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ABSTRACT

Is Inequality of Opportunity Robust to the Measurement Approach?*

Recent literature has suggested many ways of measuring equality of opportunity. We analyze in a systematic manner the various approaches put forth in the literature to show whether and to what extent different choices matter empirically. We use EU-SILC data for most European countries for 2005 and 2011. The choice between ex-ante and ex-post approaches is crucial and has a substantial influence on inequality of opportunity country orderings. Growth regressions also illustrate the relevance of conceptual choices. We only find significant negative effects for some direct parametric ex-ante measures.

JEL Classification: D3, D63

Keywords: equality of opportunity, measurement, ex-ante, ex-post, direct approach, indirect approach, responsibility, effort, income, EU-SILC

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1 Introduction

Responsibility-sensitive egalitarianism shifts the focus from outcomes to their determinants, when assessing economic inequalities, and advocates offsetting the effect of circumstances, for which individuals are not deemed responsible, while respecting the effects of effort. Since the first contributions by Dworkin (1981), Arneson (1989), and Cohen (1990), the economics literature, following seminar contributions by (Roemer, 1993, 1998), Fleurbaey (1995) and Bossert (1995), has laid out the basic principles that ought to guide measurement. In a recent paper (Ramos and Van de gaer, 2016), we bring together the theoretical and the empirical literature and draw attention to the conceptual differences of the empirical measures. This paper takes those lessons as starting point with the intention to investigate whether those important conceptual differences have any bearing in ordering distributions when taken to the data, and bring about systematic differences in orderings. To this end, we estimate a wide range of inequality of opportunity measures to the same set of data, the European Union - Statistics on Income and Living Conditions (EU-SILC), an empirical exercise which has not been done so far.

Conceptually, the most frequently used measures of inequality of opportunity can be classified on the basis of three criteria. The first criterion, distinguishes between ex-ante and ex-post measures. Ex-ante measures compute the inequality in the values of individuals' opportunity sets while ex-post measures compute the inequality in the incomes of those that have the same efforts. Initially, the theoretical literature treated ex-ante and ex-post approaches approaches as being very similar (Roemer, 2002, Roemer *et al.*, 2003). Recent theoretical contributions stress they are different and often conflict (Ooghe *et al.*, 2007, Roemer, 2012 and Fleurbaey and Peragine, 2013). Most of the empirical litterature continues to treat them as interchangeable, by motivating their concern with inequality of opportunity from ex-post intuitions and using ex-ante measures of inequality of opportunity. We find that the distiction between ex-ante versus ex-post matters a lot for country orderings. The second criterion, due to Pistolesi (2009), distinguishes between direct and indirect measures. Direct measures calculate the inequality in a counterfactual income distribution where all income inequalities are exclusively due to individuals' circumstances. Indirect measures calculate the difference between the inequality in the actual income distribution and the inequality in a counterfactual income distribution in which there is no inequality of opportunity. Our results suggest that the distinction between direct and indirect measures is of secondary importance: conditional on the ex-ante or ex-post approach, direct measures are quite different from indirect measures. The third criterion focuses on whether a parametric or non-parametric methodology is used to construct the counterfactual. This choice is relevant when the often-used parsimonious linear specification does not yield a reasonable fit, and it is thus data-dependent.

In the next Section we provide a more detailed description of these criteria, present and formally define the most frequently used measures of inequality of opportunity and classify them. Section 3 describes the EU-SILC data and the circumstances and effort variables used in the empirical analysis, while Section 4 reports our main results. We first examine the incidence of choices on country orderings, and then show estimates from growth regressions to illustrate further their empirical relevance. The concluding section wraps up.

2 Measurement Approaches

As responsibility-sensitive egalitarianism distinguishes between efforts and circumstances, the empirical model assumes that for each individual k in the population $N = \{1, \cdots, n\}$, his income, y_k, depends on his circumstances, given by a d^C-dimensional vector a_k^C, his efforts, given by a d^R-dimensional vector a_k^R, and a random term e_k, such that

$$y_k = g\left(a_k^C, a_k^R, e_k\right) \quad \text{where} \quad g: \mathbb{R}^{d^C} \times \mathbb{R}^{d^R} \times \mathbb{R} \to \mathbb{R}_{++}.$$[1]

Following Roemer (1993) (Peragine, 2004) a type (tranche) is a set of people having the same circumstances (efforts). Measures of inequality of opportuity can be classified on the basis of three criteria: whether they take an ex-ante or ex-post perspective, whether they are direct or indirect measures of inequality of opportunity, and whether the counterfactual distribution used in the measure is constructed using a parametric or non-parametric method.

A first distinction is between ex-ante and ex-post approaches. The ex-ante approach measures the inequality between individuals' opportunity sets, and assumes that these opportunity sets are determined by individuals' circumstances. It attaches the same value to the opportunity set of those that belong to the same type, and measures the inequality in the values of individuals' opportunity sets. The ex-post approach measures the inequality in the incomes of individuals that have the same effort. All inequalities between such individuals must be due to their circumstances, and is, for that reason a measure of inequality of opportunity.[2]

A second distinction is between direct and indirect measures. Direct measures of inequality of opportunity compute the inequality in a n-dimensional counterfactual income distribution y^c in which all inequalities due to differences in effort have been eliminated such that only the inequality that is due to differences in circumstances is left:

$$I\left(y^c\right), \tag{1}$$

where $I: \mathbb{R}_{++}^n \to \mathbb{R}$ is a measure of inequality. Indirect measures of inequality of opportunity compare the inequality in the actual distribution of income, $I(y)$, to the inequality in

[1] We discussed the consequences of unobserved random variation in Ramos and Van de gaer (2016), and abstract from that complication here.

[2] In parametric ex-post approaches the random term is put equal to zero in the construction of the counterfactual, such that variation in the counterfactual is due to differences in efforts. In non-parametric approaches random terms are not taken into account, but the averaging procedures make them disappear, at least asymptotically.

a counterfactual income distribution where there is no inequality of opportunity $I\left(y^{E0}\right)$. This results in the measure

$$\Theta_I\left(y, y^{EO}\right) = I\left(y\right) - I\left(y^{EO}\right), \tag{2}$$

where $\Theta_I\left(y, y^{EO}\right) : \mathbb{R}^n_{++} \times \mathbb{R}^n_{++} \rightarrow \mathbb{R}$. Based on a decomposition argument, the idea behind the appraoch is that the difference beween the inequality in the actual distribution and the inequality in the counterfactual income distribution without inequality of opportunity gives the inequality that is due to inequality of opportunity.

A third distinction is based on the method used to construct the counterfactual. This method can be parametric or non-parametric. The parametric approach imposes a functional form to estimate individuals' incomes as a function of efforts or circumstances, resulting in specifications with 3 possible domains:

$$\widehat{g}\left(a_k^C, a_k^R, e_k\right) \quad \text{where} \quad \widehat{g} : \mathbb{R}^{d^C} \times \mathbb{R}^{d^R} \times \mathbb{R} \rightarrow \mathbb{R}_{++},$$

$$\widehat{g}^C\left(a_k^C, e_k\right) \quad \text{where} \quad \widehat{g}^C : \mathbb{R}^{d^C} \times \mathbb{R} \rightarrow \mathbb{R}_{++},$$

$$\widehat{g}^R\left(a_k^R, e_k\right) \quad \text{where} \quad \widehat{g}^R : \mathbb{R}^{d^R} \times \mathbb{R} \rightarrow \mathbb{R}_{++}.$$

These equations can be used to estimate y_k by setting e_k equal to zero. Non-parametric procedures typically do not impose a functional form and rely on averaging procedures.

Table 1 uses the three distinctions to classify the standard measures used in the literature.

Table 1: Measures of inequality of opportunity

	Non-parametric	Parametric
(a) Direct $I\left(y^c\right)$		
Ex-ante	$y_k^{c1} = \frac{1}{\lvert N_{k.}\rvert} \sum_{i \in N_{k.}} y_i$	$y_k^{c3} = \widehat{g}^C\left(a_k^C, 0\right)$
	$y_k^{c2} = \frac{2}{\lvert N_{k.}\rvert\lvert N_{k.}+1\rvert} \sum_{i \in N_{k.}} i\widetilde{y}_i$	
Ex-post	$y_k^{c4} = y_k \frac{\mu(y)}{y_k^{EO1}}$	$y_k^{c5}\left(\overline{a}^R\right) = \widehat{g}\left(a_k^C, \overline{a}^R, 0\right)$
(b) Indirect $\Theta_I\left(y, y^{EO}\right) = I\left(y\right) - I\left(y^{EO}\right)$		
Ex-ante	$y_k^{EO4} = y_k \frac{\mu(y)}{y_k^{c1}}$	
Ex-post	$y_k^{EO1} = \frac{1}{\lvert N_{.k}\rvert} \sum_{i \in N_{.k}} y_i$	$y_k^{EO3} = \widehat{g}^R\left(a_k^R, 0\right)$
	$y_k^{EO2} = \frac{2}{\lvert N_{.k}\rvert\lvert N_{.k}+1\rvert} \sum_{i \in N_{.k}} i\breve{y}_i$	$y_k^{EO5}\left(\overline{a}^C\right) = \widehat{g}\left(\overline{a}^C, a_k^R, 0\right)$

Notes: $N_{k.} = \left\{i \in N \mid a_i^C = a_k^C\right\}$, $\widetilde{y}_i$ is the $i-th$ largest level of income in the set $N_{k.}$, $\overline{a}^R$ is a reference value for the vector of responsibility variables, $N_{.k} = \left\{i \in N \mid a_i^R = a_k^R\right\}$, $\breve{y}_i$ is the $i-th$ largest level of income in the set $N_{.k}$, $\overline{a}^C$ is a reference value for the vector of circumstance variables, $\mu\left(y\right)$ is mean income of vector y.

Consider the direct measures first. Three ways to measure the value of an individual's opportunity set are proposed. Counterfactual y^{c1}, proposed by Van de gaer (1993), measures the value of an individual's opportunity set by the average income of his type;

y^{c2}, proposed by Lefranc *et al.* (2008) measures it by the normalized surface under the generalised Lorenz curve of his type; y^{c3}, proposed by Ferreira and Gignoux (2011) takes the parametric estimate of his income, given his circumstances. The counterfactual for ex-post measure y^{c4}, proposed by Checchi and Peragine (2010), scales everybody's income up or down by the ratio of the average income in the population and the average income of his tranche. That way, the inequalities between those that belong to the same tranche are preserved, while the differences in average incomes of different tranches are eliminated. Finally, y^{c5}, proposed by Pistolesi (2009), relies on the choice of $\overline{a}^R$, a reference value for the vector of responsibility characteristics and takes the parametric estimate of his income, given his circumstances and efforts equal to the reference values.

The counterfactuals used in the indirect approach are obtained by switching the role of circumstance and effort variables of the direct approach. This dual relationship is reflected in the number used to label the counterfactuals: for all $i = 1, \cdots, 5$, y^{EOi} is the dual counterfactual of y^{ci}. Checchi and Peragine (2010) proposed counterfactual y^{EO1}, which assigns to every individual the average income of his tranche; y^{EO2} assigns the value of the normalized surface under the generalised Lorenz curve of the income distribution of his tranche; y^{EO3} the parametric estimate of his income, given his efforts; y^{EO5} the parametric estimate of his income, given his efforts and circumstances equal to the reference values. In all these counterfactuals, those with the same efforts have the same income, such that the corresponding indirect measure becomes a measure of the income inequality that is due to their different circumstance; they are ex-post measures of inequality of opportunity. The only ex-ante measure is y^{EO4}, proposed by Checchi and Peragine (2010), where incomes are scaled up or down by the ratio of the average income in the population and the value of the opportunity set measured by y^{c1}_k, such that in this counterfactual, the average income of every type equals average income in the population and everyone's opportunity set has the same value. In the sequel I^X denotes the inequality measure based on counterfactual y^X with $X \in \{c1, \ldots, c5, EO1, \ldots, EO5\}$.

3 Data

We draw on data from the European Union - Statistics on Income and Living Conditions (EU-SILC), which collects comparable information on socio-economic and demographic characteristics of individuals across European countries. In particular we use the 2005 and 2011 waves, which collected information on family background and circumstances when the respondent was young in separate questionnaire modules. EU-SILC data have been commonly used to study equality of opportunity across European countries, see *inter alia* Marrero and Rodríguez (2012) and Checchi *et al.* (2016).

The EU-SILC provides data for a large number of countries, which allows us to compare country orderings by inequality of opportunity when different measures are used. The main limitation of EU-SILC is the reduced sample sizes for some countries, which obliges us to work with a reduced number of circumstances and efforts.

As in previous studies, e.g. Marrero and Rodríguez (2012), we select individuals aged 25 to 59 to avoid the noise associated to the school-job transition for the younger population and to retirement decisions for the older individuals.

Our outcome of interest is disposable equivalent income.[3] To check the reliability of our income variable, we compare our income inequality estimates with other estimates coming from different sources, such as the OECD, and obtain correlation coefficients above 0.9, indicating that our estimates are in line with those from the OECD.

Working with a limited amount of circumstances and effort variables, and thus types and tranches, results in partitions that are too coarse and that end up driving the estimates of the various direct and indirect measures. Because of this, we use a set of 5 circumstance and 4 effort variables, which translate into 48 types and 24 tranches, thus achieving finer partitions than the majority of recent empirical studies on equality of opportunity. Our circumstances include parental education and occupation, gender, birthplace, and whether the respondent lived with both parents when young, while the set of efforts includes own educational attainment, own occupation, work status, and marital status. All variables have two categories, except the two occupation variables, which have 3 categories each. Description and summary statistics of circumstance and effort variables can be found in Appendix Tables 10 to 13.

The circumstance variable "whether both parents were present at home when respondent was young" has not been used before, and thus deserve some justification. Growing up in non-intact families is found to condition several later-life outcomes, and earnings during adulthood is one of them (Mohanty and Ullah, 2012).

Own education has been previously used as effort variable (e.g. Almås *et al.*, 2011), but we believe deserves some discussion. Undoubtedly own effort affects educational attainment (De Fraja *et al.*, 2010), which in turn determines wages and thus incomes. What may be a bit more controversial is the choice of own education as an effort variable, as some may argue that children cannot be deemed responsible for their own effort before the age of consent, and such effort levels are also determining later educational attainment after the age of consent. As discussed above, however, since there are only few variables in the EU-SILC that can be used as effort variables and most of them provide only very small cell sizes, we decided to use own educational attainment as an effort variable.

The other variables included in the set of circumstances or effort are not new and rather uncontroversial, and do not deserve further discussion.[4]

[3]Disposal equivalent individual income is computed by deflating disposal equivalent household income (variable HY020, including the sum for all household members of gross personal income components plus gross income components at household level, minus taxes paid), with the modified OECD equivalent scale, (variable HX050, which assigns a weight of 1 to the first adult, of 0.5 to remaining adults of the family, and of 0.3 to children younger than 14).

[4]See Table 25.8 in Ferreira and Peragine (2016) for a list of circumstance variables used in eight papers that cover 41 countries. Roemer and Trannoy (2015) discuss important issues in the use of effort variables often included in empirical analyses.

4 Results

This section presents the results of testing whether the main conceptual issues discussed in Section 2 matter in practice. To this end, we first estimate inequality of opportunity for all counterfactual distributions y^{c1} to y^{c5} and y^{EO1} to y^{EO5}, and then check whether different measures of inequality of opportunity change the ordering of inequality of opportunity across countries by means of Spearman's rank correlations. When they do, we analyze whether the conceptual issues shape these ordering changes.

Empirical studies mostly use two well known inequality indices to compute inequality of opportunity: the MLD and the Gini coefficient. As we discuss below, both indices have advantages and drawbacks for the measurement of inequality of opportunity. We employ the Gini coefficient in our baseline estimates reported below, and present the robustness of our findings to using the MLD in Section 4.1. In this section we refer to and present results for 2005. Our findings also hold to a very large extent for 2011, and when they differ we indicate it in the text. The evidence for 2011 is shown in the Appendix Tables 6 to 8.[5]

Rank correlation coefficients displayed in Table 2 are for some measures surprisingly low and sometimes not significantly different from zero. This raises doubts that all these measures capture the same concept. Looking at the Table in more detail, it becomes clear that some conceptual and theoretical differences outlined in Section 2 matter in practice. The clearest lesson is that ex-ante and ex-post views lead to different country orderings. The rank correlations between ex-ante and ex-post measures are often not significantly different from zero. The distinction between direct and indirect approaches matters only conditional on choosing an ex-ante or an ex-post view. Next we discuss this in more detail and examine the empirical importance of other relevant issues that the analyst must address when estimating inequality of opportunity.

If we were to group the measures discussed in Section 2 according to the correlations displayed in Table 2, we would have three groups: $G_1 = (y^{c1}, y^{c2}, y^{c3}, y^{EO4})$, $G_2 = (y^{c4}, y^{EO1}, y^{EO2}, y^{EO3}, y^{EO5})$, and $G_3 = (y^{c5})$. G_1 includes all ex-ante measures, while G_2 includes all ex-post measures but y^{c5}, which seems to yield different orderings than all other measures, so we put it separately into G_3. Thus, the difference between ex-ante and ex-post measures comes out as an important empirical divide.[6]

The direct and indirect approaches do not seem to shape the estimated rank correlations as much as the ex-ante/ex-post divide. While rank correlations amongst direct measures are reasonably high ($> .69$), direct ex-ante measures y^{c1}, y^{c2}, and y^{c3} show higher correlations with the indirect ex-ante measure y^{EO4} than with direct ex-post measures y^{c4} and y^{c5}. Indirect measures show a similar pattern, as the indirect ex-ante measure y^{EO4} shows a higher correlation with direct ex-ante measures than with indirect ex-post mea-

[5]Our results are also robust to dropping Cyprus from the analysis, as it showed an unreasonable increase in income inequality, according both to the Gini ($>$ 20% increase from 2005 to 2011) and to the MLD ($>$ 45% increase).

[6]For 2011, y^{c3} correlates most strongly with y^{c5}, and so should be included in group G_3.

sures y^{EO1}, y^{EO2}, y^{EO3}, y^{EO5}. Likewise, excluding y^{c5}, indirect ex-post measures show higher correlations with direct ex-post measures than with indirect ex-ante measures. That is, conditional on the ex-ante or ex-post approach, measures yield closer rankings within direct and within indirect methods than across them.

We turn next to the third distinction between measures based on *parametric and non-parametric counterfactuals*. Non-parametric counterfactuals are equivalent to those obtained from fully saturated parametric models that include all possible interaction effects. Most of the literature, however, uses linear specifications for the parametric approach. In the light of this, the relevant question is: To what extent does the importance of interaction effects differ enough across countries as to change the country orderings? Our findings suggest that the answer is data-dependent. In fairly parsimonious specifications that provide a reasonable fit, interaction effects are not so relevant in determining country orderings, as non-parametric and analogous or similar linear parametric approaches yield similar orderings. For instance, Table 2 shows that the rank correlation between ex-ante direct non-parametric y^{c1} and linear parametric y^{c3} is 0.89, while the rank correlation between indirect ex-post non parametric y^{EO1} and its parametric counterpart y^{EO3} is also large (0.92). However, when the fit of the parsimonious specification is rather poor, interaction effects are indeed relevant in determining country orderings. The fit of our linear regressions for 2011 is much poorer than the fit for 2005. As a consequence, the rank correlation between ex-ante direct non-parametric y^{c1} and linear parametric y^{c3} is remarkably low, 0.18 –see Table 6.[7] Our 2011 findings are in line with Brunori *et al.* (2016). They use the same EU-SILC dataset for 2011 to compare a parsimonious linear specification with another specification that includes all possible interaction terms and where categorical variables are partitioned more finely, and obtain a rank correlation of 0.52 between direct measures y^{c1} and y^{c3}.

As we explained above, parametric approaches estimate counterfactuals in two ways: either by using $\widehat{g}^C$ ($\widehat{g}^R$) in the direct (indirect) approach i.e. including in the regression only the set of circumstances (efforts), or by using the functional form ($\widehat{g}$), i.e. including both circumstances and efforts in the specification. The latter allows for a more flexible treatment of the correlation between circumstances and efforts and is thus likely to yield different parameter estimates and counterfactual distributions. The best comparison to see whether and to what extent including both circumstances and efforts matter empirically is provided by measures y^{EO3} and y^{EO5}, as they are both indirect and ex-post. The large correlation (0.95) displayed in Table 2 suggests that conditioning on circumstances in the indirect approach does not lead to substantially different country orderings. In contrast, the somewhat lower correlation between measures y^{c3} and y^{c5} (0.81) may suggest that taking efforts into account in the direct approach is relevant. This conclusion, however, must be taken with caution as y^{c3} is ex-ante while y^{c5} is ex-post, and this difference may

[7] In the indirect approach, poor regression fits result in measurements of inequality of opportunity being very similar to measurements of inequality of outcome. This explains why the rank correlation between indirect ex-post non parametric y^{EO1} and its parametric counterpart y^{EO3} is large in 2011, 0.97.

also be behind the lower correlation.

Dual counterfactuals provide a somewhat natural way of making conceptual analogies between views and approaches. The data reveal that they lead to country orderings that are quite different –rank correlation coefficients amongst dual counterfactuals range from 0.11 to 0.41. Moreover, in our grouping of measures on the basis of their correlation, it never happens that dual counterfactuals belong to the same group.

Finally we examine whether it matters allowing for *inequality aversion with respect to income differences due to differences in effort*. We compare the non-parametric measures, y^{c1} and y^{c2} for the direct approach, and y^{EO1} and y^{EO2} for the indirect approach. The results in Table 2 show that allowing for inequality aversion does not matter neither for the direct nor for the indirect measures, as rank correlations are larger than 0.93.

Table 2: Rank correlations between inequality of opportunity measures. Gini coefficient, 2005.

	Direct measures					Indirect Measures			
	EA			EP					EA
	y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}
y^{c2}	0.968								
	0.000								
y^{c3}	0.894	0.916							
	0.000	0.000							
y^{c4}	0.729	0.740	0.702						
	0.000	0.000	0.000						
y^{c5}	0.759	0.829	0.814	0.685					
	0.000	0.000	0.000	0.000					
y^{EO1}	0.412	0.389	0.279	0.794	0.414				
	0.037	0.050	0.168	0.000	0.036				
y^{EO2}	0.232	0.225	0.159	0.733	0.299	0.928			
	0.256	0.257	0.438	0.000	0.138	0.000			
y^{EO3}	0.221	0.186	0.110	0.647	0.196	0.915	0.932		
	0.278	0.364	0.594	0.000	0.338	0.000	0.000		
y^{EO4}	0.964	0.931	0.841	0.639	0.695	0.321	0.174	0.167	
	0.000	0.000	0.000	0.000	0.000	0.110	0.395	0.416	
y^{EO5}	0.394	0.368	0.287	0.740	0.346	0.917	0.901	0.952	0.347
	0.046	0.065	0.155	0.000	0.083	0.000	0.000	0.000	0.082

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row. EA means Ex-ante, EP means Ex-post.

4.1 Robustness to using the MLD instead of the Gini

The high cross index correlations of Table 5 show that using the Gini coefficient or the MLD does not matter much for our country orderings. Table 4 shows that our findings about the correlations between the different measures also hold for the MLD index. It is striking, however, that the correlations between ex-ante and ex-post measures are substantially higher for the MLD than for the Gini.[8] Due to its path independence property (Foster and Sneyerov, 2000), y^{c1} and y^{EO4}, as well as y^{EO1} and y^{c4} yield exactly the same ordering when using the MLD. The other indirect counterfactuals give a distribution in which all inequality is due to differences in efforts, and, a decomposition argument can be used to say that the difference in inequality in the actual distribution and the inequality that is due to efforts equals the inequality that is due to circumstances, which is what direct measures capture. Our finding that the rank correlations between ex-ante and ex-post measures are larger for the MLD than for the Gini confirms that the decomposition argument makes more sense for the MLD than for the Gini coefficient.

4.2 Inequality of Opportunity and Economic Growth

To illustrate further the empirical relevance of the different conceptual choices, this section explores the relationship between inequality of opportunity and economic growth, which has captured the attention of the recent literature. It is important to note that given the many limitations that the EU-SILC imposes, this empirical exercise is solely illustrative. As outlined in Section 3, the EU-SILC collects data on family background and circumstances when the respondent was young at two points in time, 2005 and 2011. This means that we can only estimate inequality of opportunity for these two years. This data structure imposes two major limitations on our empirical exercise: First, our time series is very short, as we can only exploit variability at two points in time, and second, we can only study growth over a time period which is much shorter than the 5 or 10 year period, which is customary.

Recent literature has explored the idea that inequality due to efforts and inequality due to circumstances (inequality of opportunity) have opposite effects on economic growth, which in turn may help explain the inconclusive evidence of the effects of overall inequality on economic growth (see among others Marrero and Rodríguez, 2013 and Ferreira *et al.*, 2014). While inequality of opportunity is argued to have a deleterious impact on economic growth, effort inequality is deemed to have an enhancing impact on growth. The empirical papers that test this hypothesis usually use only one of the many options outlined in Section 2 to estimate inequality of opportunity. However, as we have reported above, different opportunity inequality measures give rise to different country orderings. Do the findings reported in the literature crucially hinge on the specific inequality of opportunity measure used? To answer this question, this section runs growth regressions and checks

[8] The same is true for the correlation between y^{EO4} and the other indirect measures, but remember that the former produces rankings that are more similar to the ones produced by ex-ante measures.

whether results are robust to the way inequality of opportunity and inequality of effort are measured.

Following Forbes (2000), we estimate the following panel regression

$$g_{c,(t,t-s)} = \beta_1 IO_{c,t-s} + \beta_2 IE_{c,t-s} + \beta_3 GDP_{c,t-s} + \beta_4 Ed_{c,t-s} + \beta_5 Inv_{c,t-s} + \alpha_c + \tau_t + \epsilon_{ct}$$

where g_{ct} is the average annual growth rate of per capita GDP between t and $t-s$, $IO_{c,t-s}$ is one of the inequality of opportunity measures outlined in Section 2, $IE_{c,t-s}$ is residual inequality, often assumed to be inequality of effort, and computed as the difference between outcome and opportunity inequality, $GDP_{c,t-s}$ is the Gross Domestic Product, $Ed_{c,t-s}$ is the population share with upper secondary education or above, $Inv_{c,t-s}$ is the business investment to GDP ratio, and α_c and τ_t capture country and time specific fixed effects. Control variables, namely GDP, education shares, and investment, come from Euorstat, and all regressors refer to the initial period over which growth is estimated to avoid simultaneity issues.

We estimate the model by fixed effects, which control for time-invariant omitted variables. It is a demanding estimation strategy, as we are identifying effects using within-country variation with only two time points, but nonetheless still suffers from endogeneity problems (Bond, 2002). Given the difficulty to find external instruments, system-GMM methods are usually employed to address such endogeneity issues (Bond *et al.*, 2001). These models, however, require three time points, while we only have two, which precludes us from taking due account of the possible endogeneity bias. If we however assume that the possible bias does not change across different measures of inequality of opportunity, it should not invalidate our comparative results, which is what we are mainly concerned with in this empirical exercise.

Table 3 reports the fixed effects estimates of outcome inequality and of the two variables of interest, $IO_{c,t-s}$ and $IE_{c,t-s}$ for one to three year average annual growth rates and the ten measures of inequality of opportunity, measured with the Gini coefficient. Outcome inequality regressions simply replace the two inequality of opportunity and effort measures in the specification above with a measure of outcome inequality. We find non-significant effects of outcome inequality on growth, regardless of whether the latter is measured over one, two or three years.

Inequality of Opportunity is only significant at the standard 5% level with the expected negative sign when the measure y^{c5} is used for one- and two-year growth rates. The measure y^{c3} is also negative and significant at 10% but only for three-year growth rates, while inequality of effort is systematically not significant. Appendix Table 9 shows that when the MLD is used to measure inequality in the counterfactual distributions inequality of opportunity shows no significant effect on growth.[9]

Given the difficulty of identifying precise effects using within-country variation with

[9] As it happens with the correlation between different measures, our growth results are also robust to dropping Cyprus from the analysis, as it showed an unreasonable increase in income inequality, according both to the Gini (> 20% increase from 2005 to 2011) and to the MLD (> 45% increase).

only two time points, we next abstract from the precision of the point estimates, and examine how the conceptual divides relate to the following two hypotheses about the effects of opportunity and effort inequality.

Strong hypothesis (SH): The effect of inequality of opportunity is negative while the effect of effort inequality is positive (i.e. $\beta_1 < 0$ and $\beta_2 > 0$).

Weak hypothesis (WH): The effect of inequality of opportunity is more negative than the effect of effort inequality (i.e. $0 > \beta_1 < \beta_2$).

The estimates reported in Table 3 show that, ignoring issues of statistical significance, SH occurs only twice (for one-year growth), each time for ex ante measures. For indirect measures it never happens that the two effects have opposite signs. Direct measures are always in line with WH, except for y^{c4} with 3-period growth. However, for indirect measures, this is the case in only 5 instances out of 15.[10] All and all, this evidence may be seen as a (admittedly) weak argument in support of the direct approach.

In sum, this empirical exercise illustrates that the effect of inequality of opportunity (and effort) on growth is not robust to the measure of inequality of opportunity employed. These findings cast doubt on existing evidence, which is exclusively based on the ex-ante parametric measure y^{c3}, and highlights the importance of different measurement choices. We hope we provide grounds for the still incipient empirical literature that explores the effects of equality of opportunity on growth to check the sensibility of its findings to different choices.

[10]When we use the MLD as inequality index, our findings are also consistent with SH for ex ante (direct) measures. However, both direct and indirect measures are consistent with WH in about two thirds of the cases –Table 9 in the Appendix shows the coefficient estimates.

Table 3: Growth regressions. Fixed effect estimates of Outcome, Opportunity and Effort Inequality. Inequality measured with the Gini coefficient.

Period	Inequality			Direct Approach									
		y		y^{c1}		y^{c2}		y^{c3}		y^{c4}		y^{c5}	
		β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
(t, t-1)	Outcome	-0.240	0.353										
	Opportunity			-0.354	0.289	-0.335	0.340	-0.591	0.128	-0.280	0.332	-1.494**	0.016
	Effort			-0.152	0.289	-0.190	0.514	0.001	0.998	-0.115	0.789	0.082	0.752
(t, t-2)	Outcome	-0.275	0.250										
	Opportunity			-0.440	0.151	-0.397	0.220	-0.584	0.104	-0.305	0.253	-1.248**	0.033
	Effort			-0.147	0.595	-0.210	0.430	-0.063	0.829	-0.181	0.650	-0.025	0.921
(t, t-3)	Outcome	-0.340	0.157										
	Opportunity			-0.462	0.134	-0.406	0.210	-0.639*	0.076	-0.332	0.212	-1.098*	0.065
	Effort			-0.244	0.382	-0.304	0.259	-0.134	0.645	-0.362	0.365	-0.144	0.583
				Indirect Approach									
				y^{EO1}		y^{EO2}		y^{EO3}		y^{EO4}		y^{EO5}	
				β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
(t, t-1)	Opportunity			-0.219	0.482	-0.210	0.495	-0.219	0.476	-0.175	0.888	-0.178	0.576
	Effort			-0.242	0.365	-0.245	0.360	-0.243	0.364	-0.247	0.402	-0.246	0.357
(t, t-2)	Opportunity			-0.271	0.347	-0.269	0.334	-0.270	0.344	-0.628	0.583	-0.234	0.426
	Effort			-0.276	0.265	-0.276	0.266	-0.276	0.265	-0.239	0.376	-0.279	0.259
(t, t-3)	Opportunity			-0.303	0.290	-0.318	0.263	-0.314	0.268	-0.634	0.577	-0.282	0.335
	Effort			-0.342	0.167	-0.343	0.168	-0.343	0.167	-0.309	0.253	-0.344	0.164
N		49		49		49		49		49		49	

Notes: All regressions include GDP, population share with upper-secondary school or above, and ratio of business investment to GDP, all measured at the beginning of the period, plus a time dummy. * p-value<0.1, ** p-value<0.05.

5 Conclusion

Several choices guide the measurement of equality of opportunity. We use EU-SILC data for many European countries to examine whether those choices matter empirically. To this end, we perform two empirical exercises: First we check whether measures that share the same conceptual choices yield similar inequality of opportunity country orderings, and then we analyse whether they yield similar estimates in growth regressions.

Our findings on country orderings identify one crucially important divide, between ex-ante and ex-post views, as it leads to different country orderings. The distinction between direct and indirect approaches matters only conditional on choosing an ex-ante or an ex-post view. Recent theoretical contributions have shown that ex-ante and ex-post approaches to inequality of opportunity are incompatible. Our paper shows that the distinction also matters empirically. As the evaluation of inequality of opportunity is in essence a normative exercise, our results show that researchers should be explicit about the normative choice made between an ex-ante or ex-post criterion. From growth regressions we conclude that the particular measure of inequality of opportunity employed conditions the effect that inequality of opportunity (and inequality due to effort) has on growth. We find that the direct parametric ex-ante measures correlate more in the expected way with economic growth than the others. As the question whether inequality of opportunity has an effect on economic growth is a positive exercise, our results could suggest that it is ex-ante inequality of opportunity (i.e. inequality between opportunity sets) rather than ex-post inequality of opportunity that is detrimental for growth.

Hence we have to recognize that inequality of opportunity is a multifaced concept. Consequently, scholars should provide arguments to support the conceptual choices embedded in the measures they use. Particular attention should be paid to taking and ex-ante or an ex-post view.

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A Appendix

Table 4: Rank correlations between inequality of opportunity measures. Mean Log Deviation, 2005.

	Direct measures					Indirect Measures			
	EA			EP					EA
	y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}
y^{c2}	0.942								
	0.000								
y^{c3}	0.895	0.946							
	0.000	0.000							
y^{c4}	0.730	0.722	0.744						
	0.000	0.000	0.000						
y^{c5}	0.737	0.797	0.841	0.621					
	0.000	0.000	0.000	0.001					
y^{EO1}	0.730	0.722	0.744	1.000	0.621				
	0.000	0.000	0.000	0.000	0.001				
y^{EO2}	0.730	0.708	0.722	0.987	0.584	0.987			
	0.000	0.000	0.000	0.000	0.002	0.000			
y^{EO3}	0.733	0.717	0.744	0.997	0.612	0.997	0.986		
	0.000	0.000	0.000	0.000	0.001	0.000	0.000		
y^{EO4}	1.000	0.942	0.895	0.730	0.737	0.730	0.730	0.733	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
y^{EO5}	0.761	0.745	0.760	0.992	0.625	0.992	0.986	0.995	0.761
	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row. EA means Ex-ante, EP means Ex-post.

Table 5: Rank correlations between Gini- and MLD-based inequality of opportunity measures, 2005.

Direct					Indirect				
y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}	y^{EO5}
0.976	0.975	0.974	0.982	0.964	0.809	0.755	0.693	0.963	0.774
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row.

Table 6: Rank correlations between inequality of opportunity measures. Gini coefficient, 2011.

	Direct measures					Indirect Measures			
	EA			EP					EA
	y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}
y^{c2}	0.770								
	0.000								
y^{c3}	0.181	0.425							
	0.348	0.022							
y^{c4}	0.225	0.345	0.235						
	0.241	0.068	0.220						
y^{c5}	0.211	0.489	0.965	0.253					
	0.271	0.007	0.000	0.186					
y^{EO1}	-0.018	0.138	-0.011	0.875	0.020				
	0.925	0.476	0.954	0.000	0.917				
y^{EO2}	-0.025	0.117	0.030	0.899	0.045	0.793			
	0.790	0.547	0.881	0.000	0.815	0.000			
y^{EO3}	0.028	0.118	0.036	0.900	0.062	0.971	0.992		
	0.885	0.541	0.853	0.000	0.749	0.000	0.000		
y^{EO4}	0.733	0.741	0.518	0.126	0.572	-0.123	-0.123	-0.094	
	0.000	0.000	0.004	0.515	0.001	0.525	0.526	0.627	
y^{EO5}	-0.003	0.085	-0.009	0.892	0.011	0.970	0.992	0.985	-0.147
	0.990	0.662	0.964	0.000	0.954	0.000	0.000	0.000	0.446

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row. EA means Ex-ante, EP means Ex-post.

Table 7: Rank correlations between inequality of opportunity measures. Mean Log Deviation, 2011.

	Direct measures					Indirect Measures			
	EA			EP					EA
	y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}
y^{c2}	0.850								
	0.000								
y^{c3}	0.503	0.667							
	0.005	0.000							
y^{c4}	0.358	0.336	0.245						
	0.057	0.075	0.201						
y^{c5}	0.549	0.713	0.965	0.262					
	0.002	0.000	0.000	0.170					
y^{EO1}	0.358	0.336	0.245	1.000	0.262				
	0.057	0.075	0.201	0.000	0.170				
y^{EO2}	0.344	0.322	0.234	0.999	0.251	0.999			
	0.068	0.088	0.223	0.000	0.189	0.000			
y^{EO3}	0.344	0.322	0.234	1.000	0.251	1.000	0.999		
	0.068	0.089	0.223	0.000	0.190	0.000	0.000		
y^{EO4}	1.000	0.849	0.503	0.358	0.549	0.358	0.343	0.344	
	0.000	0.000	0.005	0.057	0.002	0.057	0.067	0.068	
y^{EO5}	0.358	0.336	0.245	1.000	0.262	1.000	0.995	1.000	0.358
	0.057	0.075	0.201	0.000	0.170	0.000	0.000	0.000	0.057

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row. EA means Ex-ante, EP means Ex-post.

Table 8: Rank correlations between Gini- and MLD-based inequality of opportunity measures, 2011.

Direct					Indirect				
y^{c1}	y^{c2}	y^{c3}	y^{c4}	y^{c5}	y^{EO1}	y^{EO2}	y^{EO3}	y^{EO4}	y^{EO5}
0.781	0.817	0.981	0.980	0.982	0.873	0.887	0.886	0.928	0.865
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Rank correlations are shown in the upper row, while p-values are shown in the lower row.

Table 9: Growth regressions. Fixed effect estimates of Outcome, Opportunity and Effort Inequality. Inequality measured with the Mean Log Deviation.

Period	Inequality			Direct Approach									
		y		y^{c1}		y^{c2}		y^{c3}		y^{c4}		y^{c5}	
		β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
(t, t-1)	Outcome	-0.180	0.393										
	Opportunity			-0.351	0.739	0.372	0.764	0.358	0.788	-0.209	0.412	-5.892	0.376
	Effort			-0.157	0.541	-0.237	0.346	-0.234	0.358	-0.117	0.744	-0.103	0.653
(t, t-2)	Outcome	-0.203	0.298										
	Opportunity			-0.610	0.529	0.072	0.950	0.207	0.866	-0.233	0.324	-4.376	0.478
	Effort			-0.149	0.527	-0.231	0.320	-0.244	0.300	-0.139	0.673	-0.147	0.492
(t, t-3)	Outcome	-0.243	0.216										
	Opportunity			-0.552	0.569	0.178	0.876	0.202	0.869	-0.240	0.310	-1.663	0.788
	Effort			-0.202	0.394	-0.286	0.221	-0.288	0.224	-0.250	0.452	-0.224	0.305
				Indirect Approach									
				y^{EO1}		y^{EO2}		y^{EO3}		y^{EO4}		y^{EO5}	
(t, t-1)	Opportunity			-0.209	0.412	-0.204	0.431	-0.197	0.456	-0.351	0.739	-0.160	0.549
	Effort			-0.117	0.744	-0.132	0.708	-0.148	0.679	-0.157	0.541	-0.222	0.578
(t, t-2)	Opportunity			-0.233	0.324	-0.237	0.323	-0.228	0.351	-0.610	0.529	-0.203	0.413
	Effort			-0.139	0.673	-0.136	0.675	-0.156	0.636	-0.149	0.527	-0.204	0.579
(t, t-3)	Opportunity			-0.240	0.310	-0.252	0.294	-0.249	0.309	-0.552	0.569	-0.224	0.367
	Effort			-0.250	0.452	-0.225	0.490	-0.231	0.484	-0.202	0.394	-0.285	0.439
N		49		49		49		49		49		49	

Notes: All regressions include GDP, population share with upper-secondary school or above, and ratio of business investment to GDP, all measured at the beginning of the period, plus a time dummy. * p-value<0.1, ** p-value<0.05.

Table 10: Summary Statistics of Circumstance Variables, 2005

	Parental Education	Parental Occupation				
Country	>Secondary	Skilled	Unskilled	Male	Foreign	Parents at home
BE Belgium	0.19	0.41	0.21	0.49	0.08	0.89
	0.39	0.49	0.40	0.50	0.26	0.32
DK Denmark	0.22	0.45	0.20	0.49	0.04	0.84
	0.41	0.50	0.40	0.50	0.19	0.37
DE Germany	0.34	0.45	0.18	0.44	0.05	0.85
	0.47	0.50	0.38	0.50	0.23	0.36
GR Greece	0.08	0.67	0.15	0.49	0.06	0.95
	0.27	0.47	0.36	0.50	0.24	0.22
ES Spain	0.09	0.53	0.30	0.48	0.05	0.91
	0.29	0.50	0.46	0.50	0.21	0.29
FR France	0.10	0.43	0.29	0.48	0.09	0.84
	0.30	0.50	0.45	0.50	0.29	0.37
IE Ireland	0.13	0.27	0.29	0.47	0.03	0.92
	0.34	0.44	0.45	0.50	0.17	0.27
IT Italy	0.03	0.49	0.28	0.49	0.04	0.92
	0.18	0.50	0.45	0.50	0.20	0.27
LU Luxembourg	0.18	0.40	0.28	0.49	0.09	0.90
	0.39	0.49	0.45	0.50	0.28	0.31
NL Netherlands	0.17	0.34	0.17	0.49	0.05	0.90
	0.37	0.48	0.37	0.50	0.21	0.30
AT Austria	0.06	0.56	0.22	0.49	0.09	0.85
	0.24	0.50	0.42	0.50	0.29	0.36
PT Portugal	0.04	0.63	0.24	0.48	0.01	0.85
	0.19	0.48	0.43	0.50	0.11	0.36
FI Finland	0.15	0.57	0.20	0.50	0.02	0.85
	0.36	0.50	0.40	0.50	0.12	0.35
SE Sweden	0.21	0.49	0.18	0.49	0.08	0.83
	0.41	0.50	0.38	0.50	0.28	0.38
UK United Kingdom	0.33	0.36	0.31	0.48	0.10	0.84
	0.47	0.48	0.46	0.50	0.31	0.37
CY Cyprus	0.07	0.57	0.31	0.47	0.09	0.91
	0.26	0.50	0.46	0.50	0.29	0.29
CZ Czech Rep.	0.09	0.50	0.28	0.48	0.01	0.86
	0.29	0.50	0.45	0.50	0.10	0.35
EE Estonia	0.25	0.38	0.39	0.46	0.15	0.76
	0.43	0.49	0.49	0.50	0.36	0.43
HU Hungary	0.13	0.52	0.30	0.48	0.02	0.84
	0.34	0.50	0.46	0.50	0.14	0.37
LV Latvia	0.19	0.34	0.44	0.45	0.16	0.70
	0.39	0.47	0.50	0.50	0.37	0.46
LT Lithuania	0.24	0.38	0.45	0.45	0.06	0.80
	0.42	0.48	0.50	0.50	0.25	0.40
PL Poland	0.06	0.64	0.22	0.48	0.00	0.89
	0.25	0.48	0.41	0.50	0.05	0.32
SK Slovak Rep.	0.09	0.37	0.41	0.47	0.00	0.91
	0.29	0.48	0.49	0.50	0.06	0.29
SI Slovenia	0.08	0.47	0.36	0.50	0.11	0.84
	0.28	0.50	0.48	0.50	0.32	0.37
IS Iceland	0.23	0.52	0.13	0.50	0.02	0.84
	0.42	0.50	0.34	0.50	0.15	0.37
NO Norway	0.41	0.48	0.18	0.49	0.05	0.91
	0.49	0.50	0.39	0.50	0.22	0.29
Total	0.14	0.49	0.27	0.48	0.05	0.87
	0.34	0.50	0.44	0.50	0.23	0.33

Notes: Statistics for each country follow this order: Mean values, standard deviation. All variables are dummies.

Table 11: Summary Statistics of Circumstance Variables, 2011

	Parental Education	Parental Occupation				
Country	>Secondary	Skilled	Unskilled	Male	Foreign	Parents at home
BE Belgium	0.16	0.72	0.07	0.48	0.11	0.85
	0.36	0.45	0.26	0.50	0.31	0.36
DK Denmark	0.23	0.41	0.15	0.49	0.10	0.87
	0.42	0.49	0.35	0.50	0.30	0.34
DE Germany	0.12	0.53	0.27	0.50	0.00	0.91
	0.33	0.50	0.45	0.50	0.07	0.29
EL Greece	0.17	0.49	0.10	0.47	0.11	0.85
	0.38	0.50	0.30	0.50	0.31	0.36
ES Spain	0.09	0.63	0.18	0.45	0.12	0.91
	0.29	0.48	0.38	0.50	0.32	0.29
FR France	0.10	0.50	0.27	0.48	0.01	0.86
	0.30	0.50	0.44	0.50	0.09	0.35
IE Ireland	0.29	0.42	0.21	0.47	0.06	0.84
	0.45	0.49	0.41	0.50	0.24	0.37
IT Italy	0.26	0.59	0.08	0.48	0.05	0.83
	0.44	0.49	0.26	0.50	0.21	0.37
LU Luxembourg	0.22	0.37	0.38	0.49	0.13	0.76
	0.41	0.48	0.49	0.50	0.34	0.43
NL Netherlands	0.07	0.70	0.12	0.49	0.08	0.93
	0.26	0.46	0.32	0.50	0.27	0.25
AT Austria	0.09	0.57	0.15	0.49	0.07	0.90
	0.29	0.50	0.36	0.50	0.26	0.30
PT Portugal	0.23	0.50	0.19	0.50	0.02	0.84
	0.42	0.50	0.40	0.50	0.16	0.37
FI Finland	0.13	0.50	0.07	0.48	0.07	0.83
	0.34	0.50	0.26	0.50	0.26	0.37
SE Sweden	0.07	0.58	0.16	0.48	0.11	0.88
	0.25	0.49	0.37	0.50	0.31	0.32
UK United Kingdom	0.10	0.52	0.30	0.46	0.00	0.85
	0.30	0.50	0.46	0.50	0.06	0.36
BG Bulgaria	0.17	0.53	0.09	0.48	0.07	0.89
	0.37	0.50	0.28	0.50	0.25	0.31
CY Cyprus	0.17	0.59	0.11	0.49	0.04	0.90
	0.37	0.49	0.31	0.50	0.19	0.30
CZ Czech Rep.	0.05	0.55	0.15	0.48	0.06	0.90
	0.21	0.50	0.36	0.50	0.23	0.29
EE Estonia	0.13	0.53	0.23	0.46	0.06	0.85
	0.33	0.50	0.42	0.50	0.24	0.35
HU Hungary	0.14	0.44	0.22	0.49	0.10	0.87
	0.35	0.50	0.41	0.50	0.30	0.33
LV Latvia	0.17	0.47	0.27	0.45	0.14	0.77
	0.37	0.50	0.45	0.50	0.34	0.42
LT Lithuania	0.07	0.54	0.13	0.48	0.05	0.93
	0.25	0.50	0.33	0.50	0.23	0.26
MT Malta	0.24	0.46	0.09	0.48	0.05	0.89
	0.43	0.50	0.28	0.50	0.22	0.31
PL Poland	0.34	0.49	0.12	0.50	0.05	0.92
	0.47	0.50	0.32	0.50	0.22	0.27
RO Romania	0.08	0.69	0.16	0.48	0.00	0.89
	0.27	0.46	0.36	0.50	0.03	0.31
SK Slovak Rep.	0.04	0.68	0.15	0.47	0.06	0.87
	0.20	0.47	0.36	0.50	0.24	0.34
IS Iceland	0.24	0.54	0.13	0.48	0.12	0.81
	0.43	0.50	0.34	0.50	0.32	0.39
CH Switzerland	0.09	0.48	0.28	0.47	0.00	0.92
	0.28	0.50	0.45	0.50	0.05	0.27
HR Croatia	0.21	0.44	0.18	0.47	0.09	0.83
	0.40	0.50	0.38	0.50	0.29	0.38
Total	0.13	0.54	0.18	0.48	0.06	0.87
	0.34	0.50	0.39	0.50	0.24	0.34

Notes: Statistics for each country follow this order: Mean values, standard deviation. All variables are dummies.

Table 12: Summary Statistics of Effort Variables, 2005

	Own Education	Own Occupation			
Country	>Secondary	Skilled	Unskilled	Married	Working
BE Belgium	0.39	0.24	0.19	0.69	0.69
	0.49	0.43	0.39	0.46	0.46
DK Denmark	0.34	0.25	0.15	0.73	0.88
	0.47	0.43	0.35	0.44	0.33
DE Germany	0.48	0.22	0.11	0.72	0.71
	0.50	0.41	0.31	0.45	0.45
GR Greece	0.25	0.43	0.15	0.78	0.70
	0.43	0.50	0.36	0.41	0.46
ES Spain	0.27	0.37	0.26	0.75	0.68
	0.45	0.48	0.44	0.43	0.47
FR France	0.26	0.27	0.22	0.67	0.77
	0.44	0.44	0.41	0.47	0.42
IE Ireland	0.37	0.26	0.22	0.70	0.69
	0.48	0.44	0.41	0.46	0.46
IT Italy	0.18	0.31	0.20	0.71	0.66
	0.38	0.46	0.40	0.45	0.47
LU Luxembourg	0.30	0.25	0.18	0.68	0.71
	0.46	0.43	0.38	0.47	0.45
NL Netherlands	0.36	0.21	0.11	0.75	0.73
	0.48	0.41	0.31	0.44	0.44
AT Austria	0.29	0.39	0.17	0.73	0.76
	0.45	0.49	0.38	0.44	0.43
PT Portugal	0.11	0.44	0.24	0.79	0.74
	0.32	0.50	0.43	0.41	0.44
FI Finland	0.37	0.35	0.12	0.71	0.81
	0.48	0.48	0.33	0.46	0.39
SE Sweden	0.39	0.30	0.14	0.61	0.85
	0.49	0.46	0.34	0.49	0.35
UK United Kingdom	0.41	0.25	0.19	0.65	0.78
	0.49	0.43	0.39	0.48	0.42
CY Cyprus	0.29	0.35	0.24	0.85	0.77
	0.45	0.48	0.43	0.36	0.42
CZ Czech Rep.	0.15	0.36	0.19	0.73	0.77
	0.36	0.48	0.39	0.45	0.42
EE Estonia	0.38	0.33	0.28	0.64	0.79
	0.49	0.47	0.45	0.48	0.41
HU Hungary	0.15	0.38	0.24	0.65	0.72
	0.35	0.49	0.42	0.48	0.45
LV Latvia	0.32	0.34	0.30	0.57	0.77
	0.47	0.47	0.46	0.49	0.42
LT Lithuania	0.56	0.39	0.25	0.78	0.77
	0.50	0.49	0.43	0.42	0.42
PL Poland	0.17	0.46	0.21	0.80	0.60
	0.37	0.50	0.41	0.40	0.49
SK Slovak Rep.	0.17	0.31	0.23	0.81	0.77
	0.38	0.46	0.42	0.39	0.42
SI Slovenia	0.18	0.28	0.26	0.69	0.75
	0.38	0.45	0.44	0.46	0.44
IS Iceland	0.35	0.33	0.10	0.68	0.89
	0.48	0.47	0.30	0.47	0.31
NO Norway	0.38	0.30	0.10	0.67	0.84
	0.49	0.46	0.30	0.47	0.37
Total	0.29	0.32	0.19	0.72	0.73
	0.45	0.47	0.39	0.45	0.44

Notes: Statistics for each country follow this order: Mean values, standard deviation. All variables are dummies.

Table 13: Summary Statistics of Effort Variables, 2011

	Own Education	Own Occupation			
Country	>Secondary	Skilled	Unskilled	Married	Working
BE Belgium	0.33	0.30	0.19	0.62	0.76
	0.47	0.46	0.39	0.49	0.43
DK Denmark	0.44	0.23	0.17	0.61	0.75
	0.50	0.42	0.38	0.49	0.43
DE Germany	0.23	0.41	0.27	0.69	0.74
	0.42	0.49	0.44	0.46	0.44
EL Greece	0.39	0.25	0.11	0.69	0.82
	0.49	0.43	0.31	0.46	0.38
ES Spain	0.33	0.32	0.25	0.83	0.78
	0.47	0.47	0.43	0.38	0.42
FR France	0.16	0.33	0.21	0.68	0.78
	0.37	0.47	0.41	0.47	0.41
IE Ireland	0.46	0.20	0.18	0.66	0.78
	0.50	0.40	0.38	0.47	0.41
IT Italy	0.40	0.15	0.12	0.75	0.87
	0.49	0.36	0.32	0.43	0.33
LU Luxembourg	0.34	0.31	0.29	0.57	0.74
	0.47	0.46	0.45	0.50	0.44
NL Netherlands	0.30	0.41	0.16	0.76	0.62
	0.46	0.49	0.37	0.43	0.49
AT Austria	0.33	0.32	0.27	0.70	0.66
	0.47	0.46	0.44	0.46	0.47
PT Portugal	0.43	0.37	0.13	0.67	0.80
	0.50	0.48	0.33	0.47	0.40
FI Finland	0.32	0.26	0.21	0.60	0.79
	0.47	0.44	0.40	0.49	0.41
SE Sweden	0.15	0.42	0.21	0.74	0.55
	0.35	0.49	0.41	0.44	0.50
UK United Kingdom	0.25	0.33	0.29	0.63	0.67
	0.43	0.47	0.45	0.48	0.47
BG Bulgaria	0.51	0.30	0.23	0.66	0.61
	0.50	0.46	0.42	0.47	0.49
CY Cyprus	0.45	0.32	0.10	0.66	0.83
	0.50	0.47	0.30	0.47	0.37
CZ Czech Rep.	0.20	0.29	0.19	0.67	0.70
	0.40	0.45	0.39	0.47	0.46
EE Estonia	0.61	0.36	0.24	0.75	0.73
	0.49	0.48	0.43	0.43	0.44
HU Hungary	0.29	0.26	0.21	0.71	0.74
	0.45	0.44	0.41	0.46	0.44
LV Latvia	0.35	0.31	0.27	0.53	0.70
	0.48	0.46	0.44	0.50	0.46
LT Lithuania	0.14	0.27	0.31	0.78	0.58
	0.34	0.44	0.46	0.41	0.49
MT Malta	0.40	0.20	0.10	0.71	0.85
	0.49	0.40	0.30	0.46	0.36
PL Poland	0.46	0.28	0.09	0.65	0.88
	0.50	0.45	0.29	0.48	0.32
RO Romania	0.24	0.43	0.20	0.78	0.71
	0.43	0.50	0.40	0.41	0.45
SK Slovak Rep.	0.15	0.41	0.26	0.72	0.71
	0.36	0.49	0.44	0.45	0.45
IS Iceland	0.44	0.30	0.13	0.61	0.89
	0.50	0.46	0.34	0.49	0.31
CH Switzerland	0.23	0.32	0.19	0.72	0.79
	0.42	0.47	0.40	0.45	0.41
HR Croatia	0.39	0.24	0.18	0.65	0.79
	0.49	0.43	0.38	0.48	0.41
Total	0.32	0.31	0.21	0.68	0.74
	0.46	0.46	0.40	0.47	0.44

Notes: Statistics for each country follow this order: Mean values, standard deviation. All variables are dummies.