The empirical assessment of (in)equality of opportunity and intergenerational income mobility

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Introduction : Objectives

Topic of the talk : how can the theoretical work be used to empirically assess equality of opportunity

- motivations
- here "real" and not "theoretical" applications
- partial overlap / complementarity with Vito's presentation

Focus

- discuss empirical issues : main problem is the observability of the determinants of individual outcomes
- offer a more complete framework : three determinants
- approach taken :
  - endorse the compensation principle but is agnostic wrt to the reward of responsibility factors
  - conditional equality perspective
  - ex ante
- one empirical example : equality of opportunity for income acquisition in France

Introduction (ctd)

Empirical application : equality of income distribution, conditional on circumstances

- circumstances measured by social origin and also parental income
- empirical application is at the intersection of two strands of literature : equality of opportunity and intergenerational income mobility

Equality of opportunity vs. intergenerational income mobility

- common starting point : immobility as lack of equality of opportunity
- common emphasis on the determinants of observed in equality
- perspective is markedly different

Introduction (ctd)

Equality of opportunity

- partitioning of the determinants into two sets (C and R) where the partitioning criteria is derived from moral principles or social or political decision
- aim at providing a full account of the share of C and R in total inequality. Concern for "how much" rather than "how".
- Key tool : decomposition analysis

Intergenerational earnings mobility

- Full list of potential inequality transmission mechanisms. Key opposition is btw market failure and competitive advantage.
- Aim at estimating causal effects.
- Key tool : IV / natural experiments

Outline of the lecture

1. Introduction
2. Empirical issues in the assessment of inequality of opportunity
   - Characterizing equality of opportunity
   - Dealing with partial observability of the determinants of outcomes
3. Assessing equality of opportunity based on discrete partitioning : social origin and income
   - Empirical strategy and tests
   - Results
4. From discrete to continuous : parental income and opportunities for income acquisition
   - Discrete approach conditioning on income classes
   - Intergenerational regression
   - Regression based inequality of opportunity index and decomposition

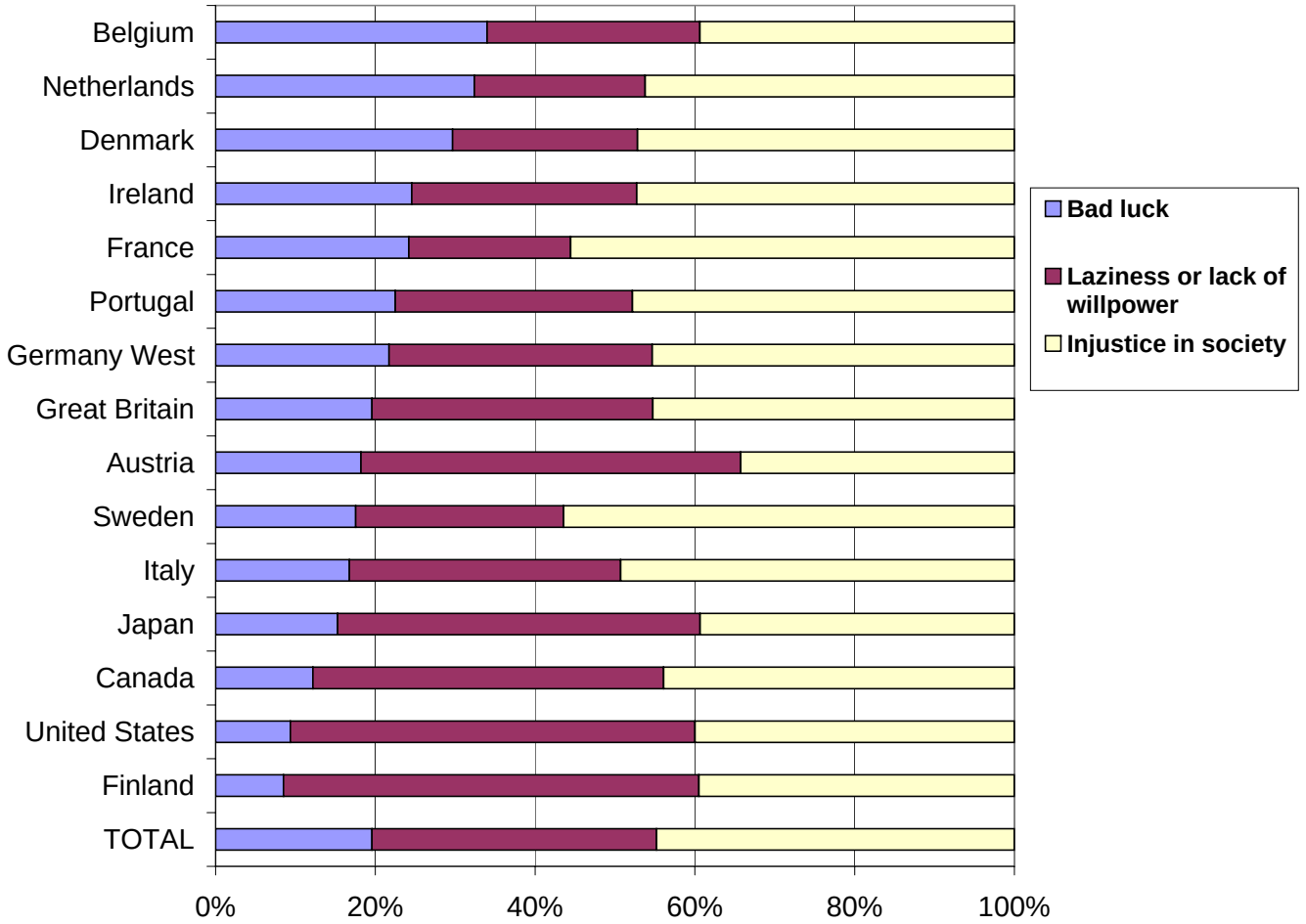
Joint work with Nicolas Pistolesi and Alain Trannoy

Determinants of individual outcomes

- Diversity of determinants of individual outcomes (e.g. health, income, welfare) : individual choices and investments, "inherited" advantage (economic, social, cultural), random factors (good or bad luck, people we met - e.g. marriage market).
- Dichotomic view : circumstances vs. effort
  - Cohen (1989) : "*eliminate involuntary disadvantage, i.e. disadvantage for which the sufferer cannot be held responsible, since it does not appropriately reflect choices that he has made*"
  - Roemer : effort is pretty much everything that lies outside circumstances
- Dichotomic view stands at odd with public perceptions of inequality and some theoretical views (e.g. option luck).

Determinants of individual outcomes

Figure: Beliefs in the role of luck, effort and social injustice in bad economic outcomes



Source : World Values Survey (1990). Answers to the question : "*Why are there people living in need ?*".

Determinants of individual outcomes (ctd)

Claim : three sets of determinants of individual outcomes should be distinguished :

- circumstances : the non-responsibility factors that are not considered a legitimate source of inequality; a type denotes the set of individuals who have similar circumstances.
- effort : the determinants of outcome that pertain to individual responsibility and/or are seen as a legitimate source of inequality;
- luck : the non-responsibility factors that are seen as a legitimate source of inequality as long as they affect individual outcomes in a neutral way, given circumstances and effort.

Note : these should be understood in a generic sense.

Definitions

Notations

- y : individual outcome
- F : the CDF of outcome
- $y = Y(c, e, l)$
  - c : circumstances
  - e : effort
  - l : luck

Principle

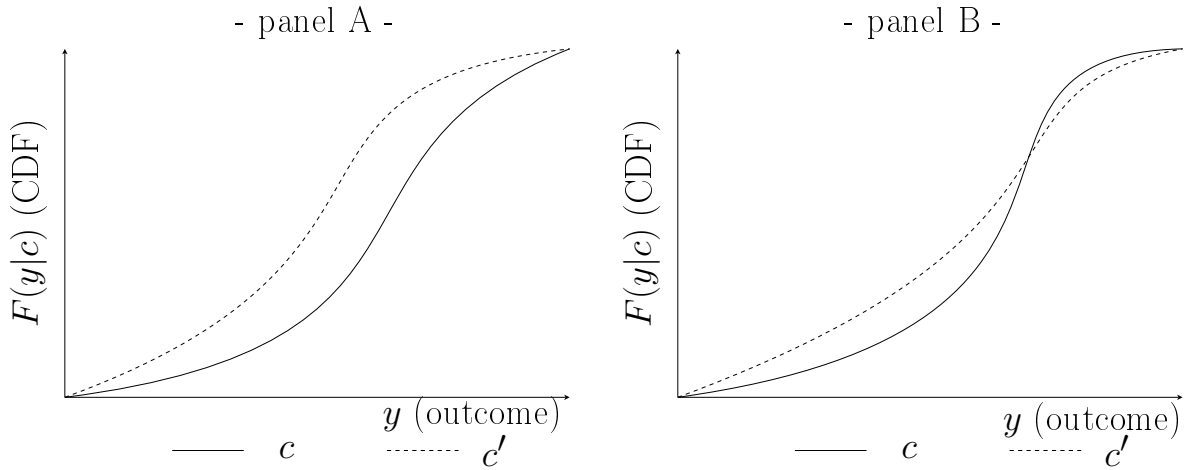
- Equality of opportunity is satisfied if, given effort, no one is put at an advantage or disadvantage because of her circumstances
- Question : how to define advantage and the lack thereof ?
  - given effort and circumstances, luck determines the income distribution that individual are offered.
  - assessing advantages requires to compare those conditional income distributions $F(y|c, e)$ for different values of c and e.

Definition 1 : strong equality of opportunity (EOP-S)

Definition (EOP-S)

Equality of opportunity is satisfied iff :
$\forall e \forall (c, c'), \quad F(y|c, e) = F(y|c', e)$.

- Interpretation : circumstances do not influence outcome prospects; luck is even-handed w.r.t circumstances
- Very stringent requirement ; probably rarely met in practice. Are those situation where the CDF are not equal equally bad ?
- Two generic cases can occur when EOP-S is not satisfied:



Definition 2 : weak equality of opportunity (EOP-W)

Definition (EOP-W)

Weak quality of opportunity is satisfied iff :
$\forall e \forall c \neq c', \quad F(.|c,e) \not\succ_{SSD} F(.|c',e)$.
where $\succ_{SSD}$ denotes 2nd order stochastic dominance

- Interpretation : given effort, no set of circumstances is unanimously preferred
- Second-order stochastic dominance implicitly assumes risk aversion. It can be relaxed at the cost of a more partial ranking criterion.

Partial observability of the determinants of outcomes

- Substantively defining what should count as circumstances or as effort is a contentious issue
- Theoretically several partially conflicting ethical principles can be invoked
- In practive, people's perception may vary :
  - Attempts at eliciting people's equity judgments
  - Dependency on individual success or outcomes
- Here, I assume away this problem by considering that what should count as circumstances, effort and luck has been defined, as in Roemer, *"by society"*
- Different from the approach taken in Roemer (2004) and Dardanoni, Fields, Roemer, and Sanchez Puerta (2005)

Partial observability of the determinants of outcomes (ctd)

- Once these determinants are defined, assessing whether EOP-S or EOP-W is satisfied requires, in general that both circumstances and effort be observable.
- In the sequel, I consider that part of the determinants of outcomes are unobserved, which seems the most empirically relevant situation
- Big empirical issue is : how to devise implementation criteria in order to test whether EOP is satisfied or not in these situations ?

Unobservability of effort

- If effort is not observed we can only analyze : $F(y|c) = \int_e F(y|c,e)dG(e|c)$
- Can equality of opportunity be assessed in this case ?
  - It depends on the property of $G(e|c)$
  - No : in general
  - Yes : if e is distributed independently of c

Definition (Implementation criterion (IC1))

IC1 is satisfied iff : $\forall(c,c'), \quad F(y|c) = F(y|c')$.

Proposition : If e is distributed independently of c, IC1 is a necessary condition for EOP-S.

- EOP-S requires that outcome prospects, given effort, are similar for all types.
- If this is true and if effort is independent of type, by aggregation over effort, the distribution of outcome should be the same for all types, without conditioning on effort.

Unobservability of effort (ctd)

- Weak equality of opportunity is harder to assess without observing effort : Averaging inequalities over effort levels does not work.
- Special case : *strong inequality of opportunity*.
  - Case where for all effort levels, the outcome distribution for some circumstances c dominates the outcome distribution for some circumstances c'.
  - Under the independence of effort, this case implies that the outcome distribution conditional on c alone will dominate the outcome distribution conditional on c'.

Definition (Implementation criterion (IC2))

IC2 is satisfied iff : $\forall c \neq c', \quad F(.|c) \not\succ_{SSD} F(.|c')$.

Proposition : IC2 is a sufficient condition for avoiding strong inequality of opportunity

Making sense of the independence assumption

- The assumption that effort is independent of circumstances is more than an empirical claim. It can be interpreted as a requirement of equality of opportunity.
  - By definition, individuals are responsible for effort but not for circumstances. The case where effort is correlated with circumstances appears, from the point of view of EOP as an inconsistent definition of effort.
  - Alternative view : define EOP conditional on the relative degree of effort in each type
- This view of effort is not consistent with all conceptions of equality of opportunity : Barry's asian student counter-exemple
- The only way out of the independence assumption is to observe effort : Bourguignon, Ferreira, Menendez (2007), Pistolesi (2008)

Special case - Roemer's model

- Special case with only two determinants : circumstances of effort
- Assumptions :
  - The distribution of e is independent of c
  - Outcome y is an increasing function e
- Consequence : individuals who sit at the same rank in the distribution of outcome conditional on their circumstances have similar effort.
  $\Rightarrow$ allows to recover the unobservable effort

Proposition : Under these assumptions IC1 is a necessary and sufficient condition for equality of opportunity.

Difference btw the full model and the Roemer model

- In Roemer, once circumstances have been defined, the only thing left is effort. Not in the full model.
- Raises difficulties for assessing EOP.
- Also a concern for the "tranche approach". Effort cannot be deducted from (outcome, circumstances) so it needs to be directly defined and observed.
- The variety of factors that make up luck is unlikely to be observed in empirical application.
- Residual view of luck : everything outside circumstances and effort. So observing luck requires that the other two factors be observed.

Partial observability of circumstances

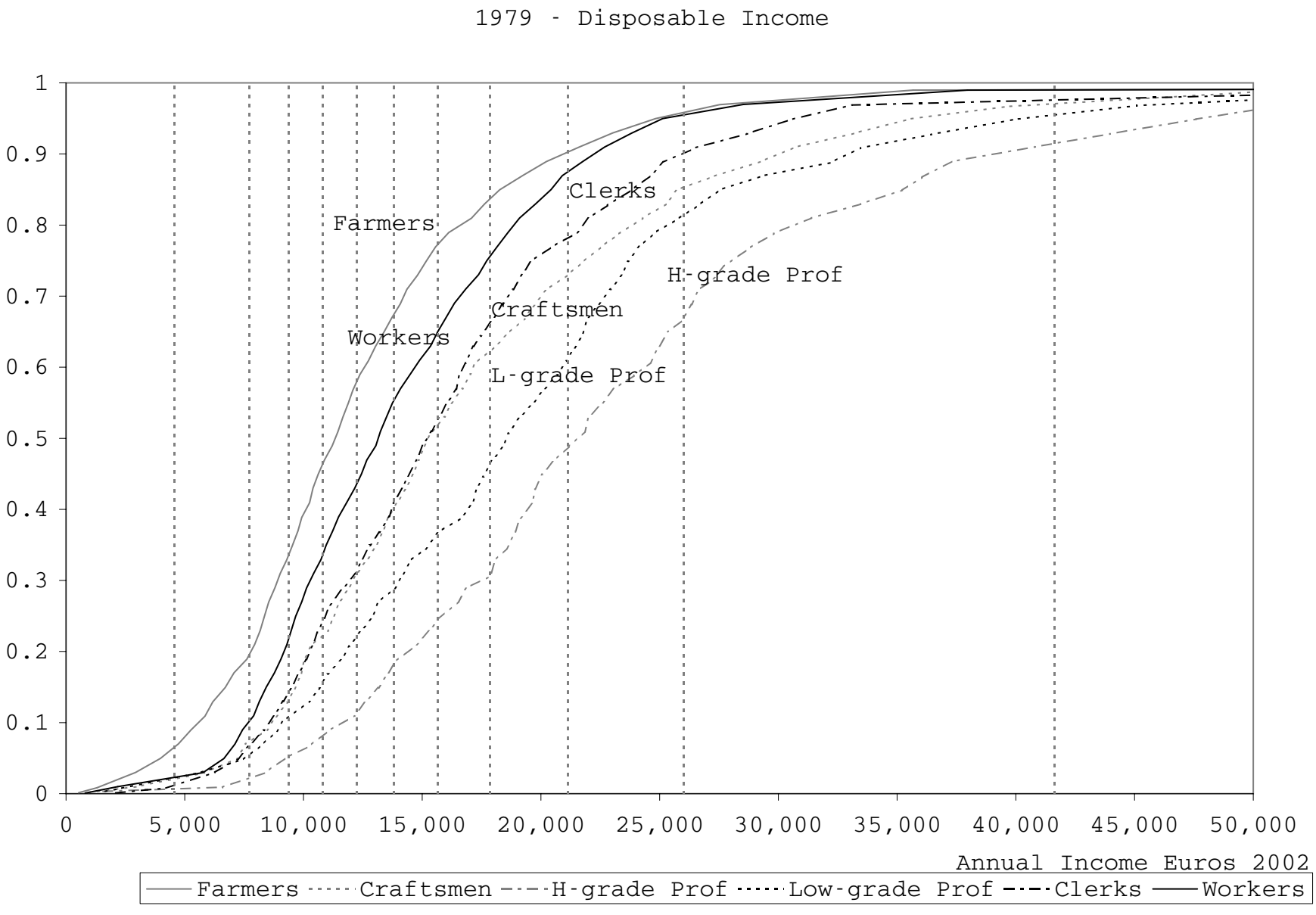
- $c = \{c_1, c_2\}$ and we can only observe c_1
- Can we assess EOP-S ?
  - Under the independence of effort, a necessary condition is : $\forall (c_1, c_1'), \quad F(y|c_1) = F(y|c_1')$
  - This does not require that c_1 and c_2 be independent.
- Can we assess EOP-W ?
  - Special case : super strong inequality of opportunity (SSIOP) $\forall (c_2, c_2') \quad \forall e, \quad F(y|c_1, c_2, e) \succ_{SSD} F(y|c_1', c_2', e)$
  - Under the independence of effort, a sufficient condition to avoid SSIOP is : $\forall (c_1, c_1'), \quad F(|c_1) \not\succ_{SSD} F(|c_1')$

Data

- French household surveys (Budgets des familles), 1979-2000.
- Outcome variable : family income (disposable and primary) adjusted for family size
- Circumstances : social origin (one digit occupation of the head of household).
  - Usually considered as a good candidate for circumstances
  - Limit : too large a set of circumstances (Roemer, 2004)
  - 6 groups of social origin : children of farmers, small proprietors and artisans, higher-grade professionals, lower-grade professionals, non-manual workers, manual workers. (min type size $\simeq 300$)

Methodology

- estimation of the income distribution function, conditional on social origin
- statistical tests of equality of these distributions and stochastic dominance
- tests are performed at k fixed values of the income range (we use k=10 and 20)
- non-parametric tests developed by Davidson and Duclos (2000) and Beach and Davidson (1983)
- the k constraint are tested simultaneously.


1979 - Disposable Income
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
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0.1
0
Farmers
Clerks
H-grade Prof
Craftsmen
Workers
L-grade Prof
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5,000
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Annual Income Euros 2002
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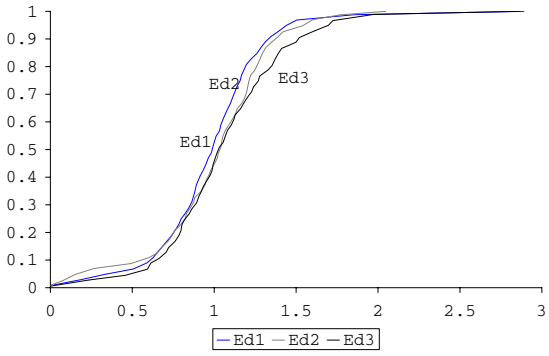
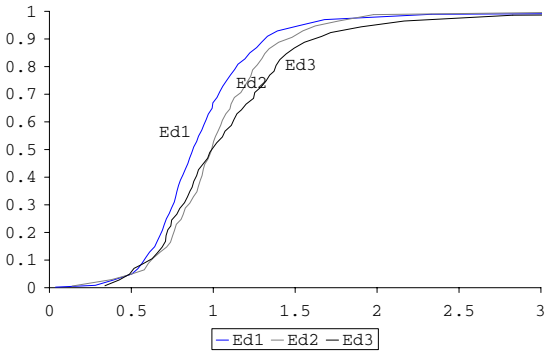
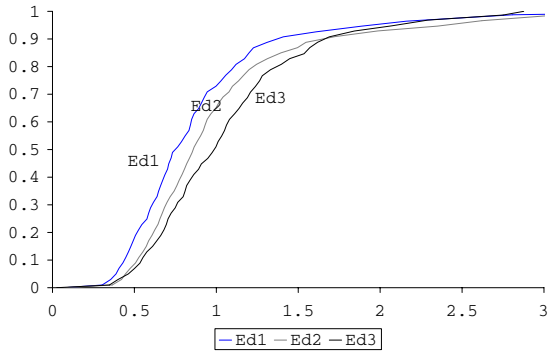
Sweden: Disposable Income



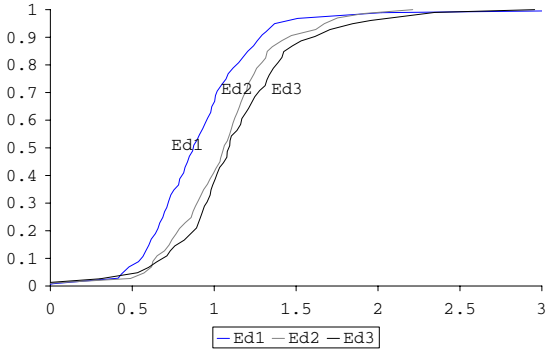
Norway: Disposable Income



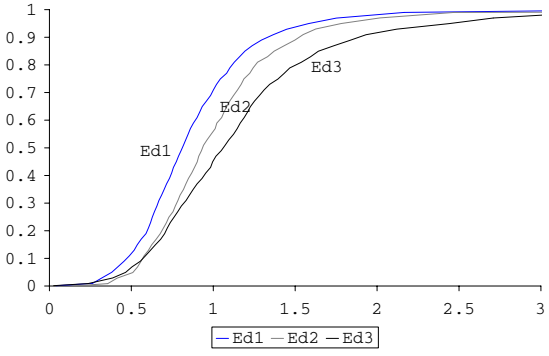
Netherlands: Disposable Income



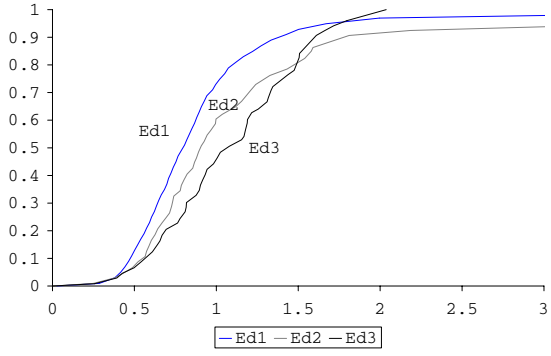
Belgium: Disposable Income



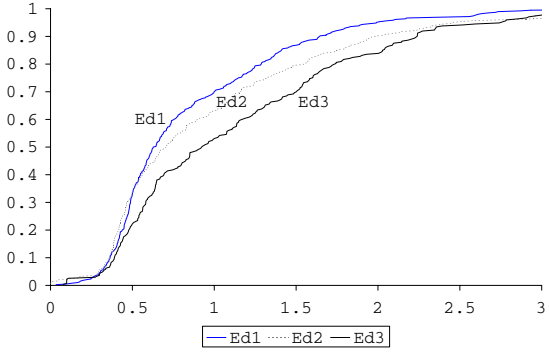
France: Disposable Income



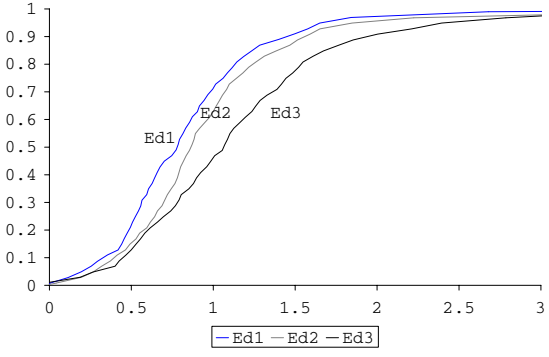
West-Germany: Disposable Income



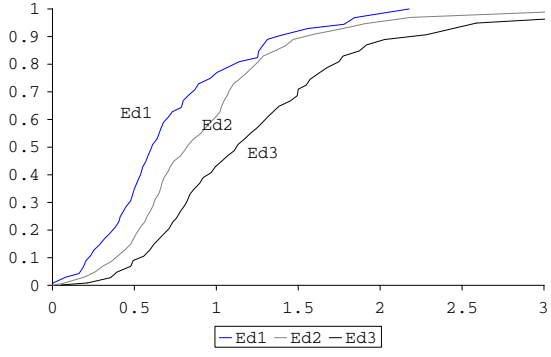
Great-Britain: Disposable Income



USA: Disposable Income



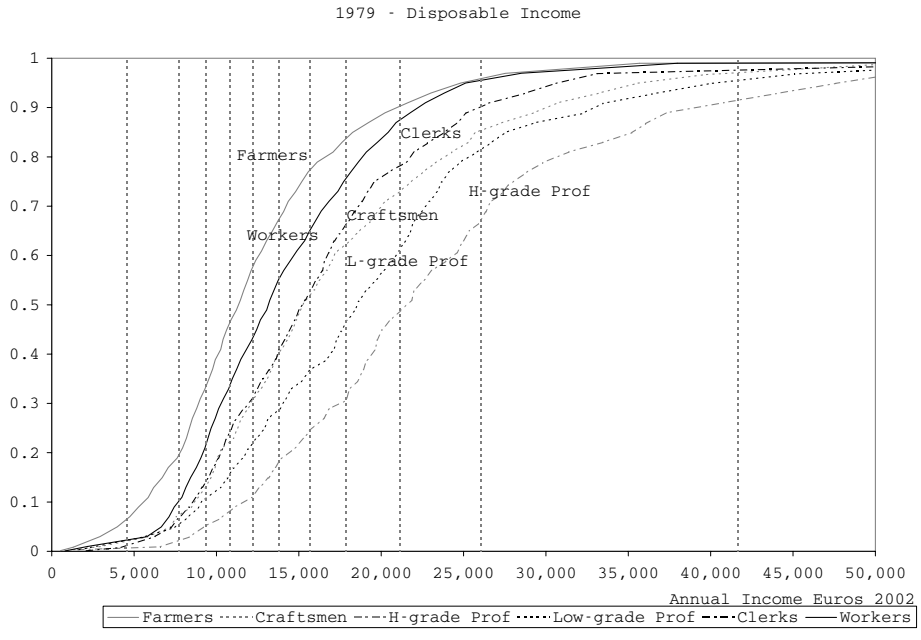
Italy: Disposable Income



Stochastic dominance tests

1979	Farmers	Craftsmen	H-grade Prof.	L-grade Prof.	Clerks	Workers
Farmers	-	$<_1$	$<_1$	$<_1$	$<_1$	$<_1$
Craftsmen	-	-	$<_1$	$<_1$	$=$	$>_1$
H-grade Prof.	-	-	-	$>_1$	$>_1$	$>_1$
L-grade Prof.	-	-	-	-	$>_1$	$>_1$
Clerks	-	-	-	-	-	$>_1$
Workers	-	-	-	-	-	-

2000	Farmers	Craftsmen	H-grade Prof.	L-grade Prof.	Clerks	Workers
Farmers	-	$<_1$	$<_1$	$<_1$	?	$>_1$
Craftsmen	-	-	$<_1$	$=$	$>_1$	$>_1$
H-grade Prof.	-	-	-	$>_1$	$>_1$	$>_1$
L-grade Prof.	-	-	-	-	$>_1$	$>_1$
Clerks	-	-	-	-	-	$>_1$
Workers	-	-	-	-	-	-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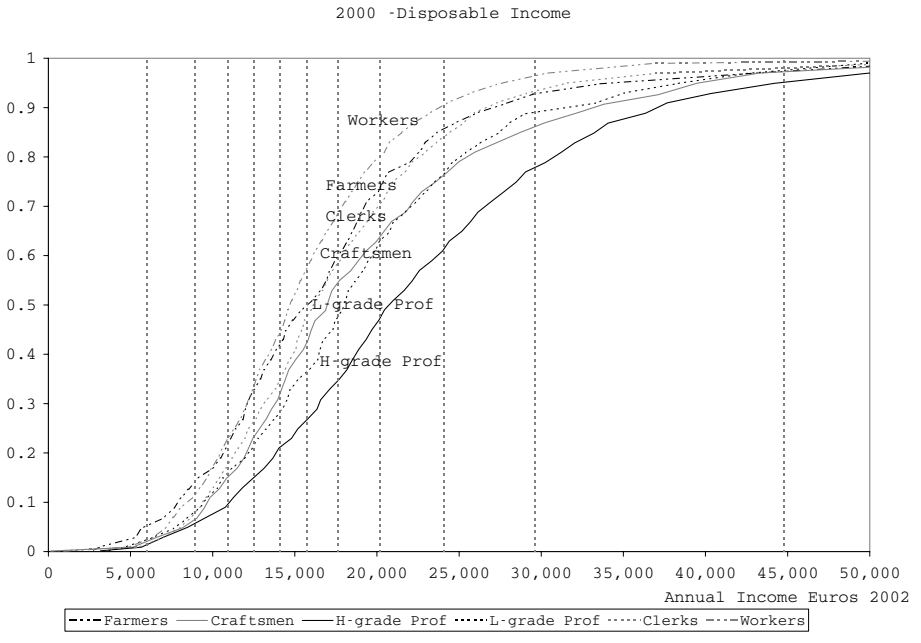
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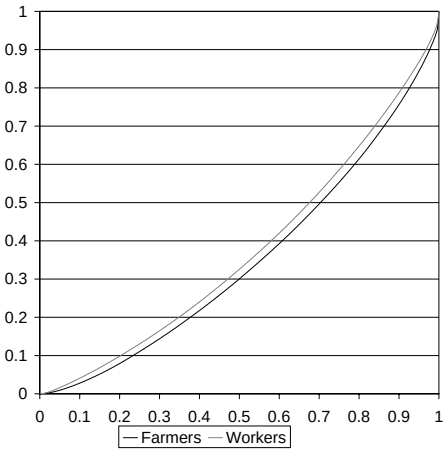
Determinants of stochastic dominance

- Stochastic dominance among social types can arise from differences in the mean or in the dispersion of their income distribution.
- Differences in the dispersion can be investigated using Lorenz curves.
- Conclusions
  1. Stochastic dominance arises from differences in the mean income conditional on social origin.
  2. The within-type dispersion of income is equal for all types. The impact of circumstances is only through the mean, not the distribution of the "residual".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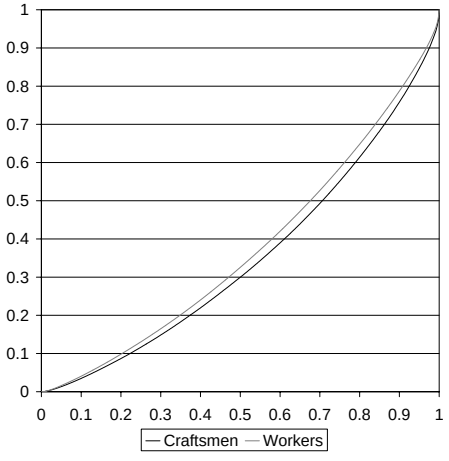
Farmers
Workers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Craftsmen
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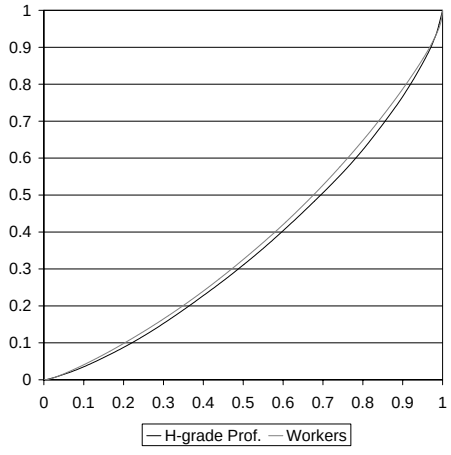
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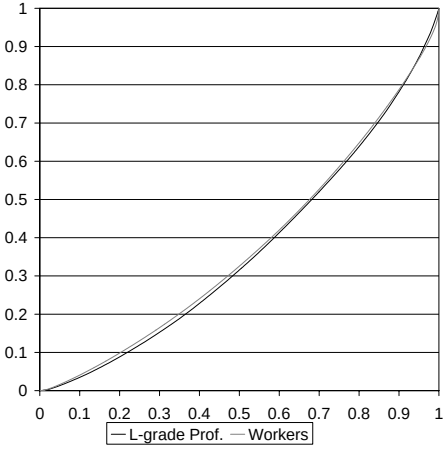
H-grade Prof.
Workers


0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
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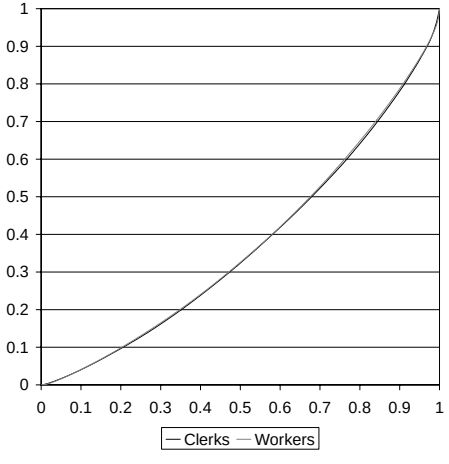
Workers


0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Clerks
Workers

Motivation

- Limitation of previous analysis : conditioning on social origin makes the assessment of changes in the degree of inequality of opportunity subject to caution
  - structural mobility + classification effects
  - changes in the "distance" between social groups (between group inequality)
- Idea is to partition the set of circumstances based on parental income, which is more readily comparable across time periods
- Two possible approach : discrete (comparison of conditional distributions using stochastic dominance) vs continuous (intergenerational regression approach)
- Here : take both approaches and develop a unifying framework

Data

- French labor market surveys (FQP), two waves 1977 and 1993
- Sample : heads of household or spouse, aged 30-40
- 1977: 1200 obs (M: 675, F:525),
- 1993: 2554 obs (M: 1683, F:871)
- Income variable: annual earnings
- Father's income : predicted on the basis of occupation, education, location and industry

Income classes : Ranks or Francs ?

Table: Social Background groups definition

Group of social background	ordinal partition					
	1977			1993		
	centiles	x_{inf}	x_{sup}	centiles	x_{inf}	x_{sup}
C1	[1,15]	.377	.555	[1,15]	.538	.687
C2	[16,35]	.556	.699	[16,35]	.701	.777
C3	[36,55]	.704	.839	[36,55]	.781	.867
C4	[56,70]	.843	1.033	[56,70]	.869	1.028
C5	[71,85]	1.034	1.443	[71,85]	1.031	1.367
C6	[86,100]	1.450	3.167	[86,100]	1.388	2.569

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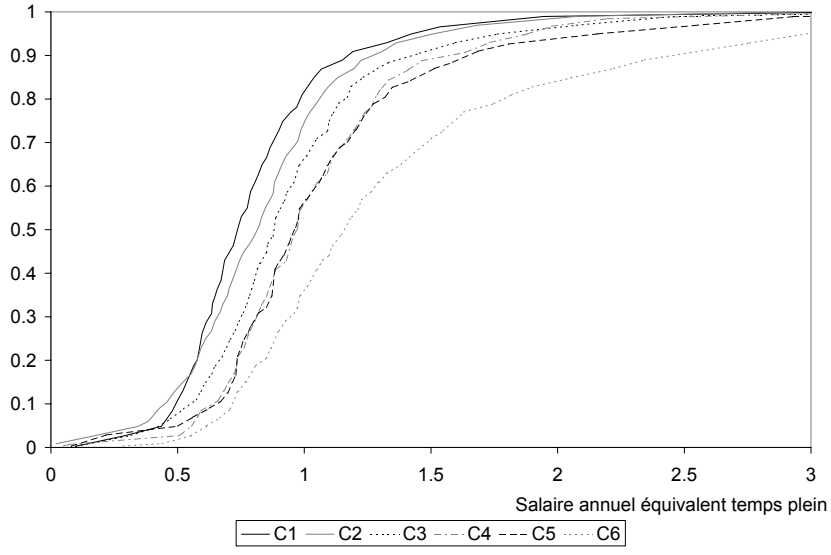
social background	cardinal partition 1977 centiles	x_{inf}	x_{sup}	1993 centiles	x_{inf}	x_{sup}
C1	[8, 22]	.538	.687	[1,15]	.538	.687
C2	[24,35]	.701	.777	[16,35]	.701	.777
C3	[38,43]	.781	.867	[36,55]	.781	.867
C4	[46,65]	.869	1.028	[56,70]	.869	1.028
C5	[67,84]	1.031	1.367	[71,85]	1.031	1.367
C6	[87,97]	1.388	2.569	[86,100]	1.388	2.569

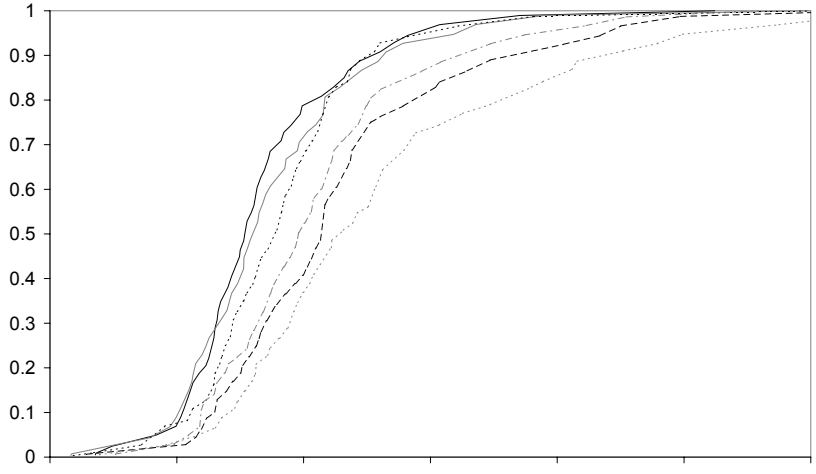
Note : x_{inf} and x_{sup} represent the bounds of the social groups expressed relative to the mean father predicted earnings.

The conditional CDFs

A- 1977, ordinal partitioning

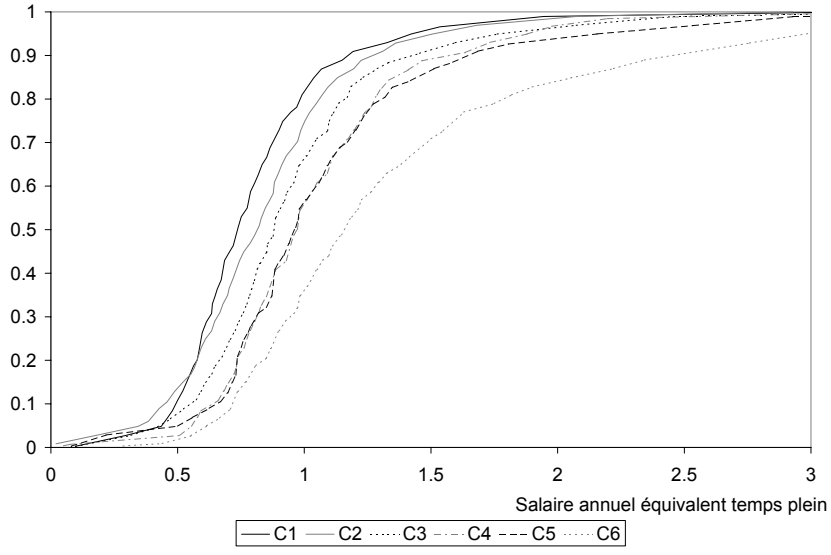


B- 1993, ordinal and cardinal partitioning



The conditional CDFs

A- 1977, ordinal partitioning



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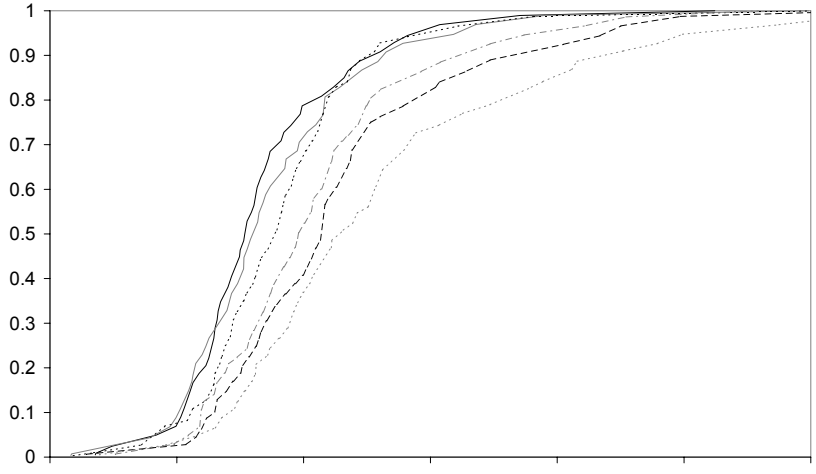
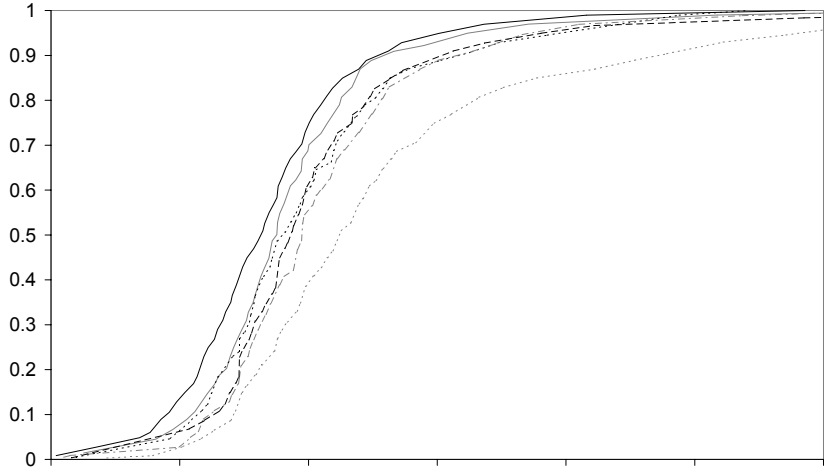


C- 1977, cardinal partitioning



Conditional Means: confirmation

Table: 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).

Formal tests with ordinal partitioning

Table: 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.

Formal tests with cardinal paritionning

Table: 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.

Intergenerational earnings regression

Notations

- y_{it}^c : child's income from family i at date t, where t is an index of the child's cohort
- y_{it}^p : parents earnings
- $\overline{y_t^c}$, $\overline{y_t^p}$ respective arithmetic means
- Standardize by the arithmetic mean and take logs :

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

Intergenerational transmission model

We posit the following linear relationship :

$$\widetilde{y}_{it}^c = \alpha_t + \beta_t \widetilde{y}_{it}^p + \epsilon_{it}, \tag{1}$$

where β_t is the intergenerational earnings elasticity for cohort t

Intergenerational earnings regression : comments

- What does β measure ?
  - omnibus measure (Solon) of the association in earnings across two generations
  - captures the impact of everything that is correlated with income : no causal interpretation
  - underlying question : should the different factors correlated with income be ascribed to circumstances or to effort ?
- How bad is it to use predicted income ?
  - strong attenuation bias in 1st generation studies of intergenerational income mobility : income is plagued with measurement error
  - solution : use IV to cure the measurement error problem (not the endogeneity)
  - prediction is equivalent to two-sample IV (Angrist and Krueger).

Intergenerational Earnings Elasticity: a small increase

Table: Intergenerational earnings regression

β_{77}	.3488
	(.0225)
β_{93}	.4064
	(.0359)
α_{77}	-.0576
	(.0107)
α_{93}	-.0568
	(.0123)
Observations	3754
R-squared	0.1490

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

Measuring inequality of opportunity using the IGE model

Objective :

- To reconcile the two approaches and sets of results
- Main sources of divergence :
  - The intergenerational regression model measures what **share** of previous generation inequality is transmitted to the next
  - The equality of opportunity perspective measures the **level** of inequality received from previous generation
  - Limitation of the cardinal approach to equality of opportunity : does not provide a measure of how much we deviate from the objective

Approach :

- Rely on the regression model to decompose inequality among children between what's inherited and what's not.

How to measure earnings **inequality** ?

- The choice of a particular index is a contentious issue.
- We use the *mean logarithmic deviation*

$$I_t^c = \frac{1}{n}\sum_{i=1}^{n} \log \frac{\overline{y_t^c}}{y_{it}^c} = -\frac{1}{n}\sum_{i=1}^{n} \widetilde{y}_{it}^c. \qquad (2)$$

Decomposition

The transmission model writes :

$$\widetilde{y}_{it}^{c} = \alpha_t + \beta_t \widetilde{y}_{it}^{p} + \epsilon_{it}, \tag{3}$$

Taking means, this straightforwardly implies the following **decomposition** :

$$I_t^c = -\alpha_t + \beta_t I_t^p \tag{4}$$

- $I_{oppt} = \beta_t I_t^p$ results from the transmission of previous generation inequality and represents inequality of opportunity
- $-\alpha_t$ measures residual inequality

Result : Inequality of opportunity results from (1) the degree of inequality in the parent's cohort and (2) how much of this inequality is transmitted

More equal fathers, more equal children

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

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

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Table: 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

Linking the continuous and discrete approach

The previous decomposition helps understand why using ordinal or cardinal partitioning leads to different results

- ordinal partitioning indicates a reduction in inequality of opportunity
  - the reason is that the distance between income classes falls over time
- cardinal partitioning indicates that inequality of opportunity has remained constant
  - the reason is that, by construction, the distance between income classes has remained constant

Linking the continuous and discrete approach (2)

Within/Between groups decomposition

Suppose that we partition parents into income classes and ignore within-class inequality, do we lose much information ?

- Parents generation

$$I_t^p = I_{Wt}^p + I_{Bt}^p \tag{5}$$

- Inequality among children is the sum of 3 terms : the within-group and between group inequality of opportunity and residual inequality.

$$I_t^c = -\alpha_t + \beta_t I_{Wt}^p + \beta_t I_{Bt}^p = -\alpha_t + I_{oppW\,t} + I_{oppB\,t} \tag{6}$$

Table: 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
1977	0.1233	0.1158	0.0075
1993	0.0717	0.0678	0.0038

Conclusion

- Possibility of empirically assessing equality of opportunity
- Limitation : observation of the relevant factors. Not only a data limitation but also a "political" problem.
- Need to : improve our understanding of the transmission mechanisms, account for individual choices, preferences,

Evolution of mean income conditional on social origin 1979-2000

	Farmers	Craftsmen	H-grade Prof	L-grade Prof	Clerks	Workers
Variation 1979-2000						
	4481	1 553	-1 457	- 521	863	1 118
Decomposition (%)						
Return effect	83	122	38	-75	121	117
Mobility effect	17	-22	62	175	-21	-17

Variation of mean income in Euros 2002, occupational group of the father

- Mobility effect : change in social mobility
- Return effect : change in the income conditional on social class destination