INCOME INEQUALITY AND OPPORTUNITY INEQUALITY IN EUROPE

DANIELE CHECCHI, VITO PERAGINE E LAURA SERLENGA

Income inequality and opportunity inequality in Europe

Daniele Checchi, University of Milan
Vito Peragine, University of Bari
Laura Serlenga, University of Bari

Abstract

This paper proposes an estimate of the extent of opportunity inequality and of its determinants in a sample of European countries. The aim of this work is to deepen our knowledge on the genesis of standard income inequality. This might be helpful to identify the priorities of a redistributive public intervention and the cases of inequality traps. Although the classification 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 also show that equality of opportunity might increase by promoting pre-primary education and by de-tracking the secondary school system. Equality of opportunity is also negatively affected by labour market regulation, union density and wage centralisation whereas is positively correlated with fiscal redistribution.

JEL Classification: D31, D63, J62
Keywords: Inequality of opportunity, income inequality, intergenerational mobility.

1 Introduction

This paper proposes an estimation of the extent of opportunity inequality and its determinants in 24 European countries. 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.

Equality of opportunity (EOp) is not a new concept in economics and in social sciences in general. In different strands of the scientific literature, analysis and results are often interpreted in terms of "equality of opportunity": consider, for instance, the literature on the economics of education or the literature on social mobility. However, the precise concept of equality of opportunity is rarely spelt out and different, sometimes conflicting, definitions are implicitly assumed. In this paper we refer to the conceptualization of EOp proposed by philosophers such as Dworkin (1981a,b), Arneson (1989), Cohen (1989) and on the economic literature - initiated by Roemer (1993, 1998) - that has flourished in the last two decades and that has explored 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 part of the literature that has explored methods and techniques in order to measure 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 24 European countries and make an attempt to analyze the determinants of the extent of opportunity inequality 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 two main approaches to measuring opportunity inequality, namely the ex-ante and the ex-post approach. The two approaches give different definitions of EOp and embody the ethical principles illustrated above in different ways. According to the ex-ante approach, there is equality of opportunity (EOp) if the set of opportunities

is the same for all individuals, regardless of their circumstances. This approach partitions 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 between types inequality.

On the other side, according to the ex-post approach, there is EOp if and only if all those who exert the same level of effort end out with the same outcome. This means that opportunity inequality within this approach is measured as inequality within responsibility classes, i.e. set of individuals at the same effort level (tranches).

Although at the optimum these two approaches converge on the same allocation, the equality of opportunity allocation, the ex-ante approach and the ex-post approaches may originate different ranking of social situations; in fact they express different and sometimes conflicting views on equality of opportunity (for a discussion on this see Fleurbaey and Peragine 2009).

Moreover, it is possible to further distinguish the existing literature according to the methods used in the measurement of EOp. In some cases the existence of EOp in a given distribution is tested by using the concept of stochastic dominance, as in the studies by Lefranc et al. (2006a; 2006b) and Peragine and Serlenga (2008) both based on an ex-ante approach. 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 by which it is possible 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 tools 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 those two methodologies, parametric and non parametric ones, following the model proposed by Bourguingon et al. (2007). Each approach has its own advantage and shortcoming: the non parametric models allow one to avoid the discretionary choice of a 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, *ceteris paribus*.

To conclude we notice that, although the ex post approach, originally proposed by Roemer (1993, 1998) and defended by Fleurbaey (1995, 2008)

as the proper definition of EOp, is in general referred to as the theoretical definition of EOp, all the empirical studies referred above, with the exception of Checchi and Peragine (2009), have adopted an ex ante approach. In this paper we explore both the ex ante and ex post approaches, and both the parametric and the non parametric methodologies. Furthermore, once an estimation of EOp measures is derived, we employ a parametric approach to study the effect of institutional characteristics on 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 the ex ante and the ex post approach as well as 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 classification among Northern European and Mediterranean countries is generally respected, our measures of equality of opportunity provide a differ ranking with respect to the one offered by the measures of overall income inequality. Our figures also show that equality of opportunity might be increased by promoting pre-primary education and by de-tracking the secondary school system. Equality of opportunity is also negatively affected by labour market regulation, union density and wage centralization whereas is positively correlated with 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.

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 $\mathbf{c}$; examples of circumstances are race, gender, family background, etc. The individual sets of circumstances belong to a finite set $\Omega = \{\mathbf{c}_1, ..., \mathbf{c}_n\}$. Suppose that 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: $\Omega = (\{$female, non graduate parents$\}$, $\{$female, graduate parents$\}$, $\{$male, non graduate parents$\}$, $\{$male, graduate parents$\})$.

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.

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

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

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 any variation in individual income is 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).

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, on the basis of the data available, we will treat only gender and parental background, which will be proxied by the level of parents' education, as 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[1].

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

[1] On the effect of partial observability of the circumstances on the estimates of opportunity inequality see Fleurbaey, Luongo and Peragine (2009).

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 monotonically 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 (clearly discussed by Pistolesi 2008), 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 this paper.

We now propose two different partitions of the total population. First, for $\mathbf{c}_i \in \Omega$, we call *type* i the set of individuals whose set of circumstances is $\mathbf{c}_i$. 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 $\mathbf{c}_i$.

The second partition is based on the effort variable: for $e \in \Theta$, we call *tranche* e the set of individuals whose effort is e. However, as we are considering the case of non observability of effort, we need to deduce the *degree* of effort from some observable behavior. More precisely, we need a *proxy* in order to measure it in an ordinal sense and to compare the effort of different individuals. Given the monotonicity of the income function and the independence of effort from circumstances, this will correspond to the quantile in the income distribution of the type. Following Roemer (1993, 1998) we say that all individuals at the p^{th} quantile of their income distributions, across types, have tried equally hard.

Thus, we define the tranche p in a population as the subset of individuals whose incomes are at the p^{th} rank of their respective type income distributions. The two partitions suggest two different approaches to mea-

sure opportunity inequality.

The first approach focuses on ex post inequalities in classes of individuals with identical effort. Consequently, it looks at the tranches distributions.

Definition The ex post approach. *There is EOp if all those who exerted the same degree of effort have the same outcome. Inequality of opportunity decreases if outcome inequality decreases among the individuals at the same degree of effort.*

Thus, the tranches approach emphasizes inequalities within effort groups: it is therefore an expression of the principle of compensation. On the other hand, differences between the tranches are interpreted as due to individual effort, and are not considered as unfair.

This is the approach proposed by Roemer (1993, 1998) and defended by Fleurbaey (2008).

In contrast, the second approach focuses on the types distributions and is based on the following definition of equality of opportunity.

Definition The ex ante approach. *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, the ex ante approach 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. By stating the irrelevance of the effort based inequalities within each types, the ex ante approach is an expression of a reward-focused approach to equality of opportunity (see Fleurbaey 2008, ch. 9).

This is also the approach proposed, in a different framework, by Van de gaer (1993), Kranich (1996), Peragine (2004a).

Both approaches appear as relevant and plausible, and it is difficult to give priority to one or another. Therefore, we now develop each of them in turn, and for each of them we provide a measure of opportunity inequality.

2.1 The ex-post approach

In the ex post approach opportunity inequality is given by inequality within tranches. To capture such inequality we may construct an hypotetical *standardized distribution* obtained after the following transformation:

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

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

values of both circumstances and effort.

Note that for every scale invariant inequality measure I:

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

Hence, in the ex post approach inequality of opportunity is given by a (scale invariant) inequality index I applied to the artificial distribution[2] $\frac{x(\mathbf{c},e)}{x(\overline{\mathbf{c}},e)}$:

$$OI^{ex-post}=I\left(\frac{x\left(\mathbf{c},e\right)}{x\left(\overline{\mathbf{c}},e\right)}\right)$$

or, in relative terms:

$$OI_{relative}^{ex-post}=\frac{I\left(\frac{x(\mathbf{c},e)}{x(\overline{\mathbf{c}},e)}\right)}{I\left(x\left(\mathbf{c},e\right)\right)}.$$

What is the meaning of the reference value $x\left(\overline{\mathbf{c}},e\right)$? This depends on the specific measurement approach one decides to adopt[3]:

In a non parametric approach: $x\left(\overline{\mathbf{c}},e\right)$ may be interpreted as the average income of a given tranche identified by e (call it μ_e), and $x\left(\overline{\mathbf{c}},\bar{e}\right)$ as the grand mean of the overall distribution (call it μ).

If we opt for a non parametric approach, then for any *path independent* measure of inequality[4] (Foster and Shneyrov, 2000)we have that

$$\begin{aligned}I\left(x\left(\mathbf{c},e\right)\right) &= I\left(\frac{x\left(\mathbf{c},e\right)}{x\left(\overline{\mathbf{c}},e\right)}\right)+I\left(x\left(\overline{\mathbf{c}},e\right)\right)\\ I\left(x\left(c,e\right)\right) &= I\left(\frac{x\left(c,e\right)}{\mu_e}\right)+I\left(\mu_e\right)\end{aligned}$$

[2] $OI^{ex-post}$ corresponds to the *fairness gap approach* of Fleurbaey and Shokkaert (2009) and in fact Condition 2 of Fleurbaey and Shokkaert (2009) corresponds to Ex post inequality. On the other haned, $OI^{ex-ante}$ corresponds to the *direct unfairness approach* of Fleurbaey and Shokkaert (2009) and in fact Condition 1 of Fleurbaey and Shokkaert (2009) corresponds to Ex ante inequality. They use an absolute approach to inequality, while we use a relative approach.

[3] Other interpretations are possible: for instance, in a normative approach, $x\left(\overline{\mathbf{c}},e\right)$ 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 $X=(x_1,...,x_N)$ with mean μ_X the MLD is defined as:

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

The distribution $x(c,e)$ is the original income vector; μ_e is a hypothetical smoothed distribution in which each person's income is replaced with the mean income of the tranche to which she belongs. This smoothing process removes all inequality within the tranches, hence $I(\mu_e)$ captures the inequality only due to individual responsibility ; $\frac{x(c,e)}{\mu_e}$ is a standardized distribution obtained by proportionally scaling each tranche distribution until it has the same mean as the overall distribution. Standardization suppresses between-tranche inequality while leaving within tranche inequality unaltered. Hence $I\left(\frac{x(\mathbf{c},e)}{x(\bar{\mathbf{c}},e)}\right)$fully captures the income inequality only due to circumstances, i.e., the inequality of opportunity.

Hence the decomposition above can be interpreted as:

$$\text{total inequality} = \text{within tranches} + \text{between tranches}$$
$$\text{total inequality} = \text{opportunity inequality} + \text{effort inequality}$$

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

In a parametric analysis this procedure corresponds to estimate, for each tranche (p), the following equation

$$\ln x_i = \beta_p c_i + \varepsilon_i, \forall p, \tag{1}$$

where c_i is the all set of characteristics, and obtaining a counterfactual distribution of income as $\hat{x}_p = \exp\left(\hat{\beta}_p \bar{c}_p\right)$, where $\bar{c}_p$ is the average value of characteristics in each tranche. Inequality of opportunity can be therefore calculated parametrically by

$$I\left(\frac{x_i}{\hat{x}_p}\right).$$

2.2 The ex-ante approach

In the ex ante approach opportunity inequality is given by inequality between types ranches. To capture such inequality we may construct an hypotetical *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, in the ex ante approach inequality of opportunity is given by a (scale invariant) inequality index I applied to the distribution $x(c_i,\bar{e})$:

$$OI^{ex-ante} = I(x(\mathbf{c},\bar{e}))$$

or, in relative terms:

$$OI_{relative}^{ex-ante} = \frac{I\left(x\left(\mathbf{c},\bar{e}\right)\right)}{I\left(x\left(\mathbf{c},e\right)\right)}.$$

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

In a non parametric descriptive approach $x\left(c,\bar{e}\right)$ can be represented by the average income of a given type identified by $\mathbf{c}$ (call it μ_c).

If we opt for a non parametric approach, then for any *path independent* measure of inequality[5] (Foster and Shneyrov, 2000) we have that

$$\begin{aligned} I\left(x\left(\mathbf{c},e\right)\right) &= I\left(\frac{x\left(\mathbf{c},e\right)}{x\left(\mathbf{c},\bar{e}\right)}\right) + I\left(x\left(\mathbf{c},\bar{e}\right)\right) \\ I\left(x\left(c,e\right)\right) &= I\left(\frac{x\left(\mathbf{c},e\right)}{\mu_c}\right) + I\left(\mu_c\right). \end{aligned}$$

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 capture only and fully 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 the within-types inequality, to be interpreted as inequality due to individual responsibility. Hence the decomposition above can be interpreted as:

$$\begin{aligned} &\text{total inequality} = \text{within types} + \text{between types} \\ &\text{total inequality} = \text{effort inequality} + \text{opportunity inequality} \end{aligned}$$

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

As in the previous case, inequality of opportunity by the ex ante approach can also be computed paramentrically[6]. In this case we need to estimate (1)

[5] 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 $X = (x_1, ..., x_N)$ with mean μ_X the MLD is defined as:

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

[6] This is the approach followed by Ferreira and Guignoux (2008).

for the whole population such that

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

and derive the following counterfactual distribution $\hat{x}_i = \exp(\hat{\beta} c_i)$. Hence, inequality of opportunity according to the ex ante approach will be given by

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

In the following empirical analysis we will compare our estimates of $OI^{ex-post}$ (parametric and non parametric) and $OI^{ex-ante}$ (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 Central Statistics Office (CSO) 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. The countries we consider in our analysis are 24, 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.

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, this allows to significantly improve the comparability of our results. EUSILC is expected to become the EU reference source for comparative statistics on income distribution and social exclusion at European level. Indeed, this study has became possible because the 2005 EUSILC comprehends a special data module which provides data for attributes of each respondent's parents during her childhood period of the age 14-16. This additional module reports on 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 particular, the survey contains information on common set of circumstances as parental education and parental occupation. 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 refers to individuals who have at least one of the parents occupied as legislator, senior official, manager, professional, technician, associate professional or clerk; 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; finally, category 3 corresponds to individuals having both parents occupied as plant and machine operator and assembler or in elementary occupations.

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.[7] 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. [8] 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, 1996a, 1996b, 2002) we censored the countries' income distributions by dropping the very extreme values.[9]

[7] 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.

[8] Tables 1, 2, 3, 4 and 5 show the progressive tax rate used for the conversion. As for Slovakia we imputed a flat tax rate of 19% whereas for Iceland a tax rate of 37.7% has been imputed for income higher than 1.191.000 ISK.

[9] Van Kerm (2007) discusses how ordinal comparisons of countries are found to be robust to variants of data adjustment procedures such as trimming and winsorizing.

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 ex ante and the ex post approach.

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 6).[10] In particular our evidence shows that Poland, Latvia, Lithuania, Portugal and Estonia 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 lead the ranking with low values of both Gini and MLD, (see Figures 1 and 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 (8). Notice that both Netherlands and Norway have very few observations on parental socio-economic background, hence results in those cases might not be fully interpreted.

According to the ex ante approach inequality of opportunity explains from the 2% to the 22% of income inequality whereas considering the ex post definition we obtain much larger values, from the 13% to the 40%. As mentioned in the previous section, given the partial observability of circumstances, those values can only be considered as lower bound estimates. By construction we also expect the ex post values to be higher than the ex ante ones.

Table (7) shows the ranking obtained by absolute measures of type and tranche approach, respectively (see also Figures 3 and 4). The ex post measure shows higher correlation with total MLD than the ex ante: Spearman rank correlations are 0.76 and 0.42, both significant at 5%. More interestingly the ex ante and the ex post measures are proved to be highly correlated, showing a correlation of 0.8. This evidence confirms the importance of measuring EOp using both the ex ante and the ex post definition: those figures build on different definitions of EOp but lead to approximately the same conclusion in terms of ranking. Going from the ex post to the ex ante approach we find that the largest shifts in the ranking are recorded for Portugal, Poland and

[10] Spearman rank correlation between EUSILC Gini and the ones calculated by OECD and Eurostat are 0.9 and 0.84, respectively.

Estonia that improve their position whereas Luxemburg and Norway worsen their position, see Table (7).

Finally, we note in passing that the absolute ranking obtained by both the type and the tranche approach is roughly similar to figures showed by OECD (2008), Lefranc et al. (2007) and Mocetti (2007) on intergenerational mobility although those studies only analyze a subset of the countries included in our study and the measurements of inequality of opportunity proposed are somehow different.

3.3 Explaining opportunity inequality

In the second step of our empirical analysis we aim to analyze the effect of individual and institutional characteristics on opportunity inequalities. In order to do so we consider a typical outcome function

$$y_i = g(C_i, effort(C_i, f_i), \varepsilon_i),$$

where y_i is the outcome (earnings, income, etc.) C_i are circumstances, f_i and ε_i are unobserved.

More explicitly, we propose the following specification:

$$\begin{aligned} e_i &= \delta_{0i} + \delta_{2i} C_i + \delta_{3i} f_i + v_i && (2) \\ l_i &= \eta_{0i} + \eta_{1i} e_i + \eta_{2i} C_i + \eta_{3i} f_i + u_i && (3) \\ y_i &= \alpha_i + \beta e_i + \sigma C_i + \gamma l_i + \rho f_i + \varepsilon_i && (4) \end{aligned}$$

where e_i and l_i are variables which are affected by both effort and circumstances, namely level of education and employment status, and y_i is the outcome variable that is individual net income; C_i are the circumstances, i.e. family background and gender; whereas f_i, v_i, u_i and ε_i are residuals and in particular since effort, f_i, is unobserved, it ends up being counted as residual.

As widely acknowledged in the literature, an important issue here is the endogeneity of the effort variable, see Bourguignon et al (2003) among others. Indeed, the correlation between the unobservable components of the effort equations, (2) and (3), and ε_i introduces bias in the estimation of the coefficients β and σ and we need to implement instrumental variable technique in order to provide consistent estimates

Our main interest lies in estimating the outcome variable. However, it is clear that in order to consistently estimate equation (4) we need to take into account the effort equations (2) and (3). We therefore use two set of instruments: Z_{ei} for the identification of e_i 's effect and Z_{li} for the identification of l_i's effect. In particular, the instruments Z_{li} are used to identify the

effect of the labour market status in a Heckman selection set-up. The set of instruments that we consider are quarter of birth, number of siblings, age of parents, household composition and financial problems when young for Z_{ei} and dwelling type, tenure status, number of rooms, household size and household income except individual income for Z_{li}.[11] Table (9) shows estimated impact of circumstances from equation (4) for the seventeen countries under analysis. This parametric measure of opportunity inequality turns out to be highly correlated with the non parametric measure of opportunity presented in the previous section.[12]

Given the estimates of the structural model, we have investigated whether these measure are correlated with institutional features of these countries. If we focus on the impact of parental education onto earned incomes, its effect may pass through either acquired education or through family networking when entering the labour market.

On the first side, empirical evidence suggest that family impact is lowered when children are early exposed to pre-primary education (Heckman et al 2002, Cunha and Heckman 2007). Vice versa parental education reinforces its impact when the educational system is stratified, i.e. it offers alternative tracks leading to different (expected) outcomes in the labour market (Hanushek and Wößmann 2006, Brunello and Checchi 2007). These two dimensions could be captured by reporting student enrolment rates, at pre-primary institutions and in vocational tracks. In principle these measures should be referred to the period when each interviewed was potentially attending these two levels of education. Due to the lack of data that go back half century ago for all countries, in Figures 5 and 6 we report currently observed variables. While pre-primary education exhibit a rising trend in recent years, the fraction of student attending vocational school at secondary school level is more persistent, especially if one consider that most of the de-tracking reforms took place in the 70's of last century (see Brunello and Checchi 2007). In both cases, but especially in the second one, there is clearly a negative correlation with parental education onto individual income. This would suggest that EOp can increased by promoting pre-primary education and by de-tracking the secondary school system. This is in line with what invoked by most of the literature (see in particular Heckman and oths. 2002).

Once we consider the entrance in the labour market, we expect (total) income inequality being attenuated by stronger labour market institutions (Visser and Checchi 2009). However the reduction in overall inequality

[11] All variables included in Z_{ei} refer to the period when the interviewee was a young teenager, between the ages of 12 and 16.

[12] Spearman rank correlation coefficient between opportunity inequality by type and estimated parameters on parental education is equal to 0.831

does not necessarily translates into greater EOp, because it rigidity in the labour market may reduce the employment possibilities, especially among the youngest cohorts (OECD 2004). A widely accepted measure of labour market flexibility is provided by the index of employment protection legislation (EPL) proposed by OECD (2004), which is based on the legal procedures and severance payments required in case of firing. In Figure 7 we show the existing positive correlation between this index and the impact of parental education onto individual income. This graph suggests that rigid labour market are associated to greater inequality of opportunities. If parental networks are relevant in finding job opportunities, labour market rigidity may reinforce this effect by reducing job turnover. However this result is partially contradicted when moving to gender differentials, as we do in Figure 8. In this case greater rigidity reduces the impact of gender differentials. This does not come as a surprise, since it was already noticed that EPL was positively associated with employment probability of adult men, representing the core of the labour force (OECD 2004). The suggested interpretation is that EPL is intended to protect the male bread-winner in single income household, especially in countries where welfare provisions are limited (as in most Mediterranean countries). Figure 6 would be compatible with such a story if there would be a trade-off between income and employment security: in countries with high EPL, men are (differentially) protected in terms of employment, and therefore they do not need higher earnings; at the other extreme, where the labour markets are more flexible, they are (differentially) compensated in terms of higher income.

Also wage bargaining has some impact onto EOp, as accounted by Figures 9 and 10. In Figure 9 we have associated the impact of parental education with union density, which is a standard proxy for trade union power. We find a negative correlation between the two measures, suggesting that whenever unions are stronger they tend to link earnings to jobs and not to people, thus reducing the role for individual characteristics (including education – see Visser and Checchi 2009). For the same token, a measure of wage centralization (following the procedure proposed by Iversen 1999) also exhibit a negative (though weak) correlation with our measure of inequality of opportunities based on parental education. In this case the link could work through the reduction of wage differential across sectors and/or qualification, thus diminishing the advantages potentially associated to the family of origin. When going to gender differentials, we do not detect any statistically significant association with these two measures of union activities.

An additional dimension of institutions that could be potentially correlated with EOp is given by the welfare state, through fiscal redistribution. The larger is the extent of progressive taxation and/or the generosity of pub-

lic transfers (in case of unemployment, disability, sickness or retirement), the lower should be the role exerted by parental background in shaping your actual income. In Figure 11 we take as a proxy of the redistributive role of the state the ratio of the Gini index computed before tax and transfer over the same index computed on incomes after tax and transfers (both measures obtained from OECD 2008). As expected, we observe a clear negative correlation between redistribution and EOp. A similar relationship is obtained when using an alternative proxy for the role of the welfare state, the extent of expenditure in social protection over the GDP of the countries (from Eurostat). As long as this correlation corresponds to a causal link, this represents good news for governments, since it would suggest that in addition to increase social protection against uninsurable risks, the support to individuals in economic troubles also reduces the inequality of opportunities.

Table 1: tab:tax rate inDNK

Taxable income in euro	tax rate
0 - 3250	0
32501 - 6500	13.3
65001 - 9750	19.2
97501 - 13000	24.1
130001 16250	27.6
162501 19500	28.7
195001 26000	30.4
260001 32500	32.7
325001 39000	34.5
390001 45500	36.2
455001 52000	38.9
520001 65000	42.3
650001 97500	48.4
975001 130000	53
130001	59.2

Source:www.skm.dk.

Table 2: tab:tax rate in FIN

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 3: tab:tax rate in HUN

Taxable income in euro	tax rate
1 - 5960	18
5961 -	38

Source:www.worldwide-tax.com.

Table 4: tab:tax rate in NLD

Taxable income in euro	tax rate
1 - 16265	0
16266 - 29543	7.95
29544 - 50652	42
50653 -	52

Source:OECD.

Table 5: tab:tax rate in NOR

Taxable income in NOK	tax rate
lower limit	tax rate
0	0.0
29'600	25.0
43'023	7.8
66'000	35.8
102'581	27.1
185'161	35.8
381'000	47.8
800'000	51.3

Source:www.Taxnorway.no.

Table 6: Inequality of income and Comparable Gini Calculations

country	gini OECD	gini EUROSTAT	gini EUSILC	mld EUSILC
AT	0.265	0.26	0.275	0.164
BE	0.271	0.28	0.266	0.145
DE	0.298	0.26	0.29	0.185
DK	0.232	0.24	0.217	0.083
EE			0.344	0.243
ES	0.319	0.32	0.314	0.216
FI	0.269	0.26	0.271	0.136
FR	0.281	0.28	0.285	0.163
GR	0.321	0.33	0.316	0.2
HU	0.291	0.28	0.305	0.161
IE	0.328	0.32	0.296	0.187
IS	0.28	0.25	0.279	0.188
IT	0.352	0.33	0.309	0.197
LT			0.356	0.228
LU	0.258	0.26	0.276	0.148
LV			0.357	0.229
NL	0.271	0.27	0.27	0.184
NO	0.276	0.28	0.262	0.145
PL	0.372	0.36	0.364	0.271
PT	0.385	0.38	0.354	0.247
SE	0.234	0.23	0.231	0.106
SI			0.239	0.104
SK	0.268	0.26	0.278	0.132
UK	0.335	0.34	0.319	0.204

Notes: Gini and MLD EU SILC are driven by authors' calculations; Gini OECD and Gini Eurostat are taken from OECD (2008).

Table 7: Inequality of opportunity in absolute term

country	ex ante	ex post
AT	0.037	0.065
BE	0.023	0.054
DE	0.03	0.05
DK	0.01	0.02
EE	0.021	0.066
ES	0.038	0.071
FI	0.012	0.023
FR	0.017	0.042
GR	0.026	0.054
HU	0.007	0.034
IE	0.032	0.063
IS	0.023	0.07
IT	0.024	0.06
LT	0.016	0.049
LU	0.026	0.046
LV	0.02	0.049
NL	0.033	0.07
NO	0.025	0.04
PL	0.017	0.056
PT	0.022	0.077
SE	0.011	0.02
SI	0.002	0.014
SK	0.014	0.032
UK	0.037	0.064

Notes: First two columns refer to MLD and Gini in absolute term calculated by the type approach when considering only parental education as circumstance. The last two columns show calculations when adding gender as a characteristic.

Table 8: Inequality of opportunity as a percentage of total inequality

country	ex ante	ex post
AT	0.226	0.396
BE	0.159	0.372
DE	0.162	0.270
DK	0.120	0.241
EE	0.086	0.272
ES	0.176	0.329
FI	0.088	0.169
FR	0.104	0.258
GR	0.130	0.270
HU	0.043	0.211
IE	0.171	0.337
IS	0.122	0.372
IT	0.122	0.305
LT	0.070	0.215
LU	0.176	0.311
LV	0.087	0.214
NL	0.179	0.380
NO	0.172	0.276
PL	0.063	0.207
PT	0.089	0.312
SE	0.104	0.189
SI	0.019	0.135
SK	0.106	0.242
UK	0.181	0.314

Notes: First two columns refer to MLD and Gini in percentage calculated by the type approach when considering only parental education as circumstance. The last two columns show calculations when adding gender as a characteristic.

Table 9: Estimated impact of circumstances onto (log) individual net income

	male	parental education
Austria	0.453***	0.075***
Belgium	0.292***	0.040***
Czech Republic	0.129***	0.024***
Germany	0.562***	0.041***
Estonia	0.246***	0.087***
Spain	0.332***	0.082***
France	0.258***	0.069***
Greece	0.312***	0.077***
Ireland	0.580***	0.082***
Italy	0.333***	0.091***
Lithuania	0.155***	0.084***
Latvia	0.248***	0.125***
Poland	0.128***	0.112***
Portugal	0.285***	0.160***
Sweden	0.249***	0.050***
Slovenia	0.062***	0.053***
United Kingdom	0.511***	0.049***

Notes: Instruments for education are quarter of birth, number of siblings, age of parents, household composition and financial problems when aged 15. Labour market participation estimated using Heckman's procedure; selection identified using dwelling type, tenure status, number of rooms, household size and household income except individual income. * significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 1 Total income inequality (EUSILC MLD)

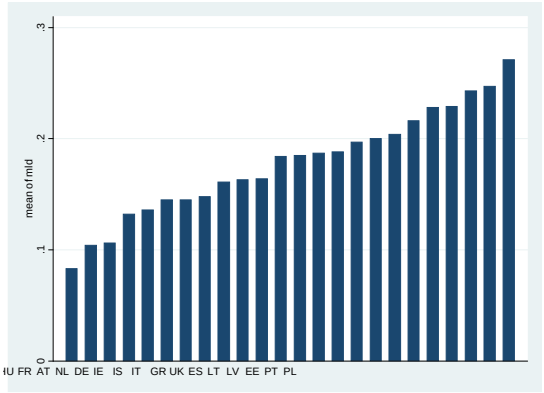


Figure 2 Correlation between EUSILC Gini and MLD

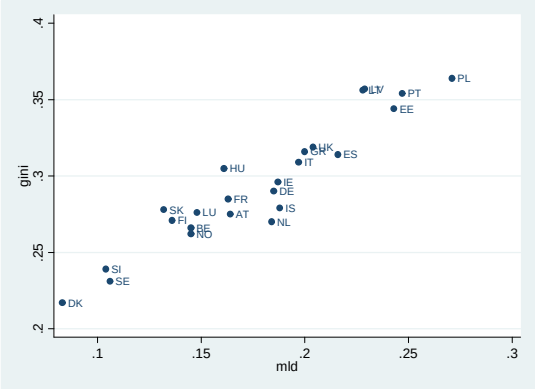


Figure 3 Ex post opportunity inequality: absolute MLD

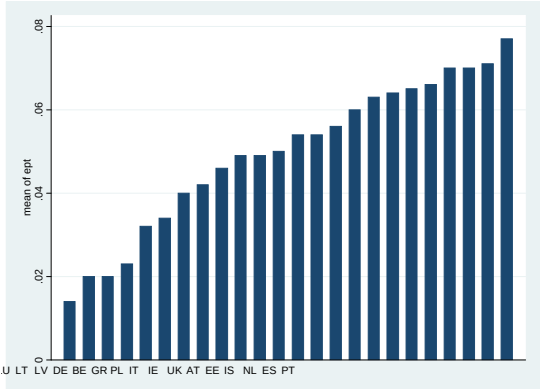


Figure 4 Ex ante opportunity inequality: absolute MLD

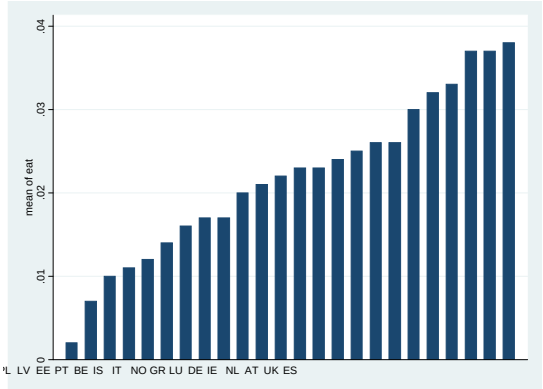


Figure 5 Opportunity inequality and fraction of children in pre-primary

school

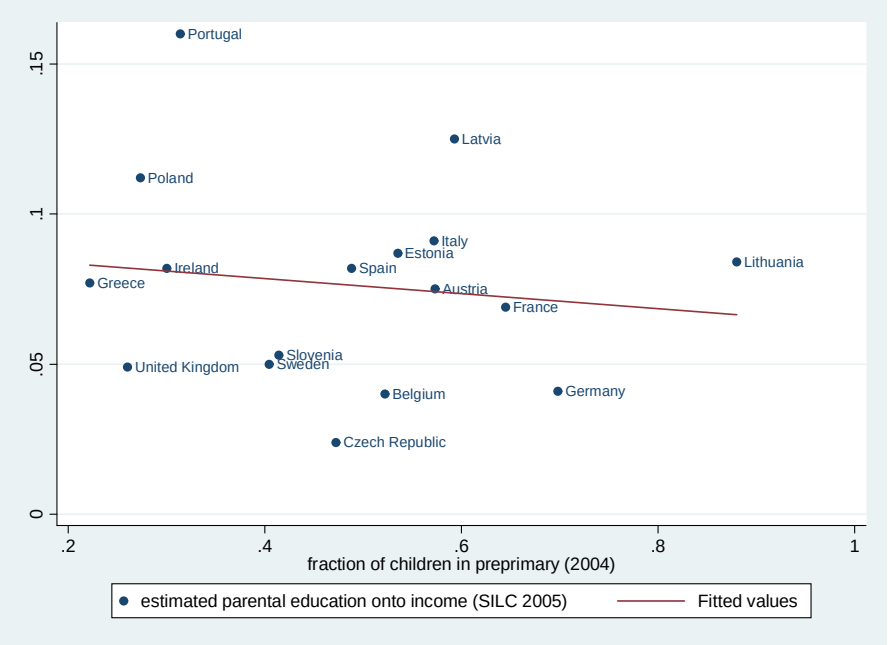


Figure 6 Opportunity inequality and fraction of secondary school students in vocational programmes

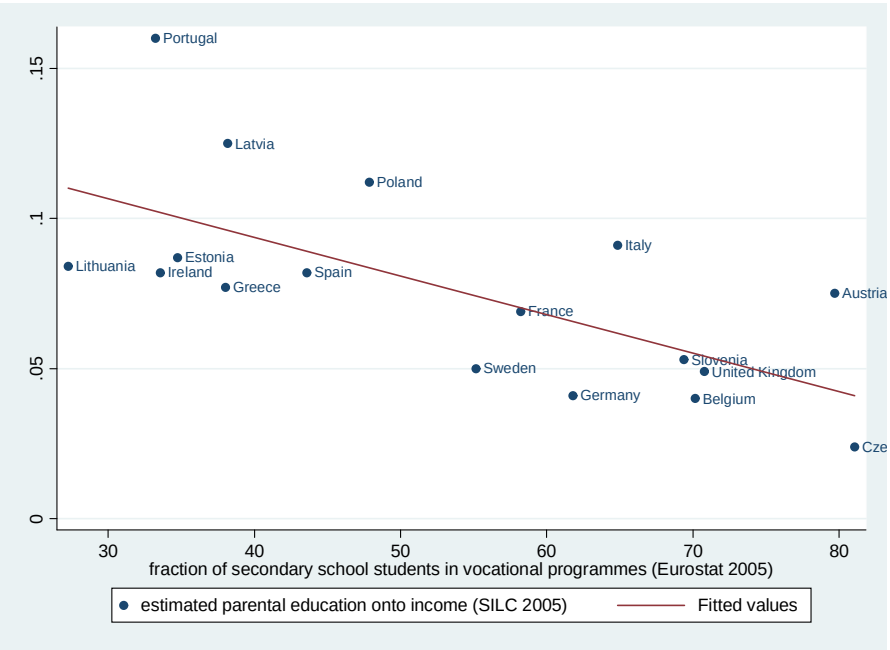


Figure 7 Opportunity inequality and employment protection legislation

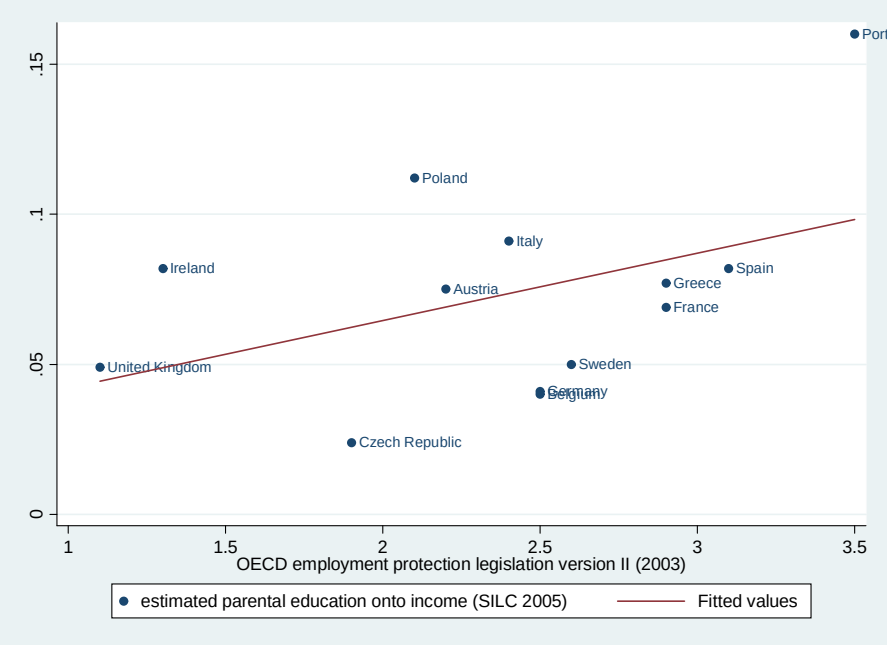


Figure 8 Opportunity inequality and employment protection legislation

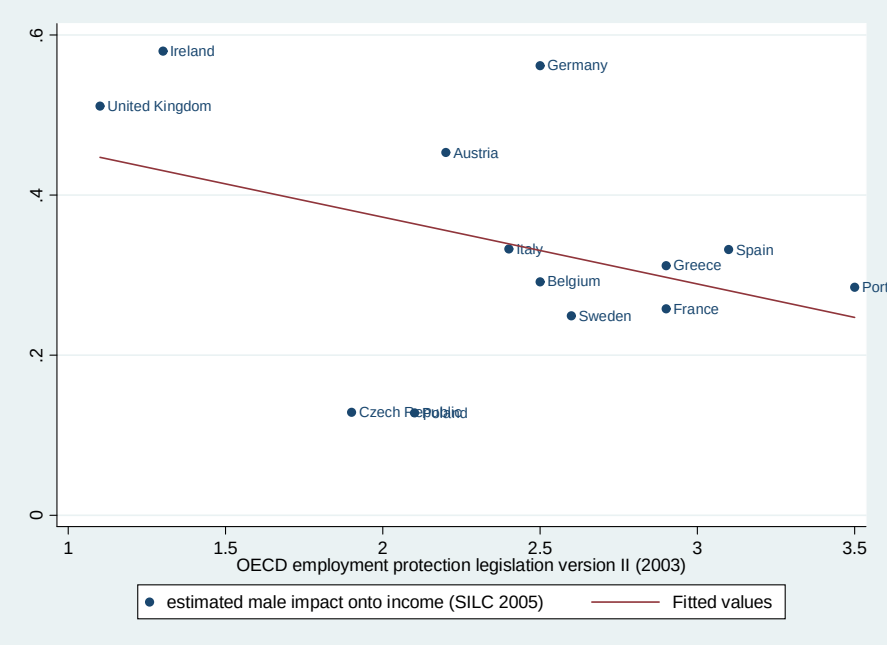


Figure 9 Opportunity inequality and union density rate

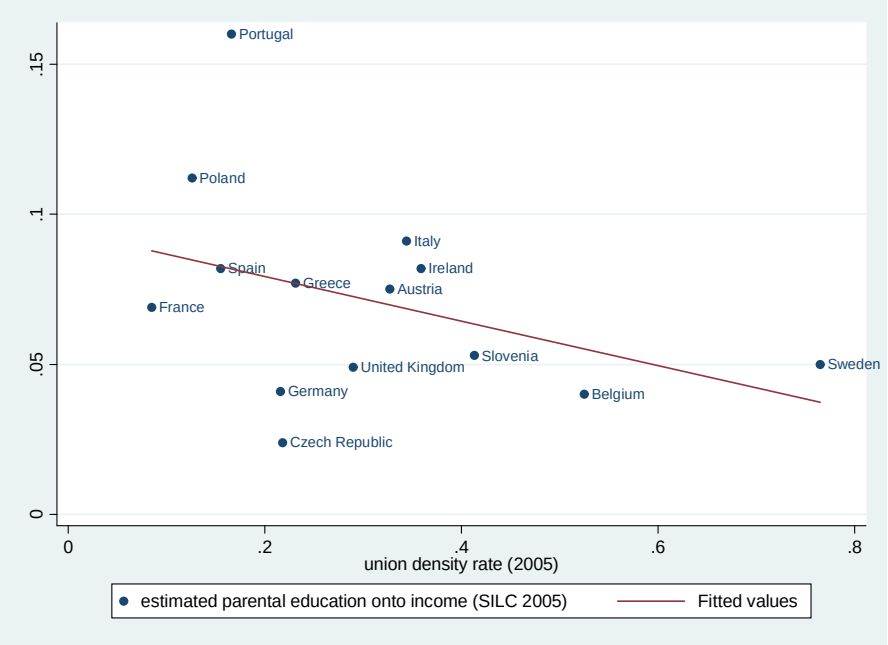


Figure 10 Opportunity inequality and Inversen centralization index

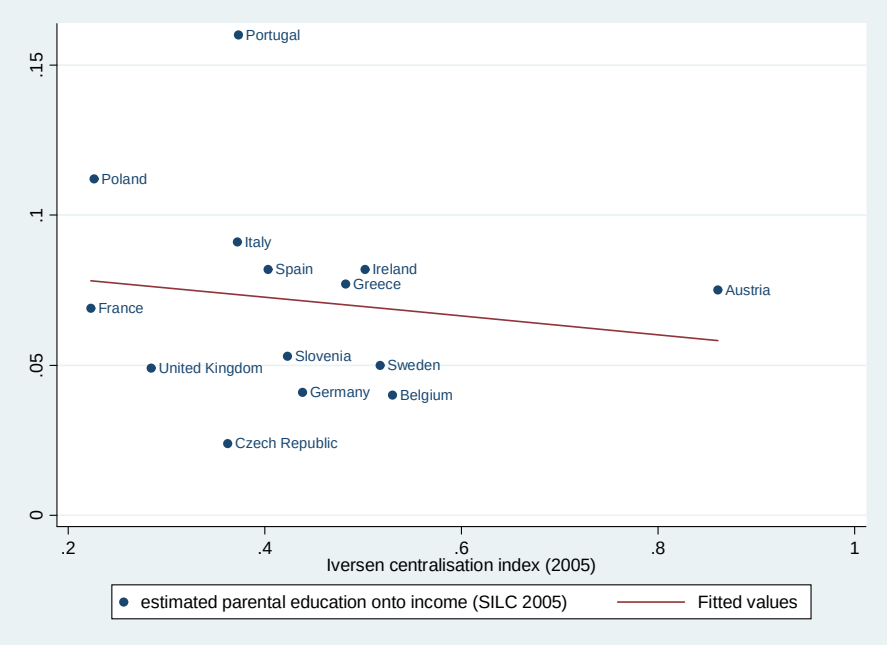
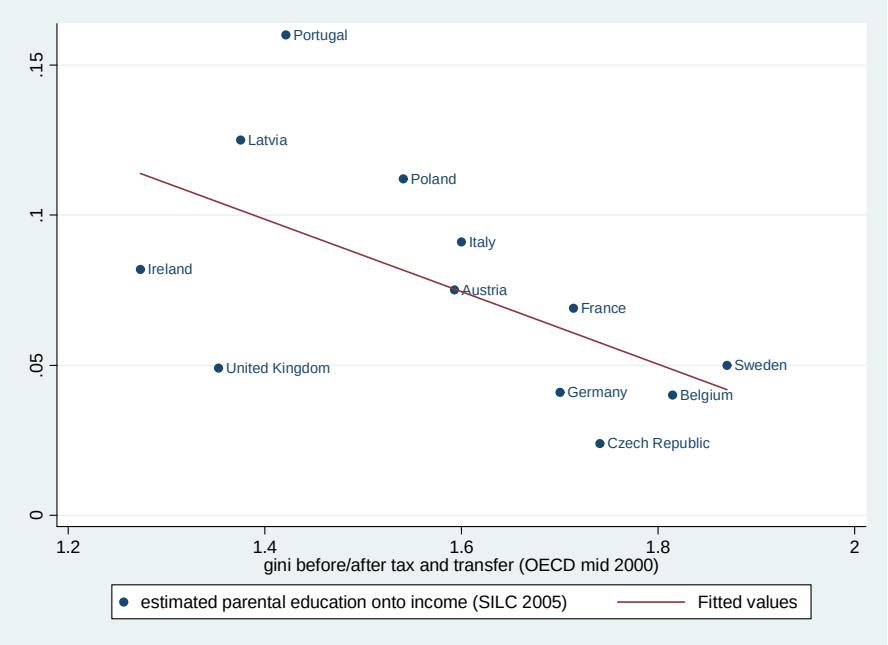


Figure 11 Opportunity inequality and Gini index



4 Bibliography

Bourguignon F. Ferreira F. and Menendez M. (2003), "Inequality of Outcomes and Inequality of Opportunities in Brazil", Policy Research Working Paper Series 3174, The World Bank, Washington DC;

Brunello, G. and D.Checchi. 2007. "Does School Tracking Affect Equality of Opportunity? New International Evidence", Economic Policy 2007, 52: 781-861

Checchi D. and Peragine V. (2009) Inequality of opportunity in Italy, Journal of Economic Inequality (forthcoming)

Cowell, F. A. and Victoria-Feser, M.P. (1996a), 'Poverty measurement with contaminated data: A robust approach', European Economic Review, 40(9):1761–1771.

Cowell, F. A. and Victoria-Feser, M.P. (1996b), 'Robustness properties of inequality measures', Econometrica, 64(1):77–101.

Cowell, F. A. and Victoria-Feser, M.P. (2002), 'Welfare rankings in the presence of contaminated data', Econometrica, 70(3):1221–33.

Cunha, F. and J.Heckman. 2007. The Technology of Skill Formation. American Economic Review, 97(2):31-47, (2007).

Dardanoni V., Fields G., Roemer J. E. and Sanchez-Puerta M. L. (2006), "How demanding should equality of opportunity be and how much we have

achieved?", in Morgan S. L., Grusky D. B. and Fields G. "Mobility and Inequality", Stanford University Press;

Ferreira F. H. G., Gignoux J. (2008), "The measurement of inequality of opportunity: Theory and an application to Latin America", the World Bank Policy Research WP # 4659;

Fleurbaey M (2008), "Fairness, responsibility and welfare", Oxford University Press;

Hanushek, E. and L.Wößmann. 2006. Does Educational Tracking Affect Performance and Inequality? Differences-In-Differences Evidence Across Countries. Economic Journal 116: C63-C76.

Heckman, J. J., Krueger, A. B., & Friedman, B. M. 2002. Inequality in America: what role for human capital policies? Cambridge, Mass.: MIT Press

Iversen, T. 1999. Contested Economic Institutions. The politics of macroeconomics and wage bargaining in advanced democracies. Cambridge, Mass., Cambridge University Press.

Lefranc A., Pistolesi N. Trannoy A. (2006a), "Equality of Opportunity: definitions and testable conditions, with an application to income in France", IDEP WP # 62;

Lefranc A., Pistolesi N. and Trannoy A. (2006b), "Inequality of opportunity vs inequality of outcomes: are western societies all alike?", Review of Income and Wealth, vol. 54;

OECD 2004. Economic Outlook. Paris

OECD "Growing Unequal? Income distribution and poverty in OECD countries.Paris

Peragine V. (2002), "Opportunity egalitarianism and income inequality: a rank-dependent approach", Mathematical Social Sciences, vol. 44;

Peragine V. (2004), Measuring and implementing equality of opportunity for income", Social Choice and Welfare, vol. 22;

Peragine V., Serlenga L. (2008), "Higher education and equality of opportunity in Italy", in J. Bishop and B. Zheng (eds.) Research in Economic Inequality, vol XIV;

Mocetti, S. (2007) "Intergenerational Earnings Mobility in Italy", Contributions to Economic Analysis & Policy, Berkeley Electronic Press, vol. 7(2), pages 1794-1794.

Van Kerm, P. "Extreme incomes and the estimation of poverty and inequality indicators from EU-SILC", IRISS Working Paper Series, 2007-01

Visser J. and D.Checchi. 2009. Inequality and the labour market: Unions. in W.Salverda, B.Nolan and T.Smeeding, (eds) Oxford Handbook of Economic Inequality, Oxford University Press