Income Inequality and Opportunity Inequality in Europe

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This paper proposes an estimate of the extent of opportunity inequality and of its determinants in a sample of European countries, based on the Survey on Income and Living Conditions conducted in 2005. Although the ranking among Northern European and Mediterranean countries is generally respected, our measures of equality of opportunity provide a different ranking with respect to the one offered by the measures of overall income inequality. Our figures show that equality of opportunity has correlation with both institutional measures of schooling (pre-primary education, de-tracked secondary school) as well as with labour market institutions (union density, but not employment protection). [JEL Classification: D31, D63, J62]

Keywords: inequality of opportunity, income inequality, intergenerational mobility.

Questo lavoro propone una stima della disuguaglianza delle opportunità e delle sue determinanti in un campione di paesi europei utilizzando i dati della Indagine Europea sul Reddito e le Condizioni di Vita (Survey on Income and Living Conditions) del 2005. Sebbene l'ordinamento fra paesi nordici e paesi mediterranei sia generalmente rispettato, le nostre misure di uguaglianza delle opportunità forniscono un ordinamento diverso rispetto a quello delle misure di disuguaglianza complessiva del reddito. La nostra indagine inoltre evidenzia che l'uguaglianza delle opportunità è correlata sia con caratteristiche istituzionali che misurano il grado di scolarizzazione (tasso di iscrizione alla scuola materna, stratificazione nella scuola secondaria) sia con caratteristiche strutturali del mercato del lavoro (importanza del ruolo dei sindacati piuttosto che di meccanismi di tutela dell'occupazione).

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1. - Introduction

This paper proposes an estimation of the extent of opportunity inequality in Italy and in other 23 European countries. In Italy the theme is quite important, given the low level of intergenerational social mobility and the geographical differences in the measure inequality of opportunities between North and South of the country. The evidence we propose, in addition to be interesting *per se*, if one believes that equality of opportunity is the "right" theory of distributive justice, may also have an instrumental value: it might help to understand the genesis of standard income inequality; it may help to identify the priorities of a redistributive public intervention; finally, it could help identifying cases of inequality traps (World Bank, 2006) which, by preventing social groups from their full participation into economic and social life, might be partially responsible for the poor performance of some economies.

In this paper we refer to the conceptualization of EOp proposed by philosophers such as Dworkin (1981*a,* 1981*b*); Arneson (1989); Cohen (1989) and explored within the economic literature – initiated by Roemer (1993, 1998) and Fleurbaey (1995) – that has flourished in the last two decades and that has analyzed different ways in which the concept of equality of opportunity may be translated in formal economic models (see Fleurbaey, 2008 for a survey). More specifically, our contribution, which is both theoretical and empirical, is devoted to the issue of measuring opportunity inequality.

The contribution of this paper is twofold. First, we first provide a methodology to both measure opportunity inequality and decompose overall income inequality into two components: income inequality due to initial inequality in opportunities and income inequality due to individual responsibility. Secondly, we apply this methodology to measure opportunity inequality in Italy and in other 23 European countries and make an attempt to correlate the extent of opportunity inequality to institutional measures in such countries.

A common feature of the EOp literature is the basic idea that

individuals' outcomes arise from two classes of variable: variables for which they should not be held responsible for (circumstances) and variables which belong to the sphere of individuals' responsibility (effort). Once this basic partition has been made, the concept of EOp can be decomposed into two distinct ethical principles: the Compensation Principle, which states that differences in outcomes due to circumstances are ethically inacceptable and should be compensated; the Reward Principle, which takes the view that differences due to effort are to be considered ethically acceptable and do not need any intervention.

The existing literature has developed different approaches to measuring opportunity inequality. The analysis starts with partitioning the population in circumstance classes (types), where each class is formed by individuals endowed with the same set of circumstances: the income distribution within a circumstance class is interpreted as the opportunity set open to individuals in that class. Hence, in order to measure opportunity inequality, one focuses on the inequality between types inequality.

In some cases the existence of EOp in a given distribution is tested by checking for stochastic dominance between the types distributions, as in the studies by Lefranc *et* al. (2006*a*; 2006*b*) and Peragine and Serlenga (2008). Other studies propose opportunity-egalitarian social welfare functions to obtain partial rankings of income distributions (see Van de Gaer, 2003 and Peragine, 1998, 2004 on the theoretical side; Peragine and Serlenga, 2008 for an empirical application). Finally, some authors use inequality indices to obtain complete rankings of income distributions (see Bourguignon *et* al., 2003; Checchi and Peragine, 2009; Dardanoni *et* al., 2005; Ferreira and Gignoux, 2008; Pistolesi, 2007). Studies which use this third methodology can be further distinguished depending on the empirical estimators they use. Bourguignon *et* al. (2003); Dardanoni *et* al. (2005) and Pistolesi (2007) estimate EOp by using parametric models, while Checchi and Peragine (2009) use a non parametric method for their estimations. Recently, Ferreira and Gignoux (2008) compare parametric and non parametric methodologies, following the model proposed by Bourguignon *et* al. (2007). Each approach has pros and cons: the non parametric models avoids the arbitrary choice of a specific functional form on

the relationship between outcome, circumstances and effort; on the other hand, parametric models allow to study partial effects of circumstances on outcome, other things constant (*i.e.* they make it easier building and studying counterfactuals).

In this paper we focus on complete rankings of opportunity inequality and explore both the parametric and the non parametric methodologies[1]. Furthermore, once an estimation of EOp measures is derived, we study the correlation between institutional characteristics and the opportunity inequality ranking for the countries under consideration.

The empirical application is therefore divided in two parts. First, along with the standard measures of inequality, we provide estimates of income inequality and opportunity inequality in 24 European countries available in the EU-SILC database. The purpose here is to rank European countries with respect to EOp by using both parametric and non parametric measures. Second, we focus on institutional characteristics that might influence the degree of opportunity inequality in the countries under analysis. Although the intuitive ranking among Northern European and Mediterranean countries is generally respected (with the formers exhibiting more EOp than the latter), our measures of equality of opportunities provide a different ranking with respect to the one offered by the measures of overall income inequality. Our figures also show that equality of opportunity is positively correlated with pre-primary education and de-tracked secondary school systems. Equality of opportunity is also positively associated to labour market regulation, to union density and to wage centralization whereas is positively related to fiscal redistribution. The paper is organized as follows. Section 2 introduces our methodology for measuring opportunity inequality and decomposing overall income inequality. Section 3 contains our empirical analysis: the data description, the estimating procedure and the discussion of the results. Section 4 concludes with some final remarks and some directions for future research.

[1] In a companion paper (CHECCHI D., PERAGINE V., SERLENGA L., 2009) we explore an alternative approach to measuring opportunity inequality, the *ex post* approach as opposed to the present ex ante approach, and we compare the results obtained with the two methodologies.

2. - Measuring Opportunity Inequality: A Simple Model

Each individual in our society is completely described by a list of traits, which can be partitioned into two different classes: the first class includes traits beyond the individual responsibility, represented by a person's set of circumstances **c**. The individual sets of circumstances belong to a finite set $\Omega = \{\mathbf{c}_1, \ldots, \mathbf{c}_n\}$. Circumstances include a vast list of income generating inputs that are out of control of the individual, like gender, age, ethnicity, region of residence or parental background: various notions of equality of opportunity correspond to different choices of which of these variables are to be regarded as circumstances. In the sequel, or semplicity of exposition, we will treat only gender and parental education as circumstances. If the only circumstances are gender, which can only take values in the set {male, female}, and parental education, that only takes values in the set {graduate parents, non graduate parents}; in this case the set Ω would be the following:

$$\Omega = \begin{pmatrix} \{\text{female, non graduate parents}\},\{\text{female, graduate parents}\} \\ \{\text{male, non graduate parents}\},\{\text{male, graduate parents}\} \end{pmatrix}.$$

The second class includes factors for which the individual is fully responsible and is represented by a scalar variable, *effort*, $e \in \Theta$. We assume that effort is one-dimensional. It is important to stress that by effort in this paper we mean not only the extent to which a person exerts himself, but all the other background traits of the individual that might affect his success, but that are excluded from the list of circumstances. This amounts to say that any other factors, as native ability, talent, luck, and so on, are implicitly classified as within the sphere of individual responsibility. This assumption may lead us to overestimate the portion of inequality which is ethically acceptable[2].

Income is generated by a function g: $\Omega \times e\ \Theta \rightarrow \mathbb{R}_+$, that assigns individual incomes to combinations of effort and circumstances:

[2] On the effect of partial observability of the circumstances on the estimates of opportunity inequality see FLEURBAEY M., LUONGO P. and PERAGINE V. (2009).

$$x = g(\mathbf{c}, e)$$

To save notation, we may also write x ($\mathbf{c}$, e) and refer to it as both the individual income and the relevant income distribution.

Hence, this is a pure deterministic model, where for any given existing circumstances all variations in individual income are attributed to personal effort. We therefore deviate from standard Mincerian models of income generation, where incomes are explained by circumstances, proxies for effort and a random component which is typically assumed to be i.i.d. In our analysis, the individual is held responsible for any random component that may affect his/her income (included native ability or talent, as long as they are not included in the set of circumstances).

Effort is unobservable. Unobservable is also the function g, hence we do not make any assumption about the degree of substitutability or complementarity among the circumstances in order to keep the approach as general as possible. We assume, however, that the function g is fixed and identical for all individuals. Moreover, we introduce two basic assumptions:

ASSUMPTION 1 *The function g is monotoni cally increasing in effort e*

ASSUMPTION 2 *The distribution of effort e is independent of the circumstances*.

Assumption 1 is fairly reasonable. Assumption 2 appears to be more problematic, given the non observability of effort. From a theoretical point of view it would be hardly sustainable to hold people accountable for the factor e, were it dependent on external circumstances. However, from the empirical point of view, there are income determinants that are clearly the joint outcomes of effort and circumstances. Typical is the case of acquired education, which is the result of parental background (educated parents are typically richer in monetary and cultural resources) but also requires personal effort (in order to afford the psychological costs of studying). Since income is correlated with education, this would violate our Assumption 2. In such a case, we would be forced to extend the requirement of orthogonality between circumstances and effort to all these "intermediate" variables (where we could

add labour market participation, fertility choices, migration, and similar). For this reason, we consider Assumption 2 to be the simplest property compatible with the empirical non parametric application that we adopt in the next section.

For $\mathbf{c}_i \in \Omega$, we call *type i* the set of individuals whose set of circumstances is c. The type income distribution represents the set of outcome levels which can be achieved – by exerting different degrees of effort – starting from the same circumstance $\mathbf{c}_i$. That is to say, the type distribution is a representation of the *opportunity set* – expressed in outcome terms – open to any individual endowed with circumstances $\mathbf{c}_i$.

We propose the following definition of equality of opportunity.

DEFINITION *There is EOp if the set of opportunities is the same, regardless of the circumstances. Inequality of opportunity decreases if inequality between individual opportunity sets decreases*.

Thus, this definition puts special emphasis on the differences in the outcome prospects for classes of individuals with identical circumstances. Accordingly, it focuses on inequality between types, and is instead neutral with respect to inequality within types.

Hence, in the model introduced the measure of opportunity inequality in a distribution is given by the degree of inequality between types. To capture such inequality we may construct an hypothetical *smoothed distribution* obtained after the following transformation:

$$x\ (\mathbf{c},\ e) \rightarrow x\ (\mathbf{c},\ \bar{e})$$

where $x\ (\mathbf{c},\ \bar{e})$ is the artificial distribution obtained by using a constant reference value of effort $\bar{e}$.

Hence, inequality of opportunity is given by a (scale invariant) inequality index I applied to the distribution $x\ (c_i,\ \bar{e})$

$$OI = I(x(\mathbf{c},\ \bar{e}))$$

or, in relative terms:

$$OI_{relative} = \frac{I\left(x\left(\mathbf{c},\bar{e}\right)\right)}{I\left(x\left(\mathbf{c},e\right)\right)}$$

The meaning of x (c_i, $\bar{e}$) depends on the specific measurement approach one decides to adopt.

In a non parametric descriptive approach x (c, $\bar{e}$) can be represented by the average income[3] of a given type identified by **c** (call it μ_c. If we opt for a non parametric approach, then for any *path independent* measure of inequality[4] (Foster and Shneyrov, 2000) we have that

$$I\left(x\left(\mathrm{c},e\right)\right)=I\left(\frac{x\left(\mathbf{c},e\right)}{x\left(\mathbf{c},\bar{e}\right)}\right)+I\left(x\left(\mathbf{c},\bar{e}\right)\right)$$

$$I\left(x\left(\mathrm{c},e\right)\right)=I\left(\frac{x\left(\mathbf{c},e\right)}{\mu_c}\right)+I\left(\mu_c\right)$$

The interpretation is as follows: by measuring the inequality in the artificial vector μ_c, obtained by replacing each income with its type mean income, we only capture the between types inequality, which, in turn, reflects the opportunity inequality. On the other hand, by rescaling all type distributions until all types have the same mean income, hence obtaining the distribution $\frac{x(\mathbf{c},e)}{\mu_c}$, we are left with an income vector in which the only inequality present is th within types inequality, to be interpreted as inequality due to individual responsibility. Hence the decomposition above can be interpreted as:

total inequality = within types + between types
total inequality = effort inequality + opportunity inequality

Thus, we have a measure of opportunity inequality and a decomposition of overall inequality into an ethically acceptable and an ethically offensive part.

[3] Other interpretations are possible: for instance, in a normative approach, x (c, e) could be represented by the equally distributed equivalent income of a given tranche identified by e.

[4] In particular, we need to use the *mean logarithmic deviation* (*MLD*), which is the only index which has a path-independent decomposition using the arithmetic mean as the representative income. For a distribution $X = (x_1, \ldots, x_N)$ with mean μ_x the *MLD* is defined as:

$$MLD\left(X\right)=\frac{1}{N}\sum_{i=1}^{N}\ln\frac{\mu_X}{x_i}$$

Inequality of opportunity by the ex ante approach can also be computed parametrically[5]. In this case we need to estimate the following relationship for the whole population such that

$$\ln x_i = \beta c_i + \varepsilon_i$$

derive the following counterfactual distribution $\hat{x}_i = \exp(\hat{\beta} c_i)$. Hence, inequality of opportunity in the parametric case will be given by

$$I\left(\hat{x}_i\right)$$

In the following empirical analysis we will compare our estimates *OI* (parametric and non parametric) and use them for our an analysis of relationship between the extent of opportunity inequality and some relevant policy or institutional variables.

3. - The Empirical Analysis: Income Inequality and Opportunity Inequality in Europe

3.1 *Data Description*

We use data from the 2005 wave of the European Survey on Income and Living Conditions (EUSILC) which is annually conducted by the national Central Statistics Offices (CSOs) in order to obtain information on the income and living conditions of different household types. The survey contains information on a large number of individual and household characteristics as well as specific information on poverty and social exclusion. Representative random samples of households throughout a large number of European countries are approached to provide the required information. We consider 24 countries in our analysis, namely Austria, Belgium, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Hungary, Ireland, Iceland, Italy, Luxemburg, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Sweden, Slovakia, Slovenia and the United Kingdom.

[5] This is the approach followed by FERREIRA F.H.G. and GUIGNOUX J. (2008).

Differently from other sources of data, EUSILC provides a common data source with comparable individual and household level micro-data on income and living conditions in the EU countries, allowing for significant improvements in the comparability of countryspecific measures. EUSILC is expected to become the EU reference source for comparative statistics on income distribution and social exclusion at European level. Indeed, our study has became possible because the 2005 EUSILC includes a special data module which provides information for attributes of each respondent's parents during her childhood period in the age 14-16. This additional module reports family composition, number of siblings, the educational attainment, occupational as well as the labour market activity status of each respondent's mother and father and the presence of financial problems in household. In what follows parental education is measured by the highest educational attainment in the couple of parents. Individuals are therefore divided in three groups: group 1 refers to individuals having both parents with no education; 2 corresponds to individuals who have at least one of the parents with primary or secondary (lower and upper) school degree, while group 3 corresponds to individuals who have at least one of the parents with post-secondary or tertiary degree. Parental occupation is also divided in three categories: category 1 corresponds to individuals having both parents occupied as plant and machine operator and assembler or in elementary occupations (groups 8,000 and 9,000 according to the 15C088 classification); category 2 refers to individuals who have at least one of the parents occupied as service worker, shop and market sales worker, skilled agricultural and fishery worker or as craft and related trades workers (groups from 5,000 to 7,000 of the 1SC088 classification); finally, category 3 refers to individuals who have at least one of the parents occupied as legislator, senior official, manager, professional, technician, associate professional or clerk (groups from 1,000 to 4,000 of the ISCO88 classification).

In the empirical analysis we also consider some additional individual characteristics as circumstances. This set comprehends gender, nationality (distinguishing those who declare the country

of birth to be the same of the country of residence) and geographical location (distinguishing people living in densely populated area form others).

We restrict the sample to individuals working full-time or part-time, unemployed and those fulfilling domestic tasks and care responsibilities aged between 30 and 60.[6] Our reference variable is post-tax individual income which is available for 17 out of 24 countries under analysis, for the remaining ones we derived net income information from gross income by imputing the tax rate in 2004.[7] Being aware of the fact that welfare indicators estimated from micro-data can be very sensitive to the presence of extreme incomes (Cowell and Victoria-Feser, 1996*a*, 1996*b*, 2002) we censored the countries' income distributions by dropping the very extreme values.[8] Tables 9 and 10 in the Appendix show summary statistics of both individual and parental characteristics.

3.2 *Income and Opportunity Inequality Ranking in Europe*

In this section we aim to rank European countries with respect to EOp using both the parametric and non parametric approaches.

Starting with the estimates of overall income inequalities, we notice that the ranking based on calculation of Gini index from our data is quite consistent with the ranking provided by OECD and Eurostat (see Table 1 and Graph 1).[9] In particular our evidence shows that formerly planned economies (Poland, Latvia,

[6] We exclude pupils, students, those in an unpaid work experience, those in retirement or in early retirement, permanently disabled or/and unfit to work, those in compulsory military community or service and other inactive person.

[7] Tables 4, 5, 6, 7 and 8 in the *APPENDIX* show the progressive tax rate used for the conversion. As for Slovakia we imputed a flat tax rate of 19% (source: *http://www.finance.gov.sk/*) whereas for Iceland a tax rate of 37.7% has been imputed for imcome higher than 1.191.000 ISK (*source: http: //www.ministryoffinance.is*).

[8] VAN KERM P. (2007) discusses how ordinial comparisons of countries are found to be robust to variants of data adjustment procedures such as trimming arid wimisorizing.

[9] Spearman rank correlation between EUSILC Gini and the ones calculated by OECD and Eurostat are 0.90 and 0.84, respectively.

TABLE 1

INEQUALITY OF INCOME AND COMPARABLE GINI CALCULATIONS

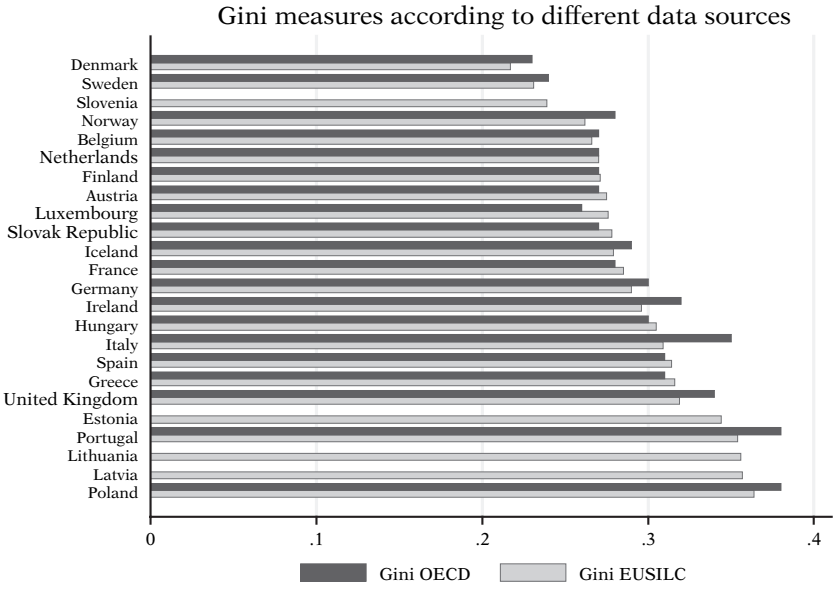
country	OECD Gini	EUROSTAT Gini	EUSILC Gini	EUSILC Mld
AT	0.27	0.26	0.275	0.164
BE	0.27	0.28	0.266	0.145
DE	0.3	0.26	0.29	0.185
DK	0.23	0.24	0.217	0.083
EE			0.344	0.243
ES	0.31	0.32	0.314	0.216
FI	0.27	0.26	0.271	0.136
FR	0.28	0.28	0.285	0.163
GR	0.31	0.33	0.316	0.2
HU	0.3	0.28	0.305	0.161
IE	0.32	0.32	0.296	0.187
IS	0.29	0.25	0.279	0.188
IT	0.35	0.33	0.309	0.197
LT			0.356	0.228
LU	0.26	0.26	0.276	0.148
LV			0.357	0.229
NL	0.27	0.27	0.27	0.184
NO	0.28	0.28	0.262	0.145
PL	0.38	0.36	0.364	0.271
PT	0.38	0.38	0.354	0.247
SE	0.24	0.23	0.231	0.106
SI			0.239	0.104
SK	0.27	0.26	0.278	0.132
UK	0.34	0.34	0.319	0.204

Note: EUSILC Gini arid MLD are given by authors' calculations; OECD Gini on working age population and Eurostat Gini are taken from *http://stats.oecd.org* and OECD (2008).

Lithuania, Estonia plus Portugal) obtain the highest values of both Gini and MLD. They are followed by the UK, Ireland and Mediterranean countries like Greece, Italy and Spain whereas Northern countries like Denmark, Finland, Norway and Sweden

GRAPH 1

CORRELATION BETWEEN EUSILC GINI AND OECD GINI ON WORKING AGE POPULATION

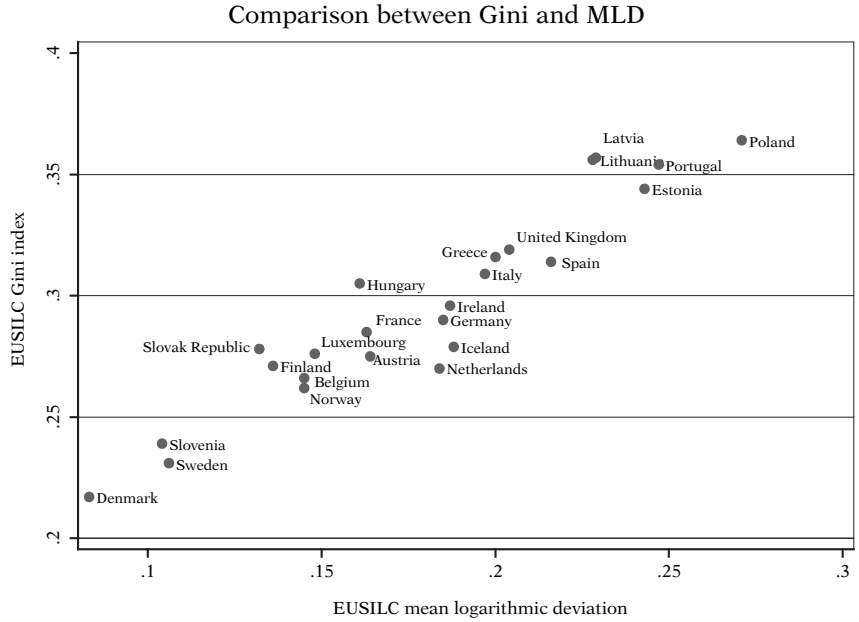


Source: Authors' calculations and *http://stats.oecd.org*.

lead the ranking with low values of both Gini and Mean Logarithmic Deviation (MLD) (see Graph 2). Turning to the measurement of inequality of opportunity, our attention is confined to the MLD which is the only index that allows for a perfect decomposition of total income inequality in effort inequality and opportunity inequality. As a first insight we notice that inequality of opportunity generally accounts for a substantial share of income inequality in the EU countries under analysis, see Table (2). Notice that both the Netherlands and Norway have very few observations on parental socio-economic background, hence results in those cases might not be fully interpreted (see Tables 9 and 10). Summary statistics on the characteristics of the sample also show that we could not take into consideration information on degree of urbanization for the Netherlands and Slovenia

GRAPH 2

CORRELATION BETWEEN EUSILC GINI AND EUSILC MLD ON WORKING AGE POPULATION



Source: Authors' calculations.

whereas in the case of Sweden, given few observations available on parental occupation, we choose not to consider this characteristic.[10] Inequality of opportunity explains from the 2% to the 22% of income inequality. As mentioned in the previous section, given the partial observability of circumstances, those values can only be considered as lower bound estimates. Table (2) shows the ranking obtained by absolute measures, also reporting the incidence on total inequality).

[10] Few observations on parental occupation are also present in the UK case. However, in this case we considered both parental characteristics in the calculation as the results on the restricted sample are qualitative similar to those obtained using the larger sample with only education as parental characteristic.

TABLE 2

INEQUALITY OF OPPORTUNITY IN ABSOLUTE AND AS PERCENTAGE OF TOTAL INEQUALITY

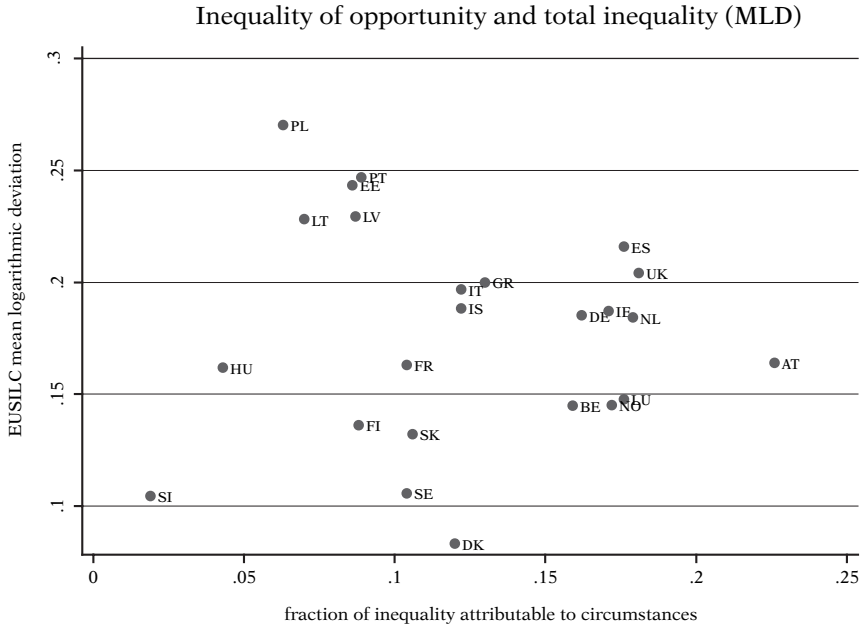
country	absolute	relative
AT	0.037	0.396
BE	0.023	0.372
DE	0.03	0.27
DK	0.01	0.241
EE	0.021	0.272
ES	0.038	0.329
FI	0.012	0.169
FR	0.017	0.258
GR	0.026	0.27
HU	0.007	0.211
IE	0.032	0.337
IS	0.023	0.372
IT	0.024	0.305
LT	0.016	0.215
LU	0.026	0.311
LV	0.02	0.214
NL	0.033	0.38
NO	0.025	0.276
PL	0.017	0.207
PT	0.022	0.312
SE	0.011	0.189
SI	0.002	0.135
SK	0.014	0.242
UK	0.037	0.314

Note: The columns refer to MLD in absolute terms and as percentage of total inequality as measured by MLD.

It is interesting to note that country ranking based on inequality of opportunities does not coincide with the picture emerging when looking at total inequality (see Graph 3). Countries that were characterised by high levels of total inequality (Poland, Estonia, Lithuania and Latvia) show that only a small fraction of it was due to the effect of circumstances, indicating that most of it may be due to individual unobservable components (within which individual effort). A second pattern is observed among Nordic countries (notably Sweden, Denmark and Finland, with Norway partially apart), which report low level of both total

GRAPH 3

OPPORTUNITY INEQUALITY AND TOTAL INEQUALITY



Source: Authors' calculations.

inequality and inequality of opportunities. Finally, most of the continental Europe and the Mediterranean area gather in an intermediate situation, with average inequality but high impact of circumstances. For these reasons we wonder whether these patterns could be associated to institutional features existing in these countries, which is the argument of the next section.

3.3 *Accounting for Opportunity Inequality*

While searching for institutional features which may attenuate the impact of circumstances on income formation, we were induced to look at two passages which are crucial in individual careers: schooling and entrance in the labour market. As far as

the first dimension, the literature suggests that early schooling may contribute to reducing the role of parental background in competence formation (Cunha and Heckman, 2007). In addition, the stratification of the educational system may reinforce the impact of parents' education, since low educated parents may prevents their kids from aspiring to more academic oriented careers (Brunello and Checchi, 2007). The quality of education may also play a role, since it may compensate the disadvantage of students coming from poor environment. Unfortunately, data on school quality are not easily available (unless one is ready to consider students achievements as a proxy for "revealed" quality). More modestly, we have considered economic resources publicly invested in the educational system as proxies for quality of education. In Graph 4 and Graph 5 we report the scatter plots of inequality of opportunities against some of these measures. In the left panel of Graph 4 we show that the ratio of enrolment in preprimary education over primary enrolment (a rough indicator of preprimary participation, in the absence of good quality data on the relevant age cohort for preprimary education[11]) is negatively correlated with IO. Similarly, the right panel of the same Figure shows that a larger fraction of students enrolled in vocational education (another proxy for the extent of school stratification[12]) enhances the IO. When considering the resources available to the educational system, we have included in the left panel of Graph 5 the ratio of students to teachers in primary school (a negative proxy for resources – we were forced to use primary education, as it was the only variable which was non

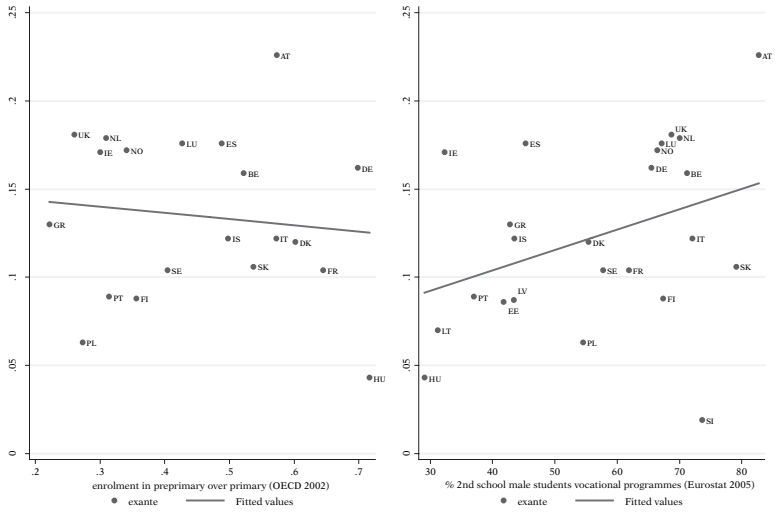
[11] *Source:* OECD online database (*http: //www.oecd .org/education/database*). Data are referred to 2002, and are obtained from BRUNELLO G. and CHECCHI D. (2007). The enrolment in preprimary schooling of 4-year-old children made available from Eurostat with reference to 2005 was discarded because it was reporting values at 100% for some countries, contradictimig the figures contained in Education at a glance from OECD.

[12] Data from Eurostat 2005 (*http : //epp.eurostat .ec .europa.eu/portal/page/portal/statistics/search database*). This indicator provides information on the percentage of boys and girls in upper secondary education who are enrolled in the vocational stream. It is indicative in the importance of initial vocational education and training in a country, taking into account also the gender dimension.

GRAPH 4

OPPORTUNITY INEQUALITY AND SCHOOLING

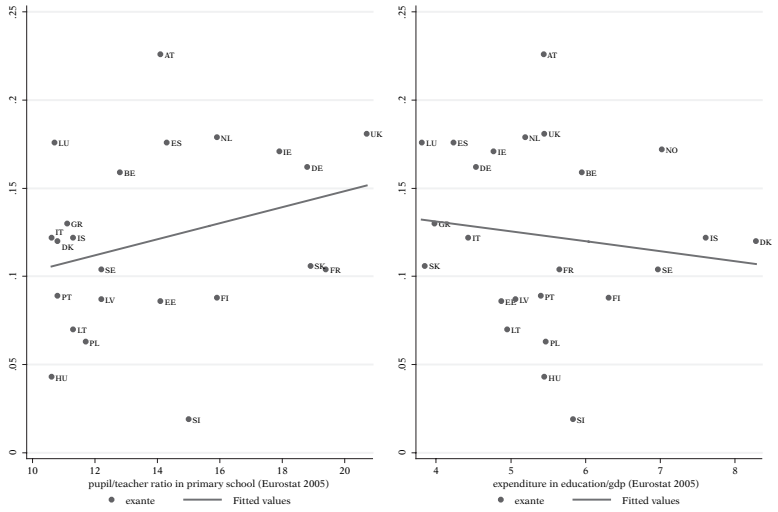
Schooling and inequality of opportunities



GRAPH 5

OPPORTUNITY INEQUALITY AND EDUCATIONAL RESOURCES

Resources in education and inequality of opportunities



missing[13]), while in the right panel we have considered the incidence of public expenditure on gross domestic product.[14] In both cases, we show that greater resources invested in education reduce IO. However, we must recall that these are just simple correlations, which may be reflecting spurious correlation. If we use OLS regressions, including the absolute level of inequality as a sort of country control, we find that among this first group of variables related to schooling, only the share of students in vocational education comes out slightly significant (see Table 3).

Then let us move to labour market institutions (Graph 6). Here data availability, especially for new entrants in the EU, is scarce. We have considered two indirect measures of the degree of institutionalisation: the presence of union (proxied by union membership over dependent employment[15]) and the degree of employment protection, computed by OECD[16]. In accordance with the literature, we expected that when the labour market is heavily regulated, wages are less related to individual features, since unions press for job-related pay scales. In addition, employment protection reduces labour turnover, reducing individual income variability (and therefore aggregate wage inequality). Both measures have been proved to reduce total income inequality in the aggregate (Checchi and Garcia Peñalosa, 2008). However labour market institutions are only weakly and negatively correlated with IO, as it can also be seen in OLS regressions (see again Table 3).

Eventually, we have considered the role of welfare provisions.

[13] Also from Eurostat 2005. The pupil-teacher ratio is calculated by dividing the number of full-time equivalent pupils by the number of full-time equivalent teachers teaching at ISCED level 1. Only teachers in service (including special education teachers) are taken into account.

[14] Also from Eurostat 2005. This indicator is defined as total public expenditure on education, expressed as a percentage of GDP. Generally, the public sector funds education either by bearing directly the current and capital expenses of educational institutions or by supporting students and their families with scholarships and public loans as well as by transferring public subsidies for educational activities to private firms or non-profit organisations. Both types of transactions together are reported as total public expenditure on education.

[15] Data were kindly made available by Jelle Visser (University of Amsterdam).

[16] It is the index of overall Employment Protection Legislation (version 2), referred to 2003 (OECD, 2004).

TABLE 3

MULTIVARIATE ANALYSIS OF INEQUALITY OF OPPORTUNITY - OLS

enrolment in preprimary over primary	–0.0511			
	[0.78]			
	0.0014			
	[1.77]*			
expenditure in education/gdp		–0.0082		
		[0.90]		
pupil/teacher *ratio* in primary school		0.0039		
		[1.38]		
union density rate			–0.0003	
			[0.22]	
OECD employment protection legislation			–0.0086	
			[0.41]	
gini before/after tax and transfer				–0.0889
				[1.14]
expenditure in social protection/gdp				0.0028
				[1.42]
Observations	20	23	17	17
R-squared	0.21	0.11	0.02	0.2
Log likelihood	35.94	37.61	27.86	31.44

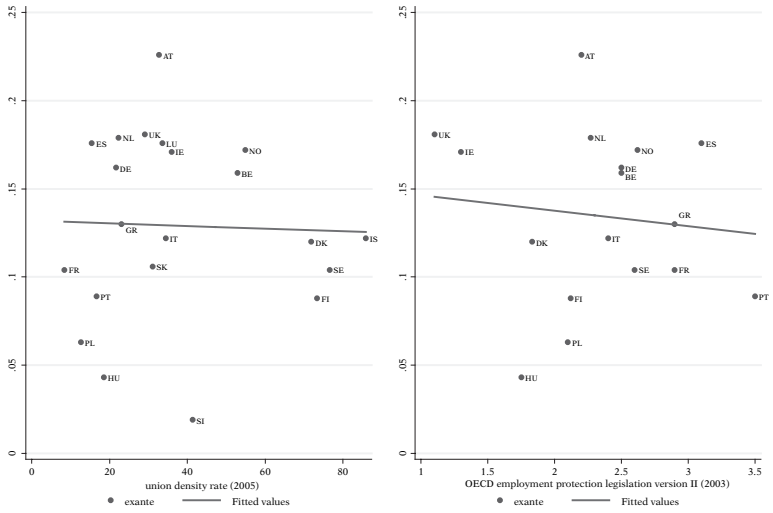
Note: Robust *t* statistics in brackets – * significant at 10%; ** significant at 5%; *** significant at 1%. Total inequality and constant added as controls.

In general we do not have apriori theoretical expectation on their impact onto IO, since taxes and subsidies aim to contain income inequality (through taxation) and to provide income insurance against unforeseeable events (through subsidies), but in no case they include compensatory measures which attenuate the impact of circumstances. However, as long as fiscal redistribution sustains low incomes (that may be correlated to disadvantaged conditions), we could find some negative correlation with IO. We have selected two proxies for the welfare state, which are shown in Graph 7. In the left panel we have computed the ratio between the Gini index computed over gross incomes and the Gini index computed over disposable incomes: the larger is the ratio, the stronger is the

GRAPH 6

OPPORTUNITY INEQUALITY AND LABOUR MARKET INSTITUTIONS

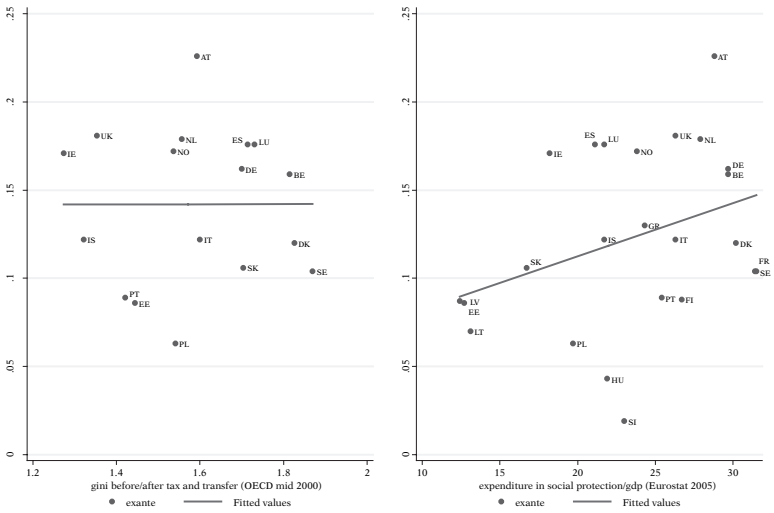
Taxes and transfer and inequality of opportunities



GRAPH 7

OPPORTUNITY INEQUALITY AND FISCAL REDISTRIBUTION

Labour market institutions and inequality of opportunities



redistributive role of the state.[17] We find a slightly negative correlation, which however does not reach statistical significance. More surprising is the right panel, which exhibits the scatter plot of IO against social expenditure.[18] In such a case we find a positive correlation with IO, as if a targeted expenditure may reinforce the income generating impact of circumstances. In both cases however the coefficients of these variables in multivariate regressions do not achieve statistical significance.

4. - Concluding Remarks

In this paper we have presented an approach to measuring inequality of opportunities based on the identification of circumstances, which are out of responsibility of the individual. We have made explicit assumptions, which are necessary to validate our proposed measure, both parametrically and not. We have then applied these methods to European countries, providing alternative country rankings. We show that standard income inequality and inequality of opportunities do not necessarily offer the same type of rankings. We have also searched for potential correlation with the most favourable institutional environment with respect to maximising EOp. Our results suggest that equality of opportunity is positively correlated with pre-primary education and de-tracked secondary school systems. Some correlation is also found for labour market regulation (namely with union density and EPL), while we find some counterintuitive result when considering social expenditure.

We would like to search for more robust results with respect to the role of institutions. However this requires to move to

[17] Data are from the OECD database (*http://stats.oecd.org/Index.aspx?DataSetCode=INEQUALITY*) and are referred to mid-2000.

[18] From Eurostat, 2005: Expenditure on social protection contains: social benefits, which consist of transfers, in cash or in kind, to households and individuals to relieve them of the burden of a defined set of risks or needs; administration costs, which represent the costs charged to the scheme for its management and administration; other expenditure, which consists of miscellaneous expenditure by social protection schemes (payment of property income and other).

structural model estimation, where through interactions with circumstances we may exploit temporal and cross-country variations in order to be able to assess the contribution of the institutional set-up to income formation. But this is left to future research.

APPENDIX

TABLE 4

TAX RATE IN DENMARK

Taxable income in euro	tax rate
0-3,250	0
3,251-6,500	13.3
6,501-9,750	19.2
9,751-13,000	24.1
13,001-16,250	27.6
16,251-19,500	28.7
19,501-26,000	30.4
26,001-32,500	32.7
32,501-39,000	34.5
39,001-45,500	36.2
45,501-52,000	38.9
52,001-65,000	42.3
65,001-97,500	48.4
97,501-130,000	53
130,001	59.2

Source: www.skm.dk.

TABLE 5

TAX RATE IN FINLAND

Taxable income in euro	tax rate
12,200-17,000	9
17,001- 20,000	14
20,001- 32,800	19.5
32,801- 58,200	25
58,201	32.5

Source: www.vero.fi.

TABLE 6

TAX RATE IN HUNGARY

Taxable income in euro	tax rate
1-5,960	18
5,961	38

Source: www.worldwide-tax.com.

TABLE 7

TAX RATE IN THE NETHERLANDS

Taxable income in euro	tax rate
1-16,265	0
16,266-29,543	7.95
29,544-50,652	42
50,653	52

Source: OECD.

TABLE 8

TAX RATE IN NORWAY

Taxable income in NOK	tax rate
lower limit	tax rate
0	0.0
29,600-43,022	25.0
43,023-65,999	7.8
66,000-102,580	35.8
102,581-185,160	27.1
185,161-380,999	35.8
381,000-799,999	47.8
800,000	51.3

Source: www.Taxnorway.no.

TABLE 9

SUMMARY STATISTICS ON MAIN INDIVIDUAL VARIABLES

country	m(x)	sd(x)	female	foreign	not densely pop	m(age)	sd(age)	education 1	education 2	education 3	N
AT	18,237	8941	45.0	11.6	70.5	43.4	7.9		0.69	0.31	4,256
BE	21,310	12,343	44.4	10.8	49.1	43.2	7.9	0.006	0.525	0.169	3,601
DE	19,508	9,999	54.1	4.8	56.1	44.2	7.5		0.49	0.51	8,296
DK	19,601	8,206	50.2	3.6	67.2	44.1	8.5		0.65	0.35	2,796
EE	3,807	2,847	54.6	14.2	69.4	44.3	8.2		0.59	0.41	3,730
ES	14,062	8,052	41.3	6.2	50.9	42.7	8.3		0.67	0.33	10,012
FI	20,915	10,178	49.3	1.9	76.9	44.9	8.5		0.60	0.40	4,535
FR	19,368	10,099	48.3	10.9	56.0	43.6	8.2		0.67	0.33	7,164
GR	13,870	8,698	36.9	8.7	60.2	43.0	8.4		0.70	0.30	3,980
HU	4,353	4,934	47.1	2.5	63.6	43.4	8.5	0.001	0.797	0.202	4,591
IE	23,938	12,545	45.5	11.6	62.7	44.2	8.2		0.57	0.43	4,072
IS	20,466	10,001	50.2	4.9	42.9	42.7	8.6		0.97	0.03	1,248
IT	18,654	13,943	42.1	5.8	64.9	43.1	8.1	0.005	0.774	0.221	17,151
LT	3,022	2,301	53.0	6.4	54.7	44.6	7.9		0.38	0.62	3,659
LU	30,034	14,482	43.6	50.6	54.0	41.5	8.1		0.69	0.31	2,498
LV	2,871	2,062	54.4	15.7	49.9	43.8	8.3	0.002	0.639	0.359	2,706
NL	18,198	8,768	45.2	5.1		43.5	8.3		0.61	0.39	8,441
NO	19,809	9,403	48.7	6.8	50.6	43.8	8.5	0.001	0.596	0.403	5,674
PL	3,690	2,547	45.9	0.3	60.2	42.9	7.8	0.003	0.752	0.246	10,347
PT	8,997	6,199	45.5	2.4	64.4	43.2	8.4		0.88	0.12	3,375
SE	19,453	8,256	49.4	9.9	81.5	44.5	8.9		0.57	0.43	2,435
SI	95,57	4,117	48.6	11.3		42.4	7.9		0.78	0.22	3,011
SK	3,748	3,146	48.8	2.0	71.0	43.8	8.0		0.80	0.20	4,461
UK	23,861	13,872	50.9	8.7	26.7	44.0	8.6		0.55	0.45	5,421
Total	15,129	11,911	46.7	7.4	59.5	43.48	8.21	0.003	0.752	0.246	127,460

The columns of this table show the following statistics: 1. average post tax individual income; 2. post tax individual income standard deviation; 3. percentage of females; 4. percentage of foreigners; 5. percentage of individuals not living in a densely populated area; 6. average age; 7. age standard deviation; 8. percentage of individuals with no education; 9. percentage of individuals with primary or secondary school degree; 10. percentage of individuals with higher degree; 11. number of observations.

TABLE 10

SUMMARY STATISTICS ON MAIN PARENTAL VARIABLES

country	occupation			N	education			N
	1	2	3		1	2	3	
AT	0.59	0.32	0.09	3,845	0	0.94	0.06	4,025
BE	0.47	0.25	0.25	2,995	0.11	0.67	0.22	3,601
DE	0.52	0.23	0.25	7,421	0	0.66	0.34	5,296
DK	0.45	0.30	0.22	2,649	0	0.78	0.22	2,796
EE	0.75	0.10	0.15	3,029	0.01	0.72	0.27	3,730
ES	0.60	0.28	0.12	9,496	0.20	0.69	0.11	10,012
FI	0.52	0.32	0.17	3,810	0.03	0.81	0.16	4,535
FR	0.55	0.29	0.16	6,562	0.04	0.86	0.10	7,164
GB	0.35	0.51	0.14	3,817	0.25	0.66	0.09	3,980
HU	0.66	0.22	0.12	3,986	0.00	0.84	0.16	4,591
IE	0.47	0.14	0.39	2,612	0.01	0.83	0.15	2,792
IS	0.35	0.37	0.25	1,053	0	0.76	0.24	1,245
IT	0.55	0.24	0.19	15,562	0.11	0.85	0.04	17,151
LT	0.77	0.11	0.12	3,170	0.05	0.69	0.26	3,659
LU	0.55	0.23	0.22	2,365	0.06	0.76	0.18	2,495
LV	0.77	0.10	0.13	2,104	0.02	0.77	0.21	2,706
NL	0.39	0.20	0.41	3,534	0	0.83	0.17	3,866
NO	0.45	0.31	0.24	2,519	0	0.58	0.42	2,752
PL	0.53	0.36	0.11	9,377	0.11	0.80	0.09	10,347
PT	0.61	0.31	0.08	3,057	0.35	0.61	0.03	3,375
SE	0.50	0.29	0.21	535	0.01	0.79	0.20	2,435
SI	0.61	0.27	0.11	2,623	0.04	0.87	0.09	3,011
SK	0.72	0.14	0.14	4,070	0	0.90	0.10	4,461
UK	0.62	0.24	0.13	2,750	0.50	0.16	0.34	5,421
Total	0.57	0.26	0.17	103,001	0.10	0.75	0.15	118,452

The columns of this table show the following statistics: 1. percentage of individuals who have at least one of the parents occupied in the categories 8,000 and 9,000 of the ISCO88 classification; 2. percentage of individuals who have at least one of the parents occupied in categories from 5,000 to 7,000 of the ISCO88 classification; 3. percentage of individuals who have at least one of the parents occupied in categories 1,000 to 4,000 of the ISCO88 classification (see the text for further details); 4. number of observations available for the parental occupation variable; 5. percentage of individuals who have both parents with no education; 6. percentage of individuals who have at least one of the parents with primary or secondary school degree; 7. percentage of individuals who have at least one of the parents with post-secondary or higher degree; 8. number of observations available for the parental education variable.

BIBLIOGRAPHY

BOURGUIGNON F. - FERREIRA F. - MENENDEZ M., «Inequality of Outcomes and Inequality of Opportunities in Brazil», The World Bank, Washington DC, Policy Research, *Working Paper*, Series no. 3174, 2003.

BRUNELLO G. - CHECCHI D., «Does School Tracking Affect Equality of Opportunity? New International Evidence», *Economic Policy*, no. 52, pages 781-861, 2007.

CHECCHI D. - GARCÍA PEÑALOSA C., «Labour Market Institutions and Income Inequality», *Economic Policy*, vol. 56, 2008.

CHECCHI D. - PERAGINE V., «Inequality of Opportunity in Italy», in *Journal of Economic Inequality*, (forthcoming), 2009.

CHECCHI D. - PERAGINE V. - SERLENGA L., *Fair and Unfair Income Inequality in Europe*, mimeo, 2009.

COWELL F.A. - VICTORIA-FESER M.P., «Poverty Measurement with Contaminated Data: A Robust Approach» in *European Economic Review*, vol. 40, 1996*a*.

— - —, — - —, «Robustness Properties of Inequality Measures», *Econometrica*, vol. 64, 1996*b*.

— - —, — - —, «Welfare Rankings in the Presence of Contaminated Data», *Econometrica*, vol. 70, 2002.

CUNHA F. - HECKMAN J., «The Technology of Skill Formation», *American Economic Review*, vol. 97, 2007.

DARDANONI V. - FIELDS G. - ROEMER J.E. - SANCHEZ-PUERTA M.L., «How Demanding Should Equality of Opportunity be and How Much we Have Achieved?», in MORGAN S.L. - GRUSKY D.B. - FIELDS G., *Mobility and Inequality*, Stanford University Press, 2006.

FERREIRA F.H.G. - GIGNOUX J., «The Measurement of Inequality of Opportunity: Theory and an Application to Latin America», World Bank, *Policy Research*, *Working Paper*, no. 4659, 2008.

FLEURBAEY M., «Three Solutions for the Compensation Problem», *Journal of Economic Theory*, vol. 65, 1995.

FLEURBAEY M. - LUONGO P. - PERAGINE V., *Implications and Partial Observability of Circumstances on he Measurement of* EO_p, 2009.

— - —, *Fairness, Responsibility and Welfare*, Oxford University Press, 2008.

HANUSHEK E. - WÖßMANN L., «Does Educational Tracking Affect Performance and Inequality? Differences-In-Differences Evidence Across Countries», *Economic Journal*, vol. 116, 2006.

LEFRANC A. - PISTOLESI N. - TRANNOY A., «Equality of Opportunity: Definitions and Testable Conditions, With an Application to Income in France», *IDEP, Working Paper*, no. 62, 2006*a*.

— - —, — - —, — - —, «Inequality of Opportunity vs Inequality of Outcomes: Are Western Societies All Alike?», *Review of Income and Wealth*, vol. 54, 2006*b*.

OECD, *Economic Outlook*, Paris, 2004.

— - —, *Growing Unequal? Income Distribution and Poverty in Oecd Countries*, Paris.

PERAGINE V., «Opportunity Egalitarianism and Income Inequality: A Rank-dependent Approach», *Mathematical Social Sciences*, vol. 44, 2002.

— - —, «Measuring and Implementing Equality of Opportunity for Income», *Social Choice and Welfare*, vol. 22, 2004.

PERAGINE V. - SERLENGA L., «Higher Education and Equality of Opportunity in Italy», in BISHOP J. - ZHENG B. (eds.), *Research in Economic Inequality*, vol. 15, 2008.

VAN KERM P., «Extreme Incomes and the Estimation of Poverty and Inequality Indicators from EU-SILC», Iriss, *Working Paper Series*, 2007-01, 2007.

VISSER J. - CHECCHI D., «Inequality and the Labour Market: Unions», in SALVERDA W. - NOLAN B. - SMEEDING T. (eds.), *Oxford Handbook of Economic Inequality*, Oxford University Press, 2009.