# The Link between Inequality of Opportunity for Income Acquisition and Income Inequality: the French Example 1977-1993.

Arnaud LEFRANC[*] Nicolas PISTOLESI [†] Alain TRANNOY[‡]

July 16, 2009

**Abstract**

We analyze equality of opportunity for earnings acquisition in France between 1973 and 1993 conditional on the father earnings in the earnings distribution using two waves of the French data set FQP. First, using stochastic dominance tools, we find that inequality of opportunity has remained stable when conditioning on the earnings level of the father, while it has diminished when conditioning on his rank in the earnings distribution. The former result is explained by the stable intergenerational earnings elasticity. The latter by the decreasing wage inequality in the previous generation. Then, we decompose the evolution of inequality of opportunity using the mean logarithmic deviation and the results of regressions of descendants'earnings on their parents earnings. It is shown that the main reason beneath the reduction of inequality of opportunity lies in the decrease of earnings inequality taking place in the eighties.

**JEL Codes:** D1, D3, J3

**Key words :** Inequality of opportunity, stochastic dominance, circumstances, decomposition, mean logarithmic deviation.

[*]THEMA, IDEP, Institut Universitaire Européen et Université Pierre Mendès-France. arnaud.lefranc@u-cergy.fr

[†]THEMA, Université de Cergy-Pontoise. Nicolas.Pistolesi@univ-tlse1.fr

[‡]EHESS, GREQAM-IDEP. alain.trannoy@ehess.cnrs-mrs.fr

# 1 Introduction

Quite recently, the empirical analyses of inequality have been agonized about the issue of responsibility raised by philosophers such as Dworkin

This distinction provides ethical foundations to a public policy aiming at compensating inequalities coming from circumstances and providing equality of opportunity in income acquisition. In an intergenerational perspective, the debate mainly focuses on the influence of parental background on children outcomes. The parental background may be described both by discrete variables such as socio-economic status or level of education or by merely continuous variables such as parental income. The first have the advantage to be measured without errors and to be more or less constant over the childhood. On the other hand, such a broad category as for instance farmers may reflect very different initial conditions for a child. The shortcomings of parental income are at the opposite. We generally know the income of the parents for a too short period while it may have varied a lot during childhood or teenage years. Moreover measurement errors plague the knowledge of income. In some sense, the first tools may be not enough precise to accurately describe the circumstances while parental income is somewhat too precise.

Despite its weakness, parental income is a powerful tool enabling parents to impact their children's outcomes through at least three channels. It is an indicator of the parental economic success positively correlated to their genetic abilities and so to their offspring's. At the same time, parental income can be correlated to transmission of values, gifts, and social privileges such as acquisition of believing and abilities, constitution of preferences and aspirations, and sharing of social relations. Finally, parental income is related to the amount of bequests. Thus, parental income represents an omnibus measure of parental abilities influencing the economic outcomes of their children.

This article aims at determining to what extent social background measured by parental earnings impacts significantly on their children earnings in France and its change over time. Any income difference associated to parents' income will be interpreted as an inequality of opportunity. This assimilation is by no means obvious. Neutralizing any children earnings differences correlated with parental income is linked to the idea that the necessity of compensation should overcome the respect of responsibility. In particular it implies correcting the effect of a correlation between social background and effort. It means that determinants of success correlated with earnings are circumstances which impact must be neutralized. Roemer

We now clarify the statistical framework of the exercise. The contribution of the paper is to offer a quite innovative way of combining a discrete and a continuous approach to measure the impact of parents' income on children earnings. As it is usual, the continuous statistical approach builds upon an estimate of the intergenerational earnings elasticity. It measures the percentage increase in descendant earnings when parental earnings are increased by one percent. Using the mean logarithmic deviation as the cardinal measure of inequality of incomes both in parents and descendants generations enables us to propose an index of inequality of opportunity computed as the product of the intergenerational earnings elasticity and the inequality of parents' income. One of the advantages of this choice is to easily decompose the evolution of inequality of opportunity into two factors: the change in the income inequality in the parents' generation and the change in the intergenerational earnings elasticity. This decomposition sheds light on the fact that, contrary to the philosophical premises, inequality of outcomes and inequality of opportunities are not independent concepts and are closely related. In general, a reduction of inequality of outcomes leads to a reduction of inequality of opportunities at the next generation.

Despite its interest, this continuous approach presents a limit in that it only focuses on the conditional earnings expectation. If the regression slope is not significantly different from zero, one would conclude to equality of opportunity while social background could still have an impact on others moments of the distribution. For example, parental earnings could have an influence on the conditional variance of their descendants' earnings. A nonlinear regression analysis would not be able to detect such a relation. The full conditional earnings distribution must be studied in order to assess inequality of opportunity. A generalization of the regression analysis could come from a quintile regression modeling the conditional income expectation for adult children. This approach has been followed by Dardanoni *et al.* (2005) for other parental characteristics than earnings. However, this approach is not general enough. It supposes a parametric relation between parental and their descendants earnings. We retain a full non parametric approach which is more robust statistically. A first approach explored by O'Neill *et al.*

Admittedly, defining the groups entails some arbitrary, since it comes to partitioning a continuous measure of the circumstance. Keeping in mind that our aim is to quantify the change in inequality of opportunity over time, the choice of a stable partition over time is recommended. To that extent two partitions are possible. Firstly, a purely ordinal partition, secondly a cardinal one. For the former, two individuals will be in the same group if their parental earnings are in the same quintile. Then, the circumstances are supposed comparable if the father earnings ranking is identical. This partition presents the advantage that groups keep a constant relative size from one period to another. However, if the dispersion of the parental earnings distribution changes over time, the advantage in terms of earnings level associated to any given quintile will change either. Belonging to the first decile represents a relative weaker drawback when parental earnings are low. That is why we adopt either a second partition. It considers that two descendants have the same circumstances if their parental earnings relative to the mean belong to a fixed interval. By construction, this circumstance is invariant to any change in the dispersion in the father's generation. On the other hand, the relative size of the groups can vary over time. If the distribution of the fathers gets less contracted, the size of the groups near the median or the mean will increase at the expense of the groups at the top or the bottom of the social scale. These two kinds of ranking aim at representing two different dimensions of earnings. In the first, the rank of the father in the transmission process matters. It captures status phenomena. In the second, the monetary affluence of earnings is at the center of the stage. We assess inequality of opportunity using the same methodology based on stochastic dominance tests applied to the conditional earnings distribution of the descendants as in our previous papers (Lefranc Pistolesi, Trannoy (2004), (2006)).

It is worth it to observe that both approaches, the discrete and the continuous ones, are quite complementary since they illuminate a different face of inequality of opportunity. By relying on a discrete analysis, we underestimate the inequality of circumstances because we ignore the within group inequality of circumstances, whereas a regression analysis shows that a tiny income difference has a statistically significant impact on descendant income. On the opposite, by resorting to a continuous analysis, we cannot analyse the full distribution of opportunities because the support of the conditional distribution is truncated for the limited sample size. Performing a discrete partionning allows to extend the analysis beyond the study of the only conditional expectation. That is why discrete and continuous approaches of equality of opportunity are implemented simultaneously in this paper. The two approaches may lead to different conclusions. In Lefranc, Pistolesi, Trannoy (2006) we concluded to a decreasing inequality of opportunity when comparing descendants income distributions by occupational group of the father. While in Lefranc and Trannoy (2005) we concluded to a constant inequality of opportunity from a regression analysis. One of the goals of this paper is to know whether differences of results are due to differences of approaches or differences in the conditioning variables defining individual circumstances.

Section 2 presents the data. In section 3 we implement the discrete approach. Section 4 uses a regression analysis to measure inequality of opportunity in the continuous setting. Section 5 discusses the differences of results obtained with the two approaches and concludes.

## 2 Data

To measure inequality of opportunity conditional on social background, individual incomes over two generations are necessary. Such data are not available for France: in French data bases only individual income can be observed. This limit is overcome by using data providing information on individual income and some parental demographic characteristics correlated with their income such as education or occupational group. Parental income can be predicted from these characteristics. Firstly, we use an auxiliary sample representative of the population of the parents with these observable characteristics and their income. Then we estimate an income equation regressing income on demographic characteristics. For each individual we predict his parental income from his parental characteristics. We concentrate only on the income of the father.

## 2.1 Data base: survey "Formation-Qualification-Profession" (FQP)

Data come from the French survey FQP carried out by the French statistical office INSEE. We use waves 1964, 1977, and 1993. The first two waves represent a stratified sample of the French population of working age, and sampling rates vary from one stratum to another. Results presented here are weighted by sampling frequency[1].

Respondents provide information on their schooling career, qualification, job, sector of activity and on annual wage in the previous year[2]. For 1977 and 1993 respondents provide the number of worked months, and whether it is part or full time. On the other hand, activity income is known only for wage earners. Data include family composition (marital status and number of children). Waves 1977 and 1993, provide detail information on social background with the father schooling, his occupation (2-digits), if he was civil servant, and the living region of his parents[3].

In any wave, education level is included with a ten-level scale distinguishing general and technical institutions. Across the three waves of data several nomenclatures have been used, and we have computed a uniform nomenclature[4].

## 2.2 Samples selection

Our analysis uses two sample sets: main samples (or adult-children samples) from which we measure inequality of opportunity, and auxiliary samples to predict parental income of individuals in the main samples. Adult-children samples come from 1977 and 1993 FQP data waves. In each wave we restrict to 30 to 40 years old individuals at the time of the survey and declaring being head of the household or spouse of the head. We exclude individuals of birth rank superior to three, in order to limit the age interval of the fathers of the individuals in our samples (see below). Insofar as we observe only wage-earners, we exclude self-employed and children of self-employed. Lastly, individuals with wages below half the minimum wage are excluded from our sample.

[1]Weighting is necessary in our case since we estimate the wage distribution.

[2]In 1964, the exact wage is not known. Nine bracket answers are provided. Estimations for that year use interval regressions.

[3]These pieces of information are declared by the interviewed and refer to the date when she finished studying.

[4]Occupation has been recoded using Erikson and Goldthorpe (1992) social scale. Education level has been recoded using a eight-level scale.

Auxiliary samples come from wave 1964 and 1977. Wave 1964 (respectively 1977) is used to predict parental income of the wave 1977 (resp. 1993). We restrict to males, head of households, wage-earners and fathers of at least one child at the time of the survey. Moreover we keep only individuals aged 25-30 at the birth of individuals in the main samples[5].

## 2.3 Main variables

We focus on two income variables: the outcome variable, measured by individual equivalent full-time earnings, and the circumstance variable defined by his father predicted earnings. Equivalent full-time earnings is defined from annual declared earnings taking into account the number of months worked full time and part time. It represents more a measure of individual labor market ability than his effective earnings. In addition, age effects are removed from adult-children earnings. In the following analysis earnings are normalized by the mean.

Father's earnings is predicted from four observable characteristics. These characteristics are declared in the main samples: level of education, social group, private or public company status, and place of living[6] of the father. Table 11, in appendix, displays estimations results predicting the father earnings. Using father predicted rather than real earnings has some advantages. First, real earnings includes transitory elements poorly linked to permanent earnings which represents individual social background. On the contrary, earnings differences linked to education differences of social group are more lasting and are a better representation of individual circumstances.

After, estimating the father earnings, we test equality of opportunity in France and its evolution between 1977 and 1993 from two complementary approaches. We implement the first in the next section, the second in section 4.

[5]Mean age of the fathers at birth of the first child in our samples is near 27. As individuals in main samples are aged 30 to 40 at the survey date, we thus restrict to individuals aged [30+25-$v$+$v'$, 40+30-$v$+$v'$]. with $v$ the survey wave used to predict income in wave $v'$.

[6]One dummy variable for Île de France, ie: Paris region, and one dummy variable for living in the country.

# 3 Discrete Approach: equality of opportunity and stochastic dominance

In social choice theory, it is common to distinguish equity criteria from social pre-orders. The formers give conditions defining equitable solutions, while the latter provide criteria in order to rank social states. We propose here an equity criterion[7] based on dominance concepts[8]. Then we present results obtained with the equity criterion applied to FQP data.

## 3.1 A definition from stochastic dominance concepts

Social background is represented by a discrete variable noted $s$, $s \in S = \{1, \ldots, \overline{s}\}$. A social decision-maker must be able to define preferences on $S$. Adult-children earnings is defined as a continuous variable $x$ on $\mathbb{R}_+$. Cumulative distribution function of the adult-children earnings $x$ given $s$ is noted $F(x \mid s)$.

In the hypothetical situation of a decision maker that would have to choose her social background before been born, her best option is to compare these conditional cumulative distribution functions. Her preferences on $S$ will be determined by the comparisons of conditional distributions belonging to the set of probability distributions on the real positive line. Proprieties of preferences on this set determine those on $S$. We make the hypothesis that the social decision maker accepts the stochastic dominance criterion at the first order ($\mathrm{SD}_1$) and at the second order ($\mathrm{SD}_2$).

**Definition** *Social background s* $\mathrm{SD}_1$*-dominates social backgrounds'* ($s \succeq_{SD_1} s'$) *iff:*

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

Strict dominance ($s \succ_{SD_1} s'$) demands at least one $x$ such as $F(x \mid s) < F(x \mid s')$. It is well known that with expected utility theory (EUT) any decision maker preferring

[7] Benabou and Ok (2001) focus on mobility processes rankings, while our interest lies on a definition of equality of opportunity.

[8] Van de Gaer (1993) already proposed to build on stochastic dominance criteria to defined equality of opportunity. See Lefranc *et al.* (2006) for a longer justification of equality of opportunity criteria defined from stochastic dominance concepts.

more to less (his VNM utility function is increasing in $x$) will never choose a distribution dominanted at the first order $SD_1$. Even if some laboratory experiments display breaching of $SD_1$ (See for example Birnbaum and Navarette (1998)), a large consensus among decision theory specialists (See, Starmer (2000)) concludes that any satisfactory theory must accept the first order dominance criterion. Moreover, Martinez *et al.* (2001) consider that any equality of opportunity measure must respect this property.

Stochastic dominance criterion implemented at the first order determines a preorder on $S$. Non-dominated social backgrounds are defined by the binary relation $\succeq_{SD_1}$ as :

$$P_1 = \{s \in S \mid \nexists s' \in S \text{ such as } s \succ_{SD_1} s'\} \tag{1}$$

A less partial preorder corresponding to risk adversion can be implemented when cumulative distributions intersect.

**Definition** *Social backgrounds $SD_2$- dominates social background $s'$ ($s \succeq_{SD_2} s'$) 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 expected utility framework, dominating distribution according to $SD_2$ is preferred by any agent having risk aversion (her utility function is increasing and concave in $x$). Machina (1982) [9] proves that respecting $SD_2$ is not only due to the respect of independence axiom. He demonstrates that if a preference at real values defined on the set of any probability distribution is regular, then respecting $SD_2$ (attributing a larger utility to a dominating distribution according to $SD_2$ than a dominated one) is satisfactory if locally the utility function is concave in $x$. Then, our definition of equality of opportunity does not imply in any case that the decision maker accepts axioms of expected utility theory.

Shorrocks (1983) has demonstrated than second order dominance is equivalent to dominance of the generalized Lorenz curve. More precisely:

$$\forall x \in \mathbb{R}_+ \quad s \succeq_{SD_2} s' \quad \Leftrightarrow \quad \forall p \in [0,1] \quad GL_{F(.|s)}(p) \geq GL_{F(.|s')}(p) \tag{3}$$

With $GL_{F(.|s)}(p)$, the value of the Generalized Lorenz curve in $p$ for distribution

[9] See Chew and Mao (1995) for an extension.

$F(. \mid s)$.

Non-dominated social backgrounds for $\succ_{SD_2}$, $P_2$, is defined similarly to $P_1$. As, $SD_2$ is a less partial criterion than $SD_1$, $P_2 \subseteq P_1$. We propose identifying equality of opportunity as a situation where no social background is dominated for second order stochastic dominance. ie:

**Definition** We define weak equality of opportunity when $P_2 \equiv S$.

In other words, it means that for any $s$ and $s'$ belonging to $S$ , there exists $x$ and $x'$ belonging to $\mathbb{R}_+$ such as

$$\int_0^x F(y \mid s)dy \geq \int_0^x F(y \mid s')dy \text{ and } \int_0^{x'} F(y \mid s')dy \geq \int_0^{x'} F(y \mid s)dy \tag{4}$$

$$\text{and if } \exists x \in \mathbb{R}_+ \text{ such as } \int_0^x F(y \mid s)dy > \int_0^x F(y \mid s')dy \tag{5}$$

$$\text{then } \exists x' \in \mathbb{R}_+ \text{ such as } \int_0^{x'} F(y \mid s)dy > \int_0^{x'} F(y \mid s')dy \tag{6}$$

This definition of equality of opportunity admits as a special case equality of the conditional distributions. That is:

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

Such a situation can be described as strong equality of opportunity. Roemer (2004) uses this concept to define equality of opportunity. It appears as a rival definition to weak equality of opportunity. However, such a situation will be rarely met in practice. Weak equality of opportunity represents a more accessible objective. Moreover, restricting to this single notion of strong equality will not make it possible to distinguish when two distributions are not equal the cases when it is not possible to rank them of the cases when a ranking can be achieved. Whereas these two situations differ profoundly. One of the advantages of our criterion of equality of opportunity defined as lack of dominance is on the contrary to distinguish these two situations.

Our criterion does not imply equality of conditional means (Van de Gear (1993) criterion). Roemer supposes that differences of outcome for a given circumstance are solely due to differences of effort. This interpretation does not fit our definition. Roemer supposes that conditional distributions deciles be equal, but the weak criterion does not ask such assumption. The criterion of strong equality respects Roemer and Van de Gaer conditions.

Comparing conditional distributions centered at their means is useful to compare only the risk of the lotteries independently of their returns. One would use the criterion of the Lorenz curves to draw that comparison. Equivalently, the result of this comparison provides information on the inequalitarian aspect of the distributions. Noting $L_{F(.|s)}(p)$ the ordinate of the Lorenz curve in $p$, for the conditional distribution $F(. \mid s)$, one would say that the lottery associated to group $s$ has less risk than lottery $s'$ if :

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

In order to implement these criteria of equality of opportunity, it is necessary to build types representing the set of individuals benefiting of the same circumstances. Next section explains how we proceed.

### 3.2 Partitioning in different circumstances

To implement our definition of equality of opportunity it is necessary to group individuals by income of the father. A first solution comes to gathering individuals by income quintile of the father. For each wave of data we get a relative ordinal partitioning of the circumstance "income of the father". It comes to considering that the relative advantage or disadvantage that individual experience depends uniquely of their father rank in the income distribution. At the opposite, circumstances can depend from the family income level. If such is the case, a changing income inequality among fathers may limit the longitudinal comparison of equality of opportunity. Implementing a cardinal partitioning would take more closely into account the income level of the parents.

In the rest of the article, we use the two approaches. The values of the centiles defining the ordinal partitioning are given in table 1. In the definition of these groups, we try obtaining groups of sufficient size to implement the nonparametric tests of stochastic dominance. Between 1977 and 1993, we observe a decrease in the spread of the father predicted earnings: the interval of observed values, expressed relative to the mean goes from [.377,3.1673] to [.538,2.569].

The second partitioning is defined from the value of the father earnings relatively to the father mean earnings: a social group of origin is composed of individuals whose father perceived a predicted earnings belonging between $x$ times and $y$ times the mean earnings in that year. We maintain as long as possible [10] unchanged boundaries $x$ and $y$ whatever the data wave. To define our second partitioning of social background, we use as boundaries the values of earnings (expressed in proportion to the mean) that serve to define the relative ordinal partitioning in 1993. For this wave the two partitions match perfectly by construction. In 1977, individuals with earnings lower that the minimum threshold[11] in 1993 are discarded as are those with a father earnings superior to the maximum of 1993. Lastly, 442 observations have been deleted in 1997, representing 11% of the initial sample, 8% in the lower part of the distribution and 3% in the top. Table 1 summarizes differences between groups with the two approaches.

Most analysis of equality of opportunity divide the population from social group or education level of the parents. Table 2 exhibits a comparison with the one generally used in the literature[12]. Groups of origin defined by the father income are very close to those build from the single information of the father social group, and in particular, the groups in Lefranc *et al.* (2004). Individuals in the first two groups are barely all children of workers. Those of groups (C3) and (C4) are one third children of lower-grade professionals or clerks. Lastly, groups (C5) (respectively (C6)) are mainly children of lower-grade professionals (respectively higher-grade professionals). Besides, during the period the groups compositions change only very slightly. It excludes any explanation for the observed evolutions from a change of composition in the social groups of origin.

Next section applies our definition of equality of opportunity to the ordinal conditioning. Section 3.4 turns to cardinal partition.

[10] A perfect match between the two dates may sometimes not be possible. It is due to the discrete nature of the distributions. The slight bracket differences in table 1 exhibit this property for the cardinal definition.

[11] relative to the mean.

[12] The table is established for the cardinal partitioning. Ordinal partitioning changes only slightly the results.

Table 1: Social Background groups definition

| Group of social background | ordinal definition | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1977 | | | 1993 | | |
| | centiles | $x_{inf}$ | $x_{moy}$ | $x_{sup}$ | $x_{inf}$ | $x_{moy}$ | $x_{sup}$ |
| C1 | [ 1,15] | .377 | .499 | .555 | .538 | .635 | .687 |
| C2 | [16,35] | .556 | .652 | .699 | .701 | .734 | .777 |
| C3 | [36,55] | .704 | .775 | .839 | .781 | .833 | .867 |
| C4 | [56,70] | .843 | .949 | 1.033 | .869 | .958 | 1.028 |
| C5 | [71,85] | 1.034 | 1.223 | 1.443 | 1.031 | 1.153 | 1.367 |
| C6 | [86,100] | 1.450 | 2.163 | 3.167 | 1.388 | 1.903 | 2.569 |
| | cardinal definition | | | | | | |
| | | 1977 | | | 1993 | | |
| | centiles | $x_{inf}$ | $x_{moy}$ | $x_{sup}$ | $x_{inf}$ | $x_{moy}$ | $x_{sup}$ |
| C1 | [8, 22] | .559 | .652 | .699 | .538 | .635 | .687 |
| C2 | [24,35] | .709 | .751 | .786 | .701 | .734 | .777 |
| C3 | [38,43] | .803 | .822 | .857 | .781 | .833 | .867 |
| C4 | [46,65] | .860 | .952 | 1.028 | .869 | .958 | 1.028 |
| C5 | [67,84] | 1.037 | 1.145 | 1.334 | 1.031 | 1.153 | 1.367 |
| C6 | [87,97] | 1.369 | 1.840 | 2.531 | 1.388 | 1.903 | 2.569 |

Note : $x_{inf}$, $x_{sup}$ et $x_{moy}$ represent respectively, limits and mean values of the social groups expressed relative to the mean father predicted earnings.

Table 2: Composition by social group of the father

| | 1977 | | | | | | 1993 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C1 | C2 | C3 | C4 | C5 | C6 |
| H-grade Prof. | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 80.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.6 |
| L-grade Prof. | 0.0 | 0.0 | 0.0 | 26.6 | 85.0 | 19.1 | 0.0 | 0.0 | 0.0 | 39.9 | 84.2 | 23.7 |
| Clerks | 3.4 | 28.9 | 39.2 | 36.1 | 3.5 | 0.0 | 2.7 | 16.3 | 29.0 | 33.7 | 12.2 | 0.0 |
| Workers | 96.6 | 71.1 | 60.8 | 37.2 | 9.8 | 0.0 | 97.3 | 83.7 | 71.0 | 26.3 | 3.6 | 0.0 |

Composition of the groups by social group of the father. Cardinal partition In percentage. Example: in 1977, 96.6% individual of group (C1) have a worker father.

## 3.3 Ordinal approach : less inequality of opportunity?

Table 3: Stochastic dominance tests - Ordinal Approach

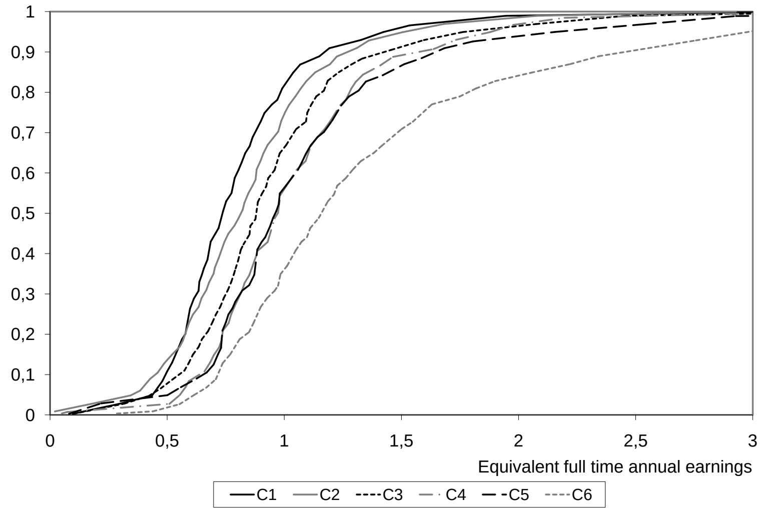
| | 1977 | | | | | | 1993 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C1 | C2 | C3 | C4 | C5 | C6 |
| C1 | - | = | $<_1$ | $<_1$ | $<_1$ | $<_1$ | - | = | ? | $<_1$ | $<_1$ | $<_1$ |
| C2 | - | - | $<_1$ | $<_1$ | $<_1$ | $<_1$ | - | - | = | $<_1$ | $<_1$ | $<_1$ |
| C3 | - | - | - | $<_1$ | $<_1$ | $<_1$ | - | - | - | $<_1$ | $<_1$ | $<_1$ |
| C4 | - | - | - | - | ? | $<_1$ | - | - | - | - | = | $<_1$ |
| C5 | - | - | - | - | - | $<_1$ | - | - | - | - | - | ? |

Equivalent full-time earnings. =: the row and the column are equal at 5%. $>_1$: the row dominates the column at 5% at the first order.

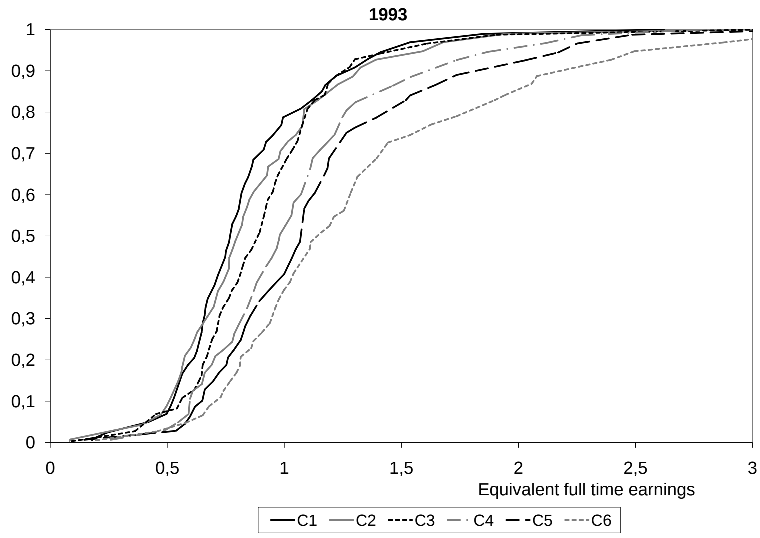
Graphics A and B in figure 1 represent adult-children distributions conditional on social background with the ordinal partition of the father income values. In 1977, the groups ranking corresponds to the earnings hierarchy. Indeed, distributions are clearly ranked from (C1) to (C6). It is nearly always preferable to come from a more privileged background. Only two comparisons cannot rank the distributions. The more disadvantaged distribution (C1) cuts clearly the distribution of the second group. Moreover, the distribution of group (C4) is very close to the group (C5) except in the tail of the distributions in which the very high and very low earnings are different. Results of the tests (table 3) confirm these observations. A strong order between the groups is observable except for groups (C1) and (C2) which are statistically equal at 5% and for the groups (C4) and (C5) which are non comparable. In 1977, the more privileged descendants distinguish clearly from the rest of the population.

In 1993, figure 1 provides a more ambiguous ranking. On the one hand, social backgrounds (C1), (C2) an (C3) are much closer. On the other hand, the distance between social backgrounds (C4), (C5) and (C6) seems weaker. Statistical tests in table 3 confirm these remarks since the first three backgrounds are either non-comparable or equal. Moreover, the tests conclude to equality in the comparison (C4) and (C5) and to non-dominance between (C5) and (C6). The narrowing reflect the results already obtained on the data *Budget des Familles* over the same period with a different conditioning with the father occupational group in Lefranc *et al.* (2004). Lastly, if the tests conclude most of the time to inequality of opportunity over the two waves (86% of the cases in 1977 and 66% of the cases in 1993), this figure is decreasing over the period. In 20% of the cases we have strong equality of opportunity and in 13% of the cases (2 comparisons out of 15) a non-comparability of the conditional distributions.

### A- 1977 - ordinal partition




### B- 1993




### C- 1977 - cardinal partition

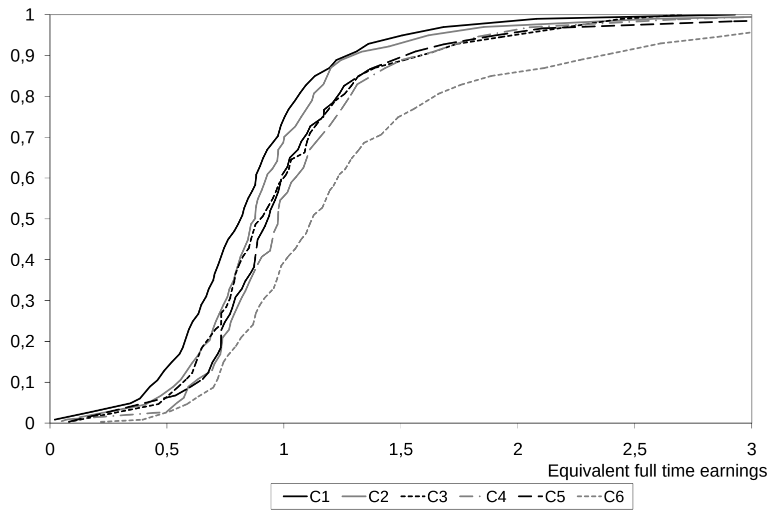



Figure 1: Conditional income distributions - relative measure of inequality of opportunity

Table 4: Stochastic dominance tests - Cardinal approach

| | 1977 | | | | | | 1993 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C1 | C2 | C3 | C4 | C5 | C6 |
| C1 | - | = | $<_1$ | $<_1$ | $<_1$ | $<_1$ | - | = | ? | $<_1$ | $<_1$ | $<_1$ |
| C2 | - | - | = | $<_1$ | = | $<_1$ | - | - | = | $<_1$ | $<_1$ | $<_1$ |
| C3 | - | - | - | = | = | $<_1$ | - | - | - | $<_1$ | $<_1$ | $<_1$ |
| C4 | - | - | - | - | = | $<_1$ | - | - | - | - | = | $<_1$ |
| C5 | - | - | - | - | - | $<_1$ | - | - | - | - | - | ? |

Equivalent full-time earnings. =: Row and column distributions are equal at 5%. $>_1$: Distribution in row dominates column distribution at 5% at the first order.

The preceding analysis supposes that a same ranking in the earnings distribution of the father leads to the same inequality of opportunity in 1977 and 1993. However, this hypothesis is questionable. Indeed, the fathers' earnings distribution evolution over the period bears consequences on the inequality of opportunity appraisal. The decreasing earnings inequality over the eighties means that a unchanged ranking in the distribution translates in a less important earnings gap to the mean. Precisely, next sub-section focuses on the gaps to the mean through the cardinal partition.

## 3.4 Cardinal approach : A constant inequality over the period

Graphics B and C on figure 1 represent income distribution of adult-children, conditional on social background defined by the cardinal partitioning of the father earnings. Results of the dominance tests are displayed in table 4. For 1977, a narrowing of the distributions can be observed compared to the ordinal approach. While in the ordinal approach the hierarchy of groups is quite clear, with the cardinal approach the distributions of social background are very close except for (C1) and (C6) displaying a gap with the rest of the sample. The visual differences are confirmed by the tests, since one can conclude six times out of fifteen to equality with the cardinal approach instead of once with the cardinal approach in 1977.

By definition, in 1993, cardinal and ordinal approaches match perfectly and results have already been discussed. We conclude to strong inequality except in the first three groups on the one hand, and the last two groups on the other. With the cardinal approach the number of times we conclude to equality of opportunity goes from 40% to 20% in these comparisons between 1977 and 1993. That is why, instead of concluding to a narrowing of the distributions, this time we conclude to a certain stability or increase in inequality of opportunity. Finally, cardinal and ordinal approaches send a contradictory message. Section 4 and 5 explain this contradiction.

### 3.5 Risk and return of the distributions

Risk is measured by centering distributions around their mean, which is also the Lorenz curve. Mean inequalities between groups are erased. Lorenz dominance tests follow a identical methodology as stochastic dominance tests. Table 5 presents results for the ordinal approach [13]. On the two waves, only one comparison produces a relation of dominance. The rest of the tests conclude to equality in two cases out of three. Differences of risk are weak. It confirms results in Lefranc, Pistolesi and Trannoy (2004) with other French data.

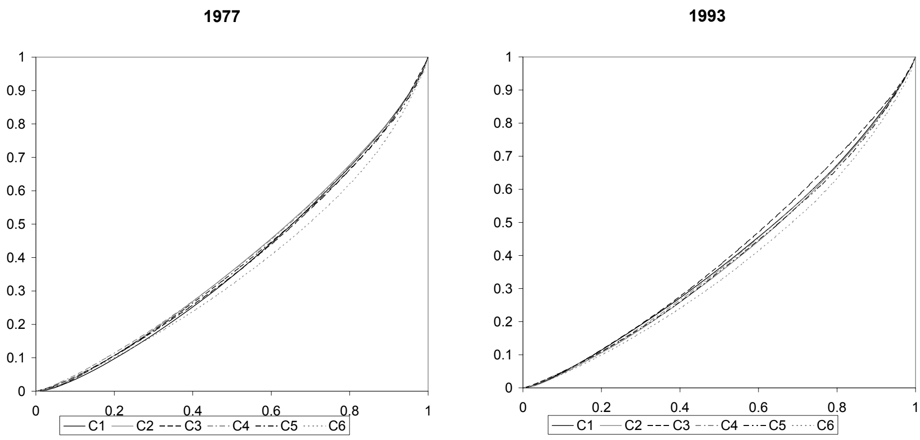



Figure 2: Conditional distribution Lorenz curves

As risks differ only slightly, it is possible to study the evolution of conditional means. Table 6 shows that the mean earnings gap between groups has diminished over the period. With the ordinal approach, mean earnings of more privileged individuals is more than four times superior to mean earnings in 1977. The gap is only three time in 1993, expressing

[13]We obtained similar results for cardinal approach.

Table 5: Lorenz dominance tests

| | 1977 | | | | | | 1993 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C1 | C2 | C3 | C4 | C5 | C6 |
| C1 | - | = | = | = | ? | ? | - | = | = | = | = | ? |
| C2 | - | - | = | < | ? | ? | - | - | ? | = | = | ? |
| C3 | - | - | - | = | = | ? | - | - | - | = | ? | ? |
| C4 | - | - | - | - | = | = | - | - | - | - | = | = |
| C5 | - | - | - | - | - | = | - | - | - | - | - | = |
| C6 | - | - | - | - | - | - | - | - | - | - | - | - |

Equivalent full-time earnings =: Lorenz curves in row and in columns are identical at 5%. >: Lorenz curve in row dominates Lorenz curve in column at 5%.

Table 6: conditional mean earnings evolution

| | Ordinal Approach | | Cardinal approach | |
|---|---|---|---|---|
| (C6)/(C1) | 4.33 | 3.00 | 2.82 | 3.00 |
| (C6)/(C2) | 3.32 | 2.59 | 2.45 | 2.59 |
| (C6)/(C3) | 2.79 | 2.28 | 2.24 | 2.28 |
| (C6)/(C4) | 2.28 | 1.99 | 1.93 | 1.99 |
| (C6)/(C5) | 1.77 | 1.65 | 1.61 | 1.65 |

In 1977, the mean earning of adult-children from (C6) is four times superior to the mean earnings in group (C1).

a decreasing from one third. This decrease confirms the results for disposable income with the data *Budget de Famille*. It is somewhat larger than what was observed between adult-children of workers and higher-grade professionals before taxes and transfers (cf Lefranc *et al.* (2004) table 4 page 70). The decrease in mean gap is decreasing along the income distribution. On the other hand, the cardinal approach provides a different conclusion since the bracket limits are identical: mean income ratios do not change over the period. The opposition of results between the cardinal and ordinal approaches suggests an important research area: Analyzing the role of the degree of inequality of circumstances (which is equal to the outcome inequality in the previous generation) and of the process of transmission of inequality of opportunity and its evolution. Next section develops this analysis.

# 4 Continuous approach: decompositions of inequality of opportunity

We develop here an alternative approach of inequality of opportunity. We use a continuous representation of the inequality transmission process. The goal is to measure inequality of opportunity from an index, and decompose its evolution through regression methods.

Combining regression and a scalar measure of inequality is not an easy task. Usually researchers use the variance of logs well appreciated from econometricians but not from specialists of the measure of inequality. This index can conflict with the Lorenz criterion. It may indicates a decrease in inequality, while the Lorenz curve provides an opposite information (Ok and Foster (1999)). To remain consistent with the beginning of the paper, we choose an index that does not conflict with the Lorenz criterion [14]. Results may depend on the chosen index but they will not contradict what has already been found. Among the most common index[15], entropy inequality indexes (Bourguignon (1979), Cowell (1980), Shorrocks (1983)) present the advantage of being additively decomposable in weighted sum of within terms and between groups inequalities. It has already been underscored that the discrete approach does not consider within group inequalities. The continuous approach enables to measure the importance of this omission and to measure its dynamics.

Regression results on the same data as in Lefranc and Trannoy (2005) enable an analysis of decomposition of inequality of opportunity using a Blinder-Oaxaca technique (1973). We demonstrate that the two decomposition analysis can be implemented using the results of the regression analysis, if one chooses the mean logarithmic deviation among the entropy indexes. This observation is new in the literature on inequality of opportunity, and more generally on the literature on inequality. It represents a methodological contribution of the paper. First we discuss the methodology, then we implement it.

[14]The mean logarithmic deviation is the only index independent of the decomposition step when using the arithmetic mean as representative income, See Foster and Shneyrov (2000).

[15]In Lefranc *et al.* (2005) we propose to measure inequality of opportunity with an extension of the Gini index.

## 4.1 Inequality of opportunity measured by the mean logarithmic deviation

Let $y_{it}^f$ and $y_{it}^p$ be the earnings of individual $i$ and her father at the time $t$, $\overline{y_t^f}, \overline{y_t^p}$, their respective arithmetic means $a_{it}$, the descendant age at $t$ and $\overline{a}_t$ the mean age at $t$.

From logs of earnings centered at their arithmetic mean

$$\widetilde{y}_{it}^f = \log \frac{y_{it}^f}{\overline{y_t^f}} \text{ and } \widetilde{y}_{it}^p = \log \frac{y_{it}^p}{\overline{y_t^p}},$$

Lefranc and Trannoy (2005) have estimated the following linear relation

$$\widetilde{y}_{it}^f = \alpha_t + \beta_t \widetilde{y}_{it}^p + \gamma_t (a_{it} - \overline{a}_t) + \epsilon_{it}, \tag{7}$$

where $\epsilon_{it}$ is a residual of zero mean, non correlated with the explanatory variables, and with finite variance. $\beta_t$ is the intergenerational earnings elasticity.

We define the log earnings centered at the mean age by

$$\widehat{y}_{it}^f = \alpha_t + \beta_t \widetilde{y}_{it}^p + \epsilon_{it} \tag{8}$$

which can still be written

$$\widehat{y}_{it}^f = \widetilde{y}_{it}^f - \gamma_t (a_{it} - \overline{a}_t). \tag{9}$$

Let us use the mean logarithmic deviation to measure inequality among descendants

$$I_t^f = \frac{1}{n} \sum_{i=1}^{n} \log \frac{\overline{y_t^f}}{y_{it}^f} = -\frac{1}{n} \sum_{i=1}^{n} \widetilde{y}_{it}^f. \tag{10}$$

It is immediate to notice that

$$I_t^f = -\frac{1}{n} \sum_{i=1}^{n} \widetilde{y}_{it}^f - \frac{1}{n} \sum_{i=1}^{n} \gamma_t (a_{it} - \overline{a}_t) = -\frac{1}{n} \sum_{i=1}^{n} \widehat{y}_{it}^f$$

Using relation (8), it is possible to write

$$I_t^f = -\alpha_t - \frac{1}{n}\beta_t \sum_{i=1}^{n} \widetilde{y}_{it}^p - \frac{1}{n}\sum_{i=1}^{n} \epsilon_{it} = -\alpha_t - \beta_t \frac{1}{n}\sum_{i=1}^{n} \widetilde{y}_{it}^p$$

Hence

$$I_t^f = -\alpha_t + \beta_t I_t^p \tag{11}$$

Income inequality among descendants measured by the mean logarithmic deviation can be written as a linear affine function of inequalities of circumstances measured by the mean logarithmic deviation among the fathers. The constant $-\alpha_t$ can be interpreted as residual inequality if there were no inequality of circumstances, namely, any parents came from the same group. In that case, this constant is equal to the difference of logs of arithmetic and geometric means.

The linear regression model, joint with the mean logarithmic deviation to measure inequality, leads to a quite simple expression of inequality of opportunity, that is:

$$I_{oppt} = \beta_t I_t^p \tag{12}$$

It is the part of inequality that would remain if the only disparity factor among descendants were their father earnings. It is the product of the intergenerational earnings elasticity and inequality of circumstances. The share of inequality of opportunity in inequality of outcomes is given by $\frac{\beta_t I_t^p}{I_t^f}$[16]. In a stationary regime, it is given by $\beta_t$

This particularly simple expression can naturally be extended to a model with a second circumstance, for example the mother earnings. With obvious notations:

$$\widetilde{y}_{it}^m = \log \frac{y_{it}^m}{\overline{y_t^m}},$$

It would be possible to estimate the relation

$$\widetilde{y}_{it}^f = -\alpha_t + \beta_t^p \widetilde{y}_{it}^p + \beta_t^m \widetilde{y}_{it}^m + \gamma_t (a_{it} - \overline{a}_t) + \epsilon_{it}$$

[16] In the implementation of this formula in our data, father earnings is rather a permanent earnings, while the adult-children earnings is rather a current earnings with a transitory component. The father earnings inequality, as we measured it may likely be smaller than the adult-children earnings inequality. Moreover, the value of the elasticity includes this difference since: $\beta_t = \frac{cov(y_{it}^f, y_{it}^p)}{var(y_{it}^p)}$

One would obtain

$$I_t^f = -\alpha_t + \beta_t^p I_t^p + \beta_t^m I_t^m$$

Inequality is then given by the following formula

$$I_{oppt} = \beta_t^p I_t^p + \beta_t^m I_t^m$$

It can be expressed as a weighted sum of circumstances inequality weighted by the intergenerational elasticities of father and mother earnings.

*Oaxaca decomposition of inequality of opportunity*

Studying the evolution of inequality of opportunity between two dates, formula (12) leads to an easy Blinder-Oaxaca decomposition. Inequality of opportunity varies according two factors, the intergenerational income elasticity and circumstances inequality, that is income inequality among fathers. There is no reason to suppose that the two forces change in the same direction. The first assesses the power of the intergenerational transmission of economic ability, while the second translates the initial conditions disparity. This leads to two parallel decompositions of the evolution of inequality of opportunity between two dates $t$ and $t'$,

$$\Delta I_{oppt} = \Delta\beta_t I_t^p + \Delta I_t^p \beta_{t'} = \Delta\beta_t I_{t'}^p + \Delta I_t^p \beta_t \quad (13)$$

with $\Delta I_{oppt} = I_{oppt} - I_{oppt'}$ and $\Delta\beta_t$ and $\Delta I_t^p$ the corresponding gaps between $t$ and $t'$.

The first terms gives the impact of the change in the elasticity applied to a given constant circumstance inequality, either the initial or the terminal value. The second terms indicates the impact of the change of the circumstance inequality applied to a given elasticity, either the initial value or the terminal one.

Of course the decomposition analysis of inequality of opportunity can be jointly led by a decomposition of the evolution of income inequality among descendants.

$$\Delta I_t^f = \Delta\alpha_t + \Delta I_{oppt}$$

Roemer would interpret the variation in the residual variation as the variation of the result of effort. We do not offer such an interpretation, since the residual term can still recover many parameters with various interpretations: luck, effort, preferences and non-observed circumstances orthogonal to father earnings.

*Within and Between groups decompositions*

One of the advantage of the mean logarithmic deviation is to allow within and between groups inequality decompositions. Here the groups are defined by parental earnings level or quintiles. When circumstance is continuous and linear modeling is adapted to the data, regrouping the data following father earnings groups does not have much meaning. We did it in the first part of the paper with ordinal and cardinal partitions to be able to represent intergenerational transmission processes of risk. However, the partition can lead to a loss of information.

More specifically, descendants belong to one of the groups $j$ from 1 to 6. We know that with logarithmic mean deviation income inequality among descendants can be obtained as a weighted sum by demographic weights of the groups of within and between groups inequalities.

$$I_t^f = \sum_{j=1}^{6} \frac{n_j}{n} I_{jt}^f + \sum_{j=1}^{6} \frac{n_j}{n} \log \frac{\overline{y_t^f}}{\overline{y_{jt}^f}} = I_{Wt}^f + I_{Bt}^f \tag{14}$$

where

$$I_{jt}^f = \frac{1}{n_j} \sum_{i=1}^{n} \log \frac{\overline{y_{jt}^f}}{y_{ijt}^f} = -\frac{1}{n_j} \sum_{i=1}^{n} \widetilde{y}_{it}^f$$

On the other hand, the additive decomposition formula can be applied to inequality of outcomes, that is inequality among fathers.

$$I_t^p = \sum_{j=1}^{6} \frac{n_j}{n} I_{jt}^p + \sum_{j=1}^{6} \frac{n_j}{n} \log \frac{\overline{y_t^p}}{\overline{y_{jt}^p}} = I_{Wt}^p + I_{Bt}^p \tag{15}$$

Thanks to (11) it is possible to write that inequality among descendants is the sum of the residual term of inequality of opportunity within groups and inequality of opportunity between groups.

$$I_t^f = -\alpha_t + \beta_t I_{Wt}^p + \beta_t I_{Bt}^p = -\alpha_t + I_{oppWt} + I_{oppBt} \qquad (16)$$

There is no obvious relation between the two equations (14) and (16). If mean earnings by groups of the fathers are equalized, the third term of (16) cancels. It does not imply that between groups inequality among descendants disappears. If earnings are equalized within each groups of the fathers, the second term of (16) cancels. It does not imply that inequality within groups among the descendants disappears.

In the first part of this paper, we concentrate on between groups inequality $I_{Bt}^f$ identifying it to inequality of opportunity, except that we focused on the full earnings distribution and not just on the conditional mean. We identified within groups inequality$I_{jt}^f$ as the degree of earnings due to risk within group $j$. It is at best a rough estimate, since in reality there are some differences of circumstance within each group producing disparities within the group. The neglected within group inequality is equal to $\beta_t I_{Wt}^p$.

To summarize, the evolution of between group inequality among descendants ($I_{Bt}^f$) must be in agreement with what we found in the first part with the ordinal approach. On the other hand, the evolution of inequality of opportunity $I_{oppt}$ and of its decomposition in within and between-groups inequality can differ from the evolution of ($I_{Bt}^f$). Attention must be paid to that point in our application.

Now, we can still refine the analysis using a Blinder-Oaxaca decomposition of within and between groups inequality of opportunity, that is:

$$\begin{aligned}
\Delta I_{oppWt} &= \Delta\beta_t I_{Wt}^p + \Delta I_{Wt}^p \beta_{t'} = \Delta\beta_t I_{Wt'}^p + \Delta I_{Wt}^p \beta_t \\
\Delta I_{oppBt} &= \Delta\beta_t I_{Bt}^p + \Delta I_{Bt}^p \beta_{t'} = \Delta\beta_t I_{Bt'}^p + \Delta I_{Bt}^p \beta_t
\end{aligned}$$

In that decomposition, the term of changing inequality of circumstance is the most interesting part. It is possible to imagine situations in which inequality of circumstances decreases between groups but not within groups.

## 4.2 Results

Table 7 and 8 display inequality of outcome and inequality of opportunity in 1977 and 1993. Table 7 presents results of the estimation of the intergenerational regression equation (7) and table 8 computes a decomposition from inequality of outcome into inequality of opportunity and residual inequality from the estimates. Two important points must be highlighted for each of the two years. Firstly, inequality of opportunity represents at least one third of outcome inequality: differences of effort or luck play an important part in differences of outcomes between individuals[17]. Secondly, only a fraction of inequality of circumstances ($I_t^p$) is transmitted to the next generation through inequality of opportunity ($I_{opp\ t}$) : this share, around one third, corresponds to the value of the intergenerational earnings elasticity $\beta$. Moreover, the change taking place between 1977 and 1993 leads to a marked decrease in inequality of outcomes ($I_t^f$), around 15%. Besides, the drop in inequality of outcomes comes only from a decrease in inequality of opportunity $I_{opp}$. Equality of opportunity decreases by about 30% during the period. On the contrary, the parameter $\alpha$, measuring the residual inequality, is remarkably stable between the two dates and table 7 indicates that the difference between the two dates is not statistically significant. The reasons why such decrease has taken place must be studied.

Two factors determining inequality of opportunity have changed in opposite directions: a sharp drop in inequality of circumstance around 40 % in table 8 and an increase in the intergenerational earnings elasticity from 0.35 to 0.4 (table 7). The Blinder-Oaxaca decomposition in equation 13 measures what would have been the change in inequality of opportunity if only one of the factors would have been modified. Results are given in table 9. If inequality of circumstances would have stayed identical during the period, one would have observed an increase in inequality of opportunity due to the increase in $\beta$. Taking into account the change in the value of $\beta$, the increase in inequality of opportunity would have been around 10 to 15%.[18]. On the contrary, if $\beta$ would have

[17] However, outcome inequality is computed for individual annual earnings, which includes one important part of transitory component. Permanent income would include a larger share of inequality of opportunity in inequality of outcome.

[18] The table indicates that an evolution in opposite direction would have been observed. Its importance represents between 29% to 51% of the observed evolution of inequality of opportunity. In addition, the observed evolution is the decrease around 30% of inequality of opportunity.

Table 7: Intergenerational earnings regression

| | |
|---|---|
| $\gamma$ | .0163 |
| | (.0026) |
| $\beta_{77}$ | .3488 |
| | (.0225) |
| $\beta_{93}$ | .4064 |
| | (.0359) |
| $\alpha_{77}$ | -.0576 |
| | (.0107) |
| $\alpha_{93}$ | -.0568 |
| | (.0123) |
| Observations | 3754 |
| R-squared | 0.1490 |

Note : explanatory variables: equivalent full-time annual earnings. Estimated model corresponds to intergenerational equation (7). Model estimated from main samples in 1977 and 1993 stacked together.

Table 8: Total inequality and inequality of opportunity in 1977 and 1993

| $t$ | $I_t^f$ | $I_t^p$ | $-\alpha_t$ | $I_{opp\ t}$ | $I_{opp\ t}/I_t^f$ |
|---|---|---|---|---|---|
| 1977 (1) | .1006 | .1233 | .0576 | .0430 | .4275 |
| 1993 (2) | .0860 | .0716 | .0568 | .0291 | .3386 |
| (2)-(1) | -.0146 | -.0516 | -.0007 | -.0139 | -.0889 |

Table 9: Oaxaca-Blinder decomposition of the evolution of inequality of opportunity between 1977 and 1993

| $t$ | $\Delta I_{opp\ t}$ | $\Delta\beta_t I_t^p$ | $\beta_{t'}\Delta I_t^p$ | $\frac{\Delta\beta_t I_t^p}{\Delta I_{opp\ t}}$ | $\frac{\beta_{t'}\Delta I_t^p}{\Delta I_{opp\ t}}$ |
|---|---|---|---|---|---|
| | | Total inequality of opportunity ($I_{opp\ t}$) | | | |
| 1993 | 0.0139 | -0.0041 | 0.0180 | -0.2965 | 1.2965 |
| 1977 | 0.0139 | -0.0071 | 0.0210 | -0.5106 | 1.5106 |
| | | Between groups inequality of opportunity ($I_{oppB\ t}$) | | | |
| 1993 | 0.0128 | -0.0039 | 0.0167 | -0.3043 | 1.3043 |
| 1977 | 0.0128 | -0.0067 | 0.0195 | -0.5197 | 1.5197 |
| | | Within groups inequality of opportunity ($I_{oppW\ t}$) | | | |
| 1993 | 0.0011 | -0.0002 | 0.0013 | -0.2097 | 1.2097 |
| 1977 | 0.0011 | -0.0004 | 0.0015 | -0.4094 | 1.4094 |

stayed identical, one would have observed a larger decrease in inequality of opportunity from one third to one half of the one observed. That is, a decrease around 40% to 45% of inequality of opportunity should have been observed, instead of the real 30%. The decrease in inequality of opportunity observed between 1977 and 1993 comes completely (and even more) from a decrease in inequality of circumstances and not in any case for a weakening link between parental and descendants earnings. On the contrary, the link seems to reinforce even one must remain careful, since differences in $\beta$ values between 1977 and 1993 are not statistically significant. In other words, the partial earnings equalization within the descendant generation between the two dates comes only from the earnings equalization within the fathers'generation between these two dates, and not from a weaker social determinism.

The analysis can be refined with a decomposition of the components of the evolution of inequality of opportunity (table 9), using the ordinal partition of the first section. Results concerning the contribution of the intergenerational elasticity and the inequality of circumstances to the evolution of the inequality of opportunity can be retrieved from distinguishing inequality of opportunity between and within groups. In fact inequalities of opportunity within and between groups evolve symmetrically under the (opposite) influence of the same causes: Increase in the elasticity and decrease of inequality of circumstances.

The previous results from the continuous model of intergenerational transmission of inequality can be linked to the results of section 3 with the discrete approach. They enlighten the apparent contradictory conclusions of the cardinal and ordinal partitions of social background. We have seen that, when we follow an ordinal partition, inequality of opportunity diminishes, that is not the case when one uses a cardinal partition. The Blinder-Oaxaca decomposition enables to explain this opposition. By definition, the ordinal partition is affected by the decrease in $I_t^p$ : It brings closer the different social groups of origin. Everything else constant, one would expect the distributions to get closer with this partition. On the contrary, the cardinal partition is not really affected by the decrease in $I_t^p$, since the limits of the social groups are defined by the earnings in proportion to the mean. If we do not take into account the changes in the distribution within each group, a decrease in $I_t^p$ should let unchanged the inequality between the groups defined with the cardinal partition. Everything else constant, on should not observe any narrowing of the earnings distributions with this partition. Moreover, if the transmission of inequality from one generation to the next gets larger ($\beta$ increases), the cardinal partition must display a widening of the conditional distributions. It is effectively what we observe.

The parallel between continuous and discrete approaches is not perfect. It has already been stressed that the discrete approach leads to erase any inequality of circumstances within each group of origin. Table 10 presents a decomposition of inequality between within and between groups inequality. It enables to quantify the size of this "neglect ". Ignoring within group inequality leads to rather minor differences. Composing a discrete partition of the social origins enables to grasp the major part of inequality of circumstances: inequality between groups (it would be observed if circumstances within each group were identical) represents nearly 95% of inequality of circumstances. This part tends to increase over the period. It has translated a sharper decrease in within groups than in between groups inequality of circumstances (a decrease of 42% against 31%). On the contrary, inequality of outcomes cannot be summarized only by the between groups term: The major part of inequality of outcomes comes from the within group term. In particular, residual inequality is mainly a part of it, and considering its stability, it is not surprising to witness a very moderate decrease in within groups inequality of outcome.

Table 10: Between and within groups - inequality of outcome and inequality of opportunity decomposition in 1977 and 1993

| $t$ | $I_t^p$ | $I_{Bt}^p$ | $I_{Wt}^p$ | $I_t^f$ | $I_{Bt}^f$ | $I_{Wt}^f$ |
|---|---|---|---|---|---|---|
| 1977 | 0.1233 | 0.1158 | 0.0075 | 0.1006 | 0.0162 | 0.0844 |
| 1993 | 0.0717 | 0.0678 | 0.0038 | 0.0860 | 0.0127 | 0.0733 |

The difference in the role of the between groups inequality component according to inequality of opportunity and inequality of outcome is by no means surprising. The partition by origin groups is defined from a continuous variable of circumstance. The partition does capture a large share of inequality of opportunity. On the opposite, the same conclusion does not hold for inequality of outcomes. It is only partly linked to circumstances, it also depends on the effort or luck components.

# 5 Conclusion

The difference of results obtained with the dominance approach between an ordinal (decrease in inequality of opportunity) or cardinal (relative stability) definition of circumstances are illuminated by the results of the continuous model.

A cardinal partition of the fathers earnings distribution removes any possible effect of a change in earnings inequality in that generation on the following generation. The only source of inequality of opportunity comes from the ability transmission to generate economic success. In the continuous model, it is measured by the intergenerational earnings elasticity which at best is stable over the studied period.

On the other hand, partitioning the father earnings according to their ranking makes it possible an impact of a change in inequality of circumstances on descendants' earnings. The drop in inequality of opportunity with an ordinal partition of the circumstances comes from the decrease in income inequality among fathers observed in the continuous approach.

Those results enlighten the differences of results obtained in two previous articles. In Lefranc *et al.* (2004), we concluded that inequality of opportunity conditioning on social groups has decreased. In Lefranc *et al.* (2005) we concluded that it is more or less constant on the premices of the stability of the value of the intergenerational earnings elasticity.

The difference could have come from different conditioning. Earnings are a much richer conditioning than social class. Moreover, the social groups conditioning is not constant to the changing structure of jobs over time: for example, the proportion of higher-grade professionals keeps increasing, and farming keeps declining. Now we can advance a different explanation. The major difference in the results of these two articles came from the fact that they did not focus on the same subject: inequality of opportunity in Lefranc *et al.* (2004) and the transmission to generate earnings in Lefranc *et al.* (2005). Usually, the literature on intergenerational mobility concentrates on the value of the elasticity: it is the value of interest in a stationary regime. However, the period between 1977 and 1993 cannot be considered as a period of constant inequality. This period has displayed a contraction of earnings spread among fathers.

These results lead to a political economic dilemma for ethics based on equality of opportunity. Decreasing inequality of outcome among descendants has two effects. On the one hand, it can be interpreted as a decrease in inequality of circumstances and it diminishes inequality of opportunity for the following generation. Ethics of responsibility advocates such a policy. On the other hand for the previous generation a policy lowering inequality of outcome would translate in a weaker return to effort. For the philosophers on responsibility, such a policy can only have ambiguous effects: negative for the present generation, and positive for the following generation. These philosophers would advocate a policy aiming at diminishing the intergenerational earnings elasticity.

According to the advocates of equality of outcome such a policy presents a double dividend: a decrease in inequality of outcome for the present generation, and a decrease in inequality of opportunity for the following generation. Moreover, the latter would translate in a diminishing inequality of outcomes for the same generation. Such a policy of reducing inequality of outcome for a given generation may impact on the inequality of their children, but either on their grand children. To that extent, it would be interesting to extend the analysis with the 2003 FQP data.

For methodological purposes, the linearity hypothesis in the intergenerational transmission of earnings must be considered as a first proxy. The elasticity can change along the income distribution, as in Corak and Heisz (1999) on Canadian data. With our data, first tests indicates that the value of the elasticity differ by groups. The non linearities[19] enable to use a Oaxaca decomposition of the within-group inequality for the descendants earnings and to bear a finer appraisal on the reasons for the evolution of inequality of opportunity.

## References


Benabou, R. et Ok, S. (2001). Ranking income processes according to equality of opportunity. NBER WP 8431.

Birnbaum, M. et Navarette, J. (1998). Testing descriptive utility theories: Violations of stochastic dominance and cumulative independance, *Journal of Risk and Uncertainty* **17**: 49–78.

Bourguignon, F. (1979). Decomposable income inequality measures, *Econometrica* **47**(4): 901–920.

Chew, S. et Mao, M. (1995). A schur concave characterization of risk aversion fir non-expected utility preferences, *Journal of Economic Theory* **67**(2): 402–435.

Corak, M. et Heisz, A. (1999). The intergenerational earnings and income mobility of canadian men: evidence from longitudinal income tax data, *Journal of Human Resources* **84**(3): 504–533.

Cowell, F. (1980). On the structure of additive inequality measures, *Review of Economic Studies* **52**: 521–531.

Dardanoni, V., Fields, G. S., Roemer, J. et Sanchez-Puerta, M. L. (2005). How demanding should equality of opportunity be, and how much have we achieved?, *in* S. Morgan, D. Grusky et G. Fields (eds), *Mobility and Inequality: Frontiers of Reasearch in Sociology and Economics*, Stanford University Press, Stanford.

Erikson, R. et Goldthrope, John, H. (1992). *The Constant Flux; A Study of Class Mobility in Industrial Societies*, Clarendon Press, Oxford.

Foster, J. et Shneyerov, A. (2000). Path independent inequality measures, *Journal of Economic Theory* **91**: 199–222.

Lefranc, A., Pistolesi, N. et Trannoy, A. (2004). Le revenu selon l'origine sociale, *Economie et statistique* **371**: 49–82.

Lefranc, A., Pistolesi, N. et Trannoy, A. (2005). Inequalities of outcome vs inequalities of opportunities: are all western societies alike? Mimeo THEMA.

Lefranc, A., Pistolesi, N. et Trannoy, A. (2006). Equality of opportunity: Definitions and testable conditions, with an application to income in france. Mimeo THEMA.

Lefranc, A. et Trannoy, A. (2005). Intergenerational earnings mobility in France: Is France more mobile than the US?, *Annales d'économie et de statistique* **78**.


[19]See O'Neill *et al.* (2000) for an analysis of nonlinearities for a study on opportunity sets.

Machina, M. (1982). Expected utility analysis without the independence axiom, *Econometrica* **50**(2): 277–324.

Martinez, P., Schokkaert, E. et Van de Gaer, D. (2001). Three meanings of intergenerational mobility, *Economica* **68**: 519–537.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets, *International Economic Review* **14**: 693–709.

Ok, E. A. et Foster, J. E. (1999). Lorenz dominance and the variance of logarithms, *Econometrica* **67**: 901–908.

O'Neil, D., Sweetman, O. et Van de Gaer, D. (2000). Equality of opportunity and kernel density estimation: an application to intergenerational mobility, *in* T. Fomby et C. R. Hill (eds), *Advances in Econometrics: Applying Kernel and Nonparametric Estimation to Economic Topics*, Vol. 14, Elsevier Science, Oxford, pp. 259–274.

Roemer, J. (2004). Going beyond intergenerational income transition matrices, *in* M. Corak (ed.), *Generational Income Mobility in North America and Europe*, Cambridge University Press.

Shorrocks, A. F. (1983). Ranking income distributions, *Economica* **50**: 3–17.

Starmer, C. (2000). Developments in non-expected utility theory: the hunt for a descriptive theory of choice under risk, *Journal of Economic Litterature* **38**(2): 332–382.

Van De Gaer, D. (1993). *Equality of Opportunity and Investment in Human Capital*, PhD thesis, K.U. Leuven.

# Annexe

Table 11: Earnings equation predicting the father earnings

| | 1977 | 1970 | 1964 |
|---|---|---|---|
| age | 0.085 | -0.020 | -0.004 |
| | (0.028) | (0.027) | (0.039) |
| $age^2$ | -0.001 | 0.000 | -0.000 |
| | (0.000) | (0.000) | (0.000) |
| educ- > bac | 0.472 | 0.447 | 0.448 |
| | (0.028) | (0.025) | (0.048) |
| educ- bac gal | 0.332 | 0.389 | 0.319 |
| | (0.039) | (0.033) | (0.043) |
| educ- bac tec | 0.338 | 0.285 | 0.324 |
| | (0.050) | (0.045) | (0.120) |
| educ- br.prof | 0.311 | 0.233 | 0.394 |
| | (0.027) | (0.030) | (0.055) |
| educ- cap | 0.166 | 0.169 | 0.160 |
| | (0.017) | (0.018) | (0.025) |
| educ- brc | 0.230 | 0.216 | 0.232 |
| | (0.034) | (0.031) | (0.044) |
| educ- cep | 0.111 | 0.112 | 0.108 |
| | (0.016) | (0.014) | (0.018) |
| eg- II | -0.365 | -0.407 | -0.414 |
| | (0.025) | (0.025) | (0.036) |
| eg- IIIa | -0.598 | -0.629 | -0.908 |
| | (0.030) | (0.026) | (0.041) |
| eg- IIIb | -0.701 | -0.760 | -0.830 |
| | (0.035) | (0.034) | (0.047) |
| eg- V | -0.415 | -0.446 | -0.417 |
| | (0.025) | (0.024) | (0.039) |
| eg- VI | -0.651 | -0.738 | -0.736 |
| | (0.024) | (0.022) | (0.034) |
| eg- VIIa | -0.783 | -0.932 | -0.973 |
| | (0.025) | (0.023) | (0.036) |
| eg- VIIb | -0.891 | -1.176 | -1.192 |
| | (0.043) | (0.036) | (0.044) |
| IdF | 0.126 | 0.209 | 0.277 |
| | (0.014) | (0.013) | (0.022) |
| Pub | -0.033 | -0.026 | 0.041 |
| | (0.015) | (0.014) | (0.018) |
| Rural | -0.033 | -0.087 | -0.115 |
| | (0.014) | (0.014) | (0.020) |
| Constant | 8.983 | 10.718 | 9.985 |
| | (0.640) | (0.629) | (0.973) |
| Observations | 4657 | 5304 | 2364 |
| R-squared | 0.50 | 0.58 | |

Notes : explained variable: log of annual earnings. Standard-errors in parentheses . Explanatory variables :**Education level** : no diploma (ref.); cep - certificat d'études primaires; brc - brevet des collèges; cap - certificat d'aptitude professionnelle; br.prof - brevet professionnel; bac tec - baccalauréat technique; bac gal - baccalauréat général ; > bac - diplôme de l'enseignement supérieur;

**Social group** : I (ref.)- Higher-grad prof.; II Lower-grade Prof., technicans (superior level); IIIa - Clerks (superior level); IIIb - Clerks (inferior level); V - technicians (inferior level) foremen; VI - Qualified Workers; VIIa - Non qualified workers, without farming; VIIb - farming workers ;

**autres**: IdF - dummy Ile de France; Pub - State owned compagny; rural - Living in the country.