Inequality of opportunities vs. inequality of outcomes: Are Western societies all alike ?

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Abstract

This paper analyzes the relationship between income inequality and inequality of opportunities for income acquisition in nine developed countries during the nineties. Equality of opportunity is defined as the situation where income distributions conditional on social origin cannot be ranked according to stochastic dominance criteria. We measure social origin by parental education and occupation and use the data base built by Roemer *et al.* (2003). Stochastic dominance is assessed using non-parametric statistical tests. Our results indicate strong disparities in the degree of equality of opportunity across countries and a strong correlation between inequality of outcomes and inequality of opportunity. USA and Italy show up as the most unequal countries both in terms of outcome and opportunity. At the opposite extreme, income distributions conditional on social origin are almost the same in Scandinavian countries even before any redistributive policy. We complement the ordinal comparison by resorting to an original scalar "Gini" index of opportunities, which can be decomposed into a risk and a return component. In our sample, inequality of opportunity is mostly driven by differences in mean income conditional on social origin and differences in risk compensate the return element in most countries.

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1 Introduction

As income inequality has risen to the top of the social agenda in many countries, the need for international comparisons has become all the more pressing. Such comparisons provide indications on how different social systems or policies cope with income inequality. Focusing on developed countries, recent studies (Gottschalk and Smeeding (1997; 2000)) have established important differences across countries in the level of income inequality, with the USA and Great-Britain being more unequal than most continental European countries, which in turn are more unequal than the countries of Northern Europe.

Although such evidence is informative, it may be criticized for not measuring the kind of inequalities that are relevant from a social, economic or moral perspective. So far, most studies have concentrated on what could be called inequality of *outcome*, that is, final inequality resulting from the economic, demographic and social process which generates the distribution of income. This concept of inequality has been used for decades and is easy to grasp. However, it does not reflect the views of inequality that are held in the current intellectual and social debates. For instance, influential philosophers such as Dworkin (1981), Arneson (1989) or Cohen (1989) have put the issue of personal responsibility at the forefront of the debate on equality. According to them, economic and social policies should only try to promote equality of opportunity (EOp). This amounts to compensate inequality stemming from factors beyond the scope of individual responsibility (*circumstances* in the terminology introduced by Roemer), while letting, at the same time, individuals bear the consequences of factors for which they can be held responsible. This line of thought was recently introduced in the economics literature by John Roemer in several important theoretical and empirical contributions (Roemer (1993), Roemer (1998) and Roemer *et al.* (2003)).

Overall, this suggests that greater attention should be paid to the role played by personal responsibility and external factors in observed inequality. In fact, the importance of such an analysis is enhanced by the observation that there is no *a priori* reason to suspect that equality of opportunity is related to the degree of equality of outcome. Indeed, if some countries tend to promote equality of opportunity over equality of outcome, one may observe a somewhat different ranking of countries according to the two criteria. Furthermore, from a normative perspective, it has been emphasized (Hild and Voorhoeve (2004)) that equality of opportunity is consistent with any degree of inequality of outcome. Similar uncertainty as to the relationship between the two notions of inequality has also been recently expressed, from a positive point of view, in the economic literature. While some authors have suggested that higher inequality could increase the incentives to intergenerational mobility and consequently lead to greater equality of opportunity (Checchi, Ichino and Rustichini (1999)), others have also stressed that higher inequality could raise the constraints to mobility and decrease equality of opportunity (Solon (2004), Hassler, Mora and Zeira (2000)).

The purpose of this paper is twofold. Its first objective is to offer an international comparison of inequality that echoes more closely the views on inequality held in contemporary societies and that is consistent with modern theories of justice. For this reason, we measure and compare the extent of equality of opportunity for income acquisition in developed economies. This complements results already obtained regarding the comparison of inequality of disposable income. The second objective is to examine how countries' performance in terms of equality of opportunity relates to their degree of inequality of outcome.

Analyzing the extent of equality of opportunity for income acquisition remains a challenging problem and only few recent analysis have addressed it (see Roemer *et al.* (2003) and Bourguignon *et al.* (2007)). This paper rests on an original definition of equality of opportunity developed in a companion paper Lefranc *et al.* (2006). Together with several authors (Roemer (1998) and Van de Gaer (1993)), we take the view that studying inequality of opportunity amounts to a comparison of conditional income distributions. Our definition focuses on the comparison of income distributions conditional on circumstances using stochastic dominance tools. We complement this ordinal criterion of equality of opportunity by developing an original index of inequality of opportunity, derived from the Gini inequality index. We further show that our inequality of opportunity index is decomposable into two components, a risk and a return component.

An major issue, in the implementation of these measures of equality of opportunity lies in the definition and the observation of the individual circumstances that should be taken into consideration. In this paper, we concentrate on individual socio-economic background. Our analysis rests on a data set gathered by Roemer *et al.* (2003) that conveys information on individual income and socio-economic background in nine countries: Belgium, France, West-Germany, Great-Britain, Italy, The Netherlands, Norway, Sweden and United-States. It contains detailed information on most sources of individual income, as well as information, albeit more limited, on the education of the father of the respondent.

Since our data differ from those commonly used in international comparisons of income inequality, we first check that they deliver results on inequality of outcome that are comparable to those found in the literature, before turning to the analysis of equality of opportunity. With respect to inequality of disposable income, we also rank countries according to the criterion of Lorenz dominance which is known to be more robust than using inequality indexes. In the comparisons of inequality of outcome and inequality of opportunity we pay particular attention to issues of statistical inference, in contrast to many empirical analysis. To this end, we implement robust non-parametric tests of stochastic dominance that have been developed recently (Davidson and Duclos (2000)).

The rest of the paper is organized as follows. Section 2 presents the definition of equality of opportunity for income acquisition, the statistical procedure and an index of inequality of opportunity. The data are presented in Section 3. Section 4 discusses inequality of outcome. Section 5 compares inequality of opportunity among the nine countries and analyzes the relationship between income inequality and inequality of opportunities. The last section concludes.

2 Equality of opportunity : definition and measurement

When measuring inequality of outcome in empirical work, a wealth of different approaches and indexes can be used. On the contrary, when departing from the analysis of outcome to examine opportunity, one first requires to provide a definition of equality of opportunity that can be implemented empirically.

2.1 Definition of equality of opportunity

2.1.1 Definition

Equal-opportunity theories differentiate between two fundamental sources of inequality among individuals: on the one hand, factors outside the realm of individual choice, usually referred to as *circumstances*; on the other hand, factors that individuals can be judged responsible for and that can be generically referred to as *effort*. Following Roemer (1998) we define a *type* as the set of individuals with similar circumstances. One important principle emphasized by equal-opportunity theories is that differences in circumstances are not a morally acceptable source of inequality. On the contrary, inequality arising from differences in effort does not require any compensation. As a consequence, any level of inequality of outcome can be compatible with equality of opportunity. However, when equality of opportunity prevails, no particular vector of circumstances should provide individuals with an advantage over any other vector. This characterization allows us to derive a condition for equality of opportunity that can be implemented empirically.

In order to derive this condition, one first needs to be more specific about the notion of advantage that some circumstances s may provide over some other circumstances s'. Consider the situation where individuals would be allowed to choose their circumstances (before knowing the level of effort they will exert). In this context, we say that s provides some advantage over s', if all individuals prefer the opportunity set associated with s to the one associated with s'. Consequently, we say that equality of opportunity prevails between circumstances s and s' if s is not preferred to s' by all individuals, and *vice versa*.

In the case of income acquisition, the opportunity set offered to an individual with circumstances s can be summarized by the distribution of income x conditional on s, denoted $F(x \mid s)$. Let S denote the set of all possible vectors of circumstances. Choosing among elements of S amounts to choose among income lotteries whose distribution is given by $F(x \mid s)$. Obviously, the characterization of equality of opportunity outlined in the previous paragraph is contingent upon the preferences used to rank these lotteries. A desirable property of the characterization of equality of opportunity is that it holds for a sufficiently broad class of preferences. In this paper, as in a first attempt made by Van de Gaer (1993), stochastic dominance criteria are used to rank the opportunity sets offered by different circumstances . We assume that individual preferences agree with the criteria of first-order stochastic dominance (*FSD*) and second-order stochastic dominance (*SSD*). We now define *FSD* and *SSD*, for two lotteries $F(x \mid s)$ and $F(x \mid s')$ and explain what restrictions on preferences they imply.

Definition 1 *The circumstances s FSD-dominate the circumstances s' ($s \succeq_{FSD} s'$) iff:*

$$F(x \mid s) \leq F(x \mid s') \; \forall x \in \mathbb{R}_+.$$

Strict dominance ($s \succ_{FSD} s'$) requires that for some x, strict inequality prevails. This requirement has been previously proposed and discussed by Van de Gaer *et al.* (2001). It is well known that under Expected Utility Theory (EUT), any individual whose utility function is increasing in x will prefer a *FSD*-dominating distribution over a *FSD*-dominated one. The *FSD* criterion determines a partial ranking on the set S of possible circumstances S. Non-dominated circumstances can be defined for the binary relationship $\succeq_{FSD}$ as

$$P_1 = \{s \in S \mid \nexists s' \in S \text{ such that } s' \succ_{FSD} s\}. \tag{1}$$

The *FSD* criterion is very demanding, when comparing lotteries, since it requires the unanimity of decision makers regardless of their attitudes towards risk (i.e. be them risk-loving, risk-averse, etc).

A less partial ranking can be defined using the *SSD* criterion, which allows to partially rank lotteries even when *FSD* is not satisfied.

Definition 2 *The circumstances s SSD-dominate the circumstances s' ($s \succeq_{SSD} s'$) iff:*

$$\int_0^x F(y \mid s)dy \leq \int_0^x F(y \mid s')dy \; \forall x \in \mathbb{R}_+. \tag{2}$$

In the EUT framework, any risk-averse individual whose utility function is increasing in x will prefer a *SSD*-dominating distribution over a *SSD*-dominated one.

Shorrocks (1983) has shown that *SSD* is equivalent to generalized Lorenz (GL) dominance. Formally :

$$\forall x \in \mathbb{R}_+ \quad s \succeq_{SSD} s' \quad \Leftrightarrow \quad \forall p \in [0,1] \quad GL_{F(.|s)}(p) \geq GL_{F(.|s')}(p) \tag{3}$$

with $GL_{F(.|s)}(p)$, the value of the generalized Lorenz curve at p for the distribution $F(. \mid s)$.

The set of non-dominated circumstances for $\succ_{SSD}$, P_2, may be defined in a similar way to P_1. Since *SSD* is a less partial criterion than *FSD*, we have $P_2 \subseteq P_1$.

We are now able to offer a formal definition of equality of opportunity according to the *SSD* criterion. We say that equality of opportunity is achieved when no s is dominated for the *SSD* criterion. Formally:

Definition 3 Equality of opportunity is achieved whenever $P_2 \equiv S$.

This definition is equivalent to saying that an individual choosing among all possible circumstances is unable to rank them using the *SSD* criterion.

2.1.2 Discussion

Four aspects of our definition of equality of opportunity are worth emphasizing.

First, our definition admits as a special case the equality of conditional distributions, *i.e.* when for all (s, s') in S^2, and for all x, $F(x \mid s) = F(x \mid s')$. In such a situation, circumstances have no impact on the distribution of income. This represents a compelling case of equality of opportunity and corresponds to the definition of equality of opportunity adopted by Roemer (1998). Indeed if the conditional distributions are identical, so are the quantile functions. Then according to Roemer's interpretation, the outcome for any degree of effort measured by the rank in the conditional income distribution is independent of circumstances. It may be seen as a situation of *strong* equality of opportunity. Of course, such a situation is unlikely to be satisfied in practice. In this perspective, our definition of equality of opportunity is less stringent and corresponds to a weaker form of equality of opportunity.

Second, when our definition of equality of opportunity is not satisfied, it must be the case that some circumstances s dominate some circumstances s' according to the *SSD* criterion. Schematically, this may occur for two reasons. The returns to the lottery attached to s may be higher than those of s' or the risk of the lottery attached to s may be lower than that of s'. The *FSD* criterion only rests on the comparison of returns, while the *SSD* criterion takes both returns and risk into consideration.

From an ethical perspective, the rationale for using *SSD* or *FSD* in the characterization of equality of opportunity depends on the nature of the factors that affect individual outcomes. If outcomes are to some extent determined by luck, they become uncertain and their riskiness needs to be taken into consideration. If outcomes are only the product of effort and circumstances, as assumed in the Roemer model, individual outcomes are not uncertain. The *FSD* criterion is sufficient and considering the *SSD* criterion is, in fact, inappropriate and inconsistent. On the opposite, if luck is the only determinant of inequality given circumstances, the *SSD* test is fully justified. Lefranc et al (2006) argue in favour of the *SSD* criterion in the more general case where inequality is the product of circumstances, effort and luck. Accounting for risk is one of the distinctive features of our analysis with respect to previous proposals made in the literature.

Third, when using the *SSD* criterion it may be informative to assess the degree of risk of each lottery, regardless of its return. This can be performed by comparing the conditional distributions centered on their mean, using the standard Lorenz criterion. Let $L_{F(.|s)}(p)$ denote the value of the Lorenz curve at p for the distribution $F(. \mid s)$, the s lottery's will be said to be less risky than that of s' if:

$$\forall p \in [0,1], \quad L_{F(.|s)}(p) \geq L_{F(.|s')}(p).$$

Fourth, the definition of equality of opportunity, either strong or weak, is contingent on the definition of the relevant circumstances. However, given data limitations, it is unlikely that all circumstances will, in practice, be observable. Any concept of equality of opportunity has to cope with incomplete information. And one may wonder if incomplete observation of the relevant circumstances may distort the empirical assessment of equality of opportunity. We address this issue in two companion papers Lefranc *et al.* (2004; 2006) and show that the two concepts of equality of opportunity brought out here are fairly robust to an incomplete description of the circumstances.

2.2 Measurement

2.2.1 Stochastic dominance tests

The condition developed in the previous paragraph suggests a natural empirical test to assess whether equality of opportunity prevails: first, estimate the conditional income distributions associated with observed circumstances and then compare these distributions using first and second-order stochastic dominance tools. When comparing two GL curves, three situations can occur: (a) one curve lies above the other, (b) the two curves intersect, (c) the two curves are identical. Our definition implies that equality of opportunity prevails in case (b) or in case (c). It is violated in case (a). Case (c) corresponds to *strong* equality of opportunity. In practice, we estimate the conditional income distributions and we perform non-parametric stochastic dominance tests at the first and second order. Our tests implement the procedure developed in Davidson and Duclos (2000) and are presented in the appendix.

For two sub-populations A and B, we perform the following three tests independently: (1) we test the null hypothesis of equality of the distributions of A and B; (2) we test the null of *FSD* of distribution A over B and *vice-versa*; (3) we test the null of *SSD* of distribution A over B and *vice-versa*.

If we fail to reject the null of test (1), we conclude to *strong* equality of opportunity between A and B and only in that case. If test (2) or (3) accepts dominance of one distribution over the other but not the other way round (*e.g.* $A \succeq_{SSD} B$ and $B \not\succeq_{SSD} A$) we conclude that equality of opportunity is violated. It may occur that we reject the null of test (1) and that test (2) or (3) conclude the two distributions dominate each other ((*e.g.* $A \succeq_{SSD} B$ and $B \succeq_{SSD} A$)). In that case, we give priority to the result of test (1) since it is a more powerful test of equality of distributions for any significance level. Hence, in that case, we conclude that strong equality of opportunity is rejected but that equality of opportunity, as defined by definition 3 is not rejected. Lastly, one should note that, given our interpretation, conclusions of test (2) and (3) cannot contradict since the null of (2) is included in the null of (3). Thus the conjunction of the results of the three tests interpreted in this way cannot be inconsistent.

2.2.2 Inequality of opportunity index

One drawback of an ordinal characterization of equality of opportunity is that it does not allow us to rank situations in which equality of opportunity is rejected. At the cost of a loss of generality, it is also possible to build an index allowing to measure the degree of inequality of opportunity.

Before proceeding further, it is useful to wonder what minimal properties such an index must satisfy. Borrowing from the literature on inequality indexes (see for instance Sen (1997)), it seems reasonable to require the following properties.

1) *Within-type Anonymity.* The index must be invariant to any permutation of two individuals with similar circumstances.

2) *Between-type Pigou-Dalton Transfers Principle.* Consider two circumstances s and s' such that the first one dominates the second one according to *SSD*. The index must decrease if we perform any transfer from a s-type individual to a s'-type individual such that (a) in the ex-ante distribution, the first individual is richer than the second individual and (b) in the ex-post distribution, the first-type individual is not poorer than the second-type individual.

3) *Normalization.* If the CDFs corresponding to all circumstances are identical, then the index must be equal to 0.

4) *Principle of Population.* The index is invariant to a replication of the population.

5) *Scale invariance.* The index is invariant to a multiplication of all incomes by a positive scalar.

This list of properties defines a large class of indexes of equality of opportunity. Among it, we construct and use a particular index, whose appeal is to relate to the most popular index of inequality, the Gini index.

Our proposition is inspired the approach of Van de Gaer (1993) and Ooghe *et al.* (2007). It focuses on the opportunity sets to which people have access and tries to make these sets as equal as possible. First we need to define a measure of the opportunities offered to individuals with given circumstances (a type in Roemer's terminology) in the space of lotteries. Here we borrow from the literature on the measurement opportunity sets (see Peragine (1999) for a survey). We measure the feasible opportunity of a given lottery by the area under its GL curve. Indeed, any lottery dominated according to the GL criterion belongs to this set. In an influential contribution to the measurement of opportunity, Pattanaik and Xu (1990) axiomatized the cardinal of a discrete set as a measure of opportunity. Among the axioms introduced by the authors, the following monotonicity property reads as follows. Given an opportunity set A and an opportunity y which does not belong to A, $A \cup y$ offers more opportunity than A. When the opportunity set is continuous, counting elements of the opportunity set does not make sense any more. A natural extension is to consider the area below the opportunity set as a cardinal measure of opportunity and, for instance, Bensaid and Fleurbaey (2003) already suggested this measure when the opportunity set is a budget set.

Now, let us rank all circumstances according to twice the area under the GL curve, starting from the smallest one. For type s, whose population share is p_s, this area is equal to

$$\mu_s(1 - G_s), \tag{4}$$

with μ denoting the mean and the G the Gini coefficient.[1] The Gini-opportunity index is defined by :

$$GO(x) = \frac{1}{\mu} \sum_{i=1}^{k} \sum_{j>i} p_i p_j (\mu_j(1 - G_j) - \mu_i(1 - G_i)). \tag{5}$$

It computes the weighted sum of all the differences between areas of opportunity sets. Dividing by the mean income of the entire population μ make this index independent of the wealth of the society. This index can be viewed as an extension of the Gini coefficient since, when there are as many circumstances s as individuals, GO is equal to the Gini coefficient, *i.e.* :

$$G(x) = \frac{1}{n^2\mu} \sum_{i=1}^{n} \sum_{j>i} (x_j - x_i). \tag{6}$$

[1] Yitzhaki (1979) already propose $\mu(1 - G)$ as a measure of satisfaction of the society, here of the society made of the individuals of common circumstance.

Therefore the GO index takes its value between 0 and 1. Comparison of formula (5) and (6) allows to establish $GO(x) \leq G(x)$ and that the Gini-opportunity index increases with the number of types. An advantage of this index is that it is closely related to the definition of equality of opportunity based on GL curves.

2.2.3 A decomposition between a risk and return component

As shown by equation (4), the opportunity set of a type is the product of two components: a return component, equal to the average income μ_s, and a risk component, $1 - G_s$ which depends on within-type inequality. These two components interact in a multiplicative way which makes the problem of decomposition a bit different from the usual case of decomposing income inequality by additive factor components. We propose a decomposition of the GO index between a return component and a risk component. The two components are computed without making a reranking of types, namely the ranking of types remains that according to twice the area under the GL curve.

Let us define the pure return component $GO_{pt}(x)$ as the value of the GO coefficient when within-type income inequality is fully erased.

$$GO_{pt}(x) = \frac{1}{\mu} \sum_{i=1}^{k} \sum_{j>i} p_i p_j (\mu_j - \mu_i).$$

Van de Gaer (1993) already proposed to use the inequality of expected conditional outcomes as a measure of inequality of opportunity. We define the pure risk component $GO_{pr}(x)$ as the value of the GO coefficient if between-type inequality of per capita income is removed.

$$GO_{pr}(x) = \frac{1}{\mu} \sum_{i=1}^{k} \sum_{j>i} p_i p_j \mu((1 - G_j) - (1 - G_i)) = \sum_{i=1}^{k} \sum_{j>i} p_i p_j (G_i - G_j).$$

A decomposition involving both pure contributions reads

$$GO(x) = GO_{pt}(x) + GO_{pr}(x) + \frac{1}{\mu} \sum_{i=1}^{k} \sum_{j>i} p_i p_j (G_i(\mu_i - \mu) - G_j(\mu_j - \mu)), \tag{7}$$

where the third term is an interaction term between the return and risk components not too easy to interpret.

The fact that there is no reranking before computing $GO_{pt}(x)$ *and* $GO_{pr}(x)$ has one important consequence. Both indexes may take negative values. It may arise for $GO_{pt}(x)$ if the per capita income for some bottom group is smaller than that for some top group. If the ranking of the types according to the GL dominance test is not ambiguous, it should not arise since GL dominance implies mean dominance. So in practice, the $GO_{pt}(x)$ will be positive in general and the absence of reranking does not matter. It is not the case for the $GO_{pr}(x)$ which may be negative if some bottom type is less risky than some top type. As a matter of fact, $GO_{pr}(x)$ incorporates a correlation between risk and mean income defined at the type level. A positive value indicates that on average the top types are less risky than the other types and a negative value the opposite. So the interest of the risk contribution is to assess if the risk element strengthens or reduces the return element in measuring the inequality of opportunity of social lotteries.

A potential shortcoming of decomposition (7) is that the interaction term can be large in practice. It is possible to provide an exact decomposition of the GO index by resorting to an alternative definition of the risk and return components. To understand the construction of the alternative decomposition, it is important to note that the GO index is defined by a series of pairwise comparisons of GL curves for all possible (ordered) pairs. In the previous decomposition, the return and risk components were respectively defined by equalizing the return across all types and setting risk equal to zero for all types. In the alternative decomposition the definition of the risk and return components assumes that return or risk have only been equalized pairwise, for all possible pairs of types.

Specifically, the contribution of between-type inequality of returns to the inequality of opportunity, $GO_t(x)$, is equal to the value of the GO index where for each pairwise comparisons within-type inequality has been equalized and set to the arithmetic mean of the Gini coefficient of the two types. Hence, $GO_{et}(x)$ is defined by

$$GO_{et}(x) = \frac{1}{\mu} \sum_{i=1}^{k} \sum_{j>i} p_i p_j (\mu_j - \mu_i)(1 - \frac{G_i + G_j}{2}).$$

It is important to note that $GO_{et}(x)$ differs from the pure return term because within-type inequality has not been erased but equalized pairwise.

The alternative risk component, GO_{er}, is equal to the value of the GO index when between-type inequality has been equalized in each pairwise comparison. That is, for all pairs (i, j), it is assumed that the mean income of each type is equal to the arithmetic mean income of the two groups. The only source of inequality of opportunity among the two types comes from differences in within-type inequality. Formally, we have :

$$GO_{er}(x) = \frac{1}{\mu}\sum_{i=1}^{k}\sum_{j>i} p_i p_j (\frac{\mu_j + \mu_i}{2})((1 - G_j) - (1 - G_i)).$$

In the same way $GO_{er}(x)$ is not a pure risk term since average income for each group may still differ in the hypothetical distribution used to define $GO_{er}(x)$.

One should note that each of the two contributions $GO_{et}(x)$ and $GO_{er}(x)$ include some part of the interaction terms in (8). Hence, their interpretation is not as straightforward as for the two pure terms. But the advantage is that the two contributions sum up to the total inequality of opportunity measured by the Gini index of inequality of opportunity and it is simple arithmetics to prove that :

$$GO(x) = GO_{et}(x) + GO_{er}(x). \tag{8}$$

3 Data description

Data requirements for comparing inequality of opportunity for income acquisition across countries turn out to be even more stringent than for comparing inequality of outcome. Indeed, the reliability of the empirical analysis calls not only for comparable measures of individual disposable income. It also requires that individual background be measured in a comparable and homogeneous way across countries.

3.1 Data sets and sample selection

The data used in the empirical analysis come from household surveys and micro-economic administrative data for nine countries: Belgium, France, West-Germany, Great-Britain, Italy, The Netherlands, Norway, Sweden, and the United States. Data were collected during the first half of the nineties. For each country, the data sets include information on individual and household income, both pre- and post-fisc, as well as information on individual family background. As discussed below, the latter information will be used to identify individual *circumstances.*

Table 1 summarizes the main characteristics of the data sets used for each country. These data were put together by national experts for the purpose of a previous international comparison of income inequality and equality of opportunity, whose results were presented in Roemer *et al.* (2003).[2] Although the national data sets were collected independently, much effort was expended to ensure the greatest degree of *ex post* comparability across countries of the different variables used in the analysis.

Needless to say, providing comparable data for a large number of countries represents a challenging task. The major advantage of the data used in this article, over harmonized micro-economic income data sets often used in comparative research (*e.g.* the Luxembourg Income Study, the OECD, the ECHP or the World Bank data sets[3]) is that it provides information on individual circumstances, beside information on individual income. Hence, being able to relate individual income to individual circumstances in nine developed economies makes the data set used here extremely valuable. One further advantage of these data is that they include information on Sweden and the Netherlands, two countries that are often absent form international comparisons of income inequality.

Samples used in the rest of the paper are restricted to men heads of households aged from 25 to 40 at the time of the survey (25 to 50 in West-Germany). This age interval is relatively narrow so we do not expect differences in the age composition across countries to have a strong impact on our results. Further restricting our sample to a narrower age interval would lead to sample sizes that would be too small to perform robust dominance analysis. One possible limitation of our age restriction is that it leads to sample individuals

[2]For providing access to the data, we are grateful to Marx (Belgium data), Wagner (German data), Jenkins (British data) Colombino (Italian data), Pommer (Dutch data), Aaberge (Norwegian data), Fritzell (Swedish data), Page and Roemer (US data).

[3]See Gottschalk *et al.* (2000) for an analysis of income inequality from the LIS data, OECD (1998) for OECD data, and Deiniger and Squire (1996) for a presentation of the World Bank data. However, these normalized data set are not immune to statistical problem. See among others Atkinson and Brandolini (2001) and Galbraith and Kum (2005) for an assessment.

Table 1: Data bases

			Year	Obs.
Belgium	PSBH	Panel survey of Belgian households	1992	1065
France	BdF	French Household Survey	1994	2 762
Great-Britain	BHPS	British household panel survey	1991	1 020
West-Germany	GSOEP	German socio-economic panel	1994	1 112
Italy	SHIW	Italian survey of household income and wealth	1993	1 433
Netherlands	AVO	Dutch facilities use survey	1995	1 748
Norway	SLL	Norwegian survey of level of living	1995	778
Sweden	LNU	Swedish level of living survey	1991	819
USA	PSID	Panel study of income dynamics	1991	1 131

relatively early in their lifecycle. Since the returns to experience are positively corrrelated to education and, consequently, to social background, this could lead to understate the extent of inequality of lifetime opportunities (see for instance Grawe (2006)). For this reason, the estimates of the extent inequality of opportunity presented here should be seen as a lower bound.

3.2 Main variables

3.2.1 Individual circumstances

Defining the exact set of individual circumstances is a deep and debatable question. Besides, in empirical work, observing this entire set is clearly out of reach. In this paper, we examine the dependence of individual opportunity on a restricted set of circumstances, namely circumstances relating to individual social origin, measured by parental education or occupation.

Of course, social origin may influence individual outcomes through a variety of channels such as economic or genetic inheritance, or the transmission of preferences. Our interest solely lies in determining the extent to which social background influences individual opportunity sets. Identifying these different channels is not the topic of this paper. In fact, from the point of view of equality of opportunity, most authors would agree that substantive (as opposed to formal) equality of opportunity requires compensating the influence of social origin on individual outcomes, *regardless of the channel through which* *it operates*, as social origin lies beyond individual responsibility and choice (see for instance Dworkin (1981), Arneson (1989), and Roemer (1993)). Nevertheless, we recognize that this egalitarian principle may conflict with other social objectives or ethical values. For instance, if the influence of social origin is driven by the intergenerational transmission of talent, equality of opportunity will go against allocative efficiency. In the light of recent philosophical debates, it can also be argued, from a normative point of view, that the above notion of equality of opportunity may contradict other ethical principles such as self-ownership and freedom. For instance, the influence of social origin may be driven by the genetic transmission of individual traits. In this case, the self-ownership principle claims that differences of outcome due to such constitutive traits should not be compensated (see for instance Vallentyne (1997)). In our view, these two criticisms do not challenge the consistency of the above notion of equality of opportunity nor dispute the relevance of the comparison undertaken here. But they suggest that there may be a tradeoff between different social and ethical objectives. Admittedly, this should be investigated empirically using a more detailed description of the individual circumstances. However, the data at our disposal prevent us from undertaking such an analysis of the different channels at work. But it is often the case that international comparisons are made at this price.

For most countries in our data, individual social background is measured by the level of education of the father. The only two exceptions are France and Great-Britain for which we only observe the occupational group of the father. For each country, we partition our sample in three categories, Ed_1 to Ed_3, where Ed_3 denotes (*a priori*) the most advantaged social background. When using father's education, we account for specificities of national educational systems. When using information on father's social group the classification is as follows: for France, (1) farmers and manual workers, (2) clerks and (3) professionals and self-employed workers; for Great-Britain, (1) farmers and unskilled manual workers, (2) clerks and skilled manual workers (3) professionals and self-employed workers[4].

Table 2 presents the classification of social background in each country, as well as the number of observations in each category. In partitioning our samples according to social background, two constraints had to be taken into account. First the need for sub-samples

[4]For the French sample it is the occupational group when then individual was 16. In Great-Britain it is the occupational group when he was 14.

Table 2: Samples description

	Observations			Years of education		
	ED_1	ED_2	ED_3	ED_1	ED_2	ED_3
Belgium	423	338	165	< 10	$10 - 12$	>12
France	1272	699	792	—	—	—
G-Britain	388	301	273	—	—	—
W-Germany	856	142	114	< 10	$10 - 13$	>13
Italy	268	724	441	< 5	$5 - 7$	> 7
Netherlands	478	784	486	< 6	$6 - 9$	> 9
Norway	465	170	143	< 9	$9 - 11$	> 11
Sweden	411	228	178	< 8	$8 - 11$	> 11
USA	386	373	372	< 12	12	> 12

Number of observations and number of years of education of the parents for the different sub-samples. —: information about the occupational group of the parents have been used.

large enough to allow for the estimation of conditional income distributions. Second the requirement of a meaningful partitioning, with respect to each country's educational and social structure. As a consequence of these two constraints, the comparability of our classification across countries remains imperfect. In particular, one should be aware of differences in the relative size of each group across countries.[5] In France, Great-Britain, the Netherlands, Norway and the US, each group represents between 1/4 and 1/2 of the overall population. This does not hold for Belgium, West-Germany , Italy and Sweden where one group represents less than 1/5 of the overall population. More specifically, the distribution of the population among the three types seems particularly unbalanced for West-Germany. It may induce a downward bias for inequality of opportunity in this country and this should be kept in mind when analyzing the extent of equality of opportunity in section 5[6].

[5]There are also differences in the absolute size of each sub-sample and one may worry that could hinder the comparability of our tests across countries. In order to assess the influence of the sample size differences between, we have drawn independent random sub-samples for each country of the same size as the smallest sample. It did not change any result.

[6]For a statistical appraisal of the consequences of errors in the conditioning variable see O'Neil *et al.* (2007).

3.2.2 Income

We focus on two measures of individual income: gross pre-fisc annual household income and net disposable annual household income.[7] Analyzing both income measures allows to examine the impact of fiscal redistribution on inequality of outcomes and opportunity.

Since household income (both pre- and post-fisc) incorporates a variety of different income sources, similar sources should be taken into account for each country in order to ensure cross-country data comparability. Gross pre-fisc income includes labor income (from both salaried and self-employed workers) and asset income. The only exception is Belgium for which neither self-employment nor capital income is available. Using data for France, a country that is close in economic terms to Belgium, we performed a sensitivity analysis and conclude that excluding self-employed individuals has a minor impact on measured inequality of both outcome and opportunity. The lack of capital income leads to underestimate inequality and inequality of opportunity for sure. However it is well known that capital income are badly reported in many household surveys.

Labor income is measured gross of any employee share of social security contributions. Taxes taken into account are income tax as well as housing and property taxes. Transfers include unemployment benefits, all social security benefits (related to sickness, disability, maternity, poverty ...), pensions, child or family allowances and means-tested benefits. Details of income sources taken into account, for each country are provided in appendix table A.1. To account for differences in household size, income is normalized using the OECD equivalence scale. It amounts to divide household income by the square root of the number of household members. Since we do not want cross-country differences in income per capita to influence our comparison of inequality of outcome and opportunity, for each country we divide household income by the country's mean household income.

[7] In most countries, taxes and employee social security contributions are simulated. Differences across countries regarding the share of social security spending financed by means of employer contribution, employee contribution or income tax is likely to reduce the comparability across countries of gross pre-fisc income levels. Comparison of disposable income distributions across countries does not raise similar concerns.

4 Inequality of outcome

Before analyzing equality of opportunity, we first compare the extent of inequality of outcome in the countries of our sample. Several papers have already compared the extent of income inequality across countries, using harmonized data. The interest of the comparison undertaken here is twofold. First, it can be seen as a test of the validity of the data used in this paper. In fact, our results broadly concur with those of previous analysis. Second, while most comparative papers have concentrated on the analysis of inequality indexes, we also compare relative inequality across countries using the Lorenz dominance criterion. The interest of this criterion lies in its greater generality. We also pay particular attention to issues of statistical inference and implement Lorenz Dominance tests.[8]

We first discuss the ranking of countries that emerges from these tests before performing a comparison with the results of other studies based on inequality indexes.

4.1 Lorenz Dominance tests

One way to get a first picture of income inequality in the nine countries is to compare the shape of the income densities. The densities are estimated in logarithm using kernel estimation[9]. Figure 1 gives the densities of the distribution of disposable income centered around their mean. The American distribution is reproduced on each graph to make comparisons easier.

The comparison of these densities reveals important differences across countries in the distribution of income. The contrast between Sweden and the US is striking with a fairly symmetric distribution concentrated around its mean for the first one and a strong right skew for the second one. The differences between other European distributions and the American one are less sharp. Norway shares with Sweden a large mode but its distribution is less concentrated than the Swedish one. The case of Belgium seems to be fairly similar to these two Nordic countries. The shape of the distribution in the Netherlands, France and Germany is comparable and lies in an intermediate position between Sweden and the US. The British density is closer to the American one than to the distribution in

[8]The methodology of these tests are presented in the appendix.

[9]A Gaussian adaptative bandwidth kernel estimator has been used.

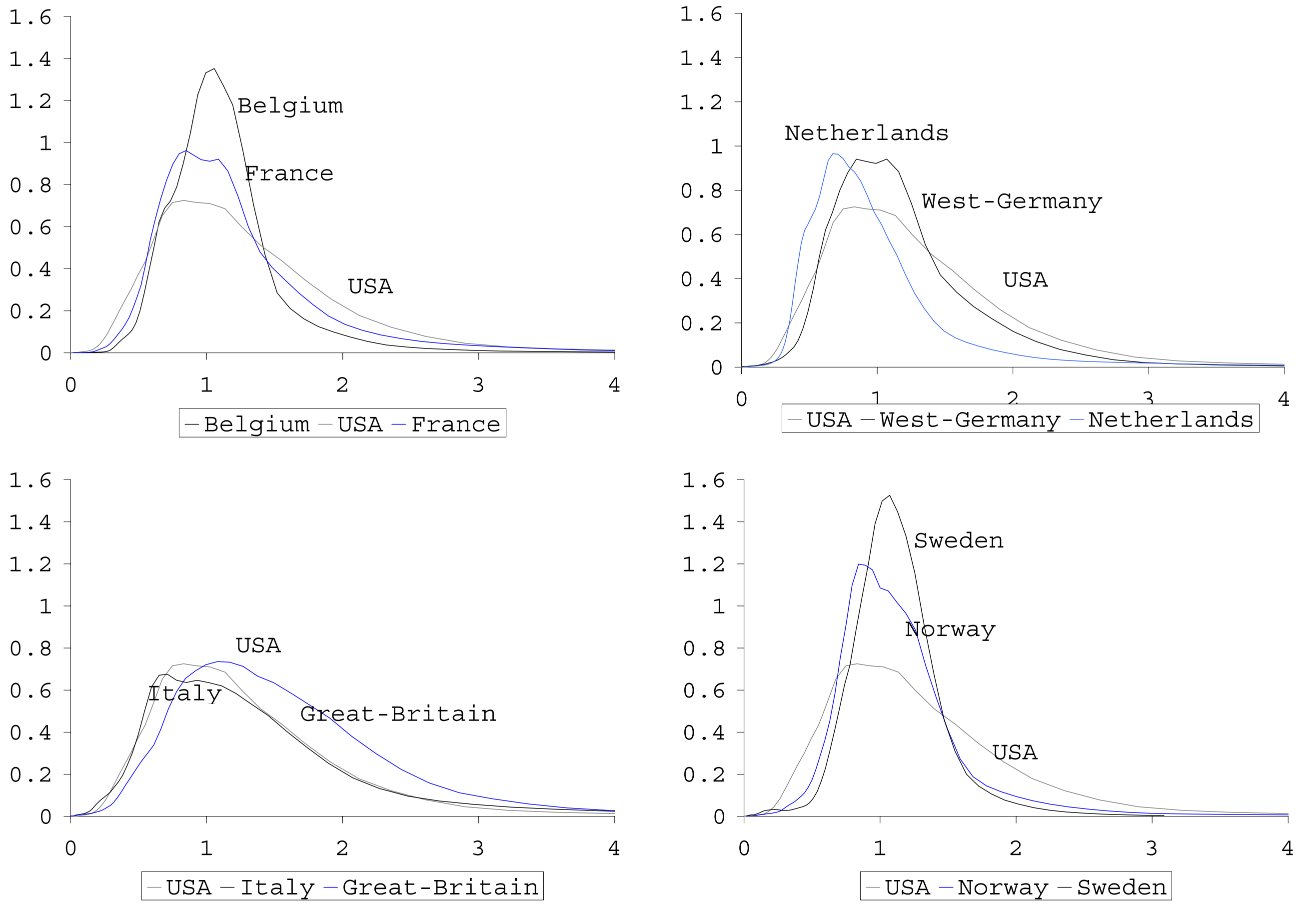

Figure 1: Disposable Income densities estimated by kernel

continental Europe, with the exception of Italy. This last country displays a distribution fairly close to the American and British ones.

To obtain a more precise picture of inequality we consider Lorenz curves. Figure 2 shows Lorenz curves for disposable income in each country. As for income densities, the American curve is represented on each graph. Their analysis corroborates our previous comments. On the top-left panel, it is apparent that the Belgian Lorenz curve is above the French curve, which itself dominates the US one. On the top-right panel, one can notice that Netherlands and West-Germany have a similar level of inequality. The bottom-left panel confirms that inequality is pretty much the same in GB, the US and Italy. Finally, on the bottom-right panel, one can notice the significant gap between Scandinavian countries and the United-States.

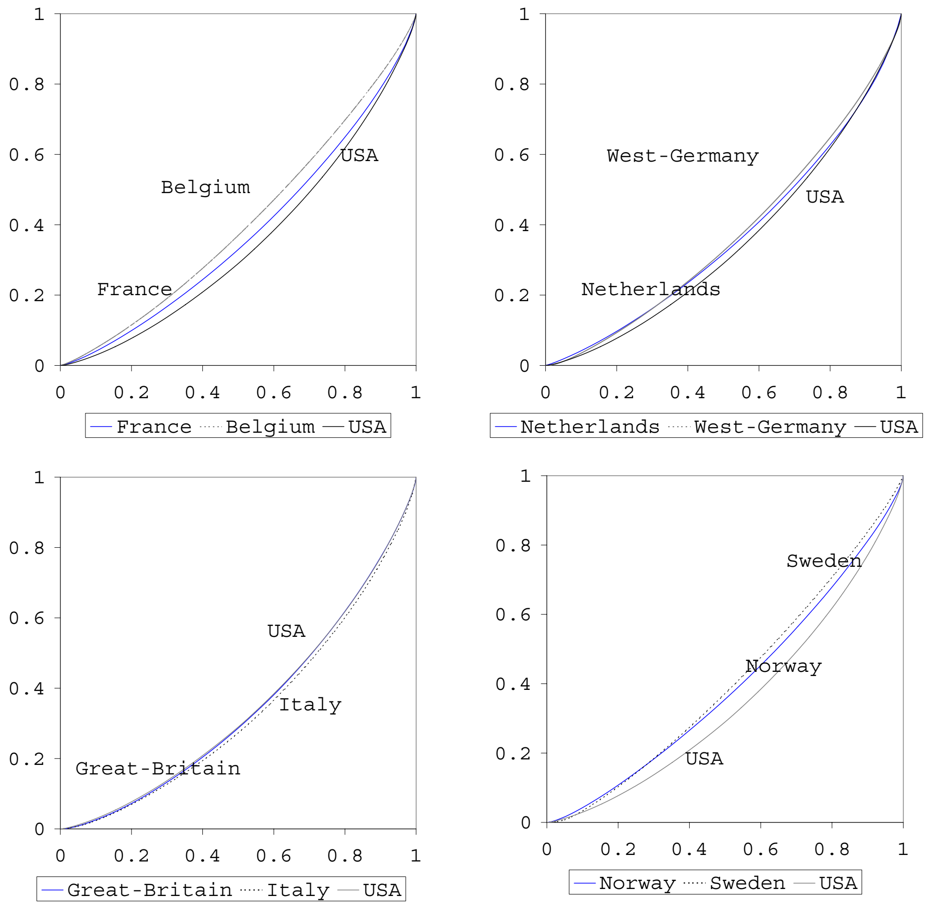

Figure 2: Lorenz curves for disposable income

This visual inspection is confirmed by the results of the Lorenz dominance tests for each pairwise comparison (table 3). These results do not lead to a complete ranking of the countries. However three groups of three countries emerge from these tests. The first group is made of Sweden, Norway and Belgium. The second one includes France, West-Germany and the Netherlands. The third one is composed of Great-Britain, Italy and the US. The hierarchy between the three groups is obvious. All countries in the first group Lorenz-dominate the countries of the second and third group, the countries of the second group Lorenz-dominates the countries of the third one. The within-group ranking is less clear. Within the first group, any pairwise comparison leads to an indeterminacy. The apparently low level of inequality in Belgium may partly be ascribed to the fact that our Belgian data do not take asset income into account. Within the second and third group, for each pairwise comparison, dominance tests conclude to either equality or crossing of the Lorenz curves, except for the comparison between the Netherlands and West-Germany for which the latter dominates the former.

Table 3: Lorenz dominance tests

	Sweden	Norway	Belgium	France	W-Germ	Nether	G-Britain	Italy	USA
Sweden	-	?	?	>	>	>	>	>	>
Norway	-	-	?	>	>	>	>	>	>
Belgium	-	-	-	>	>	>	>	>	>
France	-	-	-	-	=	=	>	>	>
W-Germ	-	-	-	-	-	<	>	>	>
Nether	-	-	-	-	-	-	>	>	>
G-Britain	-	-	-	-	-	-	-	=	=
Italy	-	-	-	-	-	-	-	-	?
USA	-	-	-	-	-	-	-	-	-

The symbols read as follows: >: The row dominates the column. <: The column dominates the row. =: Lorenz curves are identical. ?: Lorenz curves are non comparable.

4.2 Comparison with other studies

In order to assess the reliability of our data, we now compare our results to the ones obtained in other studies, using harmonized income data. To this end, we estimate scalar indexes of relative inequality in the nine countries. Estimates are reported in table A.2, with bootstrapped standard-errors in brackets. For obvious reasons, inequality indexes (Gini, CV) and inter-quantile ratios presented in table A.2 suggest a ranking of countries that is similar to the one established in the previous section. Within-group differences in inequality indexes are not statistically significant, while between-groups differences are.

One natural benchmark to gauge the reliability of our income data is to compare our results to those obtained in Gottschalk and Smeeding (1997; 2000), using data from the Luxembourg Income Study for the early nineties. Three points should be emphasized. First our relative ranking of countries is to a large extent consistent with the results presented in their studies. Second, for most countries, our estimates of inequality indexes are lower than those reported in their studies. This may largely reflect differences in sample selection rules, and in particular the fact that we have restricted our samples to a narrower age interval[10]. Third, two noteworthy differences appear regarding the level of inequality and the ranking of two countries : France and Italy. In our data the former appears less unequal and the latter more unequal than in Gottschalk and Smeeding (2000), both in absolute and relative terms [11]. Regarding France, the difference can be explained by the fact that we use data from 1994, against 1989 or 1984 in their study. Moreover, Hourriez *et al.* (2001) demonstrates that disposable income inequality decreases slightly between these dates. Regarding Italy, their data refer to 1991, a year for which measured inequality is markedly lower than in adjacent years, in particular 1993, the year used in our study. For Italy as well as more generally, our results seem close to those of other studies, both in terms of levels of inequality and of ranking of the countries: Bertola *et al.* (2001) find a Gini of 0.348 for disposable income with LIS data in 1994, and rank Italy among the more unequal countries in Europe. The same conclusion emerges from Atkinson (1996), OECD (1998) and Smeeding *et al.* (2000), who establish an overall ranking similar to ours. Sastre and Trannoy (2001) find very similar results for Gini indexes using LIS data.

Overall, our results closely mimic those obtained in various sources our data, which suggests that we should be reasonably confident in the validity of our income data for international comparisons of inequality. We now turn to the analysis of inequality of opportunity.

5 Equality of opportunity for income acquisition

The above conclusions for inequality of outcomes may not prevail for inequality of opportunity. In fact, in a country with limited inequality of opportunity, there can still be important differences in individual success (hence important inequality of outcome) if individuals exert very heterogeneous effort levels. Conversely, a low level of inequality of

[10]For most countries, our samples are restricted to household whose head is aged 25 to 40, while their sample includes all non-institutionalized households.

[11]According to the value of Gini coefficients displayed in Gottschalk and Smeeding's study, France ranks third with a Gini of 0.32 after the United-States (0.36) and Great-Britain (0.34). In our data income inequality is larger in Italy and the Netherlands than in France. See table A.2.

outcomes is compatible with important differences according to social origin. We first test for equality of opportunity and then analyze differences in the return and risk of income lotteries conditional on social origin. Lastly, using our index of inequality of opportunity, we examine how countries' performance in terms of equality of opportunity compares to their ranking in terms of overall inequality.

5.1 Dominance tests

Figure 3 draws the conditional distributions for primary and disposable income in each country. Again, for each country, income is expressed as a fraction of the country's mean income. The results are then dimension-free and fully comparable to the results obtained for inequality of outcome. Not surprisingly, having more educated parents is associated with a higher level of income.Indeed in every country but Norway, Sweden and West-Germany, the CDF for individuals from more privileged origin is always below the CDFs for individuals coming from the two less privileged social backgrounds.

These graphs also reveal important differences between countries in the *magnitude* of the advantage conferred by more privileged backgrounds over less privileged ones. Intuitively, this advantage corresponds to the gap between the CDFs corresponding to the different social backgrounds. As apparent from these graphs, this distance varies strongly from one country to another. For Sweden, the three conditional distributions for Ed_1 to Ed_3 are strikingly close, suggesting that differences in social background translate into very small differences in income. The same holds true, to a lesser extent, in Norway where the gap between the income distributions of the different backgrounds is rather modest.

This stands in marked contrast with the situation in Italy and the US where the gap between the three distributions is important. In Great-Britain, the advantage conferred to the most privileged group is still quite large but the gap between the second most privileged group is less wide than in the US and Italian cases. Moreover, the income distribution of groups Ed_1 and Ed_2 are closer together than in Italy and the US, suggesting more equality of opportunity in this country at the bottom of the social ladder.

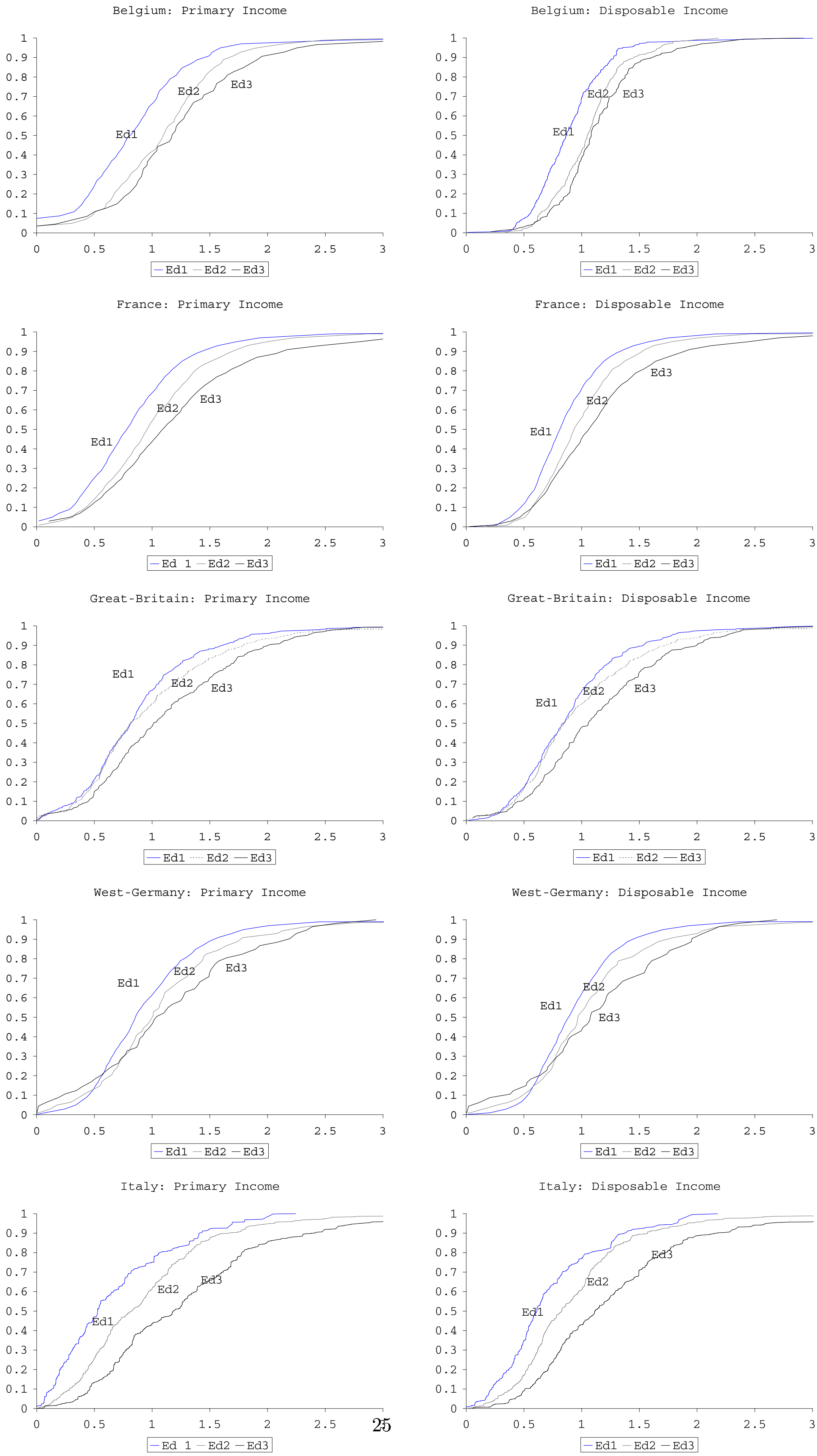

Figure 3: Income distributions conditional on social background

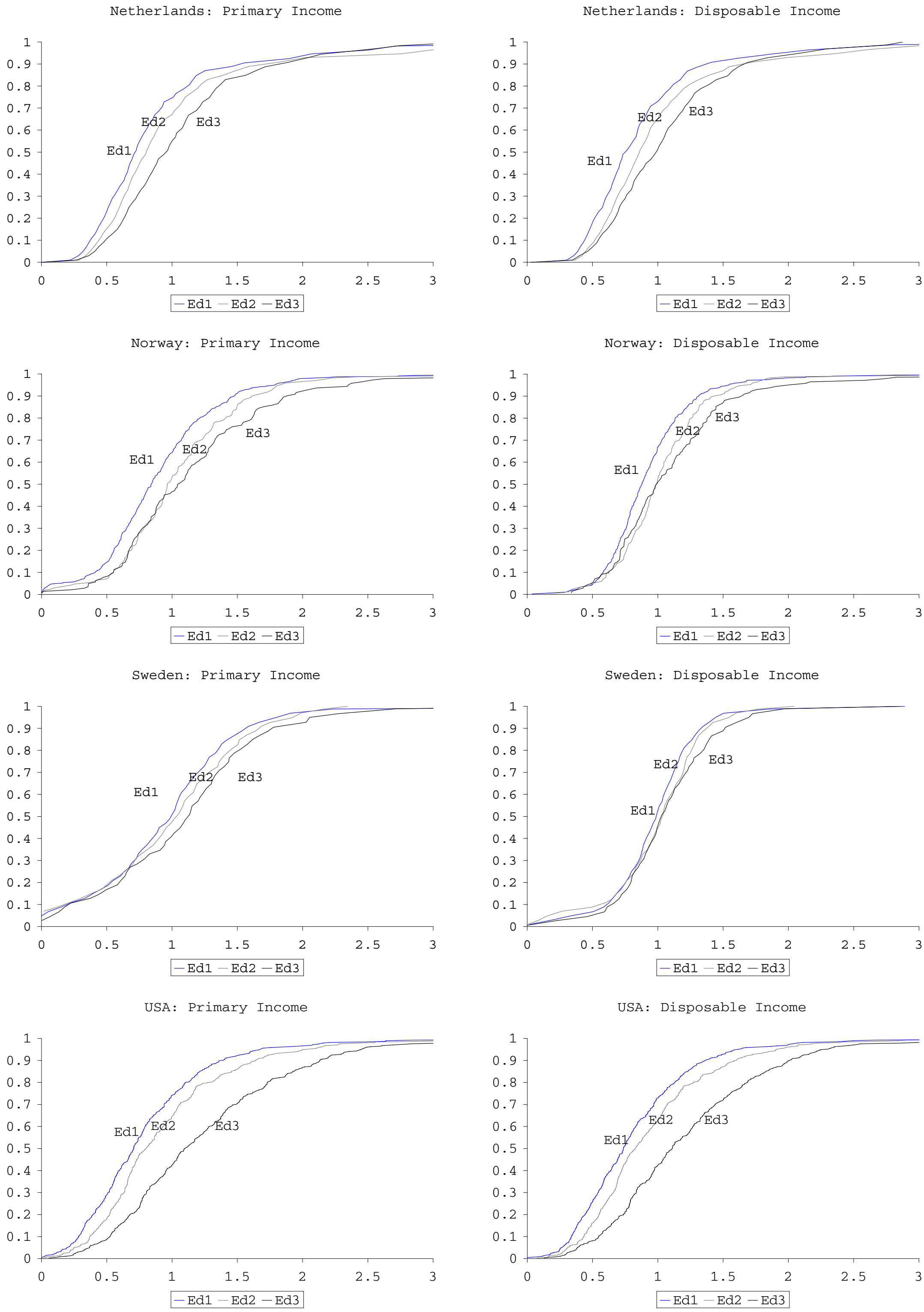

Figure 3: Income distributions conditional on social background (cont.)

The rest of the countries in our data (Belgium, France, Germany and the Netherlands) exhibit an intermediate degree of inequality of opportunity. There are significant differences in the income distributions offered to individuals according to their social background. However, the distance between these distributions is smaller than in Italy and the US. It should also be noted that in the former group of countries, especially in Belgium, inequality of opportunity is more pronounced at the bottom of the social hierarchy, to the extent that the gap between the distributions of groups Ed_1 and Ed_2 is larger than the distance between Ed_2 and Ed_3. This contrasts with the situation in Italy, Great-Britain and the US. However, these differences in the locus of inequality of opportunity may partly reflect differences in the classification used to partition our sample according to social background rather than national specificities.

Whether equality of opportunity prevails can be formally assessed using stochastic dominance tests. To complement visual inspections in terms of *FSD* offered by Figure 3, the results according to *SSD* appear in table 4[12]. In fact, in almost all cases dominance results also are obtained for *FSD*, except mostly for Germany[13]. The only country in which our equality of opportunity criterion is satisfied for all groups is Sweden. In fact, this country exhibits a situation described previously as strong equality of opportunity, as the pairwise tests conclude to the equality of the three conditional distributions. It should also be stressed that this strong requirement holds for both primary and disposable income. In all other countries, according to our definition, equality of opportunity does not prevail. There exists at least one social background whose income distribution is dominated by that of another group. It is nevertheless possible to rank these countries according to the number of times the statistical tests conclude to dominance in the three pairwise comparisons. In this respect, when focusing on comparisons of disposable income, West-Germany is the second-least unequal (in terms of opportunity) since equality prevails in one case and non-comparability in two other cases. Great-Britain, Belgium and Norway come next with two cases of dominance and one equality.

[12] One can wonder if the differences in results from a country to another come from the differences in samples size. We have checked that the results exhibited in table 4 are robust to difference in sample size. For instance, France results are the same when its samples are downsized to Norway's figures.

[13] The only other exception is the comparison between Ed2 and Ed3 in which results in non-comparability at the first order in Netherlands.

Table 4: Stochastic dominance tests

	Belgium						**France**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	$<_2$	$<_2$	-	$<_2$	$<_2$	-	$<_2$	$<_2$	-	$<_2$	$<_2$
Ed_2	-	-	?	-	-	=	-	-	$<_2$	-	-	$<_2$
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-
	Great-Britain						**West-Germany**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	=	$<_2$	-	=	$<_2$	-	?	$<_2$	-	?	?
Ed_2	-	-	$<_2$	-	-	$<_2$	-	-	=	-	-	=
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-
	Italy						**Netherlands**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	$<_2$	$<_2$	-	$<_2$	$<_2$	-	$<_2$	$<_2$	-	$<_2$	$<_2$
Ed_2	-	-	$<_2$	-	-	$<_2$	-	-	$<_2$	-	-	$<_2$
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-
	Norway						**Sweden**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	$<_2$	$<_2$	-	$<_2$	$<_2$	-	=	=	-	=	=
Ed_2	-	-	=	-	-	=	-	-	=	-	-	=
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-
	U.S.A.											
	Primary Income			Disposable Income								
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3						
Ed_1	-	$<_2$	$<_2$	-	$<_2$	$<_2$						
Ed_2	-	-	$<_2$	-	-	$<_2$						
Ed_3	-	-	-	-	-	-						

The symbols read as follows: $<_2$: The column dominates the row at the second order of stochastic dominance. =: Equality of the CdF at the second order. ?: CdF are not comparable at the second order.

Lastly, in France, Italy, the Netherlands and the US, the three tests conclude to dominance at the second order, indicating that the hierarchy of social backgrounds apparent on the graphs of the CDF is indeed very robust.

In all countries but one, Belgium, the results of the dominance tests for primary income are identical to the results for disposable income. This can be interpreted as the weak impact of redistributive policy on equality of opportunity as it is measured here. Hence redistributive policy is not able to fully neutralize the effect of the initial background on the economic success of the next generation. Nevertheless Figure 3 reveals that redistributive policy tends to partially offset the impact of social origin on individual income: in all countries the CDFs for primary income, conditional on social background are always further apart than the CDFs for disposable income.

5.2 Risk and return of the social lotteries

Using standard tools in risk theory, it is also possible to compare the income lotteries attached to different social background in terms of their return and risk. Since for most countries, the tests conclude to first-order stochastic among social backgrounds, we already know that the expected income (*i.e.* the return) is usually larger for the more favored social background. However, whether the lotteries offered to the most advantaged type are also less risky remains an opened question.

5.2.1 An almost equal risk of conditional lotteries

To focus solely on risk, we examine conditional distributions centered around their means, and we draw Lorenz curves of these centered distributions. Comparing two distributions, if the Lorenz curve of the first distribution is above the Lorenz curve of the other then the first distribution will be preferred by all risk-averse individuals, whatever their degree of risk-aversion. Table 5 contains the results of the Lorenz dominance tests. The sequence of tests is similar to the one used for stochastic dominance.

These results suggest that the degree of risk[14] of the income lotteries associated with social background tend to be rather similar. For most countries, the Lorenz curves of the different types are very close, especially for disposable income. Regarding the tests, there is a surprisingly large proportion of pairwise comparisons for which we conclude to the equality of the Lorenz curves: 18 times out of 27 for primary income and 15 times out of 27 for disposable income. Even if we exclude all cases in which the uncentered distributions are already equal, we conclude to the equality of the Lorenz curves in about

[14] Two types of inequalities are mixed up in this measure of the degree of risk: transitory income fluctuations and differences in permanent income among individuals of similar social origin.

Table 5: Lorenz dominance tests

	Belgium						**France**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	?	=	-	=	=	-	=	=	-	=	$>$
Ed_2	-	-	=	-	-	=	-	-	=	-	-	$>$
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-

	Great-Britain						**West-Germany**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	=	=	-	$>$	=	-	=	=	-	=	$>$
Ed_2	-	-	$<$	-	-	$<$	-	-	=	-	-	=
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-

	Italy						**Netherlands**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	$<$	$<$	-	?	$<$	-	=	$<$	-	=	?
Ed_2	-	-	=	-	-	=	-	-	$<$	-	-	$<$
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-

	Norway						**Sweden**					
	Primary Income			Disposable Income			Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	$<$	?	-	=	$>$	-	=	=	-	=	=
Ed_2	-	-	?	-	-	$>$	-	-	=	-	-	=
Ed_3	-	-	-	-	-	-	-	-	-	-	-	-

	U.S.A					
	Primary Income			Disposable Income		
	Ed_1	Ed_2	Ed_3	Ed_1	Ed_2	Ed_3
Ed_1	-	=	=	-	?	=
Ed_2	-	-	=	-	-	=
Ed_3	-	-	-	-	-	-

The symbols read as follows: $<$: The column dominates the row. $>$: The row dominates the column. =: Lorenz curves are identical. ?: Lorenz curves are non-comparable.

half of the cases. In each country there is at least one pairwise disposable income comparison for which equality holds.

All three conditional distributions display the same degree of risk in four countries for primary income (France, West-Germany, Sweden and the US) and two countries for disposable income (Sweden and Belgium). For these countries, the equality of risks suggests that the impact of the family background may simply be captured by a scale parameter.

As a first approximation, in these countries, the distribution of income conditional on social background, takes the following multiplicative form :

$$x_{is} = E(x \mid s)\epsilon_i \tag{9}$$

where x_{is} denotes the income of individual i with social background s, $E(x \mid s)$ is the expectation of income conditional on s and ϵ_i is a random term independent of social background. It should be stressed that equality in the degree of risk of the different distributions is an interesting special case where the ranking of the distributions can be achieved based solely on a comparison of the returns.

When equality of risks does not hold, the tests conclude to the crossing of the Lorenz curves in one forth of the cases. When the conditional Lorenz curves can be ranked, the table indicates that less privileged backgrounds face more risky income lotteries than more privileged ones in all cases for primary income, but only in one third of the cases for disposable income. This indicates that redistributive policies tend to lower the risk of the worst social lotteries. For instance France faces a situation of perfect equality of risk in primary income, but after income tax and transfers, the lottery corresponding to the more privileged type is riskier than the other two. Suppose that we are ready to assume, following Roemer, that the dispersion of incomes within a type is the result of effort only. Then a policy aimed solely at reducing inequality of opportunity should leave the level of risk unchanged. Under this assumption, which is quite strong admittedly, we conclude that the French redistributive policies is not solely motivated by equality of opportunity as defined by Roemer.

5.2.2 Inequality of Return and inequality of Risk

So far our appraisal of risk relies on ordinal comparisons. We now implement our cardinal measure, the GO-index, and its decompositions (7) and (8) to provide additional empirical evidence, though at the price of lower robustness. Table 6 gives the values of the contributions of the return and the risk component according both decompositions.

It clearly appears that the magnitude of the risk contribution is very similar for the

Table 6: Decompositions of the Gini Opportunity index

	GO	Exact decomposition		Pure decomposition		
		GO Return	GO Risk	Go Return	Go Risk	GO residual
Belgium	4.58	4.14	.43	5.06	.45	-.93
France	4.22	5.14	-.91	6.79	-.87	-1.70
Great-Britain	3.45	3.65	-.20	5.16	-.25	-1.45
West-Germany	.88	1.98	-1.10	2.71	-1.06	-.77
Italy	7.64	7.27	.36	10.61	.42	-3.40
Netherlands	2.97	3.07	-.10	4.09	-.09	-1.02
Norway	2.18	2.98	-.80	3.82	-.75	-.88
Sweden	1.09	1.37	-.28	1.67	-.28	-.30
USA	6.93	6.54	.38	9.20	.39	-2.67

The exact decomposition corresponds to equation (8), while the pure decomposition corresponds to equation (7).

two decompositions. The interaction term is absorbed by the return term in the exact decomposition (8). Since the interaction term is quite large, (between 20% and 45% in absolute value of the GO-index) our comments will focus on the exact decomposition.

In the making of inequality of opportunity, inequality of returns stands out as the dominant force. This comes as no surprise in view of the previous ordinal analysis. What is more interesting is that in two thirds of the countries, the risk contribution is negative, meaning that risk is lower in less privileged types. In these countries, inequality of risk mitigates inequality of opportunity and this effect is quite strong in France, West-Germany and Norway. The opposite occurs in Belgium, Italy and the US where risk inequality exacerbates inequality of opportunity. When assessing the robustness of this finding, one should however keep in mind the results the risk dominance tests of table 5, while they indicate that in Italy, the least privileged type is significantly more risky than the most privileged one, the difference in risk is not significant for Belgium and the US.

It is instructive to visualize how these two components of inequality of opportunity shape in inequality of opportunity. The values of the two exact contributions are plotted against the values of the GO-index in figure 4. The positive correlation which emerges from the inspection of both panels is rather impressive and indicates that a good performance of a country according to EOp is associated to reducing both return and risk inequality among types.

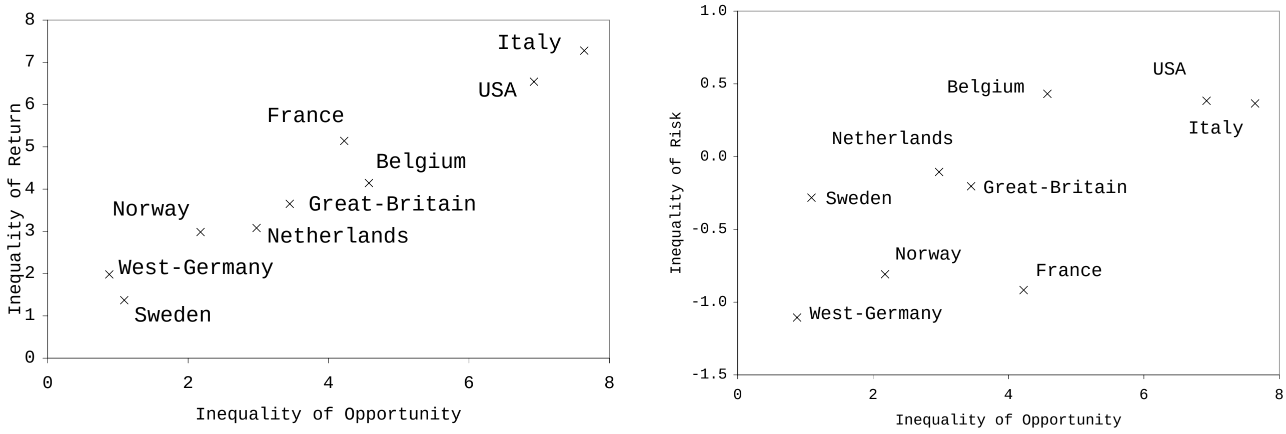

Figure 4: inequality of opportunity, inequality of return and inequality of risk

5.3 Inequality of opportunity vs. inequality of outcomes

We now examine the relationship between inequality of opportunity and inequality of outcomes among countries. To do so, we use the Gini index and the Gini-Opportunity index, since resorting to a cardinal measure of inequality makes comparisons easier. The values of these indexes are presented in table 7. Regarding the extent of inequality of opportunity, three groups of country stand out. A first group composed of Sweden, Norway and West-Germany with the lowest inequality of opportunity. An intermediate group composed of Belgium, France, Great-Britain and the Netherlands and a group of high inequality of opportunity composed of Italy and the US.

Figure 5 reveals a positive correlation between inequality of opportunity and inequality of outcomes. Sweden and Norway are the least unequal countries according to both concepts, while the United-States and Italy are the most unequal ones. The correlation between inequality of opportunity and inequality of outcome is of course far from perfect but with these data the coefficient of correlation is estimated at 0.674[15] If we draw a line that joins the two polar cases, two groups of outliers stand out: Belgium lies above the line, Great-Britain and West-Germany are below. These special cases should not be

[15] If we were to exclude the US and Italy from our graph, very little dependence would have been detected between the extent of inequality of outcome and inequality of opportunity. The coefficient would be estimated at 0.187. Of course the omission of these two large countries would have hampered the study. This observation tells us that the positive correlation between the two concepts of inequality may depend on which country is included in the sample.

Table 7: Index of inequality of opportunity (GO) and Inequality of outcome (Gini)

	GO	Gini
Sweden	1.09	18.26
	(.606)	(.727)
Norway	2.18	21.50
	(.581)	(.516)
Belgium	4.58	18.85
	(.581)	(.516)
Nether	2.97	25.10
	(.415)	(.568)
France	4.22	25.09
	(.406)	(.430)
West-Germ	0.88	25.83
	(.426)	(.943)
G-Brit	3.45	30.58
	(.683)	(.823)
Italy	7.64	32.98
	(.531)	(.680)
USA	6.93	30.43
	(.586)	(.743)

In brackets: standard errors estimated by bootstrap.

overinterpreted because of the limitations of the data for these three countries. Overall, the strong positive correlation between equality of outcome and equality of opportunity indicated in figure 5 confirms the conclusion of several recent papers that have provided evidence of a negative link between intergenerational mobility and income inequality, for instance Björklünd and Jäntti (1997) and Solon (2004).

If inequality of outcome and inequality of opportunity seem to go hand in hand, it may still be the case that equality of opportunity policy entails some cost in terms of GDP per capita. If a country with high inequality of opportunity also has a high GDP per capita, the welfare of the least advantaged type in this country may be higher than in a country that exhibits both lower inequality of opportunity and lower GDP per capita. This kind of phenomenon cannot be detected by our measure of inequality of opportunity since the opportunity set of a type is normalized to the mean income. Hence, it does not take into account differences across countries in the level of well-being reached by each type. For this reason, Figure 6 in the appendix examines the relationship between equality of opportunity and living standard. It suggests that there is no trade-off in our sample between per-capita income and equality of opportunity, as illustrated for instance, by the case of Italy and the USA, who both display a large degree of inequality of opportunity and stay at both ends of the income level spectrum.

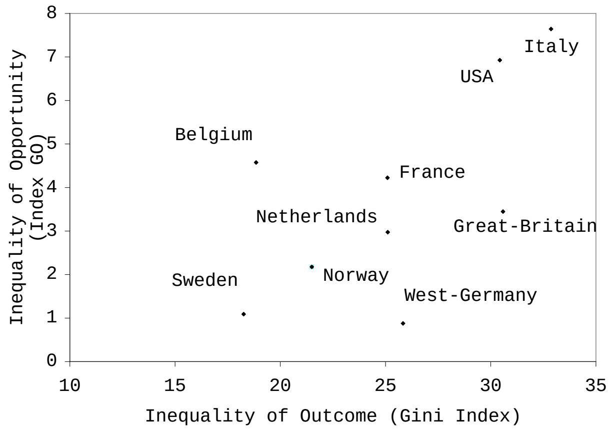

Figure 5: Inequality of outcome and inequality of opportunity

6 Conclusion

This paper provides an international comparison of the extent of equality of opportunity for income in nine developed countries. Our empirical analysis rests on a definition of EOp which is an alternative to and weaker than John Roemer's definition. Whereas Roemer's original definition requires that the distributions of income conditional on type be identical across types, we define equality of opportunity as situation in which there is no unanimous preference for one particular conditional distribution over any other among risk-averse individuals behind the veil of ignorance. We complement this ordinal comparison by relying upon an original index of inequality of opportunities, derived from the Gini inequality index, which can be decomposed into a risk and a return component.

Using the statistical methodology of Davidson and Duclos (2000) for comparing Generalized Lorenz curves, we evaluate the hypothesis of equality of opportunity by testing for second stochastic dominance across income distributions conditional on social background. Overall, we find considerable differences in the degree of inequality of opportunities across countries. There is only one country – Sweden – for which the hypothesis of equal opportunities could not be rejected. For Sweden, in fact, not even the strong (Roemerian) definition could be rejected. The proposed Gini index of opportunities is the lowest for Sweden, Norway and West Germany, and highest for Italy and the USA. The primary determinant of inequality of opportunity is the differences in average income between types. Differences between types in the degree of risk play a smaller role and, in most countries, they tend to slightly compensates for the differences in returns. The Gini index of opportunities is positively, but imperfectly, correlated (0.67) with the standard Gini coefficient for income inequality. Still, the analysis highlights that inequality of outcome and inequality of opportunity can sometimes lead to different pictures. For instance, France and Germany experience a similar level of inequality of income but the former country is much more unequal than the latter from the point of view of equality of opportunity. This may reflect different policy choices regarding what conception of equality to promote.

Obviously, more countries should be analyzed to obtain a more complete and definite picture of the potential contrast or congruence between inequality of outcome and inequality of opportunity among the developed world. Since the dominant picture seems a rather strong correlation between inequality of outcomes and inequality of opportunity, a further investigation in understanding in depth the link between the mechanisms reducing or enhancing both types of inequality is called for.

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Appendix

Statistical tests

The testing procedure has been developed in Davidson and Duclos (2000). It can be applied to any order of stochastic dominance. In this appendix we illustrate the case of second order stochastic dominance test. First, we estimate the Lorenz or the General Lorenz curves with their non-parametric estimator. From a sample of size N_A, $\mathbf{L}_A$ represents the estimated Lorenz curve of distribution A, and Σ_A its variance-covariance matrix. To compare the Lorenz curves of distributions A and B, we compute the difference of the two estimated vectors, noted $\gamma = \mathbf{L}_A - \mathbf{L}_B$. Insofar as the distributions A and B are independent, the global variance-covariance matrix is given by: $\Sigma = \Sigma_A + \Sigma_B$.

To test the equality of the Lorenz curves: the null hypothesis is given by $\mathbf{H}_0 : \boldsymbol{\gamma} = 0$. It is then possible to show (see for example Beach and Davidson (1983) and Davidson and Duclos (2000)) that under $\mathbf{H}_0$ the estimated vector $\hat{\gamma}$ is asymptotically normal, then:

$$\hat{\gamma} \sim \mathcal{N}(0, \frac{\mathbf{\Sigma_A}}{\mathbf{N_A}} + \frac{\mathbf{\Sigma_B}}{\mathbf{N_B}})$$

The asymptotic distribution of the statistic T_1, under the null hypothesis of equality :

$$T_1 = \hat{\gamma}'(\frac{\Sigma_A}{N_A} + \frac{\Sigma_B}{N_B})^{-1}\hat{\gamma} \sim \chi^2_k$$

To test equality of the two Lorenz curves A and B, one only need to compare the value of the statistic T_1 with a χ^2 at five or one percent.

To test relative dominance (ie: L_A dominates L_B), the two hypotheses are $\mathbf{H}_0 : \boldsymbol{\gamma} \in \mathbb{R}^k_+$ against $\mathbf{H}_1 : \boldsymbol{\gamma} \notin \mathbb{R}^k_+$. The Wald test statistic with inequality constraints has been developed by Kodde and Palm (1986) and Wolak (1989). The statistic T_2 defined by :

$$T_2 = \min_{\gamma \in \mathbb{R}^k_+} ||\hat{\gamma} - \gamma||$$

with $||x|| = x'\Sigma^{-1}x$. Kodde and Palm (1986) have demonstrated that T_2 follow a mixture of χ^2 distributions :

$$T_2 \sim \Sigma^k_{j=0} w(k, k-j, \Sigma) Pr(\chi^2_j \geq c)$$

with $w(k, k-j, \Sigma)$ represents the probability that $k-j$ elements of γ be strictly positive. The distribution of this mixture of χ^2 is not tabulated but upper and lower bounds of critical values are given in Kodde and Palm. It is either possible, if lower and upper bounds do not enable to conclude to estimate critical values of the statistic T_2 by a Monte-Carlo procedure[16].

[16] It is necessary to draw 10,000 normally multivariate vectors with expectation 0 and variance-covariance matrix Σ, then to compute the proportion of vectors that have j positive elements (for $j \in (0, k)$), the proportion is an estimator of the weight $w(k, j, \Sigma)$.

Data

Table A.1: Income variables by country

	Belgium	France	G-Britain	Germany	Italy	Nether.	Norway	Sweden	USA
Activity									
Wages and Salaries	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mandatory employee contrib.	S	S	S	S	S	S	Y	Y	S
Farm/non farm self. emp. income	N	Y	Y	Y	Y	Y	Y	Y	Y
In-kind earnings	N	N	N	N	Y	Y	Y	Y	N
Mand. contrib. for self-emp.	N	S	S	S	S	S	Y	Y	S
Patrimony									
Cash property income (rents, interests, dividends)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Noncash property income (imputed rent from own house)	N	N	Y	Y	Y	Y	Y	Y	N
Market value of residence	N	N	N	N	Y	Y	Y	Y	Y
Taxes									
Income taxes	S	Y	S	S	S	S	Y	Y	S
Property or wealth taxes	S	Y	S	S	S	S	Y	Y	S
Other direct taxes	N	Y	N	N	N	S	Y	Y	S
Transfers									
Sick, accident, disability pay	Y	Y	Y	Y	Y	Y	Y	Y	Y
Social retirement benefits	Y	Y	Y	Y	Y	Y	Y	Y	Y
Child or family allowances	Y	Y	Y	Y	N	Y	Y	Y	Y
Unemployment compensation	Y	Y	Y	Y	N	Y	Y	Y	Y
Maternity allowances	N	Y	Y	Y	N	Y	Y	Y	Y
Military/vet/war benefits	N	Y	Y	Y	Y	Y	Y	Y	Y
Other social insurance	N	Y	Y	N	Y	Y	Y	Y	Y
Means-Tested cash benefits	Y	Y	Y	Y	Y	Y	Y	Y	Y
Private pensions	Y	N	Y	Y	N	Y	Y	Y	N
Alimony or child support	Y	Y	Y	Y	Y	Y	Y	Y	Y

S: Simulated Y: source of income presented in the basis, N: source of income not available in the basis. For the definition of any variable see LIS webpage :http://www.lisproject.org/techdoc/variabdef.htm

Indexes of inequality of outcome

Table A.2: Inequality indexes for disposable income

	Gini	Sd log	Theil	Coef Var	P90/P10	P75/P25
Belgium	18.85	0.38	0.06	0.36	2.29	1.57
	(.52)	(.02)	(.00)	(.02)	(.06)	(.03)
France	25.09	0.47	0.11	0.53	2.96	1.73
	(.43)	(.01)	(.01)	(.03)	(.06)	(.02)
Great-Britain	30.58	0.68	0.16	0.61	4.31	2.05
	(.82)	(.03)	(.01)	(.04)	(.20)	(.05)
West-Germany	25.83	0.61	0.12	0.56	3.01	1.75
	(.94)	(.04)	(.01)	(.05)	(.11)	(.04)
Italy	32.98	0.68	0.19	0.67	4.76	2.18
	(.68)	(.03)	(.01)	(.03)	(.22)	(.04)
Netherlands	25.10	0.47	0.11	0.51	2.91	1.77
	(.57)	(.01)	(.01)	(.02)	(.07)	(.04)
Norway	21.50	0.41	0.09	0.50	2.34	1.55
	(.51)	(.03)	(.01)	(.06)	(.10)	(.04)
Sweden	18.26	0.52	0.06	0.34	2.20	1.46
	(.73)	(.04)	(.01)	(.01)	(.07)	(.03)
USA	30.43	0.64	0.16	0.61	4.31	2.11
	(.74)	(.04)	(.01)	(.04)	(.22)	(.06)

sd.log.: standard deviation of logs. Coef. Var.: coefficient of variation. In brackets: standard-errors estimated by bootstrap (200 replications).

Tradeoff

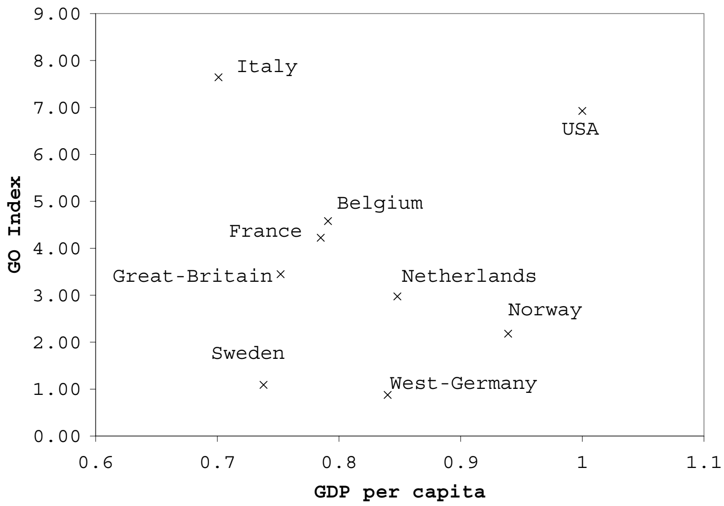

Figure 6: GDP per capital and inequality of opportunity