and Development) countries is set around 500 points. This score has been used as a benchmark. The countries can make their own conclusions about how effectively they educate their children by observing where they stand in relation to other countries. By regarding at this benchmark, there are countries that are doing better (countries that are above 500), and other countries that are doing worse (below 500).

Illustration 1



However, are these educational differences all bad? According to Human Capital theory, some differences are even desirable since it might be an indicator of the productivity of each individual. For this reason, I consider inequality as a broad concept that may well be decomposed in many ways depending on the chosen decomposition criteria.

According to modern theories of justice, inequality should be decomposed, on the one hand, into morally or socially fair components, and on the other hand, into unfair terms. This differentiation beams the notion that inequalities in the outcomes are not necessarily either all bad or all good. In addition, it claims that justice does not essentially require individual outcomes to be equal; instead, it requires the ***opportunities*** of the individuals to be equal rather than the outcomes themself.

The ***principle of inequality of opportunity*** is understood in this framework. In essence, this principle suggests compensating differences that arise from having *unequal opportunities* rather than eradicating overall outcome inequalities.

The egalitarian philosophers such as Rawls (1971), Dworkin (1981, a, b), Arneson (1989) and Cohen (1989) are (among others) pioneers that initiated the way towards the principle of inequality of opportunity. Likewise, any person that reads about inequality of opportunity will run across the name of John Roemer (1993, 1998, and 2002) for both the contribution he made and the terminology he introduced. Roemer worked on this principle mainly aimed at measuring the inequalities of opportunity in income. Since then, other prestigious authors have continued developing his theory by constructing non-parametric as well as parametric models; see for instance, Checchi and Peragine (2010), Björklund et al. (2011), Fleurbaey (1995).

Moreover, its applications have also been expanded to different study grounds such as health (Fleurbaey and Schokkaert (2009), Rosa Dias (2010), Trannoy et al (2010)) and education (Ferreira and Gignoux (2011)).

Despite the growth of the literature that analyzes this principle, it is still on its infancy. Up to now no agreement has been reached regarding how opportunities should be defined and assessed. Nevertheless, it has been generally agreed that the determinants of inequality should be classified into at least two fundamental categories: On the one hand determinants that belong to *legitimate* or *fair* sources of inequality, and on the other hand, determinants that are *illegitimate* or *unfair* sources. In this context Roemer (1998) introduced the terminology that is now usual in most studies concerning the measurement of opportunities. Roemer referred to determinants in the first category as *effort* and those in the second category as *circumstances*.

The principle of inequality of opportunity suggests that given the students' effort, circumstances should not affect their outcomes. This principle, might be more relevant concept rather than the standard inequality measurement for understanding whether students' performance is worse in more unequal educational systems or societies, and if so, why.

The goal of this paper is to compute the educational inequality of opportunity in 65 countries. In particular, it is aimed at testing whether the degree of Inequality of opportunity in a country has any significant influence in the achievements of the students in that country.

To adapt this theory to the educational field of education, the criteria used to classify the determinants of individuals' outcomes into either "effort" or "circumstances" sources has been the following:

Is the student responsible of that situation that creates inequalities in the achievements?

If the portion of educational differences are caused due to the students responsibility (or irresponsibility), in other words, if the student herself is the responsible of that situation that causes the differences in the outcome, then, that portion of the overall inequality will be "unproblematic", "legitimate" or "fair"; from now on referred as *effort*.

If the student herself is the responsible of the situation that causes the differences in the outcome, then, that part of the overall inequality will be "unproblematic", "legitimate" or "fair". From now on, this part of educational differences due to students' responsibility will be referred as *effort*.

On the contrary, if the student is not responsible for the situation that creates the differences in the outcome, then, these sources are considered as "problematic", "illegitimate" or "unfair". These determinants are better recognized as *circumstances*.

In order to avoid further confusion, it is taken for granted that the inequalities in scores due to differences in effort are unproblematic, since people should be able to control their effort.

Even if these definitions appear to be clear in theory, when working with real data, the researcher has to face the problem of choosing the variables that represent the circumstances. The inequality of opportunity measurement essentially will vary with the chosen set. This is another reason why the measure of the inequality of opportunity is likely to differ among authors depending on their opinion with respect to the choice of circumstances. In the literature of politic philosophy there are different views regarding to what people are responsible for (see Ramos and Van de gaer, 2012). This paper implements the view defended by*, inter alia,* Arneson (1989), Cohen (1989), and Roemer (1993, 1998a) which argues that individuals should hold responsible only for what lies within their control.

In order to have the opportunity to be flexible to future suggestions and able to adapt this paper to different ethical points of view, I have computed the inequality of opportunity by following the model proposed by Fleurbaey and Schokkaert (2009),

Continuing with the empirical application, there is another problem: the scarcity of relevant data. The correct measurement of the inequality of opportunity would be feasible if circumstances and effort were observable, but in practice, this situation is not likely to happen.

According to John Roemer once that circumstances have been defined and controlled, differences that are left in the outcomes should be deliberated consequence of effort. This, however, is a strong assumption since it basically implies that the individuals that have the same circumstances and makes the same effort should obtain equal results. With the aim of providing an alternative to this dichotomic partitioning, A. Lefranc et al. (2009) included an additional *generic* random determinant denoted as *luck*.

Luck is an important factor since it determines most outcomes and some authors are now identifying different types of luck (see A. Lefranc et al., 2009) to determine whether they should be compensated or not. Lefranc et al. decomposed the luck in subgroups such as i) ***social background luck*** that includes alterations caused by differences in their family background: different social connections, different way of educating, etc. ; ii) ***genetic luck*** that encompasses intelligence, ability, and natural skills; iii) **brute luck** involving if the parents of the students get divorced, if the student breaks has a punctual health problem, if there is a problem in the school building or anything that can affect the student in the exam.

Given that our data set does not provide any variable that could be used as a proxy for luck, I compute the inequality of opportunity degree only with accessible circumstances and effort determinants.

All in all, in this study I estimate to which extent differences in the PISA results can be explained by observable variable and more specially, I measure the differences that are attributed to unfair observable sources as a measure of inequality of opportunity. The aim of this process is to answer empirically whether the level of inequality of opportunity in a country has any influence in the average achievement of the tests in that country, i.e. to analyze whether the differences in the circumstances do affect the achievements of the students.

2. THE MODEL

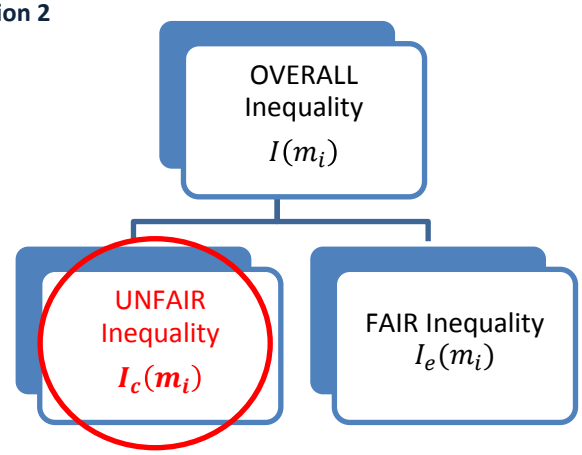
This section is aimed at measuring the inequality of opportunity empirically. For doing so I need to take into account the following limitations in the measuring process:

1) **Data limitations:** In the data set not all the relevant aspects of individual circumstances, effort or luck are considered but a subset has been analyzed and is available.
2) **No universal agreement for measuring the inequality of opportunity:** different, often conflicting, approaches have been proposed (see for instance Peragine (2004)).
3) **No universal criteria to draw the difference between three generic determinants:** Debatable opinions with respect to what belongs to circumstances, effort and luck.

Taking into account these shortcomings, this study is based on the model proposed by Fleurbaey and Schokkaert (2009) that provides the flexibility to accommodate many different ethical views. This theoretic model was proposed for measuring the inequality of opportunity in health and health care. Since the aim of this study is to empirically measure the inequality of opportunity in education, the model needs two main adjustments: First, adapting it from the health field to the education one; second modifications to apply the theoretic model with empirical data.

Basically, this model draws its attention to the **unfair inequality** in students' achievements.

Illustration 2



The measurement process consists of three steps: First of all a structural model is constructed. This model estimates the effect (positive vs negative) and the relative importance of each determinant of inequality in each country separately. Secondly, I select the determinants that explain the differences in the outcome and then, I classify these determinants into either fair sources or unfair sources. Finally, I compute the inequality of opportunity by computing the unfair inequality.

In the following sections these three steps are explained more thoroughly.

2.1 FIRST STEP: CONSTRUCTION OF THE STRUCTURAL MODEL

A model never completely captures the reality and many simplifications are needed so that the model can be applied to real data.

Ideally, I would like to estimate the model that explains the outcome, m_i, by analyzing the relationship between it and the explanatory variables circumstances, c_i, effort, e_i, and luck, l_i:

$$m_i = m(c_i, e_i, l_i) \quad (1)$$

Given the data limitations, I am only able to estimate the following model:

$$m_i = m(c_i, e_i) \text{ (2)}$$

Therefore, in this model the outcome, m_i, is determined by the variables related to circumstances, c_i, and effort, e_i.

Fleurbaey and Schokkaert (2009) suggest that the relationship between the outcome and the explanatory variables should be linear, so that the decomposition of result, m_i, into fair and unfair sources is feasible. Accordingly, the equation (1) would adopt the following form:

$$m_i = \alpha + [\beta_1 c_{1i} + \cdots + \beta_k c_{ki}] + [\gamma_1 e_{1i} + \cdots + \gamma_n e_{ni}] + [\delta_1 l_{1i} + \cdots + \delta_k l_{ki}] + \varepsilon_i \text{ (3)}$$

Nevertheless, taking into account the absence of luck variables, the equation to be estimated would come to be the following:

$$m_i = \alpha + [\boldsymbol{\beta_1 c_{1i}} + \cdots + \boldsymbol{\beta_k c_{ki}}] + [\gamma_1 e_{1i} + \cdots + \gamma_n e_{ni}] + u_i \text{ (4)}$$

Importantly, the relationships between the outcome on the one hand and observable and available variables on the other hand are by nature inexact, consequently, the influences of all other variables that affect m_i are gathered in a catch-all variable u_i, as it can be shown below:

$$u_i = [\delta_1 l_{1i} + \cdots + \delta_k l_{ki}] + \varepsilon_i \text{ (5)}$$

In this case, the disturbance term might capture the influence of:

i) Omitted variables (such as luck variables)
ii) Randomness in the human behavior
iii) Econometric measurement errors

The interpretation of the disturbance term plays an important role in the measurement of inequality, and ignoring it brings significant problems. In this investigation I estimate the parameters so that the unexplained variation is as small as possible. This estimation method is known as Ordinary Least Squares (OLS).

By running the regression we obtain the Sample Regression Lines for every country:

$$m_i = \hat{\alpha} + [\boldsymbol{\widehat{\beta}_1 c_{1i}} + \cdots + \boldsymbol{\widehat{\beta}_k c_{ki}}] + [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}] + \hat{u}_i \text{ (5)}$$

I have to choose the same variables for all the countries since I want to observe up to which extent the selected variables help explaining the variation in the outcomes in each country separately. Specially, I want to observe how strong the relationship between the circumstances and the outcome is.

As I am interested at comparing these results from country to country, computation conditions for all countries need to be the same, that is, I need to choose the same variables, use the same techniques, etc. However, it is logical to think that each variable might not explain the differences in the outcome in the same way for all the countries given the differences, for example, in culture and education system. In other words, a variable that is significant for one country might not be significant for another country. As a consequence, the disturbance term might contain more (or less) information in some countries than in other countries. To avoid further problems, I compute the inequality of opportunity with the fitted values of the outcome rather than the real outcomes. This way I assure that the inequalities levels are based on the outcomes that are explained by the effort and circumstances variables that I chose, and thus, all the inequality of opportunity degrees are computed in the "same conditions" (despite

having different outcomes and estimations). Therefore, the basis equation for inequality measures will be the following:

$$\widehat{m}_i = m_i - \hat{u}_i$$

$$\widehat{m}_i = \hat{\alpha} + \left[\widehat{\boldsymbol{\beta}}_{\mathbf{1}}\boldsymbol{c}_{\mathbf{1}\boldsymbol{i}} + \cdots + \widehat{\boldsymbol{\beta}}_{\boldsymbol{k}}\boldsymbol{c}_{\boldsymbol{ki}}\right] + [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}] \quad (6)$$

With this adjustment, the fairness principle could be applied. This principle requires that all students making the same effort should obtain the same outcomes, whatever their circumstances.

I estimate this equation separately for every selected country, thus, the coefficients also vary from country to country with accordance to their students' circumstances and effort.

2.2. SECOND STEP: SELECTION AND CLASSIFICATION OF THE RELEVANT VARIABLES

Once that the model is determined, the next step is to identify the most significant variables that help to explain the differences in the outcomes of the students in different countries. It is required to find variables that are significant to explain the differences in all the countries, not only for some of them.

The process to select the most appropriate variables consists of, firstly, making a list of possible candidates that are likely to influence the outcome. Then I run an OLS regression with those variables for each country separately. Next I observe which variables are statistically significant in each regression.

I repeat this process including and excluding new variables to check their significance, as well as the R squared (R^2). Since the R squared represents the percentage of the sample variation in the outcome that is explained by selected variables, I should choose the significant variables that provide the highest R^2 possible.

Likewise, variables should satisfy both, statistical and model structural requirements, and again ensure that all requirements are fulfilled for every country. One of the former requirements is that the circumstances and effort variables should not be correlated between them; hence I should choose variables whose correlation is the minimum possible.

All in all, I ought to choose most significant variables, with highest R^2 and lowest correlations between circumstances and effort.

Taking all these conditions into account, I have selected twelve explanatory variables from which five belongs to the circumstances group and the remaining seven to the effort group.

With the aim of understanding better the variables used in this analysis, it is worthwhile first to describe briefly the data set as well as the organization that provides them, PISA.

2.2.1. DESCRIPTION OF PISA

PISA is an acronym that stands for Program for International Student Assessment. It is the brainchild of OECD, Organization for Economic Cooperation and Development. The main objective of PISA is to measure whether youngsters that are about to conclude their compulsory education are well prepared to participate in the society. With this purpose, participating countries administrate two hour test that focuses on core subjects as reading, mathematics and science every three years. Then, the results are analyzed and extrapolated to the international level. The sample that provides PISA is stratified in two steps. In the first step the participant schools are randomly selected. In the second step students are randomly selected in those designated schools.

PISA comprises two strong advantages that I need in this investigation:

1. The results of the tests can be compared within and across countries.
2. BACKGROUND INFORMATION: PISA collects information on students' personal background, their learning habits and attitudes, their involvement and motivation, as well as information about their family and school background.

In essence, PISA makes it possible to find patterns of statistical association between achievement, on the one hand, and family, school, and other educational influences, on the other.

2.2.2. DATA SET

The data set used collects information on 452 001 students from 65 participant countries. We deal with cross-section data since all data used are gathered *in 2009*.

The test generally administers between 4 500 and 10 000 students in each country.

PISA 2009 covers the domains of reading, mathematics and science. Major domain in 2009 is reading literacy, which takes two-thirds of testing time.

2.2.3. VARIABLES

The observation unit in this analysis is the student itself.

DEPENDENT VARIABLE:

Since in 2009 the major domain has been the reading literacy, the dependent variable providing the major precision is the score of the student in the reading test. The PISA student file contains 5 plausible values for reading test scores. Since these values do not show any significant difference between them, for the sake of simplicity, this study uses the variable named "PV1READ" as a dependent variable.

EXPLANATORY VARIABLES:

In general, principal determinants of academic performance are grouped into three extensive categories: i) individual characteristics of the students ii) family background of students and iii) characteristics of schools in which students study as well as characteristics their educational system.

PISA not only provides data on the former three categories, but it also makes available meaningful indices that can be used as proxies or latent concepts that cannot be observed directly.

In this section, first of all I will mention briefly the chosen variables by specifying the category that they have been classified into (circumstances versus effort). Next, I will provide a broader insight about composition of these indices that provides PISA. For further details see OECD (2012).

SELECTED VARIABLES:

On the one hand, I consider variables that might be beyond individuals responsibility or control: 1) gender; 2) whether the student have two parents; 3) native language; 4) school climate and the last and the most important variable, 5) the index of socio-economic and cultural status of the student.

On the other hand, the selected determinants of the inequalities that the student is likely to control are the following: 1) whether the student has ever repeated a course; 2) an index that measures the extent to which the student enjoy reading; 3) three indexes that measure the student's frequency of using the control strategies, elaboration strategies and memorization strategies; 4) the index that evaluates the teacher-student relationship, and 5) the index that measures the reading diversity of each student.

INDICES

The indices are created by combining different questionnaire items and by transforming them by the means of scaling procedures.

There can be distinguished two types of indices: simple indices and scale indices:

A) SIMPLE INDICES:

These indices are dichotomic ones. These are the simple indices used in our study:

CIRCUMSTANCES

1. **Gender:** (1) if the individual is female and (0) otherwise
2. **Language spoken at home:** (1) if language at home is same as the language of assessment for that student, (0) language at home is another language.
3. **Family structure:** (1) if it is a "two parent family" (students living with a father or step farther and a mother or step mother), and (0) otherwise.

EFFORT

4. **Repeater status:** (1) if the student has repeated at least one course and (0) otherwise.

B) SCALE INDICES:

PISA's process of creating the indices has been the following:

i. The item parameters are **estimated** from equal-sized subsamples of students from each OECD country through IRT scaling
ii. The estimates are **computed for all students and all schools** by anchoring the item parameters obtained in the preceding step by using the weighted likelihood estimation (WLE; Warm, 1989).
iii. The indices are then **standardized** so that the mean of the index value for the OECD student population was 0 and the standard deviation was 1 (countries being given equal weight in the standardization process).

CIRCUMSTANCES

5. **ESCS: index of economic, social and cultural status**

Socio-economic status is usually seen as based on education, occupational status and income. Hence, the components comprising *ESCS* for PISA 2009 are:

i. Home possessions (*HOMEPOS*) index that includes another three indices provided by PISA:
   a. *WEALTH* index*:* a room of your own, a link to the internet, a dishwasher, a DVD player, three country specific wealth items, and the amount of cellular phones, televisions, cars and rooms with a bath or a shower.
   b. Cultural possession (*CULTPOS)* index: Classical Literature, Books of poetry and Works of art
   c. *Home educational Resources (HEDRES) index:* desk to study, quiet place to study, a computer for school work, educational software, books to help with your school work, technical reference books, and a dictionary
   d. Number of books at the home.
ii. The highest parental occupation (*HISEI*);
iii. The highest parental education expressed as years of schooling (*PARED*).

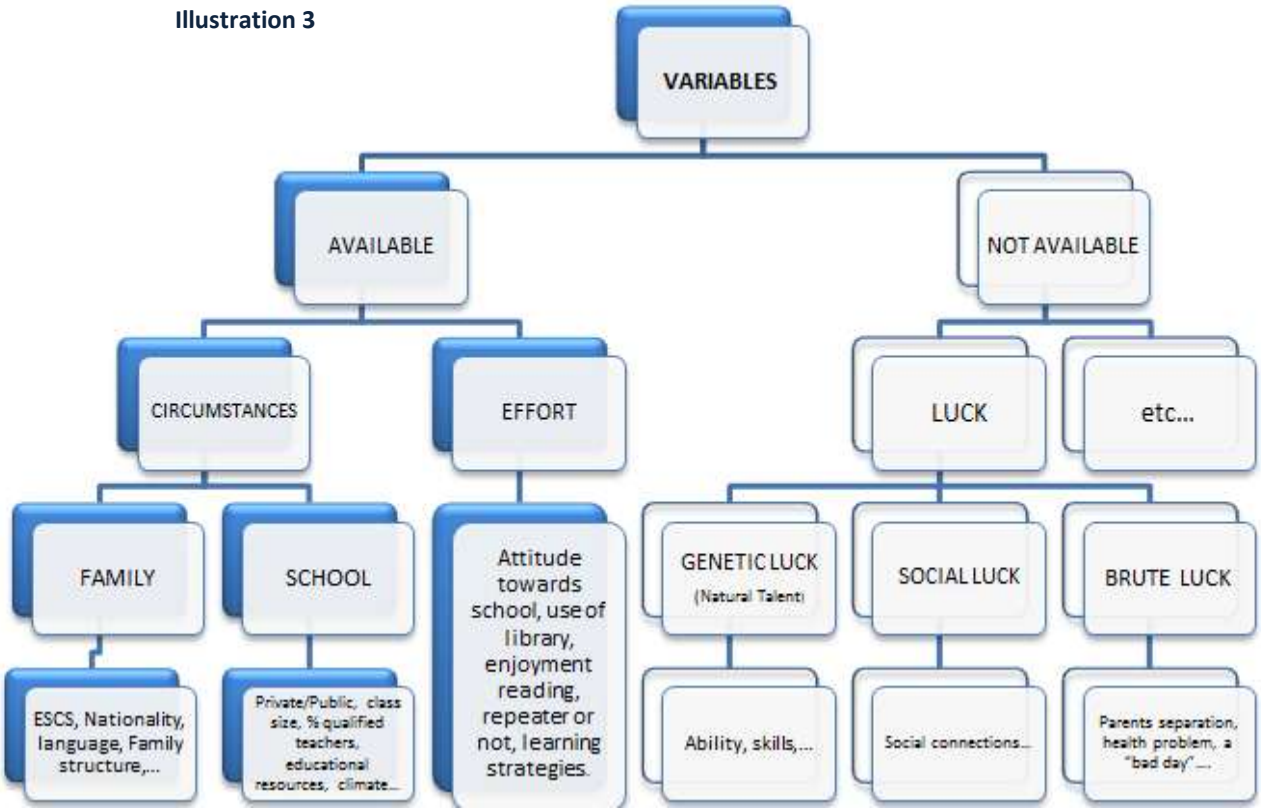
As no direct income measure is available from the PISA data, the existence of household items is used as proxy for family wealth.

6. **Classroom environment:** There are five items in this scale. There are four response categories varying from "strongly disagree", "disagree", "agree" to "strongly agree". Higher WLE's on this scale indicate a better disciplinary climate and lower WLE's a poorer disciplinary climate.

EFFORT

7. **Enjoyment of reading and frequency of reading:** Eleven items were used to measure enjoyment of reading in PISA 2009. There are four response categories varying from "strongly disagree", "disagree", "agree" to "strongly agree". All items which are negatively phrased were reverse scored for IRT scaling such that positive WLE scores on this index form PISA 2009 indicate higher levels of enjoyment of reading.
8. **Diversity in reading:** The framework questionnaire includes five items measuring the construct of diversity in reading. There are five response categories varying from "never or almost never", "a few times a year", "about once a month", "several times a month" to "several times a week". Positive WLE scores on this index indicate higher diversity in reading.
9. **Learning strategies**: The approaches to learning scale consist of three subscales: memorization, elaboration and control strategies. Students' background questionnaire includes thirteen items that are used to construct indices measuring the effectiveness of learning strategies, from which four are items for memorization strategies, other four for elaboration strategies and five items for control strategies. There are four response categories varying from "almost never", "sometimes", "often" to "almost always". Positive WLE scores on a given learning strategy index indicate greater use of that learning strategy. The internal consistency for these scales is generally high in most OECD countries, with *MEMOR* having slightly lower reliabilities across countries than the other two learning strategies.
10. **Teacher-Student relationship:** Five items on teacher student relations were included in the student questionnaire. This scale provides information on students' perception on teachers' interest in their performance. There are four response categories varying from "strongly disagree", "disagree", "agree" to "strongly agree". Positive WLE scores on this PISA 2009 index indicate positive student teacher relations.

Illustration 3



2.3. THIRD STEP: THE MEASUREMENT OF UNFAIR INEQUALITIES.

The last step is focused at connecting previous two steps with the measure of inequality. I am aimed at both measuring the inequality of opportunity as well as comparing this measure across countries. With this purpose, first, I need to compute the inequality of opportunity degree of each country and then compute a standardized measure of each inequality of opportunity degree so that they are comparable.

Our inequality of opportunity degree is given by the unfair inequality measure. According to Fleurbaey and Schokkaert, a correct measure of unfair inequality should satisfy two conditions:

Condition 1: No influence of legitimate differences:

A measure of unfair inequality should not reflect differences caused by fair sources in outcomes, i.e. inequalities which are caused by differences in the effort variables.

Condition 2: Compensation

If a measure of unfair inequality is zero, then there should not be any difference caused by having different circumstances, and all the differences in the outcomes would be only due to differences in the effort level. This means that two students making the same effort (same values in the effort variables) should obtain the same score in the exam.

Taking into account these two conditions, they propose two methods to measure unfair inequality.

2.3.1. FIRST METHOD: DIRECT UNFAIRNESS

This approach is focused on satisfying the first condition. Basically, this method removes the fair differences by fixing a reference value for effort variables. The corrected value of the scores would be:

$$\widetilde{\boldsymbol{m}}_{\boldsymbol{i}} = \boldsymbol{m}(\boldsymbol{c}_{\boldsymbol{i}}, \tilde{\boldsymbol{e}}_{\boldsymbol{i}})\ (\mathbf{7}) \qquad \textbf{or} \qquad \widehat{\widetilde{\boldsymbol{m}}_{\boldsymbol{i}}} = \widehat{\boldsymbol{\alpha}} + \left[\widehat{\boldsymbol{\beta}}_{\mathbf{1}}\boldsymbol{c}_{\mathbf{1}\boldsymbol{i}} + \cdots + \widehat{\boldsymbol{\beta}}_{\boldsymbol{k}}\boldsymbol{c}_{\boldsymbol{k}\boldsymbol{i}}\right] + [\widehat{\boldsymbol{\gamma}}_{\mathbf{1}}\tilde{\boldsymbol{e}}_{\mathbf{1}} + \cdots + \widehat{\boldsymbol{\gamma}}_{\boldsymbol{n}}\tilde{\boldsymbol{e}}_{\boldsymbol{n}}](\mathbf{8})$$

This method guarantees that differences in marks are only because the students own different circumstances. In other words, it would provide us the outcome of the student i with circumstances c_i making the reference effort $\tilde{\boldsymbol{e}}_{\boldsymbol{i}}$.In this method the only reasons to obtain different scores are unfair.

Next step is to apply absolute inequality measurement to the vector $\widehat{\widetilde{m}_i}$. This way we compute the fraction of unfair inequality or the inequality of opportunity.

$$I_C(\widehat{m}_i) = I(\widehat{\widetilde{m}_i})(9)$$

2.3.2. SECOND METHOD: FAIRNESS GAP

This method satisfies the Condition 2.

The procedure is the following: first the "ideal" situation is defined, i.e. all the differences caused by circumstances are removed by means of a reference value for circumstances.

$$\widehat{\boldsymbol{m}}_{\boldsymbol{i}}^{*} = m(\boldsymbol{c}_{\boldsymbol{i}}^{*}, e_i)\ (10) \qquad \text{or} \qquad \widehat{\boldsymbol{m}}_{\boldsymbol{i}}^{*} = \hat{\alpha} + \left[\hat{\beta}_1 c_1^{*} + \cdots + \hat{\beta}_k c_k^{*}\right] + [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}]\ (11)$$

This technique implies that if the effort made by two individuals is equal, they should obtain the same results in the questionnaires. By fixing a reference value in each of the circumstances variables it is guaranteed that there are no differences in the outcomes due to circumstances and there should not be any illegitimate differences left. If two students that make the different effort and obtain different results, it would be purely because the effort they make is different.

Once defining the desired situation for each student, I compute the fairness gap by subtracting the outcome obtained in the ideal situation to the outcome obtained actual situation:

$$(\widehat{m}_i - \widehat{m}_i^*) = \hat{\alpha} + [\hat{\beta}_1 c_{1i} + \cdots + \hat{\beta}_k c_{ki}] + [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}] - \hat{\alpha} - [\hat{\beta}_1 c_1^* + \cdots + \hat{\beta}_k c_k^*] - [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}] =$$

$$(\widehat{m}_i - \widehat{m}_i^*) = [\hat{\beta}_1 c_{1i} + \cdots + \hat{\beta}_k c_{ki}] - [\hat{\beta}_1 c_1^* + \cdots + \hat{\beta}_k c_k^*] (13)$$

The next step is to apply the inequality measurement to this last vector $(\widehat{m}_i - \widehat{m}_i^*)$:

$$I_c(\widehat{m}_i) = I(\widehat{m}_i - \widehat{m}_i^*) \ (14)$$

2.3.3. THE PROBLEM:

An appropriate measure of unfair inequality should satisfy both conditions. The problem is that first method does not necessarily satisfy the second condition, and the second method might not satisfy the second condition. If either of these two conditions is not fulfilled, then, two approaches are likely to yield different results.

2.3.4. SOLUTION:

There is one particular case in which both methods coincide and it happens when the following TWO conditions are satisfied:

1) When the equation $m_i = m(c_i, e_i)$ is ADDITIVELY SEPARABLE:

$$m_i = f(c_i) + g(e_i) (15)$$

$$\widehat{m}_i = \hat{\alpha} + [\widehat{\boldsymbol{\beta}}_{\boldsymbol{1}} \boldsymbol{c}_{\boldsymbol{1i}} + \cdots + \widehat{\boldsymbol{\beta}}_{\boldsymbol{k}} \boldsymbol{c}_{\boldsymbol{ki}}] + [\hat{\gamma}_1 e_{1i} + \cdots + \hat{\gamma}_n e_{ni}] (16)$$

This implies that effect of Effort and effect of Circumstances are independent from each other. This is the reason why I choose the variables whose correlation between circumstances and effort is the minimum.

2) When absolute measures are used. Absolute measures have the property that for any distribution (scores distribution in our case), if any number (a constant) is added to or subtracted from the scores of students, **the inequality remains unchanged**.

$$I^n_{Absolute}(x_i) = I^n_{Absolute}(x_i + k^n) \ (17)$$

Since in both, in direct unfairness and in the fairness gap, a constant is added and subtracted (or a reference value) to the unfair inequality, then this inequality remains unchanged. This is shown in the table below:

TABLE 1-Unfair inequality measurement

unfair inequality measure $I_c(m_i)$	
DIRECT UNFAIRNESS	FAIRNESS GAP
$\mathrm{I}(\widehat{\widetilde{m}_\iota}) = \mathrm{I}\left(\underbrace{f(c_i)}_{x_i} + \underbrace{g(\tilde{e}_i)}_{k}\right) \Rightarrow$	$I(\widehat{m}_i - \widehat{m}_i^*) = I\left(\underbrace{f(c_i)}_{x_i} - \underbrace{f(c_i^*)}_{k}\right) \Rightarrow$
$\mathrm{I}(\widehat{\widetilde{m}_\iota}) = \mathbf{I}(\boldsymbol{f}(\boldsymbol{c_i}))$	$I(\widehat{m}_i - \widehat{m}_i^*) = \boldsymbol{I}(\boldsymbol{f}(\boldsymbol{c_i}))$
$I_c(\widehat{m}_i) = \mathrm{I}(\widehat{\widetilde{m}_\iota}) = I(\widehat{m}_i - \widehat{m}_i^*) = \mathbf{I}(\boldsymbol{f}(\boldsymbol{c_i})) = I(\beta_1 c_{1i} + \cdots + \beta_k c_{ki})$	

This way the result obtained in the direct unfairness and in fairness gap should be the same, and the unfair inequality measure is obtained.

2.3.5. INEQUALITY MEASUREMENT:

Indices of inequality are employed for evaluating a particular outcome distribution and for comparing different distributions (Chakravarty (1999)). The goal of this research is to compute and compare unfair inequalities or inequalities of opportunity between 65 countries and to make association between those inequality measures with the explained average scores. This way we could observe the effect of unfair inequality in the performance of the students.

In order to do so, the researcher should choose the most appropriate inequality index since different inequality indexes are likely to provide different answers. Given the previous condition, the measure needs to be absolute. In this research project the measure is the variance.

The inequality of opportunity level, therefore, would be computed by applying the variance to the vector $\widehat{\widetilde{m}_\iota}$

$$I_C(\widehat{m}_i) = I(\widehat{\widetilde{m}_\iota}) = var(\widehat{\widetilde{m}_\iota}) \quad (18)$$

However this value is difficult to compare across countries since the results runs from 269 up to 2752. To compare the inequality of opportunity measures for every country, I compute the percentage of the unfair inequality measure over the overall inequalities that are explained by our variables. This process is shown below:

1) **OVERALL INEQUALITY**:

$$I(\widehat{m}_i) = Var(\widehat{m}_i) = \frac{1}{n}\sum_{i=1}^{n}\left(\widehat{m}_i - \overline{\widehat{m}}\right)^2 \quad (19)$$

2) **UNFAIR INEQUALITY or Inequality of opportunity**

$$I(\widehat{\widetilde{m}_\iota}) = Var(\widehat{\widetilde{m}_\iota}) = \frac{1}{n}\sum_{i=1}^{n}\left(\widehat{\widetilde{m}_\iota} - \overline{\widehat{\widetilde{m}_\iota}}\right)^2 \quad (20)$$

3) **Comparable INEQUALITY OF OPPORTUNITY**

$$I_c(\widehat{m}_i) = \frac{I(\widehat{\widetilde{m}_\iota})}{I(\widehat{m}_i)} \quad (21)$$

3. ESTIMATIONS

3.1. INFLUENCE OF CHOSEN VARIABLES IN THE STUDENTS' ACHIEVEMENTS

After running the regressions for our 65 countries (see APPENDIX…), it can be observed that not all the variables are significant for all those countries. Table 1, in APPENDIX A, shows which variables are not significant for which country.

According to the sings of each variable, the estimations show that they coincide across most countries. The signs of circumstances variables are summarized in the table below:

TABLE 2- Sign of circumstances variables

CIRCUMSTANCES VARIABLES	FEMALE	NUCLEAR FAMILY	NATIONAL LANGUAGE	ESCS	SCHOOL CLIMATE
INFLUENCE	+	+	+	+	+

In general, being a female; living with two parents; making the test in the mother language; having a higher socio-economic and cultural status; and a more appropriate school climate affect positively in the students' achievements.

According to effort variables, the signs vary between positive and negative signs. The table below summarizes the signs obtained in most countries:

TABLE 2- Sign of effort variables

EFFORT	REPEATER	ENJOY READING	LEARING STRATEGIES			TEACHER-STUDENT RELATIONSHIP	READING DIVERSITY
			CONTROL	ELABORATION	MEMORIZATION		
INFLUENCE	-	+	+	-	-	+/-	Mostly +

In relation to the estimations, being a repeater has a negative effect in the achievements in all the countries. Degree of reading enjoyment, on the contrary, has a positive influence. Learning strategies are divided into three different techniques: using control strategies have a favorable influence while using elaboration and memorization techniques have unfavorable influence. According to teacher-student relationship, it is not clear the effect it has in the outcome and neither it is in the case of reading diversity. This uncertainty about the sign might reflect that the error term is likely to be correlated with these variables. Correlation between the error term and the explanatory variables leads to endogeneity problem.

These mistrustful signs might lead us to conclude that the regressions I carried out suffer the endogeneity problem, especially in effort variables.

Ideal solution would be to carry out the tests such as Hausman test with every suspected endogenous variable. The former test helps checking whether that variable is correlated with the error term in every single country as well as to find a proper instrument to instrument those endogenous variables, and conduct an IV regression.

Taking into account that every country faces different conditions (cultural, political, familiar, educational, etc.), the suspected endogenous variables are likely to vary. Subsequently, the instruments are likely to vary. This means that what is endogenous in one country might not be endogenous in another and similarly with the appropriate instruments.

3.2. R SQUARE

Given the differences between countries, every country has a different R^2. Our independent variables explain the dependent variable better in some countries than in other countries.

Like in many cross-sectional analyses in the social sciences, R-squared in our regression equations are relatively low. These values vary from 15% (in Azerbaijan) up to 51% (in France). This means that from 85% up to 49% of achievement variations for these students is left unexplained.

This lack of explanatory power, however, was expected for there are many other determinants that influence the outcomes, such as luck, that are not included in the regression. All these factors that are not included are now part of the error term (which is left out in IOp computation).

In the table below the R^2 has been divided into five categories and I classified the countries into the category they belong to:

TABLE 4- categories of R^2 and the countries that belongs to

< 30%	30% – 34%		35 % - 39%		40% – 44%		> 45 %
NON OECD	NON OECD	OECD	NON OECD	OECD	NON OECD	OECD	OECD
Azerbaijan	Albania	Greece	Argentina	Austria	Bulgaria	Australia	Belgium
Kazakhstan	Croatia	Israel	Brazil	Canada	UAE	Finland	France
Indonesia	Hong Kong-China	Japan	Latvia	Chile	Peru	Germany	Hungary
Kyrgyzstan	Jordan	Korea	Macao- china	Czech republic	Uruguay	Luxembourg	Portugal
Serbia	Liechtenstein		Panama	Denmark		Netherlands	
Colombia	Mexico		Singapore	Estonia		New Zeeland	
	Montenegro		Taipei-China	Iceland		Switzerland	
	Qatar		Trinidad &Tobago	Ireland		Spain	
	Romania		Tunisia	Italy		Turkey	
	Russian federation			Lithuania		United states	
	Shanghai-china			Norway			
	Thailand			Poland			
				Slovak republic			
				Slovenia			
				Sweden			
				United Kingdom			

NON-OECD > OECD

OECD > NON-OECD

Looking at this table it can be observed that among the categories with lowest R^2, most countries are Non-OECD countries rather than OECD countries. On the contrary, in the intervals with highest R^2 there are more OECD countries. This means that the chosen explanatory variables explain better the differences in the outcome for OECD countries than for NON-OECD countries.

The R^2 coefficients of each country are shown in the APPENDIX B.

3.3. CORRELATIONS BETWEEN VARIABLES

Pairwise correlation between effort variables (between themselves) as well as between circumstances (between them) are not very problematic in this study since the estimates remain BLUE (Best Linear Unbiased Estimator). This study is mainly interested in coefficients, rather than in inferences themselves. However it is a necessary condition that the correlation between circumstances and effort to be minimum possible. By checking obtained the correlation coefficient between effort and circumstances, I observed that the variables that are highest correlated are “female” and “Enjoy Reading”. The highest coefficients are around 0.45 (Lithuania, Latvia, Finland, Estonia and Albania). I conducted our measures with both variables since this coefficient is not relatively very high, and also because both variables are statistically significant in all the countries in order to explain the variation in the outcome, and omitting them would generate graver problems.

It should bear in mind that these correlation coefficients do not tell much in dichotomic variables. For this type of variables more complex techniques are required. However, the indices provided by PISA present an advantage to be used as explanatory variables. They combine many variables in one single indicator. Consequently they take continuous values. So they are variables with not dichotomic, but continuous values

3.4. FURTHER REMARKS

A) In order to correct the standard deviation of the coefficients, the data is clustered on the basis of schools.
B) To correct any possible heterokedasticity problems I used the “robust” command in Stata.
C) Weights: Since the available data deals with averages, I have used a special command in Stata regressions that deals with analytic weights: “aweight”. This command is typically used to adjust these data containing averages.

4. MAIN FINDINGS

4.1. INEQUALITY OF OPPORTUNITY MEASURES

After carrying out the three steps of the measurement process, I obtained the Inequality of opportunity (IOp) measures for 65 countries. The table below shows the average score, number of observations, the R squared and the IOp degree (percentage of unfair inequality form overall inequality) of each country.

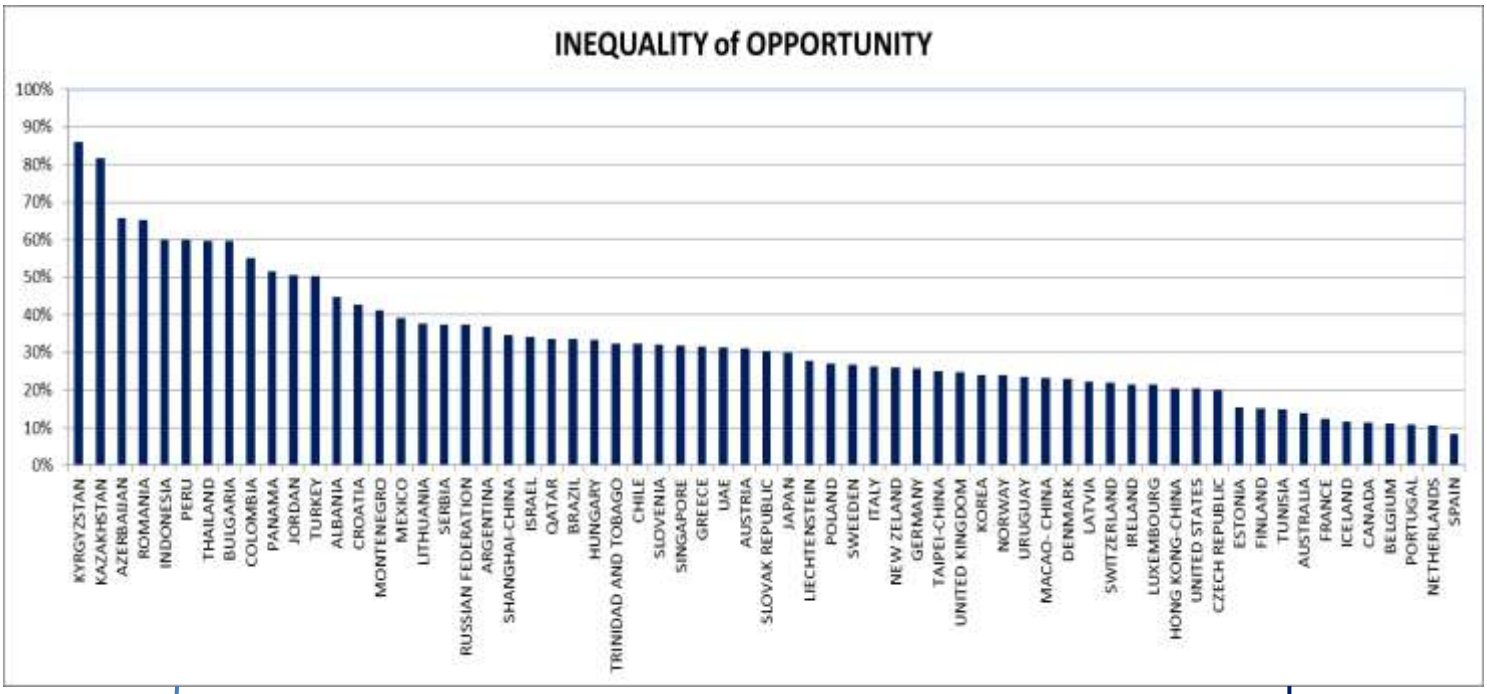
TABLE 5- The results by country

COUNTRY	AVERAGE SCORE	Nº Observations	R square	Iop
ALBANIA	385	4343	0.3089	45%
ARGENTINA	398	4422	0.3948	37%
AUSTRALIA	515	13415	0.4193	14%
AUSTRIA	470	6046	0.375	31%
AZERBAIJAN	361	3967	0.1582	66%
BELGIUM	506	7809	0.4914	11%
BRAZIL	412	18637	0.3541	34%
BULGARIA	429	4109	0.4004	59%
CANADA	524	21918	0.3652	11%
CHILE	450	5482	0.3777	32%
COLOMBIA	413	7552	0.2946	55%
CROATIA	476	4878	0.3179	42%
CZECH REPUBLIC	478	5669	0.3914	20%
DENMARK	495	5472	0.3911	23%
ESTONIA	500	4638	0.3569	15%
FINLAND	536	5516	0.4064	15%
FRANCE	495	4108	0.5136	12%
GERMANY	497	4286	0.4058	26%
GREECE	482	4871	0.3444	32%
HONG KONG CHINA	533	4733	0.3143	21%
HUNGARY	494	4499	0.474	34%
ICELAND	501	3480	0.3508	12%
INDONESIA	402	4971	0.2657	60%
IRELAND	496	3712	0.3933	22%
ISRAEL	475	5270	0.3328	34%
ITALY	486	30239	0.378	26%
JAPAN	520	5834	0.3293	30%
JORDAN	405	6150	0.3114	51%
KAZAKHSTAN	391	5299	0.2505	82%
KOREA	539	4878	0.3337	24%
KYRGYZSTAN	314	4486	0.2681	86%
LATVIA	484	4391	0.3594	22%
LIECHTENSTEIN	498	317	0.3273	28%
LITHUANIA	468	4368	0.3944	38%
LUXEMBOURG	471	4259	0.4469	21%
MACAO- CHINA	486	5830	0.3523	23%
MEXICO	425	36975	0.3486	39%
MONTENEGRO	407	4624	0.3132	41%
NETHERLANDS	508	4465	0.4182	11%
NEW ZEELAND	521	4417	0.4253	26%
NORWAY	503	4490	0.359	24%
PANAMA	371	3507	0.3686	52%
PERU	370	5592	0.412	60%
POLAND	500	4748	0.3918	27%
PORTUGAL	489	6105	0.4913	11%
QATAR	372	8314	0.3153	34%
ROMANIA	424	4635	0.3034	65%
RUSSIAN FEDERATION	459	5135	0.3123	37%
SERBIA	442	5317	0.2727	38%
SHANGHAI-CHINA	556	5052	0.3193	35%

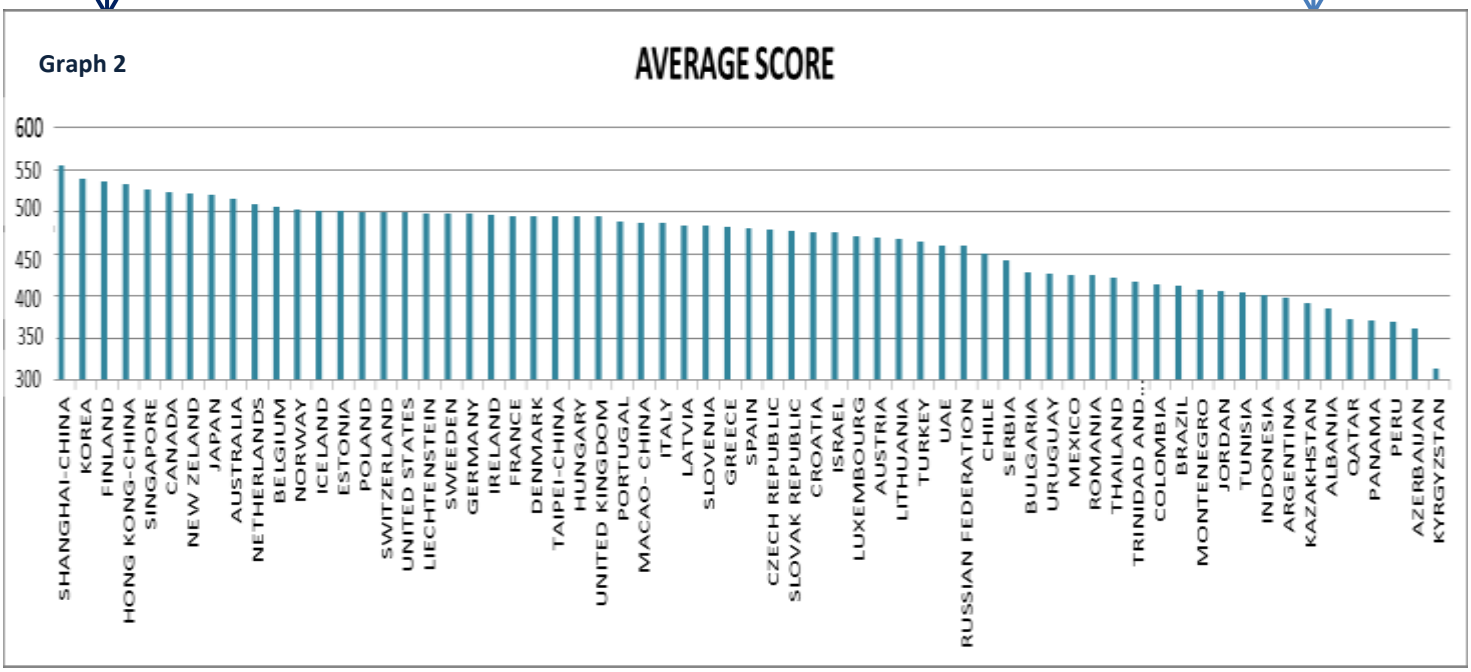
SINGAPORE	526	5207	0.371	32%
SLOVAK REPUBLIC	477	4403	0.3848	30%
SLOVENIA	483	5667	0.3948	32%
SPAIN	481	24837	0.4347	8%
SWEEDEN	498	4237	0.3774	27%
SWITZERLAND	500	11384	0.4312	22%
TAIPEI-CHINA	495	5692	0.352	25%
THAILAND	422	5957	0.3176	60%
TRINIDAD &TOBAGO	4268	4268	0.3699	32%
TUNISIA	4825	4825	0.3743	153%
TURKEY	4860	4860	0.4014	50%
UAE	5376	5376	0.4054	31%
UNITED KINGDOM	11566	11566	0.3771	25%
UNITED STATES	4981	4981	0.4305	20%
URUGUAY	5511	5511	0.4277	24%

With the intention of perceiving these results in a clearer way, I ranked the students' achievements and the inequality of opportunity degree from the highest to the lowest, and then, plotted them separately.

Graph 1



Graph 2

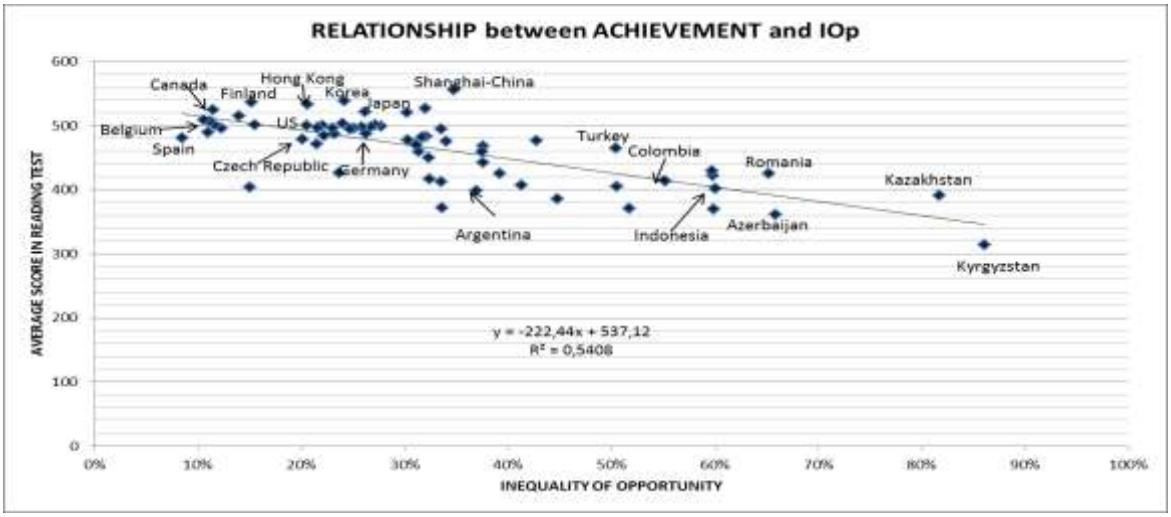


By looking at these two graphs, it can be noticed that, on the one hand, most of the countries that are at the top in the first graph, with highest IOp degree are likely to coincide with most countries that are at the bottom in the second graph, with the lowest average scores. On the other hand, most countries with lowest IOp degree are at the top of the second graph with the highest average score.

This fact might be a signal that a relationship between Inequality of opportunity and students performance exists.

The graph below shows the association between the Inequality of opportunity degree (horizontal axis) and average score (vertical axis) of each country (blue dots)

GRAPH 3- Relationship between Inequality of Opportunity degree and Average scores

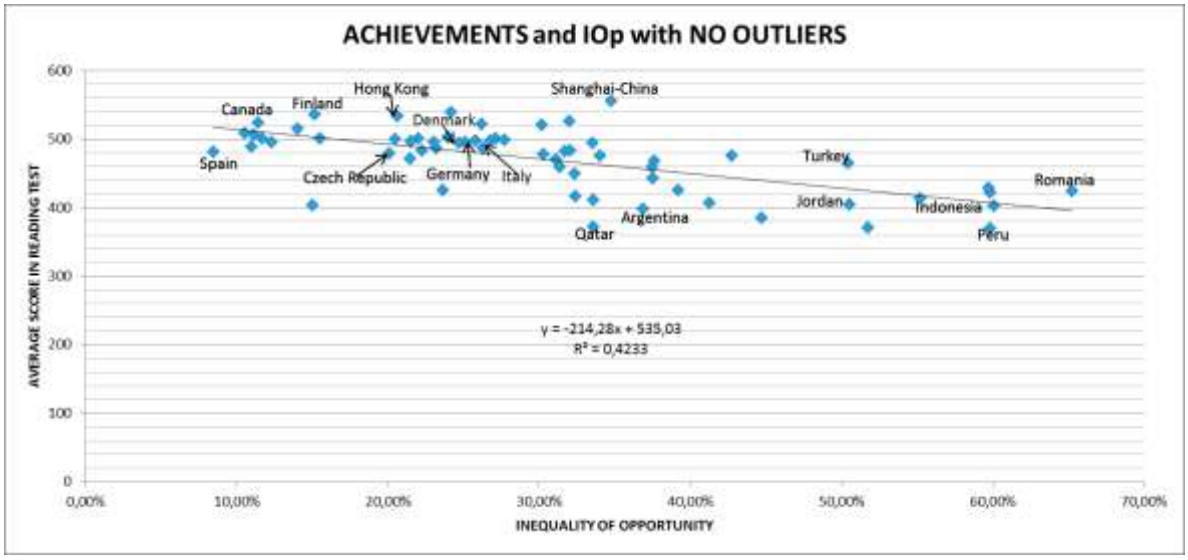


The regression line in the graph 3 shows that this relationship is negative meaning that while the inequality of opportunity degree of a country increases, the average score of that country is likely to decrease.

The analitical calculaton of the correlation between these two magnitudes takes the value of -0.6917. This coefficient confirms that the Inequality of Opportunity degree and the average achievements of a country are negatively correlated.

In graph 3, however, there are two clear outliers: Kyrgyzstan (86% , 314) and Kazakhstan (82% , 391). In order to confirm whether this negative relationship remains without these two countries, I draw the second graph without these outliers.

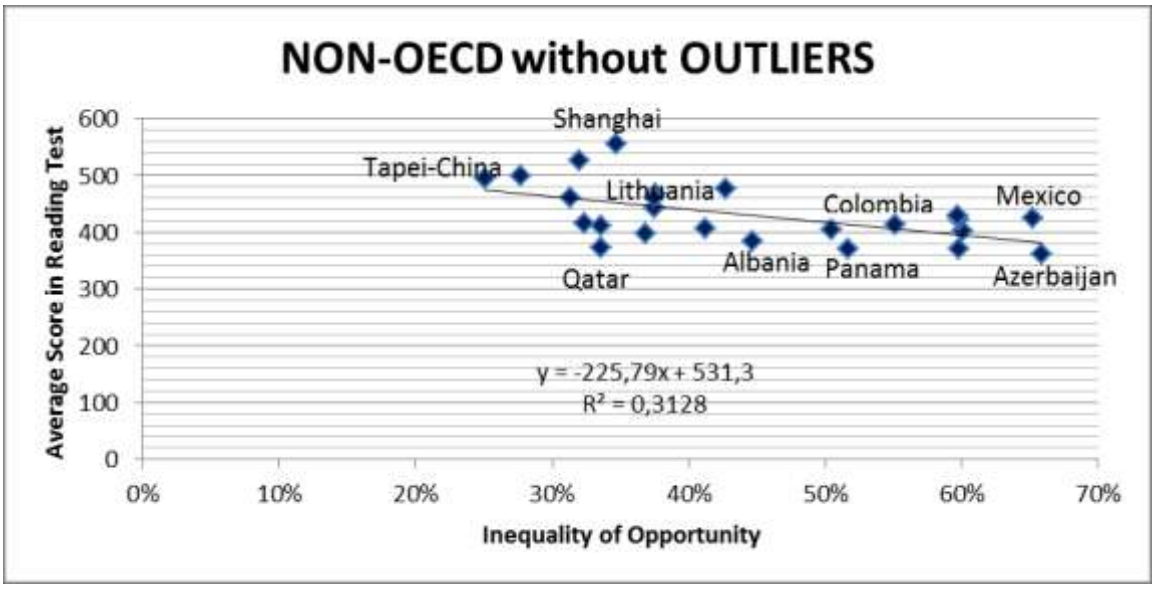
GRAPH 4- Relationship between Inequality of Opportunity degree and Average scores WITHOUT OUTLIERS



The graph 4 shows that despite leaving out the outliers, the negative relationship between the IOp and average scores remains.

The graph 5 analyzes whether this association remains only among NON-OECD countries:

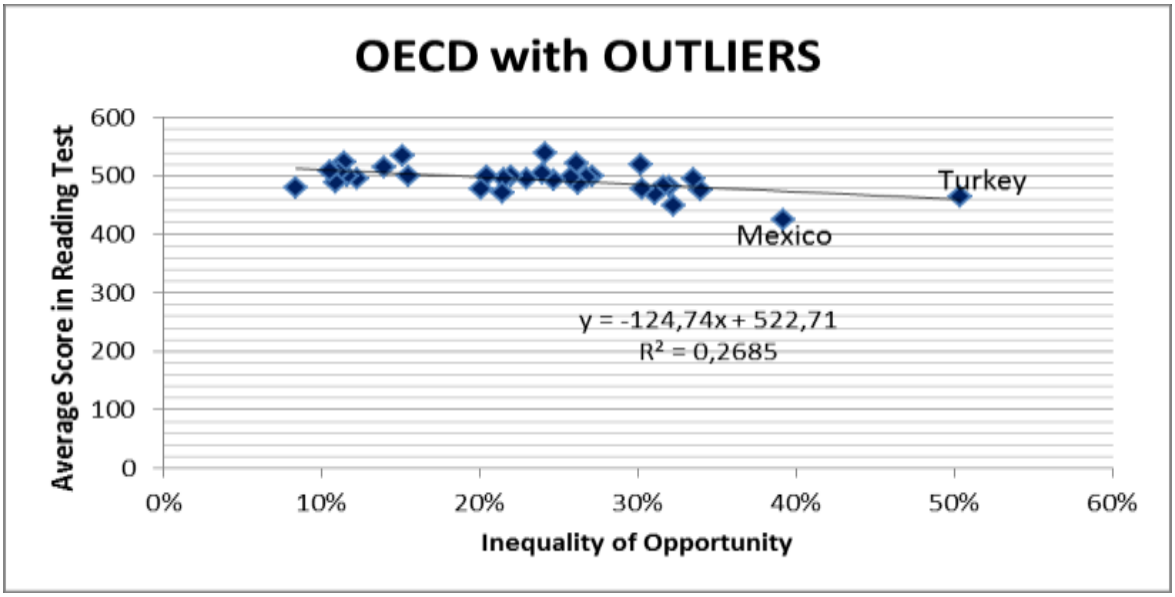
GRAPH 5- Relationship between IOp and Average scores without outliers ONLY AMONG NON OECD countries



Graph 5 shows that unfair inequalities degree might affect the average scores among the NON-OECD countries. This correlation, however, is not as strong as in the previous graphs in which all countries are taken into account.

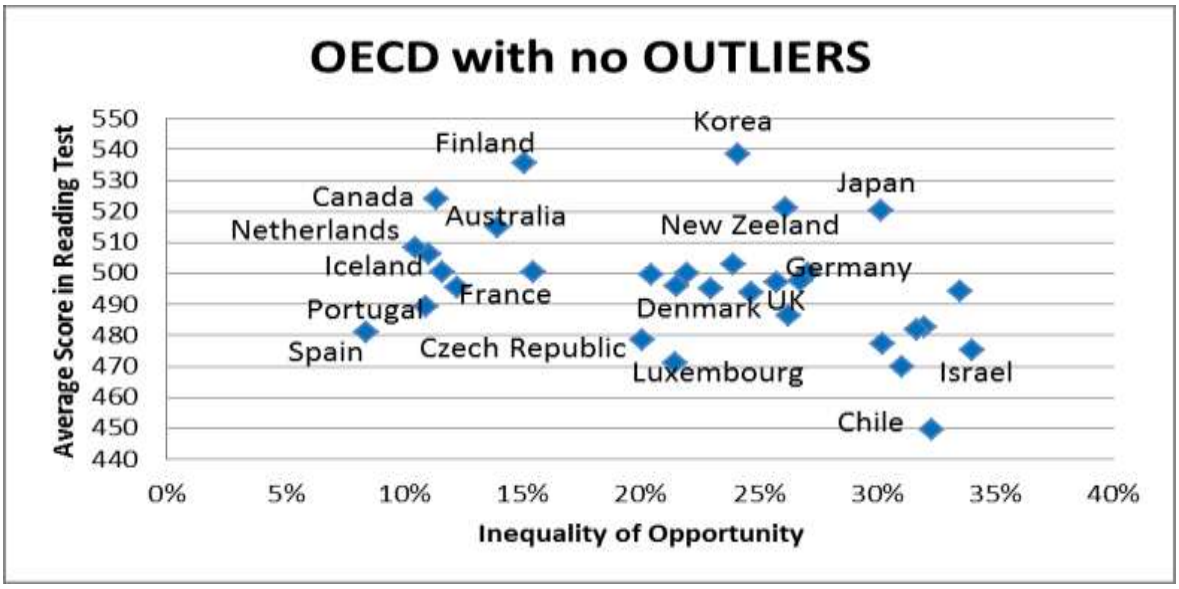
Following the same process, graph 6 shows this association only for OECD countries.

GRAPH 6- Relationship between IOp and Average scores ONLY AMONG OECD countries



Graph 6 shows that even if the link between the IOp and the average scores is still negative, it is not as robust as either with all the countries or NON-OECD countries. In addition, in this graph there are two clear outliers (Mexico and Turkey). The next plot leaves them out in order to see the relationship without distorsions.

GRAPH 7- Relationship between IOp and Average scores ONLY AMONG OECD countries WITH NO



With this last graph it can be concluded that there is no clear connection between the inequality of opportunity degree and the average scores among OECD countries.

To conclude with this section, the table 6 shows the inequality of opportunity measures divided into seven intervals, in which the countries are sorted into the intervals that they belong to. This table also shows the average score of the countries in each interval.

Table6- IOp and Average scores by countries

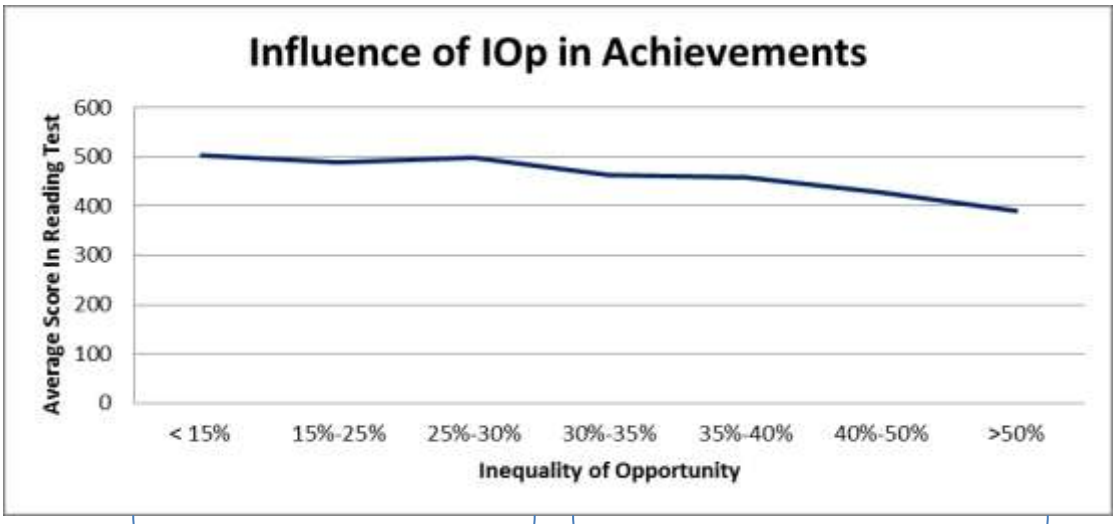
	15%	15%-25%	25%-30%	30%-35%	35%-40%	40%-50%	>50%
AVERAGE SCORE	502	490	499	464	458	427	391
COUNTRIES	CANADA AUSTRALIA NETHERLANDS BELGIUM ICELAND FRANCE PORTUGAL SPAIN	KOREA FINLAND HONG KONG NORWAY ESTONIA SWITZERLAND US IRELAND DENMARK MACAO- CHINA LATVIA CZECH REPUBLIC LUXEMBOURG URUGUAY TUNISIA	NEW ZELAND POLAND LIECHTENSTEIN SWEEDEN GERMANY TAIPEI-CHINA UK ITALY	SINGAPORE JAPAN HUNGARY SLOVENIA GREECE SLOVAK REPUBLIC ISRAEL AUSTRIA UAE CHILE TRINIDAD &TOBAGO BRAZIL QATAR	SHANGHAI LITHUANIA RUSSIA SERBIA MEXICO ARGENTINA	CROATIA TURKEY MONTENEGRO JORDAN ALBANIA	BULGARIA ROMANIA THAILAND COLOMBIA JORDAN INDONESIA KAZAKHSTAN PANAMA PERU AZERBAIJAN KYRGYZSTAN

Western Europe + North America + Oceania

Eastern Europe + South America + Asia

In table 6, most countries that belong to the first three intervals (lowest IOp) are countries from Western Europe, North America and Oceania. On the contrary, most countries that belong to the four intervals with highest IOp are countries from Eastern Europe, South America and Asia.

Graph 8- IOp and Average scores by countries



Western Europe + North America + Oceania

Eastern Europe + South America + Asia

Graph 8 shows that Western European, North American and Oceanian countries are the ones with lowest IOp and highest scores, while countries from Eastern Europe South America and Asia are the ones with highest IOp and lowest Average score.

5. FURTHER RESEARCH

A number of issues remain opened in this study. Firstly, it could be possible to complete the statistical procedure. Since the estimations for 65 countries are considered separately, the Inequality of opportunity levels are computed with OLS estimates for the chosen variables. Hence, it may be possible that these estimates are biased. It would be interesting to check the endogeneity problem in more detail or to think about more appropriate variables.

Secondly, it could be possible to use the inequality of opportunity levels as indicators to make inferences about different educational, sociologic, health and politic issues. Indeed, the obtained indicators of inequality of opportunity open the way to many possible analyses. One could think about possible magnitudes that affect the educational achievements and the education system as a whole and make inferences between them. The researcher could use available indicators such as GPD, the portion the government spends in education, HIV/AIDS and other mortal diseases level of a country, percentage spent in innovation and development, environmental indicators (pollution level…), demographic indicators and any other indicator that may be related with education.

Finally, it could also be of interest to compute the inequality of opportunity from previous PISA waves and to analyze the evolution in the inequality of opportunity level as well as in average outcomes throughout the time.

6. CONCLUSIONS

This research project has investigated whether the inequality of opportunity degree of a country does, in some way, affect the average achievement of the students in that country.

Following the modern theories of justice, in this study, inequality has been decomposed into circumstances, effort and luck. However, given the lack of variables to represent the luck, I only explained the differences by means of effort (fair) and circumstances (unfair) determinants. The goal was to test whether having unequal circumstances or opportunities do affect in the students' achievements and if so, how. With that purpose, I measured the educational inequality of opportunity grade in countries participating in PISA assessments, and then, I analyzed the relationship between the achievements and the indicators of inequality of opportunity.

The process of inequality of opportunity measurement has followed three basic steps: First of all, I determine the structural model that is later used to estimate the coefficients of circumstances and effort variables. The chosen structural model has been mainly based on the theoretic model of Fleurbaey and Schokkaert (2009). Secondly, I have selected 12 relevant variables that help explaining the variance in the students' achievements. These variables have been chosen so that they are relevant for 65 participating countries and explain as much as possible of the differences. Also, I have chosen variables so that correlation between effort and circumstances variables was the minimum possible. To conclude I measured the inequality of opportunity grade of 65 countries. Fleurbaey and Schokkaert suggest two methods: direct unfairness and fairness gap. Both methods should give the same results when the circumstances and effort variables are independent from each other and when we deal with absolute measures. Since this study relatively satisfies those both conditions, I computed the inequality of opportunity with the direct unfairness. Then, the inequality has been computed with the variance, and with the last adjustment, I assured that the measures are comparable across countries.

The selected circumstances and effort variables explain better the differences in the achievements in OECD countries than in NON-OECD countries. The unfair inequality (or the inequality of opportunity) measure, however, is computed with the fitted values of the outcome, or what is the same, with the part that is explained by our control variables.

The results show that the countries with highest inequality of opportunity degree, countries whose unfair inequality percentage is more than 30% from the total inequality are, mostly countries from South America, Eastern Europe and Asia. On the contrary, countries with lowest unfair inequality degree are those from North America, Western Europe and Oceania.

It is remarkable that most countries with highest inequality of opportunity degree coincide with countries with lowest average marks, and most countries with lowest inequality degree are likely to have higher average scores (above or close to OECD average score, 500).

This former fact is evidence that the inequality of opportunity and the students' achievements are negatively correlated. Indeed, analytical calculations show that the correlation coefficient between both indicators is -0.69.

This negative relationship is slightly lower among NON-OECD countries and there is no clear association among OECD countries.

We should take into account that the measurement might be based on biased coefficients since there might exist the endogeneity problem in some countries. This section would require more investigation.

For further research, it would be interesting to use the obtained indicators of Inequality of opportunity in order to make new inferences between the IOp and different aspects such as innovation and

development degree, political aspects, health care conditions, and education system. In addition one could compute the inequality of opportunity degree for years 2000, 2003, 2006 and soon, 2012 to analyze its evolution.

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APPENDIX A

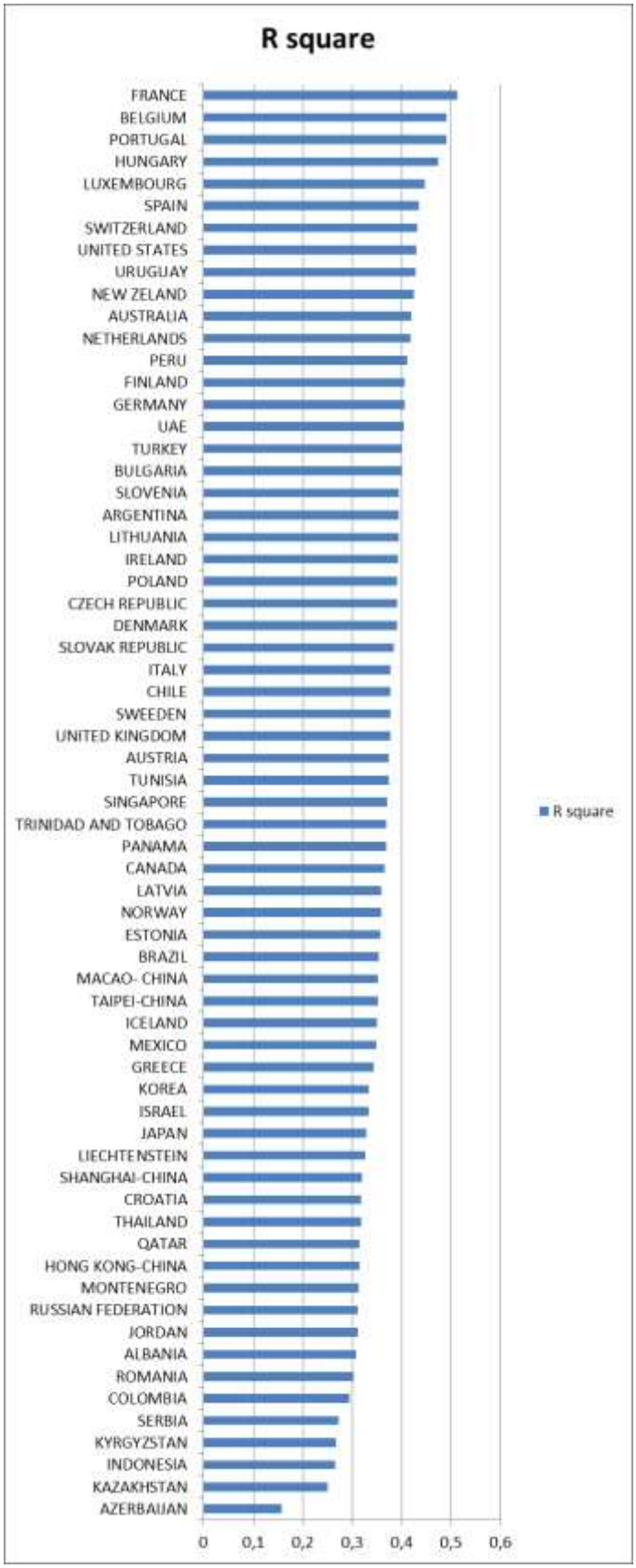
Table 1- CIRCUMSTANCES VARIABLES: Sign and countries where they are not statistically significant

CIRCUMSTANCES	FEMALE	NUCLEAR FAMILY	NATIONAL LANGUAGE	ESCS	SCHOOL CLIMATE
INFLUENCE	+	+	+	+	+
NOT SIGNIFICANT INFLUENCE	Belgium Canada Liechtenstein Netherlands Singapore United kingdom	Austria Belgium Shanghai-China Croatia Estonia France Hong Kong Italy Liechtenstein Macao-china Netherlands Portugal Russian Federation Spain Slovak Republic Switzerland Uruguay	Albania Indonesia Kazakhstan Serbia Thailand Tunisia Kazakhstan		Argentina Belgium Finland Germany Greece Indonesia Israel Liechtenstein Netherlands Slovak Republic Sweden Uruguay

Table 2- EFFORT VARIABLES: Sign and countries where they are not statistically significant

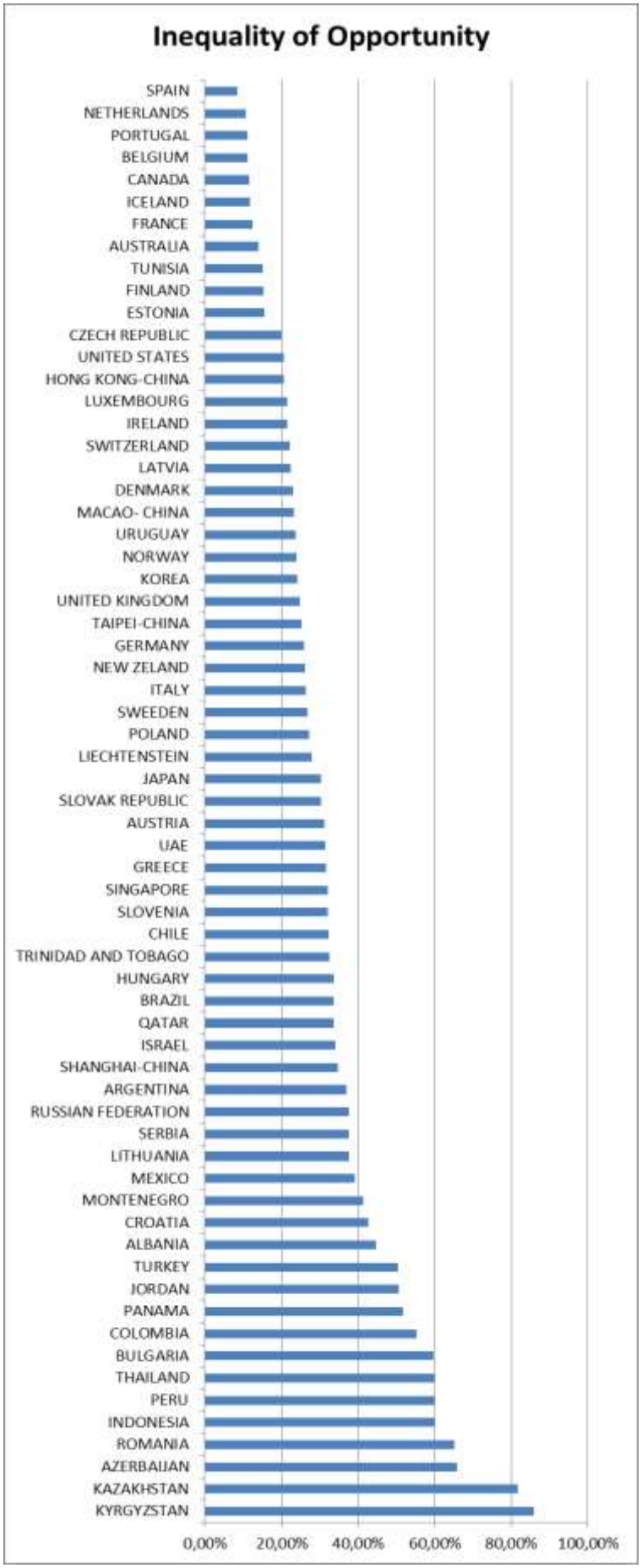
EFFORT	REPEATER	ENJOY READING	LEARING STRATEGIES			TEACHER-STUDENT RELATIONSHIP	READING DIVERSITY
			CONTROL	ELABORATION	MEMORIZATION		
INFLUENCE	-	+	+	-	-	+/-	Mostly +
NOT SIGNIFICANT FOR	Korea* Japan* Norway* Liechtenstein	Kazakhstan Tunisia	Kyrgyzstan	Azerbaijan Estonia Finland Indonesia Japan Jordan Korea Liechtenstein Montenegro Norway Thailand Tunisia Turkey	Indonesia Jordan Korea	Albania Chile France Greece Hong Kong-China Kazakhstan Korea Liechtenstein Luxembourg Macao-China Mexico Netherlands Panama Peru Poland Romania Singapore Slovak Republic Slovenia Trinidad & Tobago UEA Tunisia Turkey United States	Argentina Canada Shanghai-china Taipei-China Colombia Hong Kong-China Hungary Israel Jordan Latvia Panama Peru Portugal Romania Serbia Singapore Slovenia UK

APPENDIX B



COUNTRY	R square
FRANCE	0,5136
BELGIUM	0,4914
PORTUGAL	0,4913
HUNGARY	0,474
LUXEMBOURG	0,4469
SPAIN	0,4347
SWITZERLAND	0,4312
UNITED STATES	0,4305
URUGUAY	0,4277
NEW ZELAND	0,4253
AUSTRALIA	0,4193
NETHERLANDS	0,4182
PERU	0,412
FINLAND	0,4064
GERMANY	0,4058
UAE	0,4054
TURKEY	0,4014
BULGARIA	0,4004
ARGENTINA	0,3948
SLOVENIA	0,3948
LITHUANIA	0,3944
IRELAND	0,3933
POLAND	0,3918
CZECH REPUBLIC	0,3914
DENMARK	0,3911
SLOVAK REPUBLIC	0,3848
ITALY	0,378
CHILE	0,3777
SWEEDEN	0,3774
UNITED KINGDOM	0,3771
AUSTRIA	0,375
TUNISIA	0,3743
SINGAPORE	0,371
TRINIDAD AND TOBA	0,3699
PANAMA	0,3686
CANADA	0,3652
LATVIA	0,3594
NORWAY	0,359
ESTONIA	0,3569
BRAZIL	0,3541
MACAO- CHINA	0,3523
TAIPEI-CHINA	0,352
ICELAND	0,3508
MEXICO	0,3486
GREECE	0,3444
KOREA	0,3337
ISRAEL	0,3328
JAPAN	0,3293
LIECHTENSTEIN	0,3273
SHANGHAI-CHINA	0,3193
CROATIA	0,3179
THAILAND	0,3176
QATAR	0,3153
HONG KONG-CHINA	0,3143
MONTENEGRO	0,3132
RUSSIAN FEDERATIOI	0,3123
JORDAN	0,3114
ALBANIA	0,3089
ROMANIA	0,3034
COLOMBIA	0,2946
SERBIA	0,2727
KYRGYZSTAN	0,2681
INDONESIA	0,2657
KAZAKHSTAN	0,2505
AZERBAIJAN	0,1582

APPENDIX C



COUNTRY	Iop
SPAIN	8%
NETHERLAND	11%
PORTUGAL	11%
BELGIUM	11%
CANADA	11%
ICELAND	12%
FRANCE	12%
AUSTRALIA	14%
TUNISIA	15%
FINLAND	15%
ESTONIA	15%
CZECH REPUE	20%
UNITED STAT	20%
HONG KONG	21%
LUXEMBOUR	21%
IRELAND	22%
SWITZERLAN	22%
LATVIA	22%
DENMARK	23%
MACAO- CHI	23%
URUGUAY	24%
NORWAY	24%
KOREA	24%
UNITED KING	25%
TAIPEI-CHIN	25%
GERMANY	26%
NEW ZELAND	26%
ITALY	26%
SWEEDEN	27%
POLAND	27%
LIECHTENSTE	28%
JAPAN	30%
SLOVAK REPU	30%
AUSTRIA	31%
UAE	31%
GREECE	32%
SINGAPORE	32%
SLOVENIA	32%
CHILE	32%
TRINIDAD AN	32%
HUNGARY	34%
BRAZIL	34%
QATAR	34%
ISRAEL	34%
SHANGHAI-C	35%
ARGENTINA	37%
RUSSIAN FED	37%
SERBIA	38%
LITHUANIA	38%
MEXICO	39%
MONTENEGR	41%
CROATIA	43%
ALBANIA	45%
TURKEY	50%
JORDAN	50%
PANAMA	52%
COLOMBIA	55%
BULGARIA	60%
THAILAND	60%
PERU	60%
INDONESIA	60%
ROMANIA	65%
AZERBAIJAN	66%
KAZAKHSTAN	82%
KYRGYZSTAN	86%