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Inequality of Opportunity in Educational Achievements: cross-country and intertemporal comparisons

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preliminary version, please do not quote

Abstract

Along the line of Roemer (2013), the paper evaluates fairness in educational achievements through the ordered pair $(W^{EO},\ IEOp)$ whose components provide: ***i)*** a measure of social welfare which accounts for the achievements of less-advantaged pupils; and ***ii)*** a synthetic index of inequality in educational opportunities. Exploiting data from PISA 2003, 2006, 2009 and 2012, we use test scores as a measure of pupils' ***advantages*** and gender and parental background to identify 12 ***types***. $(W^{EO},\ IEOp)$ is then used to perform a cross-country and intertemporal comparison of fairness in education.
The cross-country comparison shows that W^{EO} is hgiher in North American and Western European countries and that $IEOp$ ranges from 5% to 26% according to the domain (reading, mathematics, science) considered. Between 2003 and 2012, improvements in the performances of the less advantaged students have been accompanied by an increase n the strenght of the association between parental background and learning outcomes. Overall, few countries outperform in both respects, moving towards greater degree of equality of opportunity all the while improving the performances of the less advantaged students. All of them, but Indonesia and Mexico, are Western European.
Comparing our results with previous findings on $IEOp$ in educational achievements we notice that they are in line with those reported by OECD (2013) for PISA2012 and those obtained by Ferreira & Gignoux (2011) for 2006 but differ from the ones reported by de la Vega & Lukuana (2013) for 2009. This confirms that the evaluation of fairness crucially depends on the choice between which characteristics constitute effort and which circumstances, on the assumptions made on their relationship and on the way they affect outcome and, finally, on the specific measure used to evaluate fairness.

Keywords: Inequality of opportunity, Educational Achievement, PISA database

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1 Introduction

Equality of opportunity has been central in recent economic and public debates. According to this ethic, only inequalities caused by individuals' choices should be considered acceptable from an ethical perspective.
Various theoretical and empirical approaches have been proposed in the literature to analyse Equality of opportunity (EOp) under two different perspectives, one related to the measurement of the degree of EOp and one focused on policies designed to equalize opportunities [1].
The literature on educational inequality, on the other hand, can be classified in three main strands. The first one includes studies which measure inequality in students' achievements by using national or international surveys on test scores obtained by pupils (Brown et al., 2007; Mickelwright and Schnepf, 2007). The second one focuses on inequalities in attainment, as levels of education or completed years of schooling (Thomas et al., 2001; Morrison and Murtin, 2007). Finally, the third strand deals with intergenerational persistence in educational achievements (Marks, 2005; Macdonald et al., 2010; Ermisch et al. 2012).
Inequality of educational opportunities differentiates from this broad literature in two main respects: first, not all the observed differences are considered "harmful"[2]; second, pupils' characteristics other than parental background are taken into account in the measurement of unfair inequality.
The concern for EOp in education comes from different sources: as pointed out by Ferreira and Gignoux (2011a) inequality in educational opportunities (IEOp hereafter) is relevant from a normative point of view for all those that, like Sen (1985) among others, see educational achievements as relevant in their own right. The analysis of IEOp matters also in a positive perspective, as the distribution of educational achievements plays a role in the distribution of earnings (Blau and Khan, 2005), as predicted by the human capital theory, and in promoting economic growth (Hanushek and Woessmann, 2010).
A number of studies in recent years have dealt with the measurement of IEOp focusing their attention on access to education (Paes de Boarros *et al.* , 2009) or on educational achievements (Ferreira & Gignoux, 2011a; and Gamboa & Waltenberg, 2011, among others). The present paper focuses on the latter and provide a measure of fairness in educational achievements along the line of Roemer (2013). The measure is based on two components: the first one is a measure of social welfare that accounts for the

[1]For complete and recent surveys on these literature see Pignataro, 2012; Ramos and van de Gaer, 2012.

[2]As we clarify later, this actually depends on the dimension considered.

achievements of pupils coming from the most disadvantaged backgrounds; the second is a synthetic index of IEOp that gives us the share of inequality in scores which is not due to students' responsibility[3].

Our measure of *advantage* is pupil's test score and the index of IEOp is given by the proportion of inequality in advantages explained by a chosen set of *circumstance* [4]. The paper differentiates from previous ones measuring IEOp in PISA test scores in two ways. First, as far as we know only Gamboa & Waltenberg (2011) and de Carvalho *et al.* (2012) provide an intertemporal comparison of inequality in educational opportunities, but both papers focus on Latin American Countries whose performances are tracked over two time periods using a different measure of IEOp, while we look at the whole sample of countries that took part in the 4 PISA surveys. Second, we complement the analysis of IEOp with a more general description of social welfare consistent with the EOp ethic that evaluates country-specific level of welfare by looking at the educational achievements of less-advatnaged pupils. Social welfare is usually proxied by the level of income or national GDP. However, as far as one agrees on the idea that education is a key determinant of, among others, economic growth, then this level of social welfare can be seen as a "predictor" of future levels of social welfare measured in more "standard" way. Moreover, for the age cohort considered in this study (pupils aged 15) it is an important measure of personal achievements and a preedictor of future earnings. Also, the focus on the worst-off is supported by the ideas that the level of social welfare crucially depends on the welfare of the less advantaged individuals (Rawls, 1971) and that a country should be judjed according to the way it treats its weakest memebers. As far as we know, there are no other papers that evaluate fairness in education considering both the *level* and the *degree* of inequality of opportunity.

We think the paper can contribute to the current debate on education policies in two ways. The cross-county analysis can be a helpful tool to assess if national schooling systems actually help children in overcoming penalties coming from their background. The tracking of country's performances over time can be used by policy makers in order to design better policies, to set national goals and benchmarks based on their previous performances and finally, as a first piece of evaluation of major policies that have been already implemented.

Before presenting our model and results, let us recall that caution is necessary in interpreting our findings. Due to the impossibility of tacking into account the whole set of pupils' circumstances, our measure of welfare should be interpreted as an upper bound

[3]We deal with the discussion on wheter and to which extent pupils should be held responsible for their outcomes in next section.

[4]See section 4 for the list of characteristics used to identify types

estimate of it [5] and our index as a lower bound estimate of inequality in educational opportunities [6]. Neither, IEOp should be considerd as a lower bound of inequality of opportunity for the whole cohort of 15-years old for two reasons. First, the coverage rate varies across countries and this variation is not uniform across them[7]; second, PISA evaluates only 15 years olders who do not drop out and have not repeated too many grads [8]. It follows that our results provide a lower bound of inequality in educational opportunities for pupils who are enrolled in school and have not repeated too many years.

These drawbacks should not be seen as undermining the results we present. We think our indexes represent a good measure of IEOp and social welfare and also that surveys like PISA, that provide cross-country individual's data on comparable basis, are good tools for the analysis presented in the paper. At the same time, we believe that in drawing conclusions and policy implications from this kind of analysis, one has to be clear on the assumptions made, on their *pros* and *cons* and, even more, on the following implications.

The rest of the paper unfolds as follows: after a brief introduction of the literature on IOp, section 2 focuses more on the literature on IEOp and presents its main findings; section 3 is devoted to the model and the theoretical approach we rely on; sections 4 briefly describes the data we use. In Section 5 we display our main results and the last section concludes.

2 Literature Review

Papers on equality of opportunity are usually distinguished depending if they use *ex-ante* or *ex-post* approaches, direct or indirect measures of IOp and, finally, parametric or non-parametric estimation procedures.

The distinciton between ex-ante and ex-post approaches relies on a different interpretation of the two principles embodied in the EOp ethic, namely the compensation and the reward principles. Besides being different from a normative point of view and giving rise to incompatible definitions of EOp (Fleurbaey, 2008; Fleurbaey & Peragine,

[5] The intuition for that is provided in section 3.

[6] A formal proof of this result is provided in Ferreira and Gignoux (2011) and Luongo (2011).

[7] The PISA coverage problem is discussed in Gamboa and Waltenberg (2011) and treated in Ferreira and Gignoux (2011a) by relying on ancillary surveys and in Carvalho, Gamboa and Waltenberg (2012) by using a composite measure that takes into account both the access and the achievement dimensions.

[8] Even if the latter problem does not affect all the countries in the same way, it could be particularly relevant for those with lower enrolment rates, like the developing countries, or those with very resilient educational system.

2011; Ramos & van de Gaer, 2012), to rely on the ex-ante or the ex-post approaches also has practical implications in terms of data requirements and measurement issues. Broadly speaking, we can say that the first one is less data demanding and it does not require to identify and measure effort because IEOp is usually evaluated by looking at opportunity sets available to individuals belonging to different types (where each type is formed by individuals who share the same set of circumstances). The second one focuses more on inequalities between individuals who differ in circumstances but have exerted a comparable degree of effort, requiring a measure also for the latter that can be proxied through parametric (Bjorklund *et al.* , 2011; Bourguignon *et al.* , 2007) or non-parametric (Roemer, 1993) procedures.

The EOp framework has been used to measure the degree of fairness in several dimensions, using different measurement techniques. Lefran *et al.* (2008) and Cogneau & Mesplé-Somps (2008), among others, focused on IOp in income distributions by relying on the ex-ante approach and using a direct measure of IOp[9]. Other authors focus on earning distributions, measuring IOp by relying on direct (Ferreira & Gignoux, 2011) or indirect (Checchi & Peragine, 2010) ex-ante approaches, and on direct (Pistolesi, 2009) or indirect (Bourguignon *et al.* , 2007; Chiecchi & Peragine, 2010; Pistolesi, 2009) ex-post approaches. These papers also differ in the specific index and estimation procedure used, and so they do in terms of countries, time period and circumstances considered.

When it comes to inequality in educational opportunities, a frequent concern in the literature is whether and to which extent pupils can be held responsible for their outcomes. Here, we argue, a distinction should be made between studies which focus on *access* to education (Paes de Barro *et al.* , 2009) and those focusing on *educational achievements* (de la Vega & Lekuana, 2013; Ferreira & Gignoux, 2011; Salehi-Isfahani *et al.* , 2013; Gamboa & Waltenberg, 2011; Schuts *et al.* , 2008; de Carvalho *et al.*, 2012) as the caveat applies more on the access dimension than on the achievement one. More precisely, we believe that, as long as one focuses on the access dimension, equality of outcome should be the correct metric to evaluate how fair a society is as pupils can not be held responsible for not having access to such a fundamental right, and then there is no portion of inequality that can be considered ethically acceptable (on the same line of reasoning, see Peragine, 2011; Brunori *et al.* , 2013). On the other side, we think a certain degree of inequality can be accepted when one considers the achievement dimensions for pupils aged 15 who are assumed to be, at least partially, accountable for

[9] In Ramos & van de Gaer words, one can distinguish between *"direct measures that measure how much inequality remains when only ineuqlaity due to circumstances is left from indirect measures that measure how much inequality remains after opportunities are equalized"*. (Ramos & van de Gaer ,2012; p.4.

the results they obtain [10].

And this, in fact, seems the underlying idea in papers that analyze IEOp. They focuses on inequalities in test scores caused by pupils' circumstances by using standardized measures of test scores provided in international surveys, like TIMSS, PIRLS and PISA, regularly conducted across different group of countries. The advatnage of using these data source derives mainly by the fact that, by providing standardized measure of achievements and individual and school level informations, they allow for cross-country and/or intertemporal comparisons.

Salehi-Isfahani *et al.* (2013), for example, use the 1999, 2003 and 2007 waves of the TIMSS to measure and compare (when possible) the level and evolution of IEOp in a selected number of MENA (Middle East and North Africa) countries [11]. They measure IEOp in both subjects examined in TIMSS, namely mathematics and science. This is done by applying to the distribution of test scores the parametric versions of the standardizeed and smoothed distributions proposed by Checchi & Peragine (2010) [12]. The direct and indirect measures of IEOp are then decomposed to evaluate the share of inequalities due to the circumstances used to partition the population into types (gender, ethnicity, family background and community characteristics). The cross-country comparison shows great variability, IEOp ranges from 4% in Algeria to 34% in Turkey in 2007, while the country rankings were almost constant with respect to the subject considered. The intertemporal comparison shows that IEOp is increased between 2003 and 2007 in almost every country for which data are availables, with Bahrain and Egypt being the only two exceptions.The authors also suggest and test for possible explanations of the observed heterogeneity, like inequality in the unconditional distribution of test scores, income inequality and per capita expenditure in education. Only weak positive correlation is found between the first two and IEOp which appears to be more strongly and negatively correlated with expenditure in education. Finally, their decomposition results show that family background is the most important determinant of IEOp in all countries but Lebanon where community characteristics play this role.

[10] Even if one considers ethically acceptable inequalities arising from differences in innate abilities or talent, these should affect achievements but not hamper access to education, at least at lower levels.

[11] The highest number of countries, in their sample, is in 2007 for which they have data on 16 MONA countries.

[12] The parametric equivalents of the standardized and smoothed distributions were firstly proposed and applied to earnings by Ferreira & Gignoux (2011). The first one correspond to the distribution of the predcted value of outcome obtained after running a reduced form equation model that considers jointly the direct and indirect effect of circumstances on outcome. The second is obtained by substituting the original distribution with the predicted scores obtained as function of predicted residuals and fixed values of circumstances.

A different approach is used by de la Vega & Lekuana (2013) to measure IEOp in PISA test scores. They exploited the 2009 pupils' results in reading and rely on the measures of unfair inequality proposed by Fleurbaey & Shocckaert (2009), *direct unfairness* and *fairness gap* . The first fixes a reference value of effort and measures IOp as inequality in the distribution obtaineed once differences due to effort are removed. The second fixes a reference value of circumstances to obtain an ideal distribution where all inequalities are due to effort; IOp is computed the difference between inequalities in the original and in the ideal distribution. Assuming that test scores are generated by a function additively separable in circumstances and effort [13] and using the variance as the inequality index, the authors compute IEOp in reading test scores evaluated in PISA 2009. IEOp is measured as the ratio between unfair inequality (inequality in fitted values of test scores when a reference value of circumstances or effort is chosen) and overall inequality (inequality in fitted values of test scores where both circumstances and effort variables take thier actual values). They find that IEOp is higher in South America, Eastern Europe and Asia, and lower in North America, Western Europe and Oceania. Moreover, they report a negative correlation between IEOp and average countries' scores.
Ferreira & Gingoux (2011a), Gamboa & Waltenberg (2011) and de Carvalho *et al.* (2012) also exploit the PISA data to measure IEOp. Gamboa & Waltenberg use 2006 and 2009 PISA waves to measure IEOp in 6 Latin American Countries (LAC). Unfair inequality is measured by applying the Mean Log Deviation to a counterfactual ex-post distribution of test scores obtained with a non-parametric procedure. Their circumstances comprehend three groups (gender, parental education and school type) whose impact on test scores is evaluated singularly and then in different combinations. Their results vary depending on circumstances, subjects and year considered but, overall, the authors report that IEOp ranges from 1% to 25%. Moreover, the country rankings change depending on the type classification used: when school type is used, Argentina and Brazile show the highest level of IEOp and Colombia and Mexico the lowest but if the selected circumstances is parental education Chile shows the highest level of inequality while Colombia is still the fairest. Parental education and school type are found as the main determinants of unfair inequality in test scores and their impacts appear stable over time and across countries.
The same countries and the same datasets are used by the Carvalho, Gamboa & Waltenberg (2012) to provide a measure of IEOp that takes into account both the access and the achievement dimensions. The reason for doing that is to take into account one drawback of PISA survey that we mention in the Introduction, namely differ-

[13] This assumption together with the use of an absolute index of inequality are necessary conditions for the two measure to coincide (Fleurbaey & Shocckaert (2009).

ences between countries in coverage rates. Their measure of unfair educational inequality is obtained by computing separately IOp in access to education and in educational achievements, then alternative aggregation procedures of the two are proposed[14]. IEOp is measured by two of these aggregations and results are compared to those obtained when only the achievement dimension is taken into accoun. This comparison shows partial changes in country rankings, more evident in 2006 than in 2009. Finally, Ferreira & Gignoux (2011a) propose a measure of educational achievement and one for IEOp and apply them to PISA 2006[15]. First, they show that very few measures of dispersion are ordinally equivalent to the standardization of test scores carried out in PISA surveys and none is cardinally equivalent. The latter is an issue of lower concern, but the former implies that many of the most commonly used indexes of inequality (like the Gini coefficient or the Theil indexes) do not provide the same ranking of countries when applied to pre- o post-standardized distribution of test scores. Then, the two authors suggest to use the variance as a measure of inequality of educational achievements and the portion of variance explained by selected circumstances as IEOp index. The latter is shown to range from 10% to 35% in Math, from 11% to 38% in Science and from 12% to 38% in Reading. They do not find a clear regional pattern but notice that Nordic and Asiatic countries, together with Australia, Italy and Russia are the fairest; Eastern and Western European countries, together with LAC display higher IEOp; and US, UK and Spain occupy an intermediate position. Moreover, they find almost no correlation between IEOp and per-capita GDP or average scores in PISA, and interpret these results as further evidence of the absence of regional patterns.

These set of results will be compared with ours (when comparability is possible), providing some intuitions on practical implications deriving from using alternative definitions of circumstances and measures of IEOp. Before doing this, next sections introduced the model applied in our analysis and the data used.

[14] Authors propose to measure inequality of opportunity in access to education through the PISA coverage rate or the Human Opportunity Index (Paes de Barro *et al.* , 2009) while IEOp in achievement is measured as in Ferreira & Gignoux (2011a)

[15] They also take into account differences in coverage rates between participating countries. To do that they use ancillary national surveys for the 4 countries with the lowest coverage rate (Indonesia, Turkey, Mexico and Brazil) and derive two procedures to assess the robustness of the measurement of inequality to sample selection biases.

3 The Model

We borrow from Roemer (2013) the idea of measuring the level and degree of inequality of opportunity within a country through the ordered pair $\left(W^{EO},\ IEOp\right)$ and adapt this measure to our framework. Each individual has a set of circumstances C, which are characteristics that are ouside the his control. We partition the population into types $t = 1, ...T$, which are combinations of circumstances, and assume that a pupil's outcome (i.e. the score) s only depends on his type t and effort e.
Effort is considered unobservable. Together with types and policy (i.e. country, in our setting), it is the determinant of outcomes. It follows that

$$s = f(C, e) \tag{1}$$

For the sake of simplicity, we omit the country suffix from the notation. As in Roemer's approach, we assume that unobservable effort corresponds to the rank $\pi \in [0, 1]$ occupied by each pupil in its own type distribution of test scores. Let $\nu^t(\pi)$ be the level of s for individuals of type t at quantile π of their respective effort distribution. Then a measure of the educational opportunities of a country can be defined as

$$W^{EO} = \int_0^1 \min \nu^t(\pi) d\pi \tag{2}$$

In words, the level of educational opportunities can be found by computing the minimum value of the indirect outcome function ν across responsibility groups, that is groups formed by pupils who occupy the same rank π in their own type distribution of test scores. Then, the social welfare function is obtained by applying the utilitarian criterion to these minimum values. An alternative way of looking at the measure (Roemer, 2005) is by defining the cumulative distribution function (CDF) of outcomes in type t , $G(\cdot|t)$. If the outcome is monotonic in effort, then the individuals at the π th quantile of the effort distribution are exactly those at the π quantile of the outcome distribution. Moreover, if the distribution function is strictly increasing, it has an inverse $G^{-1}(\pi|t) = \nu^t(\pi)$. Hence eq. (2) can be restated by writing

$$W^{EO} = \int_0^1 \min \ G^{-1}(\pi|t) d\pi \tag{3}$$

In the plane of the outcomes distributions, geometrically W^{EO} is represented by the area at the left of the left-hand envelope of the distribution functions of the types, bounded by the line at ordinate value one and the horizontal axis and equals the mean

of the left-hand envelope. In class ranked situations, that arise when the type specific outcome distributions do not cross, the level of educational opportunity in a given country corresponds simply to the average value of the worst-off type [16].
As detailed in the previous section our list of circumstances is quite restrictive, because increasing the number of types is problematic for the calculation of the measure of educational opportunities and may result in severely downward biased estimates in small samples. This can be seen by outlying the estimation procedure more in detail. Once types are identified, conditional on a set of circumstances, we estimate, for each type the associated CDF, $G|t$. Increasing the number of types might result in each type containing few observations. In turn, this might imply that the left-hand envelope of the CDFs across types (whose average is W^{EO}) reaches its maximum as a consequence of (possibly) anomalous data. To clarify, consider the following (extreme) case: suppose that a type is defined over a single unit, showing a very low score (100 hundred, for instance). Clearly, the CDF for this type will equal 0 for each score lower than 100, jumping to 1 once 100 is reached. In the worst case - that is when this CDF turns out to be dominated by all other types CDFs - the left-hand envelope of the CDFs will equal 1 at 100 and will be likely to give an enormous weight on a single, eventually anomalous observation. Summarizing, we need a sufficient number of observation to identify $G|f$ and obtain a reliable measure of W^{EO} [17]
On the other way round, the omission of relevant circumstances is likely to generate an upward bias in the estimates of social welfare. Intuitively, to see why this is the case, given a set of circumstances, suppose the left-hand envelope of the type distributions is defined by the function $G|t$. For simplicity, assume a class ranked situation, but exactly the same arguments can be applied to the more general case. Now, suppose that a new circumstance j is introduced and that, without loss of generality, it takes $N = 2$ possible values. This will result in the expansion (by a factor 2) of the cardinality of types, each type being now identified by a generic couple (t, j) . What is relevant for our purpose is that, given that $G|t$ is a convex combination of the conditional to j distributions $G|t, j$, at least one of the two conditional CDFs will lie above and the other below $G|t$ for any outcome in the support. Given that, in any interval of the support there exists at least one distribution that is dominated by $G|t$, it must be that the new left-hand envelope (the one obtained once an additional circumstance is taken

[16] In the literature that relies on stochastic dominance in order to test for EOp (see Lefranc et al. 2008, among others), this is usually referred to as a *"weaker criterion"* for empirically testing for EOp, as it focuses on the average autcome across types. The stronger version, on the other side, considers first order stochastic dominance camparison across the whole type specific distribution of outcome.

[17] The example also provide an intuition on the way the number of types affects the measure of inequality of opportunity. On this topic see also Aaberge et al. (2011), Ferreira et al. (2011c) and Ferreira and Gignoux (2011b)

into account) is first order stochastically dominated by the original one. Hence, the average of the new left-hand envelope will be smaller than the original one: in other words, when an additional circumstance is considered, the value of social welfare W^{EO} goes down. Or putting it differently, the omission of relevant circumstances from the estimates gives rise to a measure of the social welfare which is upward biased.

The second component of the measure is based on the inequality in the distribution of test scores and provides a synthetic index of IEOp. The index we use is based on the ex-ante approach that takes into account differences in the distribution of outcome between individuals who belong to different types. With this approach inequality of opportunity is usually measured as between type inequality in mean outcome, as the mean outcome of each type is interpreted as the opportunity set faced by individuals who share the same set of circumstances. We consider an empirical linear approximation of eq.(1)

$$s = C'\beta + e \tag{4}$$

In this setting, effort is interpreted as a residual term (Dunnzlaff et al., 2010), including all individual characteristics that have not been included in the set of circumstances (innate ability, luck, measurement error). Inequality in educational opportunity is then measured by using the procedure outlined by Ferreira & Gignoux (2011a), that is:

$$IEOp = \frac{var(C'\widehat{\beta})}{var(s)}$$

where $\widehat{\beta}$ is the vector of the OLS estimated coefficients and $var(s)$ represents the overall inequality in the outcome. Roughly speaking, IEOp is measured as the proportion of variance in PISA test scores explained by the vector of circumstances and corresponds to the R^2 of the OLS regression of s on C . In this model, the vector of estimated coefficients captures both the direct and indirect effect of circumstances on s , but is likely to be downward biased as a consequence of the omission of relevant circumstances. In the outlined parametric setting, this can be seen immediately by noticing that the inclusion of relevant circumstances in the regression in (4) will increase the share of variance in the outcome explained by the model.

4 Data

The data we use are taken from the Programme for International Students Assessment (PISA) by OECD.

The first round of PISA took place in 2000 and after that, it has been conducted every three years; 43 countries took part in PISA 2000, 41 in PISA 2003, 58 in PISA 2006, 74 in PISA 2009 and 65 in PISA 2012. For each country, a representative sample is selected by means of a two steps sampling scheme. Schools are first sampled and then students are sampled in the participating schools. The survey assesses students aged between 15 years and 3 months and 16 years and 3 months at the time of the test, who are enrolled in grade 7 or higher. The choice of an average age of 15 was driven by the fact that, in most OECD countries, at this age students are at the end of compulsory education[18].

Each survey provides assessments in 3 domains: mathematics, reading and science. The main focus of the survey shifts from domain to domain in rotation, so that for each domain very detailed data are periodically available. Moreover, the survey collects background information on students and the schools they attend.

The test scores collected by PISA are scaled by using item response theory (IRT). After the IRT adjustment, a second procedure standardizes the test scores. The latter *"poses serious issues for inequality measurement"* (Ferreira & Gignoux, 2011a) and justifies the use of the variance as a measure of inequality.

Our use of PISA data is mainly justified by the possibility of contrasting results obtained for 15 years olds on comparable basis and by the inclusion in the surveys of information on pupils' background. The latter characteristics of the survey surely improves the data management process as we do not need to rely on ancillary national survey that would give rise to comparability issues.

We evaluate countries' performances by looking at a measure of social welfare and an index of IEOp. Both of them are based on the identification of those pupil's characteristics that affect her/his test scores being outside her/his sphere of responsibility (*circumstances)*.

Pupils educational achievements result from the combination of several input (ability, genetic endowment, preferences, motivation, schools' endowment, socioeconomic status, parents' investments in socioemotional and financial dimensions, and so on and so far) but here we focus only on a particular channel that affects pupil's test scores, their parental background [19].

Our set of pupils' circumstances includes:

- gender (2 categories)
- parental level of education (3 categories)
- parental job classification (2 categories)

[18] The choice of this population reflects the idea of measuring *"the extent to which students are prepared for the daily challenges of adulthood in modern society"* (OECD, 2009).

[19] The reasons that justify this choice has been explained in detail in the previous section

For parental variables we consider the highest value in the couple of parents. The education variables have been aggregated according to the ISCED code in the following way: a) no education or unknown level, primary education and lower secondary education; b) upper secondary and post-secondary non-tertiary education; and c) first and second stage of tertiary education. The two categories on parental jobs distinguish between: a) blue collar, low or high skill; and b) white collar, low and high skill.We end up identifying 12 combination of circumstances (i.e. *types*) used to estimate the two measures of interest.

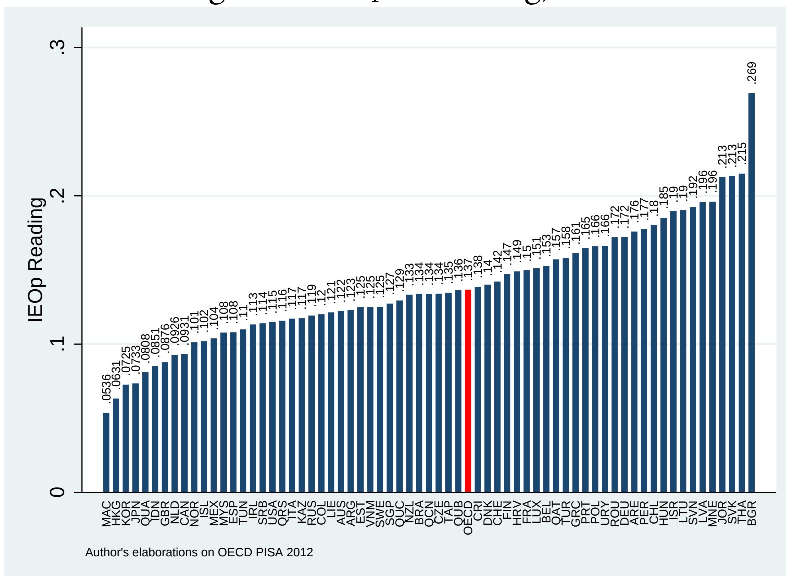
5 Results

This section presents the result obtained computing our measure $(W^{EO},\ IEOp)$ for each country, subject and year considered.
The first component was obtained by computing (separately for each subject, country and year) the cumulative conditional distribution of test scores and, in absence of *class-ranked* situations, the average of the left-hand envelopes of these distributions that corresponds to the area above it. The secon is the R^2 of the regressions of test scores on circumstances [20], runned for each subject, country and year separately.
In 2012 the portion of unfair inequality ranges from 13% (Macao- China) to 19% (Israel) in Math; from 8% (Macao-China) to 20% (Bulgaria) in Science; and from 5% (Macao-China) to 26% (Bulgaria) in Reading with Macao-China resulting the faires country in each subject (see Fig. 1 and Tables 8 and 9 in the Appendix).
These first results suggest that, as one might expect, individual circumstances impact differently according to the subject tought and more intensively on cognitive abilities related to the use of language. This is shown in Fig. 1, where we report the country ranking according to IEOp in reading. There is often accordance in rankings in diferent subjects [21], so we refer to a single subject reporting the whole set of results in the Appendix.
As said in the Introduction, at best of our knowledge, there aren't other studies that measure $IEOp$ by relying to the last wave of PISA, so that there is little room for comparisons. However, the OECD recently published a report on equity in education (OECD, 2013) focused on results in Mathematics of pupils who took part in PISA

[20] The regressions were performed with the STATA module PISAREG (Jakubowsi, 2013). The regression runs 5 times, one for each plausible value reported in datasets, and the final result is calculated as a mean of these regressions; standartdized errors are bootstrapped.

[21] The robustness of the comparison of results on country rankings depending on the subject considered is broadly analyzed by Brown, Mickelwright, Schnepf &Waldman (2007) who also consider comparisons that rely on different surveys.

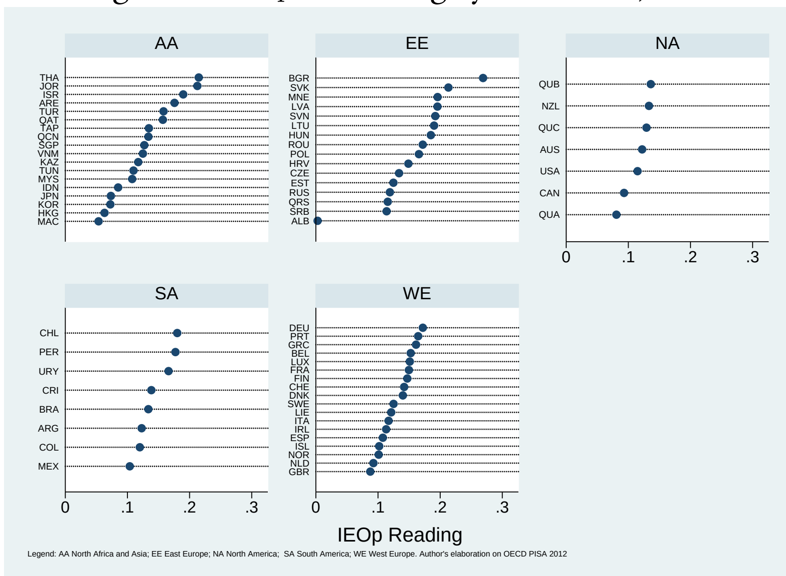
Figure 1: $IEOp$ in Reading, 2012



2012. Despite differences in the subject considered and (partially) in the definition of equity, we find some similarities with our results. As in the OECD report (2013), we find Macao-China, Hong Kong-China and Canada among the best perfomres in terms of $IEOp$ and Belgium as one of the countries where the stregth of the association between parental background and students performances is higher than the OECD average (see Fig.1 and tables in the Appendix).
Our results are partially in line with those of the OECD (2013) also when we look at the relationship between average test scores and the degree of fairness. We find Hong Kong - China and Canada belonging to the group of countries that perfom better then the OECD average both in terms of average scores and Inequality in Educational Opportunities. Others, like Finland or Belgium, combine high perfomrances in terms of test scores with higher association between parental background and students test scores (see Fig. 7 in the Appendix).
The regional pattern shows that the North American and Eastern European countries are, respectively, the best and the worst performers in terms of fairness in education; while Western European, South American and Asiatic countries occupy an intermediate position. The Asiatic area also shows the highest variability between countries in the association between parental background and learning outcomes (see Fig. 2).

Let us now look at our first component. As we said, the reason for using our mea-

Figure 2: $IEOp$ in Reading by Macroarea, 2012



sure is that a country's performance should be evaluated also according to the way it treats its less advantaged citizens; results on this issue could provide opposite or in some ways differen evaluations on country's level of fairness. In part this is what we observe, in fact, by looking at Fig. 3.
The average score of the less advantaged students, *i.e.* our measure of the level of fairness, ranges from 213 in the Slovack Republic to 516 in Shangai that occupies an intermediate position in terms of $IEOp$ (see Fig.1). Results on the level of fairness are in accordance with those on $IEOp$ for the best and the worst performing countries:W^{EO} is equal to 295 in Bulgaria and 470 in Macao - China (see Fig.3)
As regard the subject, reading is again the one most affected by circumstances showing a lower level of W^{EO} that ranges from 257 (Slovack Republic) to 554 (Shangai) in Mathematics and from 279 (Perm - Russian Federation) to 532 (Shangai) in Science. Here we can not identify a clear regional pattern; looking at Fig. 4 we notice more homogeneity within North and South America and Western Europe areas and higher heterogeneity in Eastern Europe and Asiatic countries. The level of W^{EO} is overall higher in North American and Wesern European countries and lower in those belonging to the remaining three areas, with few exceptions for some Asiatic countries.
Looking singularly at the results obtained for the two components of our measure bring us to wonder if there is a country that performs better in both respects. Fig.

Figure 3: W^{EO} in Reading, 2012

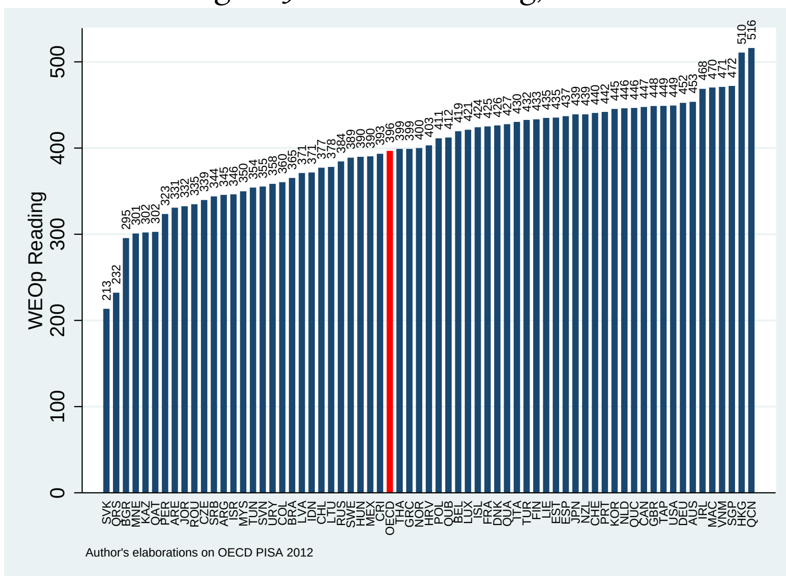
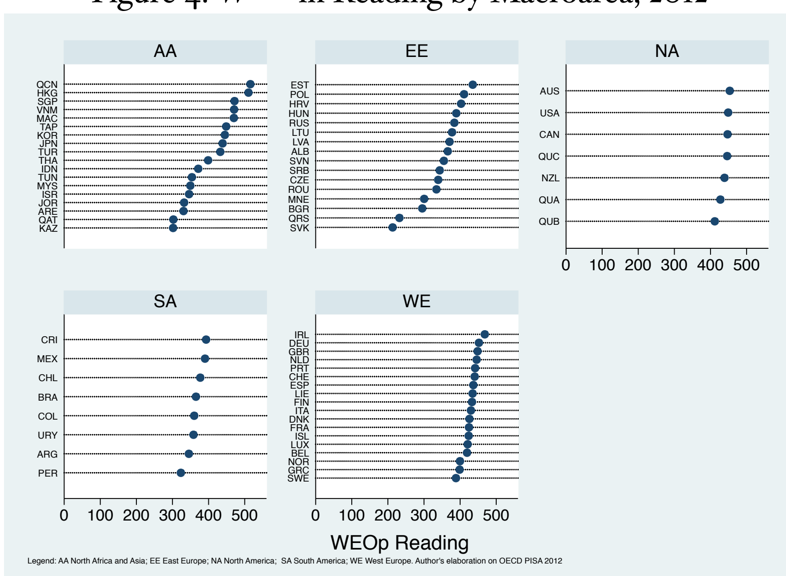


Figure 4: W^{EO} in Reading by Macroarea, 2012



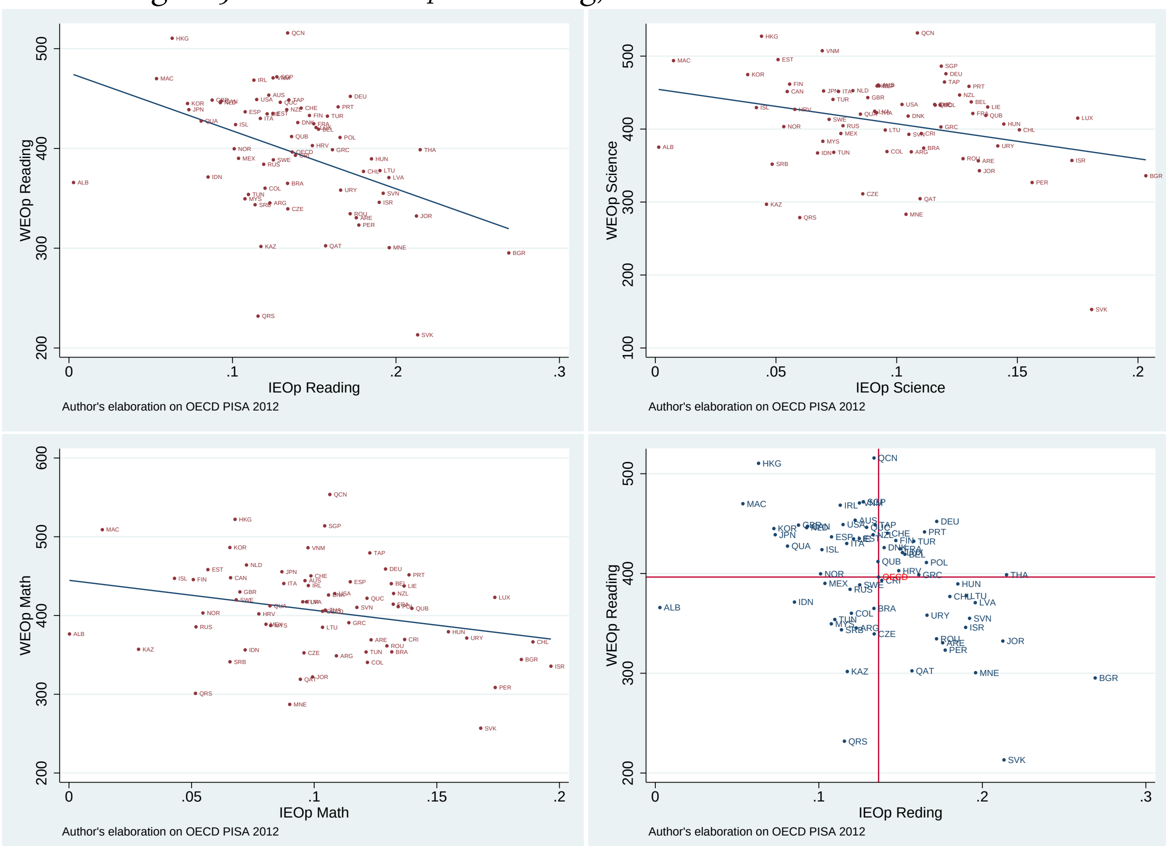
5 shows that this happens in few cases: only Macao - China and Hong Kong - China outperform in both the way they treat the less advantaged pupils and in helping children to overcome penalties coming from their background, while Bulgaria and Slovack Republic perform poorly in both respects, no matter the subject considered. For the remaining countries this is not the case, even if Fig. 5 shows that there exists a slightly negative correlation between the two components. The last panel of Fig. 5 shows that in Asiatic and in some Western countries, like Spain or Ireland, not only students with the poorest parental background reach learning outcomes higher than the OECD average, but also the relationship between students' *circumstances* and test scores is lower. By looking at simple pairwise correlations we suggest possible alternative explanations for the observed heterogeneity considering the relationship between (W^{EO}, $IEOp$) and: inequality in the marginal distribution of test scores, a measure of tracking[22] and per capita GDP [23]. All of them are positively correlated with W^{EO} while $IEOp$ is positively correlated with tracking and inequality in the marginal distribution of test scores but negatively with er capita GDP. In accordance with the OECD (2013) results, we find the latter relationship to be stronger fro countries with per-capita GDP below the OECD average (see Figures in the Appendix).
Looking at countries' performances in a point in time, we think, is interesting and provides helpful cross-country comparisons, but then a number of questions comes up. One could wonder if these figures represent an improvement or a worsening for a single country with respect to previous results or if the country rankings are stable across time and/or subjects. These are the kinds of questions we try to answer through the comparison of PISA waves.
If we do not consider the two outliers Macao & Azerbaijan that show pretty low values of $IEOp$ [24], in 2009 the portion of unfair inequality ranged from 2% to 18% in Science, from 3% to 20% in Mathematics and from 6% to 24% in Reading; with UK and Hungary resulting the fairest and unfairest country, respectively, in each subject (see figures and tables in the Appendix). The level of fairness ranged from 255 (Russia) to 458 (Korea) in Reading; from 293 (Peru) to 500 (Hong Kong) in Mathematics and from 247 (Himachal Pradesh - India) to 473 (Chinese - Taipei) in Science.
We notice some differences between our results and those obtained for the same subject and year by de la Vega & Lekuana (2013).
Interestengly, if the effort and circumstance variables used by the authors were correlated, their measure of overall inequality would correspond to our $IEOp$ index. If this

[22]Tracking is defined as the share of technical or vocational enrollment at the secondary level over total enrollment. Due to data availability, results for tracking refers to 2009

[23]Data on tracking have been obtained from UNESCO Institute for Statistics

[24]Interestingly also Ferreira & Gignoux, 2011, report Azerbaijan as an outliers in 2006

Figure 5: W^{EO} & $IEOp$ in Reading, Mathematics and Science 2012



is the case, the latter should show lower values than the former as the set of circumstances is smaller and based on a coarser partition of the population into types. On the other way around, if their assumption on additive separabiloty in the *score production function* holds, $IEOp$ is only partially comparable with their measure of inequality of opportunity, not only because of differences in the set of circumstances, but also because the two measures rely on different distributions.

The comparison of $IEOp$ with their measure of overall inequality and inequality of opportunity, in fact, confirm what stated above. As obvious, overall inequality computedby de la Vega & Lekuana (2013) is higher than $IEOp$, but the comparison of the two measures of unfair inequality is interesting: not only the country ranking but also the results on countries' degree of fairness are quite different. For example, inequality in educational opportunity in reading in Hong Kong accounts for the 6% of overall inequality according to $IEOp$ and for the 21% according to de la Vega & Lekuana (2013) while they find inequality of opportunity to be the 11% of overall inequality in Portugal against the 17% we report for $IEOp$ (see Figure 1 and Tables in the Appendix). Our results are more in accordance with theirs when looking at the regional pattern of $IEOp$ that is lower in North America, Western Europe and Asiatic countries than in Eastern Europe and South American ones, with North America showing also a lower variability between countries (see Tables in the Appendix).

These findings confirm that the evaluation of countries' performances change according to the dimension considered and the measure used. The choice of different metric depends on the assumption made on what constitutes effort and what circumstances and this, in turn, depends on the underlying definition of equality of opportunity one believes. This choice is clearly free and driven, beside data availability, on personal judjements on fairness; but it has to be made really clear and explicitly taken into account when one draws conclusions and policy implications which crucially depend on it.

In 2006 $IEOp$ ranges from 6% (Azerbaijan) to 22% (Thailand) in reading, from 4% (Norway) to 16% (Hungary) in mathematics and from 3% (Azerbaijan) to 17% (Luzemburg) in Science. [25]. Subjects in the same order show, in 2003, the following ranges: from 5% (Japan) to 18% (Hungary); from 2% (Macao - China) to 18 % (Hungary); and from 3%(Hong Kong) to 15% (Slovak Republic).[26].

[25] Again, some outliers are not considered but all the data are provided in the Appendix.

[26] The results for 2006 are in line with those of Ferreira and Gignoux (2011). Looking, as they do, at the results on $IEOp$ in mathematics, we notice that it is overall lower in North America and Asiatic countries and higher in the three remaining areas, but with some exceptions. Narrowing the focus of the analysis on South American countries we compare our results with Gamboa and Waltenberg (2011). They are similar when looking at the "extremes" (we also find Colombia ranking first and Chile last in terms of fairness) but a different ranking of countries in intermediate positions.

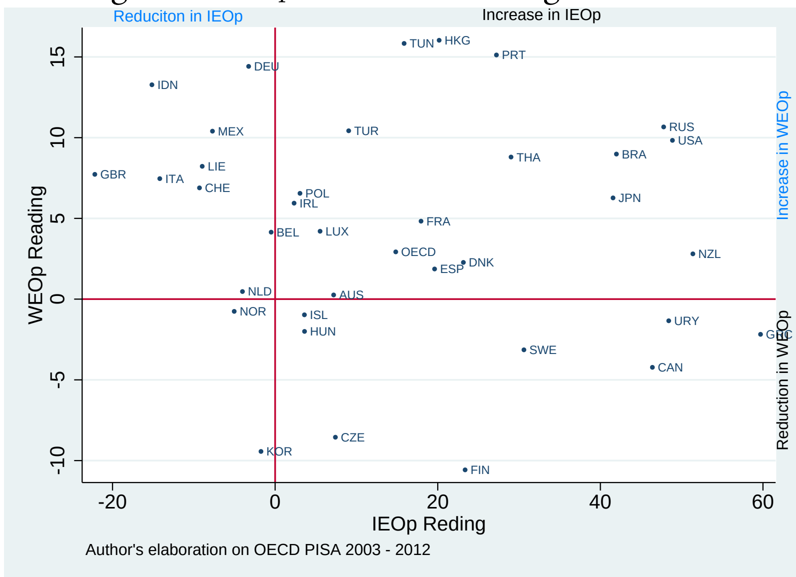
W^{EO} in reading ranges from 263 (Qatar) to 493 (Korea) in 2006 and from 289 (Czech Republic) to 483 (Korea) in 2003. In Mathematics the level of fairness goes from 285 (Tunisia) to 493 (Finland) in 2006 and from 287 (Tunisia) to 495 (Finland) in 2003. Finally, in Science we observe W^{EO} ranging from 294 (Slovak Republic) to 502(Finland) in 2003 and from 313(Qatar) to 514(Finland) in 2006.
The first thing we notice from these figures is that, no matter the time period considered, $IEOp$ is always higher in reading than in the remaining two subjects. Because of this and to allow for comparison with what we said above, let us continue to focus on reading.[27].
On average, between 2003 and 2012, the impovement in the perfomance of the less advantaged students has been accompanied by an increase in the strength of the association between parental background and learning outcomes. But the pattern is not uniform across and within areas. The number of countries where the performacne of the worst-off is increased is mich higher than the number of those where $IEOp$ has been reduced. Mexico, Great Britain and Ireland, among others, moved toward greater *level* of fairness but the formers also increased the *degree* of fairness remained almost unchanged in Ireland,
Both components of our measure of Inequality in Educational Opportunities remained almost constant over time in Netherlands, Austria, Norway and Iceand; while thei mprovement in average test scores of the wost-off students in (among others) USA and Brazil has been accompanied by an increase in $IEOp$.
Overall, few countries outperform in both respects, moving towads greater degree of equality of opportunity all the while improving the performances of the less advantaged students, and they are almost all Western European countries with the exception of Indonesia and Mexico. Almost an equal number shows a reduction in both the level and the degree of fairness, but in this case there isn't a clear regional pattern. Only in Norway and Korea the weakening of the strength of the relationship between parental background and student performances has been accompanied by a reduction in the level of fairness. Most of the Asiatic and the Western European countries moved toward higher level but lower degree of fairness (see Fig. 6).

6 Conclusion

Exploiting PISA 2003, 2006 and 2009 in this paper we provided cross-country and intertemporal evaluations of fairness in educational achievements.
Following Roemer (2013) the evaluation was carried out through an ordered pair (W^{EO},

[27]The results discussed here consider only countries participating to all rounds of PISA survey

Figure 6: $IEOp$ & W^{EO} in Reading Over Time



$IEOp$) whose components provided us a measure of social welfare focused on the less-advantaged pupils and an index of inequality in educational opportunities.

As far as we know there are no other papers that evaluates IEOp considering both the *level* and the *degree* of fairness in educational achievements. Also, this paper differentiates from previous contributions on this topic by providing cross-country and intertemporal comparisons for the whole set of countries that took part in the PISA surveys.

We underlined that due to the omission of relevant circumstances the two components are likely to be, respectively, upward and downward biased, so that caution is necessary in interpreting the results.

With these caveats in minds, we computed (W^{EO}, $IEOp$) for each subject, year and country and we find high heterogeneity across countries in terms of both levels and degrees of fairness in education. Despite a clear regional pattern did not emerge, the cross-country comparison shows that W^{EO} is higher in North American and Western European countries than in Eastern Eurpean, South American and Asiatic ones, with some exceptions. North American and Eastern European countries are, respectively, the best and the worst performers in terms of $IEOp$. Western European, South American and Asiatic countries occupy an intermediate position with the latter showing great variability between countries in the association between parental background

and learning outcomes.
The intertemporal comparisons showed that on average, between 2003 and 2012, the improvement in the performances of the less advantaged students has been accompanied by an increase n the strenght of the association between parental background and learning outcomes. Overall, few countries outperform in both respects, moving towards greater degree of equality of opportunity all the while improving the performances of the less advantaged students. All of them, but Indonesia and Mexico, are Western European.
We also noticed $IEOp$ to be always higher in reading than in the remaining two subjects confirming that, as one might expect, individual circumstances impact differently according to the subject tought and more intensively on cognitive abilities related to the use of language.
Finally, comparing our results wih previous findings on the same topic, we noticed they are in line with those obtained by Ferreira & Gignoux (2011) for 2006 but differ from those reported by de la Vega & Lukuana (2013) for 2009. This confirms that the evaluation of fairness crucially depends on the choice between which characteristics constitutes effort and which circumstances, on the assumptions made on their relationship and on the way they affect individuals' outcome and, finally, on the specific measure used to evaluate fairness.

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Figure 7: Ranking IEOp and Average Test Scores, Reading 2012

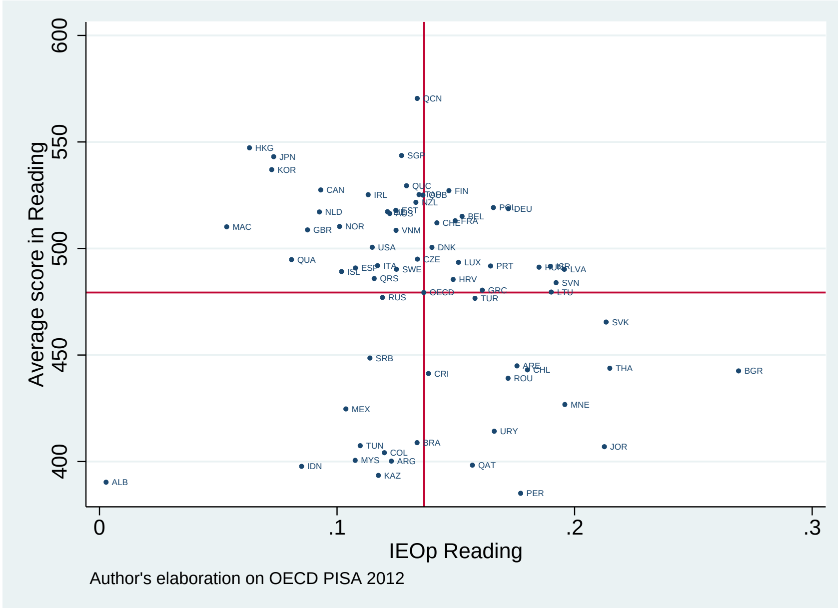

Figure 8: Correlations between $IEOp$ in Reading and: (i) IO in Reading 2012; (ii) Tracking 2009; and (iii)GDP pc. 2012

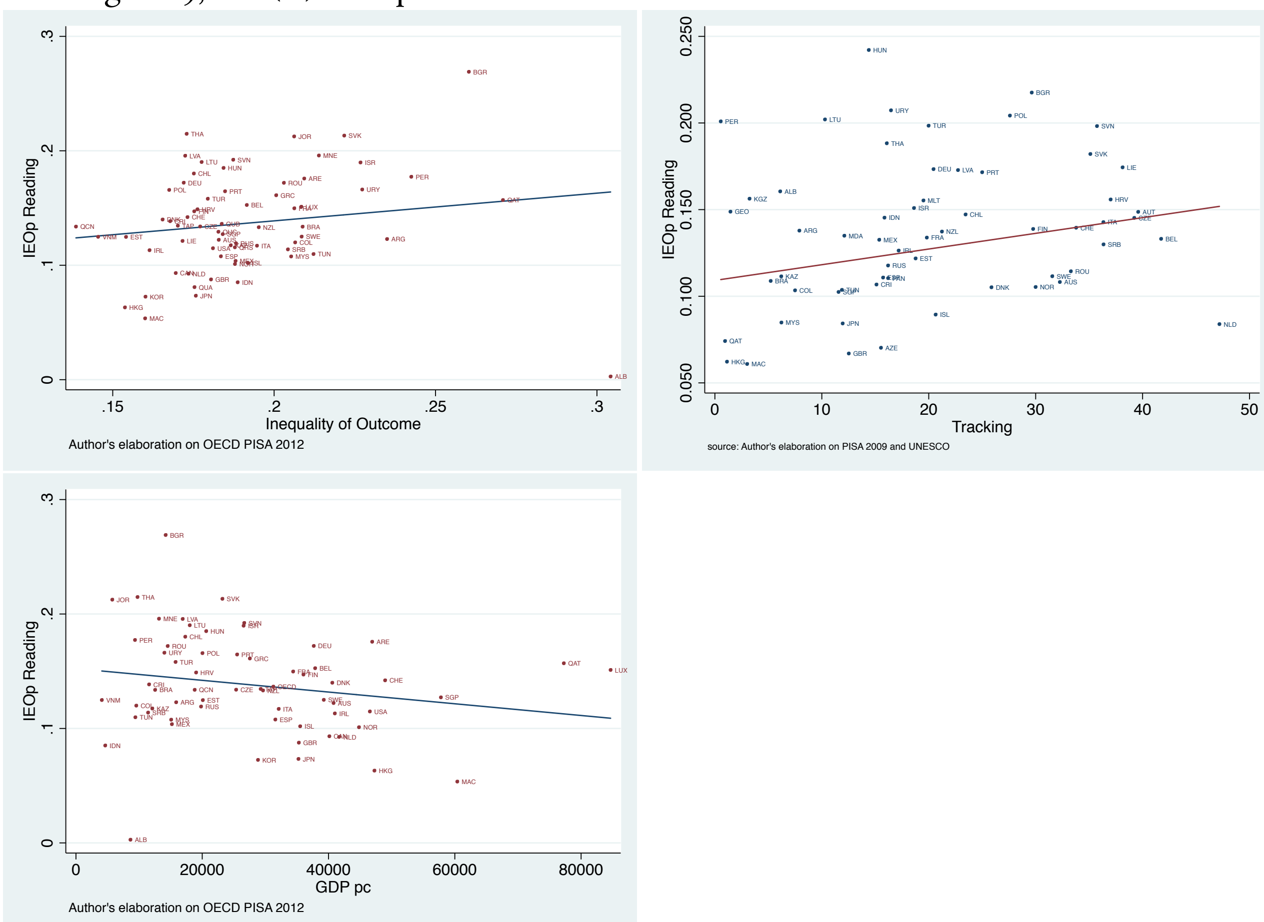

Figure 9: Correlations between W^{EO} in Reading and and: (i) IO in Reading 2012; (ii) Tracking 2009; and (iii)GDP pc. 2012

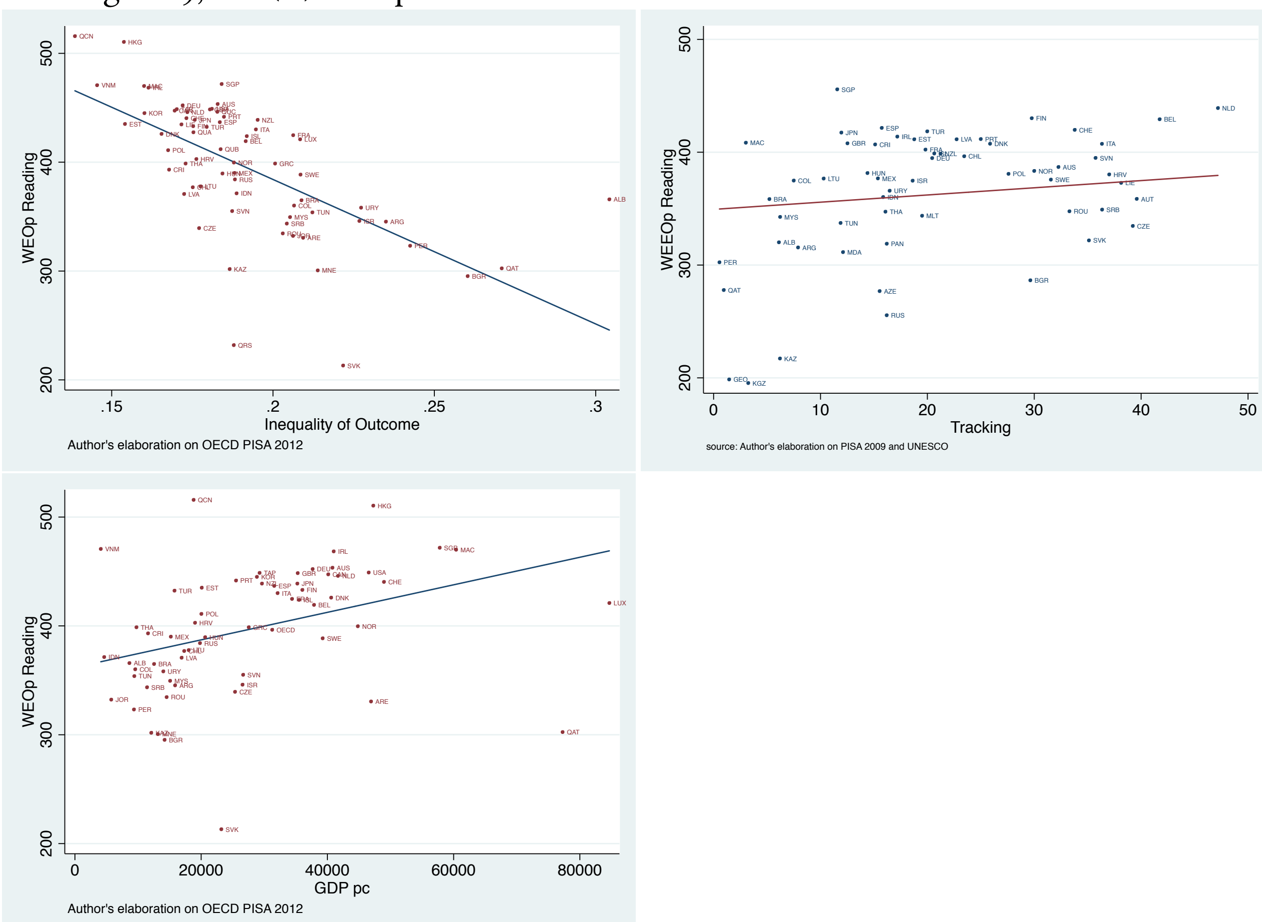

Table 1: Average test scores, IEOp and WEEOp 2003, Reading, Mathematics and Science, OECD countries

Counry	Science			Math			reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Australia	529.58	467.66	0.07	528.49	470.38	0.07	531.60	452.23	0.11
	1.98	0.01	0.00	2.00	0.01	0.01	1.93	0.01	0.01
Austria	494.41	395.71	0.11	508.78	425.83	0.08	495.58	367.35	0.17
	3.09	0.02	0.01	2.91	0.02	0.01	3.29	0.02	0.01
Belgium	520.39	419.99	0.13	541.68	441.70	0.13	519.86	402.59	0.15
	2.19	0.02	0.01	2.14	0.01	0.01	2.39	0.02	0.01
Canada	524.73	453.96	0.05	537.75	474.67	0.04	533.31	467.08	0.06
	1.76	0.02	0.00	1.58	0.01	0.00	1.53	0.01	0.00
Switzerland	516.27	419.73	0.13	529.70	443.03	0.12	502.41	412.02	0.16
	3.67	0.01	0.01	3.37	0.02	0.01	3.23	0.01	0.01
Czech Republic	529.80	381.89	0.10	523.71	392.10	0.12	497.52	371.16	0.12
	2.97	0.05	0.01	3.19	0.11	0.01	2.67	0.05	0.01
Germany	518.67	404.29	0.19	517.77	424.02	0.17	508.87	395.22	0.18
	3.30	0.02	0.01	3.12	0.01	0.01	3.05	0.02	0.01
Denmark	478.66	398.77	0.09	517.32	441.33	0.09	495.39	416.48	0.11
	2.80	0.03	0.01	2.63	0.02	0.01	2.62	0.02	0.01
Spain	489.93	444.72	0.07	487.22	446.68	0.07	483.76	428.74	0.09
	2.48	0.01	0.01	2.33	0.01	0.01	2.41	0.01	0.01
Finland	549.32	502.69	0.03	545.26	500.03	0.04	544.61	484.25	0.12
	1.79	0.02	0.00	1.74	0.01	0.01	1.53	0.02	0.01
France	517.03	428.72	0.09	515.97	444.71	0.09	502.42	405.20	0.13
	2.61	0.03	0.01	2.25	0.01	0.01	2.30	0.03	0.01
United Kingdom	523.14	435.18	0.10	511.74	432.20	0.09	511.11	416.29	0.11
	2.71	0.03	0.01	2.62	0.02	0.01	2.62	0.02	0.01
Greece	482.46	425.65	0.08	446.24	386.83	0.09	473.87	407.61	0.10
	3.48	0.01	0.01	3.87	0.01	0.01	3.86	0.01	0.01
Hungary	504.98	411.79	0.15	491.31	397.32	0.19	483.25	397.51	0.18
	2.63	0.02	0.01	2.80	0.02	0.01	2.46	0.02	0.01
Ireland	507.25	441.30	0.09	504.73	446.36	0.09	517.72	442.16	0.11
	2.51	0.01	0.01	2.33	0.02	0.01	2.49	0.01	0.01
Iceland	496.30	453.64	0.03	516.70	467.37	0.04	493.93	428.05	0.10
	1.48	0.02	0.01	1.45	0.01	0.01	1.50	0.02	0.01
Italy	487.50	421.94	0.09	466.28	415.74	0.09	476.80	400.22	0.14
	3.07	0.01	0.01	2.97	0.01	0.01	2.88	0.01	0.01
Japan	552.12	467.08	0.05	537.66	453.86	0.06	503.83	412.97	0.05
	4.07	0.03	0.01	4.00	0.03	0.01	3.69	0.02	0.01
Korea	540.08	481.83	0.06	543.72	481.48	0.09	535.74	491.39	0.07
	3.50	0.01	0.01	3.18	0.01	0.01	3.02	0.01	0.01
Luxemburg	489.66	411.70	0.12	499.15	429.83	0.11	486.56	404.01	0.14
	1.33	0.01	0.01	1.03	0.02	0.01	1.14	0.01	0.01
Mexico	405.96	371.19	0.09	386.55	348.73	0.12	401.18	353.34	0.11
	3.32	0.01	0.01	3.66	0.00	0.01	4.14	0.01	0.01
Netherlands	532.67	444.14	0.10	547.14	462.53	0.09	521.59	443.86	0.10
	2.96	0.03	0.01	2.76	0.03	0.01	2.54	0.02	0.01
Norway	487.99	394.75	0.06	498.48	423.95	0.05	504.28	402.71	0.11
	2.79	0.03	0.01	2.37	0.03	0.01	2.62	0.03	0.01
New Zealand	526.61	432.23	0.07	528.39	445.04	0.07	528.09	426.90	0.09
	2.48	0.03	0.01	2.30	0.03	0.01	2.56	0.02	0.01
Poland	499.01	400.09	0.12	491.32	395.31	0.12	498.18	385.73	0.16
	2.70	0.03	0.01	2.34	0.03	0.01	2.67	0.03	0.01
Portugal	469.78	405.63	0.09	468.13	404.12	0.10	479.70	383.66	0.13
	3.34	0.02	0.01	3.32	0.02	0.01	3.62	0.02	0.01
Slovak Republic	496.74	334.26	0.16	499.99	388.68	0.16	471.21	348.03	0.16
	3.64	0.03	0.01	3.30	0.02	0.01	3.11	0.02	0.01
Sweden	510.76	391.56	0.05	513.48	425.76	0.05	519.08	401.17	0.10
	2.39	0.02	0.01	2.45	0.02	0.01	2.17	0.02	0.01
Turkey	435.50	389.78	0.15	424.81	368.53	0.15	442.43	391.54	0.14
	5.87	0.01	0.01	6.78	0.02	0.01	5.70	0.01	0.01
United States	497.06	391.46	0.06	488.39	397.09	0.06	501.77	408.83	0.08
	2.75	0.03	0.01	2.62	0.02	0.01	2.79	0.03	0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2003.

Table 2: Average test scores, IEOp and WEEOp 2003, Reading, Mathematics and Science, Partner Countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Brazil	392.85	347.58	0.09	359.69	299.70	0.12	406.48	334.91	0.09
	3.93	0.01	0.01	4.55	0.01	0.01	4.26	0.01	0.01
Hong Kong SAR, China	542.86	473.01	0.03	553.43	492.27	0.03	513.25	439.92	0.05
	3.83	0.03	0.00	4.00	0.03	0.01	3.26	0.03	0.01
Indonesia	396.09	362.45	0.08	361.31	307.56	0.08	382.67	327.83	0.10
	3.16	0.01	0.01	3.84	0.01	0.01	3.27	0.01	0.01
Liechtenstein	527.59	401.75	0.14	538.43	422.46	0.11	528.03	401.63	0.13
	3.70	0.06	0.04	3.20	0.05	0.04	3.22	0.06	0.03
Latvia	491.01	415.59	0.04	484.93	380.54	0.05	492.55	410.09	0.08
	3.75	0.06	0.01	3.56	0.05	0.01	3.52	0.02	0.01
Macao - China	525.46	486.94	0.02	527.89	478.97	0.03	498.03	462.30	0.02
	2.90	0.03	0.01	2.88	0.07	0.01	1.90	0.05	0.01
Russian Federation	490.58	378.85	0.05	469.40	362.23	0.05	443.25	347.13	0.08
	3.95	0.09	0.01	4.03	0.05	0.01	3.77	0.04	0.01
Thailand	430.83	401.11	0.12	419.23	375.25	0.11	422.32	366.47	0.17
	2.57	0.01	0.01	2.90	0.02	0.01	2.59	0.02	0.01
Tunisia	385.24	322.55	0.07	359.30	296.89	0.12	375.79	305.50	0.09
	2.54	0.01	0.01	2.53	0.04	0.01	2.63	0.03	0.01
Uruguay	440.91	393.87	0.08	424.27	376.93	0.10	436.57	363.06	0.11
	2.85	0.01	0.01	3.28	0.01	0.01	3.35	0.01	0.01
Yugoslavia	437.91	350.73	0.07	437.99	355.33	0.07	413.17	321.92	0.13
	3.39	0.03	0.00	3.66	0.04	0.01	3.50	0.03	0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2003.

Table 3: Average test scoresIEOp and WEEOp 2006, Reading, Mathematics and Science, OECD countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Australia	531.17	467.48	0.07	523.57	464.42	0.07	517.13	439.97	0.11
	2.16	0.01	0.00	2.19	0.01	0.00	1.93	0.01	0.01
Austria	512.54	366.75	0.10	506.85	375.65	0.09	492.88	379.19	0.12
	3.82	0.03	0.01	3.64	0.02	0.01	3.97	0.02	0.01
Belgium	518.50	425.90	0.12	528.99	422.53	0.11	510.14	396.87	0.14
	2.14	0.02	0.01	2.42	0.02	0.01	2.69	0.01	0.01
Canada	538.64	467.58	0.05	530.45	470.45	0.04	531.23	437.37	0.07
	1.89	0.02	0.00	1.84	0.02	0.00	2.23	0.03	0.01
Switzerland	514.07	438.41	0.11	532.00	458.90	0.10	502.26	421.41	0.13
	2.92	0.01	0.01	2.88	0.01	0.01	2.83	0.01	0.01
Czech Republic	516.90	364.77	0.08	514.42	353.05	0.09	487.50	331.40	0.11
	3.42	0.05	0.01	3.45	0.04	0.01	3.96	0.03	0.01
Germany	523.80	427.80	0.13	512.13	415.56	0.13	505.83	386.62	0.16
	3.41	0.01	0.01	3.45	0.01	0.01	3.97	0.02	0.01
Denmark	500.28	417.38	0.08	516.71	443.21	0.07	499.13	416.68	0.09
	2.90	0.02	0.01	2.51	0.02	0.01	3.02	0.02	0.01
Spain	491.41	449.90	0.09	482.77	444.03	0.07	463.87	414.76	0.10
	2.45	0.01	0.01	2.22	0.01	0.01	2.23	0.01	0.01
Finland	564.74	508.85	0.03	549.60	492.01	0.04	548.56	478.99	0.13
	1.92	0.03	0.00	2.10	0.03	0.01	2.07	0.03	0.01
France	504.44	428.53	0.12	503.98	438.66	0.11	496.68	411.02	0.13
	3.08	0.02	0.01	2.88	0.01	0.01	3.76	0.02	0.01
United Kingdom	525.26	423.11	0.06	503.24	419.89	0.06	505.78	404.67	0.07
	2.01	0.02	0.01	2.06	0.02	0.01	2.12	0.02	0.01
Greece	475.34	396.17	0.12	461.17	394.20	0.11	462.12	359.83	0.18
	3.01	0.01	0.01	2.84	0.01	0.01	3.88	0.01	0.01
Hungary	507.37	410.88	0.14	494.45	379.35	0.16	486.65	378.01	0.18
	2.62	0.02	0.01	2.77	0.02	0.01	3.25	0.02	0.01
Ireland	512.63	452.95	0.06	505.16	444.62	0.07	522.06	462.02	0.10
	2.88	0.01	0.01	2.46	0.01	0.01	3.20	0.01	0.01
Iceland	493.82	429.72	0.05	507.92	444.99	0.05	487.99	407.49	0.11
	1.52	0.02	0.01	1.43	0.03	0.01	1.45	0.02	0.01
Italy	477.46	413.02	0.07	463.53	397.93	0.07	470.82	394.14	0.09
	1.92	0.02	0.00	2.20	0.01	0.01	2.44	0.01	0.01
Japan	535.53	444.01	0.08	526.37	435.38	0.10	503.34	398.53	0.09
	3.40	0.03	0.01	3.41	0.03	0.01	3.37	0.02	0.01
Korea	523.06	469.22	0.04	548.43	488.76	0.05	556.77	500.35	0.07
	3.26	0.02	0.01	3.70	0.02	0.01	3.65	0.01	0.01
Luxemburg	489.91	412.48	0.17	493.69	419.41	0.13	483.78	390.51	0.19
	1.07	0.01	0.01	0.98	0.02	0.01	1.12	0.01	0.01
Mexico	412.05	379.07	0.11	408.15	370.14	0.11	413.16	355.71	0.13
	2.57	0.00	0.01	2.73	0.00	0.01	2.85	0.01	0.01
Netherlands	529.50	425.19	0.10	535.04	437.33	0.09	511.66	383.44	0.10
	2.38	0.02	0.01	2.28	0.03	0.01	2.59	0.02	0.01
Norway	492.49	395.76	0.04	494.71	398.19	0.04	491.87	368.86	0.08
	2.71	0.06	0.01	2.47	0.04	0.01	2.79	0.03	0.01
New Zealand	539.88	451.37	0.07	529.47	451.67	0.06	530.49	441.24	0.09
	2.54	0.02	0.01	2.34	0.02	0.01	2.82	0.02	0.01
Poland	499.81	397.46	0.12	497.24	397.27	0.11	510.18	377.49	0.15
	2.30	0.04	0.01	2.33	0.03	0.01	2.77	0.03	0.01
Portugal	476.44	409.91	0.11	468.37	393.79	0.01	475.00	402.84	0.15
	2.89	0.02	0.01	2.90	0.02	0.14	3.43	0.01	0.01
Slovak Republic	492.57	374.01	0.13	496.36	353.82	0.01	471.36	332.39	0.15
	2.63	0.02	0.01	2.68	0.03	0.05	3.04	0.03	0.01
Sweden	507.73	441.53	0.04	505.74	443.84	0.01	511.99	428.94	0.08
	2.27	0.02	0.01	2.35	0.03	0.14	3.19	0.02	0.01
Turkey	425.46	363.49	0.13	426.06	380.87	0.01	448.31	354.68	0.14
	3.97	0.01	0.01	4.97	0.02	0.09	4.28	0.02	0.01
United States	494.93	395.98	0.09	479.16	393.61	0.01	0.00	0.00	0.00
	4.05	0.02	0.01	3.83	0.01		0.00	0.00	0.00

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2006.

Table 4: Average test scoresIEOp and WEEOp 2006, Reading, Mathematics and Science, Partners countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Argentina	397.16	335.94	0.13	386.80	330.97	0.11	380.97	292.15	0.12
	5.84	0.01	0.01	6.03	0.02	0.01	6.88	0.01	0.01
Azerbaijan	385.94	334.69	0.03	477.10	445.05	0.00	356.80	310.26	0.06
	2.70	0.04	0.01	2.22	0.03	0.00	3.10	0.03	0.01
Bulgaria	440.73	331.46	0.16	419.33	319.95	0.15	410.56	275.23	0.21
	5.81	0.03	0.01	5.79	0.02	0.01	6.28	0.02	0.01
Brazil	393.00	352.75	0.11	371.85	327.92	0.12	395.60	337.34	0.12
	2.78	0.01	0.01	2.99	0.01	0.01	3.78	0.01	0.01
Chile	439.51	376.02	0.19	412.58	346.42	0.21	444.27	377.07	0.15
	4.40	0.01	0.01	4.58	0.01	0.01	5.06	0.01	0.01
Colombia	390.02	353.20	0.07	371.93	328.01	0.10	388.28	346.16	0.07
	3.28	0.01	0.01	3.67	0.01	0.01	4.89	0.01	0.01
Estonia	532.49	472.33	0.06	515.62	431.59	0.07	502.31	410.09	0.13
	2.47	0.03	0.01	2.69	0.06	0.01	2.90	0.06	0.01
Hong Kong SAR, China	545.33	481.19	0.05	550.33	468.66	0.05	538.84	474.90	0.07
	2.39	0.08	0.01	2.53	0.04	0.01	2.30	0.05	0.01
Croatia	495.67	425.05	0.07	469.62	389.62	0.08	479.98	403.02	0.14
	2.33	0.02	0.01	2.31	0.02	0.01	2.60	0.01	0.01
Indonesia	395.32	344.49	0.08	392.58	331.48	0.08	395.08	329.58	0.10
	5.84	0.02	0.01	5.67	0.02	0.01	5.93	0.02	0.01
Israel	468.34	378.50	0.07	456.23	364.85	0.09	454.85	348.77	0.08
	3.55	0.02	0.01	3.85	0.02	0.01	4.16	0.02	0.01
Jordan	433.51	369.90	0.12	395.43	341.35	0.11	414.48	331.48	0.17
	2.91	0.01	0.01	3.30	0.01	0.01	3.16	0.01	0.01
Kyrgyzstan	326.34	228.16	0.05	316.02	247.00	0.06	290.96	205.12	0.12
	2.87	0.05	0.01	3.30	0.04	0.01	3.32	0.03	0.01
Liechtenstein	525.74	380.02	0.17	528.28	413.68	0.13	514.85	365.51	0.20
	3.74	0.06	0.04	3.61	0.05	0.03	3.58	0.05	0.04
Lithuania	491.26	388.17	0.09	489.67	376.94	0.10	474.00	368.43	0.16
	2.74	0.05	0.01	2.84	0.05	0.01	2.91	0.03	0.01
Latvia	492.20	412.82	0.05	488.47	390.06	0.06	482.69	387.05	0.12
	2.77	0.04	0.01	2.91	0.05	0.01	3.32	0.04	0.01
Macao - China	512.12	479.08	0.01	526.09	480.69	0.02	493.56	445.33	0.04
	1.04	0.02	0.00	1.09	0.05	0.00	1.00	0.03	0.01
Montenegro	416.68	338.92	0.05	404.85	326.47	0.06	397.86	0.03	0.11
	1.14	0.04	0.01	1.32	0.04	0.01	1.27	233.04	0.01
Qatar	368.78	298.89	0.04	340.81	266.53	0.04	336.97	0.04	0.07
	1.20	0.03	0.01	1.30	0.04	0.00	1.66	319.39	0.01
Romania	421.90	337.01	0.10	418.48	326.79	0.10	400.28	0.03	0.13
	4.25	0.04	0.01	4.22	0.03	0.01	4.78	355.74	0.01
Russian Federation	481.11	382.05	0.05	476.96	375.12	0.04	442.09	0.02	0.09
	3.51	0.04	0.01	3.77	0.05	0.01	4.19	308.05	0.01
Serbia	437.44	364.66	0.08	437.61	361.83	0.09	403.17	0.03	0.14
	2.97	0.02	0.01	3.34	0.03	0.01	3.34	388.50	0.01
Slovenia	520.81	412.56	0.13	506.27	396.79	0.13	496.62	0.03	0.21
	1.10	0.03	0.01	0.92	0.04	0.01	0.94	449.51	0.01
Chinese Taipei	537.24	478.57	0.10	554.42	482.54	0.10	501.08	0.01	0.11
	3.41	0.02	0.01	3.79	0.01	0.01	3.07	365.71	0.01
Thailand	423.88	391.19	0.15	419.75	381.28	0.13	419.83	0.01	0.22
	2.12	0.01	0.01	2.19	0.01	0.01	2.41	292.11	0.01
Tunisia	386.81	316.99	0.08	367.47	286.08	0.15	382.23	0.02	0.11
	2.97	0.02	0.01	3.95	0.02	0.01	3.99	344.46	0.01
Uruguay	430.88	383.61	0.11	430.06	365.47	0.11	416.27	0.01	0.12
	2.72	0.01	0.01	2.48	0.01	0.01	3.39		0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2006.

Table 5: Average test scoresIEOp and WEEOp 2009, Reading, Mathematics and Science, OECD countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Australia	534.21	443.24	0.08	520.81	442.98	0.08	522.09	408.35	0.11
	2.38	0.02	0.00	2.43	0.02	0.01	2.16	0.02	0.00
Austria	498.13	384.80	0.11	498.58	399.60	0.10	474.49	357.22	0.15
	3.10	0.02	0.01	2.63	0.03	0.01	2.78	0.02	0.01
Belgium	515.89	420.03	0.12	524.37	420.01	0.12	515.14	429.64	0.13
	2.04	0.02	0.01	1.94	0.02	0.01	1.95	0.02	0.01
Canada	532.84	459.38	0.04	530.73	458.06	0.05	528.76	446.93	0.07
	1.47	0.02	0.00	1.43	0.02	0.00	1.39	0.01	0.00
Switzerland	520.25	437.26	0.11	537.25	452.84	0.10	504.23	410.00	0.14
	2.75	0.02	0.01	3.19	0.02	0.01	2.39	0.01	0.01
Czech Republic	504.21	343.92	0.08	496.06	365.60	0.09	481.94	328.43	0.15
	2.97	0.06	0.01	2.81	0.05	0.01	2.80	0.06	0.01
Germany	530.05	421.60	0.15	521.62	423.71	0.14	506.89	391.07	0.17
	2.68	0.02	0.01	2.74	0.02	0.01	2.56	0.02	0.01
Denmark	503.94	421.14	0.08	506.80	427.04	0.07	498.98	424.22	0.11
	2.40	0.02	0.01	2.58	0.02	0.01	2.04	0.02	0.01
Spain	490.81	447.85	0.08	485.82	431.16	0.09	484.06	430.99	0.11
	2.07	0.01	0.01	2.11	0.01	0.01	2.03	0.01	0.01
Finland	555.22	468.71	0.04	541.54	460.45	0.03	537.33	442.95	0.14
	2.24	0.02	0.01	2.11	0.04	0.01	2.15	0.02	0.01
France	509.48	423.28	0.12	507.26	425.61	0.11	507.57	405.37	0.13
	3.39	0.02	0.01	2.94	0.02	0.01	3.32	0.02	0.01
United Kingdom	524.06	427.81	0.06	501.33	414.02	0.07	504.97	419.40	0.07
	2.45	0.03	0.01	2.33	0.04	0.01	2.08	0.02	0.01
Greece	471.80	399.43	0.09	467.87	407.71	0.09	484.84	390.25	0.15
	3.89	0.01	0.01	3.80	0.01	0.01	4.16	0.01	0.01
Hungary	506.98	384.39	0.18	494.83	378.36	0.19	498.95	362.99	0.24
	2.83	0.02	0.01	3.26	0.02	0.01	2.94	0.02	0.01
Ireland	513.13	447.24	0.07	491.61	434.38	0.07	500.95	412.02	0.13
	3.06	0.02	0.01	2.48	0.02	0.01	2.85	0.03	0.01
Iceland	498.60	421.09	0.04	509.79	431.94	0.05	503.66	409.51	0.09
	1.43	0.03	0.01	1.29	0.03	0.01	1.41	0.02	0.01
Italy	490.90	427.69	0.08	484.73	423.91	0.07	488.31	405.97	0.14
	1.71	0.01	0.01	1.80	0.01	0.00	1.51	0.01	0.00
Japan	547.17	457.93	0.05	535.19	456.50	0.07	528.42	425.69	0.08
	2.88	0.03	0.01	2.91	0.03	0.01	2.88	0.04	0.01
Korea	539.83	465.17	0.05	548.38	468.36	0.06	540.88	450.48	0.09
	2.86	0.03	0.01	3.55	0.03	0.01	2.90	0.03	0.01
Luxemburg	490.23	405.58	0.16	494.47	418.15	0.14	479.72	383.74	0.18
	1.25	0.01	0.01	1.22	0.01	0.01	1.24	0.02	0.01
Mexico	418.20	386.60	0.11	420.95	385.60	0.11	428.01	380.46	0.13
	1.71	0.00	0.00	1.81	0.00	0.00	1.87	0.01	0.01
Netherlands	527.94	420.12	0.10	530.86	445.11	0.09	513.44	435.32	0.08
	5.09	0.03	0.01	4.52	0.03	0.01	5.03	0.02	0.01
Norway	503.77	387.86	0.05	501.56	412.95	0.05	507.56	387.66	0.11
	2.56	0.04	0.01	2.34	0.04	0.01	2.54	0.04	0.01
New Zealand	542.26	424.79	0.09	528.18	442.34	0.10	530.84	413.92	0.14
	2.43	0.02	0.01	2.26	0.02	0.01	2.23	0.02	0.01
Poland	510.85	424.63	0.13	497.34	414.38	0.13	503.63	401.19	0.20
	2.26	0.03	0.01	2.71	0.03	0.01	2.46	0.01	0.01
Portugal	494.86	443.47	0.14	488.74	425.35	0.14	491.41	414.99	0.17
	2.88	0.01	0.01	2.90	0.02	0.01	3.05	0.02	0.01
Slovak Republic	494.63	326.83	0.10	500.72	325.99	0.10	481.14	327.95	0.18
	2.65	0.04	0.01	2.89	0.06	0.01	2.27	0.04	0.01
Sweden	502.01	394.96	0.06	500.42	409.26	0.05	504.65	390.56	0.11
	2.59	0.02	0.01	2.78	0.03	0.01	2.74	0.03	0.01
Turkey	457.38	425.57	0.13	450.04	411.74	0.16	467.79	417.28	0.20
	3.61	0.01	0.01	4.57	0.01	0.01	3.50	0.01	0.01
United States	506.39	427.24	0.10	491.14	416.67	0.09	504.02	428.63	0.10
	3.56	0.02	0.01	3.54	0.02	0.01	3.57	0.02	0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2009.

Table 6: Average test scoresIEOp and WEEOp 2009, Reading, Mathematics and Science, Partners countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Albania	397.64	336.11	0.08	384.58	319.94	0.06	393.52	313.55	0.16
	3.94	0.01	0.01	4.02	0.02	0.01	4.09	0.02	0.01
United Arab Emirates	445.97	355.55	0.12	429.49	338.25	0.12	440.52	321.24	0.17
	2.49	0.01	0.01	2.36	0.03	0.01	2.73	0.03	0.01
Argentina	407.45	348.43	0.13	393.40	339.78	0.11	405.70	330.63	0.14
	4.58	0.01	0.01	4.16	0.01	0.01	4.64	0.02	0.01
Azerbaijan	376.73	333.37	0.03	432.10	395.60	0.01	366.21	316.44	0.07
	3.01	0.03	0.01	2.78	0.02	0.00	3.35	0.02	0.01
Bulgaria	449.91	332.23	0.16	436.92	329.79	0.16	440.24	297.74	0.22
	5.53	0.03	0.01	5.79	0.03	0.01	6.41	0.02	0.01
Brazil	408.35	372.59	0.09	388.53	351.14	0.09	415.33	354.53	0.11
	2.40	0.01	0.01	2.38	0.01	0.01	2.71	0.01	0.01
Chile	450.34	404.32	0.11	423.76	367.54	0.15	452.48	395.67	0.15
	2.87	0.01	0.01	3.01	0.01	0.01	2.98	0.01	0.01
Colombia	404.63	358.21	0.12	383.23	333.26	0.16	416.27	378.72	0.10
	3.52	0.01	0.01	3.17	0.01	0.01	3.59	0.01	0.01
Costa Rica	433.46	394.24	0.09	412.48	369.03	0.12	445.92	400.78	0.11
	2.61	0.01	0.01	2.93	0.01	0.01	3.04	0.01	0.01
Estonia	529.77	455.35	0.05	513.51	454.04	0.05	503.24	419.61	0.12
	2.57	0.04	0.01	2.51	0.03	0.01	2.54	0.03	0.01
Georgia	383.51	302.31	0.07	388.19	302.17	0.07	387.13	259.05	0.15
	2.76	0.06	0.01	2.78	0.09	0.01	2.70	0.06	0.01
Hong Kong SAR, China	552.62	495.10	0.02	558.51	502.84	0.04	536.90	467.30	0.06
	2.63	0.02	0.00	2.60	0.01	0.01	2.01	0.03	0.01
Croatia	488.12	416.65	0.07	461.92	381.34	0.07	477.65	378.28	0.16
	2.73	0.02	0.01	2.99	0.02	0.01	2.79	0.02	0.01
Indonesia	384.88	362.90	0.07	372.54	347.37	0.09	403.68	365.26	0.15
	3.69	0.01	0.01	3.70	0.01	0.01	3.68	0.01	0.01
Israel	467.70	371.34	0.13	459.36	354.53	0.16	488.48	377.49	0.15
	2.65	0.02	0.01	2.98	0.03	0.01	2.91	0.03	0.01
Jordan	424.65	368.98	0.11	395.58	354.83	0.08	415.96	354.83	0.15
	3.26	0.01	0.01	3.46	0.01	0.01	3.09	0.01	0.01
Kazakhstan	402.32	308.29	0.06	406.87	316.61	0.05	392.82	293.62	0.11
	3.09	0.05	0.01	2.95	0.05	0.01	2.97	0.04	0.01
Kyrgyzstan	334.72	232.91	0.09	335.42	257.87	0.10	320.51	212.27	0.16
	2.84	0.08	0.01	2.85	0.06	0.01	3.01	0.03	0.01
Liechtenstein	522.93	417.23	0.14	539.47	436.11	0.15	502.82	400.06	0.17
	3.51	0.06	0.04	3.94	0.05	0.03	2.94	0.05	0.04
Lithuania	495.79	392.96	0.10	481.12	394.26	0.11	473.30	384.41	0.20
	2.67	0.08	0.01	2.39	0.05	0.01	2.22	0.02	0.01
Latvia	496.40	426.94	0.08	483.87	398.03	0.09	487.07	392.15	0.17
	3.02	0.04	0.01	3.07	0.04	0.01	2.91	0.02	0.01
Macao - China	512.15	448.64	0.00	526.34	454.23	0.01	487.92	429.74	0.06
	0.79	0.03	0.00	0.86	0.05	0.00	0.75	0.02	0.01
Republic of Moldova	418.85	365.84	0.06	403.41	354.19	0.07	395.18	315.79	0.13
	2.79	0.01	0.01	2.97	0.01	0.01	2.72	0.01	0.01
Malta	471.47	372.07	0.10	471.80	383.50	0.07	452.89	343.27	0.16
	1.69	0.03	0.01	1.53	0.03	0.01	1.70	0.03	0.01
Montenegro	405.62	313.15	0.08	406.88	325.41	0.10	413.17	294.47	0.17
	1.91	0.03	0.01	1.88	0.05	0.01	1.73	0.05	0.01
Mauritius	420.98	362.45	0.09	423.82	369.59	0.08	411.52	338.46	0.14
	1.00	0.02	0.01	0.91	0.01	0.01	1.03	0.01	0.01
Malaysia	426.34	373.29	0.05	408.87	361.49	0.08	418.52	357.76	0.08
	2.64	0.02	0.01	2.74	0.02	0.01	2.82	0.02	0.01
Panama	388.76	329.52	0.07	369.86	326.48	0.07	384.00	330.32	0.11
	5.19	0.02	0.01	4.97	0.02	0.01	6.25	0.02	0.02
Peru	372.51	314.72	0.17	368.52	296.43	0.20	374.11	304.86	0.20
	3.30	0.01	0.01	3.82	0.01	0.01	3.86	0.01	0.01
Qatar	394.75	316.82	0.06	382.01	311.56	0.07	388.75	288.76	0.07
	0.84	0.04	0.00	0.75	0.02	0.01	0.93	0.03	0.01
Shanghai - China	575.92	534.37	0.08	601.58	540.28	0.08	557.22	501.07	0.14
	2.19	0.01	0.01	2.75	0.01	0.01	2.31	0.01	0.01
Himachal Pradesh - India	334.59	291.79	0.13	347.43	305.73	0.15	327.16	282.20	0.11
	4.49	0.03	0.02	4.86	0.02	0.02	4.90	0.02	0.02
Tamil Nadu - India	351.38	322.27	0.08	353.84	310.37	0.09	340.05	280.77	0.10
	3.87	0.02	0.02	5.04	0.02	0.02	5.38	0.02	0.02
Miranda - Venezuela	426.39	333.13	0.16	400.94	324.52	0.18	428.38	331.46	0.15
	4.89	0.02	0.02	4.31	0.03	0.02	5.26	0.03	0.02
Romania	431.75	373.53	0.05	430.57	374.86	0.06	428.91	347.69	0.11
	3.26	0.03	0.01	3.21	0.02	0.01	3.93	0.02	0.01
Russian Federation	480.48	393.15	0.05	469.70	384.65	0.05	461.83	338.91	0.12
	3.17	0.04	0.01	3.23	0.05	0.00	3.23	0.05	0.01
Singapore	544.55	468.93	0.09	564.75	488.06	0.08	528.90	456.41	0.10
	1.24	0.02	0.01	1.18	0.02	0.01	1.06	0.02	0.01
Serbia	445.33	362.62	0.06	444.71	348.22	0.08	444.71	355.24	0.13
	2.17	0.03	0.01	2.76	0.05	0.01	2.21	0.04	0.01
Slovenia	515.73	429.76	0.10	505.09	423.12	0.11	487.52	389.29	0.20
	1.12	0.02	0.01	1.22	0.02	0.01	1.08	0.03	0.01
Chinese Taipei	525.12	475.57	0.08	548.24	484.24	0.07	500.34	437.90	0.13
	2.52	0.01	0.01	3.37	0.01	0.01	2.48	0.01	0.01
Thailand	429.39	385.34	0.11	422.13	380.83	0.11	425.35	369.04	0.19
	2.84	0.01	0.01	3.27	0.01	0.01	2.55	0.01	0.01
Trinidad and Tobago	420.34	343.66	0.06	423.06	354.93	0.06	428.49	331.00	0.10
	1.28	0.03	0.01	1.20	0.01	0.01	1.45	0.02	0.01
Tunisia	402.58	352.26	0.07	373.51	324.29	0.11	406.00	337.37	0.10
	2.72	0.02	0.01	2.99	0.01	0.01	2.92	0.02	0.01
Uruguay	430.64	382.97	0.16	430.31	383.68	0.17	429.95	363.42	0.21
	2.37	0.00	0.01	2.46	0.01	0.01	2.43	0.01	0.01

Notes. Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD PISA

Table 7: Average test scoresIEOp and WEEOp 2012, Reading, Mathematics and Science, OECD countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Australia	525.66	460.43	0.09	508.04	444.26	0.10	516.42	453.40	0.12
	1.72	0.01	0.01	1.64	0.01	0.01	1.55	0.01	0.01
Belgium	510.81	437.26	0.13	520.31	440.42	0.13	515.10	419.29	0.15
	2.18	0.01	0.01	2.20	0.02	0.01	2.29	0.02	0.01
Canada	529.35	451.48	0.05	521.65	447.99	0.07	527.49	447.34	0.09
	1.83	0.02	0.00	1.83	0.01	0.00	1.88	0.03	0.01
Switzerland	517.78	433.76	0.12	533.61	450.35	0.10	512.04	440.41	0.14
	2.67	0.01	0.01	3.04	0.01	0.01	2.47	0.01	0.01
Chile	446.23	398.99	0.15	424.02	366.52	0.19	443.04	376.95	0.18
	2.82	0.01	0.01	3.00	0.01	0.01	2.82	0.01	0.01
Czech Republic	510.20	311.29	0.09	500.55	352.58	0.10	495.02	339.42	0.13
	2.77	0.16	0.01	2.68	0.04	0.01	2.74	0.03	0.01
Germany	533.65	475.83	0.12	522.61	459.04	0.13	518.68	452.19	0.17
	3.22	0.01	0.01	3.16	0.01	0.01	2.88	0.01	0.01
Denmark	502.84	417.83	0.10	503.62	426.00	0.11	500.53	425.95	0.14
	2.58	0.02	0.01	2.13	0.02	0.01	2.36	0.01	0.01
Spain	499.11	459.23	0.09	486.41	442.80	0.11	490.86	436.74	0.11
	1.78	0.00	0.01	1.83	0.01	0.01	1.78	0.01	0.01
Estonia	542.98	495.25	0.05	522.12	458.24	0.06	517.92	435.06	0.12
	1.90	0.04	0.01	1.93	0.03	0.01	2.00	0.04	0.01
Finland	548.46	461.59	0.06	521.34	445.58	0.05	527.17	433.05	0.15
	2.11	0.03	0.01	1.85	0.02	0.00	2.24	0.03	0.01
France	505.44	421.40	0.13	501.18	414.34	0.13	513.03	424.77	0.15
	2.51	0.01	0.01	2.32	0.01	0.01	2.79	0.01	0.01
United Kingdom	523.59	443.18	0.09	502.21	429.97	0.07	508.73	448.46	0.09
	2.90	0.02	0.01	2.83	0.02	0.01	2.92	0.03	0.01
Greece	469.28	402.97	0.12	455.09	390.86	0.11	480.46	398.72	0.16
	3.05	0.02	0.01	2.43	0.01	0.01	3.16	0.01	0.01
Hungary	497.37	406.89	0.14	479.64	379.33	0.15	491.23	389.57	0.19
	2.68	0.04	0.01	2.96	0.03	0.01	2.94	0.04	0.01
Iceland	483.26	429.47	0.04	497.81	447.17	0.04	489.17	423.89	0.10
	1.74	0.02	0.01	1.58	0.02	0.01	1.63	0.02	0.01
Israel	475.13	357.00	0.17	471.37	335.63	0.20	491.62	345.98	0.19
	4.70	0.04	0.01	4.52	0.05	0.01	4.75	0.04	0.01
Italy	494.92	451.62	0.08	486.74	440.60	0.09	491.94	430.08	0.12
	1.93	0.01	0.00	2.04	0.00	0.00	1.97	0.01	0.00
Japan	550.98	452.24	0.07	540.27	455.55	0.09	543.09	438.86	0.07
	3.50	0.04	0.01	3.60	0.04	0.01	3.61	0.03	0.01
Korea	538.83	474.70	0.04	554.96	486.35	0.07	537.02	445.03	0.07
	3.48	0.05	0.01	4.37	0.03	0.01	3.79	0.02	0.01
Luxemburg	495.60	414.99	0.18	493.75	423.02	0.17	493.52	420.99	0.15
	1.05	0.01	0.01	0.94	0.01	0.01	1.10	0.01	0.01
Mexico	415.73	393.98	0.08	414.19	388.88	0.08	424.70	390.09	0.10
	1.28	0.00	0.00	1.32	0.00	0.00	1.43	0.00	0.00
Netherlands	528.22	452.65	0.08	528.65	464.12	0.07	517.15	445.94	0.09
	3.32	0.02	0.01	3.25	0.02	0.01	3.25	0.02	0.01
Norway	499.77	403.39	0.05	493.28	403.18	0.05	510.34	399.66	0.10
	2.86	0.02	0.01	2.58	0.02	0.01	2.84	0.02	0.01
New Zealand	525.29	446.69	0.13	507.99	427.95	0.13	521.66	438.87	0.13
	2.14	0.02	0.01	2.10	0.02	0.01	2.40	0.02	0.01
Poland	526.91	432.95	0.12	518.19	411.24	0.13	519.21	411.00	0.17
	3.00	0.04	0.01	3.58	0.06	0.01	3.08	0.03	0.01
Portugal	492.91	458.59	0.13	490.67	451.64	0.14	491.79	441.67	0.16
	3.58	0.01	0.01	3.62	0.00	0.01	3.57	0.01	0.01
Florida	487.53	420.51	0.08	469.02	412.30	0.08	494.79	427.45	0.08
	6.16	0.04	0.01	5.57	0.03	0.02	5.85	0.04	0.01
Connecticut	524.30	418.69	0.14	508.91	409.07	0.14	525.08	411.91	0.14
	4.93	0.04	0.02	5.48	0.04	0.01	5.64	0.04	0.02
Massachusetts	529.48	432.88	0.12	515.66	421.89	0.12	529.46	446.25	0.13
	6.03	0.03	0.01	6.28	0.03	0.01	6.04	0.03	0.01
Slovak Republic	473.80	152.73	0.01	484.38	256.91	0.17	465.48	213.16	0.21
	3.43		0.06	3.30	0.20	0.01	3.97	0.17	0.01
Slovenia	516.38	392.80	0.01	502.95	410.31	0.12	483.96	355.06	0.19
	1.05	0.06	0.03	1.08	0.08	0.01	0.97	0.07	0.01
Sweden	491.18	413.34	0.01	483.54	419.87	0.07	490.26	388.57	0.13
	2.81	0.03	0.01	2.11	0.02	0.01	2.84	0.02	0.01
Turkey	464.15	440.67	0.01	448.96	417.45	0.10	476.63	432.36	0.16
	3.82	0.01	0.01	4.74	0.01	0.01	4.14	0.01	0.01
United States	500.10	433.78		483.78	427.84	0.11	500.58	449.04	0.11
	3.69	0.01		3.47	0.01	0.01	3.66	0.01	0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2012.

Table 8: Average test scoresIEOp and WEEOp 2012, Reading, Mathematics and Science, Partners countries

cnt	Science			Math			Reading		
	Average	WEEOp read	IEop Read	Average	WEEOp math	IEOp Math	Average	WEEOp scie	Iop Scie
Albania	394.73	375.25	0.00	391.91	376.55	0.00	390.31	365.82	0.00
	2.86	0.01	0.00	2.45	0.01	0.00	3.74	0.01	0.00
United Arab Emirates	451.05	356.49	0.13	436.30	369.13	0.12	444.91	330.55	0.18
	2.75	0.03	0.01	2.44	0.02	0.01	2.38	0.02	0.01
Argentina	409.70	368.83	0.11	391.83	348.80	0.11	400.21	345.37	0.12
	3.77	0.01	0.01	3.40	0.01	0.01	3.61	0.01	0.01
Bulgaria	451.34	336.04	0.20	443.02	344.12	0.18	442.54	295.27	0.27
	4.51	0.02	0.01	3.80	0.04	0.01	5.63	0.02	0.01
Brazil	403.76	373.94	0.11	390.10	353.80	0.13	408.86	364.99	0.13
	2.00	0.00	0.01	1.95	0.00	0.01	2.01	0.00	0.01
Colombia	399.04	369.23	0.10	377.00	340.47	0.12	404.14	360.13	0.12
	3.02	0.00	0.01	2.88	0.01	0.01	3.39	0.01	0.01
Costa Rica	429.98	393.97	0.11	407.60	369.54	0.14	441.30	393.12	0.14
	2.84	0.01	0.01	3.00	0.01	0.01	3.34	0.01	0.01
Hong Kong SAR, China	557.53	527.29	0.04	564.39	522.08	0.07	547.27	510.45	0.06
	2.53	0.02	0.01	3.13	0.01	0.01	2.73	0.01	0.01
Croatia	491.95	427.06	0.06	471.75	402.06	0.08	485.48	402.84	0.15
	3.10	0.02	0.01	3.55	0.02	0.01	3.24	0.04	0.01
Indonesia	383.08	367.27	0.07	376.27	356.32	0.07	397.73	371.35	0.09
	3.69	0.00	0.01	4.00	0.01	0.01	4.12	0.01	0.01
Ireland	523.98	459.11	0.09	503.17	438.00	0.10	525.25	468.44	0.11
	2.23	0.01	0.01	2.08	0.02	0.01	2.39	0.02	0.01
Jordan	415.15	342.93	0.13	390.86	321.97	0.10	406.97	332.27	0.21
	2.82	0.03	0.01	2.82	0.05	0.01	2.96	0.02	0.01
Kazakhstan	425.32	296.97	0.05	432.29	357.11	0.03	393.49	301.75	0.12
	2.88	0.16	0.01	2.98	0.03	0.01	2.59	0.08	0.01
Liechtenstein	526.72	430.24	0.14	538.89	437.43	0.14	517.27	434.67	0.12
	3.47	0.05	0.04	3.96	0.06	0.05	3.74	0.03	0.04
Lithuania	497.59	398.70	0.10	480.81	385.02	0.10	479.56	377.77	0.19
	2.45	0.08	0.01	2.61	0.04	0.01	2.41	0.06	0.01
Latvia	503.72	424.43	0.09	491.81	417.30	0.10	490.24	370.76	0.20
	2.66	0.04	0.01	2.70	0.05	0.01	2.31	0.04	0.01
Macao - China	521.76	493.79	0.01	539.88	508.97	0.01	510.17	469.96	0.05
	0.82	0.01	0.00	0.96	0.01	0.00	0.84	0.01	0.01
Montenegro	414.92	283.24	0.10	413.97	287.14	0.09	426.77	300.56	0.20
	1.01	0.19	0.01	0.98	0.06	0.01	1.09	0.06	0.01
Malaysia	421.27	383.29	0.07	422.06	387.33	0.08	400.55	349.52	0.11
	2.81	0.01	0.01	3.08	0.01	0.01	3.14	0.02	0.01
Peru	373.80	326.79	0.16	368.74	308.61	0.17	385.10	323.18	0.18
	3.52	0.01	0.01	3.68	0.01	0.01	4.30	0.01	0.01
Qatar	392.54	304.56	0.11	384.63	319.02	0.09	398.31	302.42	0.16
	0.81	0.02	0.00	0.73	0.02	0.01	0.79	0.02	0.01
Shanghai - China	580.82	531.78	0.11	613.43	553.68	0.11	570.44	515.77	0.13
	2.92	0.01	0.01	3.22	0.01	0.01	2.73	0.01	0.01
Perm (russian federation)	482.65	278.72	0.06	486.32	301.14	0.05	485.90	231.90	0.12
	5.07	0.38	0.01	5.27	2.45	0.01	5.66	0.31	0.02
Romania	439.95	359.47	0.13	445.47	361.43	0.13	439.09	334.55	0.17
	3.21	0.10	0.01	3.68	0.08	0.01	3.90	0.03	0.01
Russian Federation	488.00	404.61	0.08	483.30	385.61	0.05	477.02	384.15	0.12
	2.82	0.04	0.01	3.06	0.07	0.01	2.94	0.03	0.01
Singapore	552.92	486.25	0.12	574.71	513.84	0.10	543.65	471.79	0.13
	1.45	0.01	0.01	1.30	0.01	0.01	1.35	0.01	0.01
Serbia	446.60	351.90	0.05	450.66	341.23	0.07	448.59	343.57	0.11
	3.25	0.04	0.01	3.32	0.05	0.01	3.32	0.05	0.01
Chinese Taipei	525.09	464.57	0.12	561.88	479.46	0.12	525.30	448.68	0.13
	2.25	0.03	0.01	3.22	0.02	0.01	2.90	0.02	0.01
Thailand	446.07	422.45	0.09	428.90	406.83	0.10	443.79	398.72	0.21
	2.83	0.01	0.01	3.40	0.01	0.01	2.96	0.01	0.01
Tunisia	400.90	368.20	0.07	390.34	353.65	0.12	407.44	353.87	0.11
	3.40	0.01	0.01	3.93	0.01	0.01	4.40	0.02	0.01
Uruguay	418.44	376.89	0.14	411.51	371.37	0.16	414.22	358.19	0.17
	2.60	0.01	0.01	2.67	0.00	0.01	2.90	0.01	0.01
Viet Nam	528.71	507.39	0.07	511.62	486.06	0.10	508.54	470.69	0.12
	4.27	0.01	0.01	4.80	0.01	0.01	4.36	0.01	0.01

Notes: Bootstrapped Std. Err. in the second lines. Source: Authors' calculations on OECD-PISA 2012.