Counting poverty orderings and deprivation curves

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Motivation:

- Deprivation/Poverty/QoL are multidimensional phenomena.
- Most of the multidimensional indices proposed deal well only with quantitative data.
- Most of the data available to measure capabilities or dimensions of poverty are either ordinal or categorical.
- An alternative to the traditional indices is the counting approach (Atkinson, 2003): the number of (weighted) dimensions in which a person is deprived. (Chakravarty and D'Ambrosio, 2006, Bossert et al, 2007, Alkire and Foster , 2007 and Bossert et al, 2009)

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Motivation (cont):

The measurement of poverty involves:

- method to identify the poor,
- an aggregative procedure.

Aim:

Dominance criteria that provides unanimous rankings for

- a range of identification cut-offs and
- a wide class of counting multidimensional measures.

(Shorrocks,1983; Foster and Shorrocks,1988; Jenkins and Lambert,1997)

Outline:

- The vector of deprivation counts and the identification method.
- Counting poverty measures.
- Mexico's dataset. (Miguel Niño, BWPI, University of Manchester)
- FD-curves: graphical representation for the *headcount ratio and dominance criteria.*
- SD-curves: graphical representation for the *multidimensional headcount ratio* and for the *adjusted headcount ratio, and dominance criteria.*
- Conclusions and further research.

1. The *vector of deprivation counts* and *the identification method.*

n=10 individuals and *d=4* dimensions

A: achievement matrix

$$A = \begin{pmatrix} 1.5 & 4 & 5 & 2 \\ 1 & 3 & 7 & 2.5 \\ \dots & \dots & \dots & \dots \\ 6 & 10 & 8 & 6 \end{pmatrix} \quad z = \begin{pmatrix} 2 & 5 & 6 & 3 \end{pmatrix}$$

$$\rightarrow \quad g^0 = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \longrightarrow$$

vector of deprivation counts

$$\begin{pmatrix} 4 \\ 3 \\ 3 \\ 2 \\ 2 \\ 1 \\ 1 \\ 1 \\ 0 \\ 0 \end{pmatrix}$$

$$c = (4,3,3,2,2,1,1,1,0,0)$$

1. The *vector of deprivation counts* and *the identification method.*

$c = (4,3,3,2,2,1,1,1,0,0)$ Who are the poor?

- $k = 4$ $q(4) = 1$ $c(4) = (4,0,0,0,0,0,0,0,0,0)$ $H(4) = 0.1$ $M(4) = 0.1$

  intersection approach
- $k = 3$ $q(3) = 3$ $c(3) = (4,3,3,0,0,0,0,0,0,0)$ $H(3) = 0.3$ $M(3) = 0.25$
- $k = 2$ $q(2) = 5$ $c(2) = (4,3,3,2,2,0,0,0,0,0)$ $H(2) = 0.5$ $M(2) = 0.35$
- $k = 1$ $q(1) = 8$ $c(1) = (4,3,3,2,2,1,1,1,0,0)$ $H(1) = 0.8$ $M(1) = 0.425$

  union approach

$$H(k) = \frac{q(k)}{n}$$ *headcount ratio*

$$M(k) = \frac{\sum_{1 \le i \le n} c_i(k)}{nd}$$ *adjusted headcount ratio*

2. Counting poverty measures.

The number of dimensions, d, is fixed. The weights are also fixed.

Let G be the set of all vectors of deprivation counts.

$$P : G \to R, \quad P_k(c) = P\big(c(k)\big) \quad \textit{counting} \quad \textit{poverty} \quad \textit{measure}$$

1. Focus (F)
2. Symmetry (S)
3. Replication Invariance (RI)

2. Counting poverty measures.

4. Dimesional Monotonicity (M)

$$c = (4,3,3,2,2,1,1,1,0,0) \qquad c' = (4,4,3,2,2,1,1,1,0,0)$$

$$P(c) < P(c')$$

5. Distribution sensitivity (DS)

$$c = (4,4,3,2,2,1,1,1,0,0)$$

$$c' = (4,3,3,2,2,1,1,1,0,0)$$

$$c'' = (4,4,3,2,1,1,1,1,0,0)$$

$$P(c) - P(c') > P(c) - P(c'')$$

2. Counting poverty measures.

Examples.

- Headcount ratio, H(k) for all values of k : 1,..,d.
- Adjusted headcount ratio, M(k) for all values of k : 1,..,d.
- The class of poverty measures characterized by Bossert et al. (2009) $M(c(k)) = \frac{1}{n} \sum_{1 \le i \le n} \phi(c_i(k)) \quad \phi : \mathbb{R}_+ \longrightarrow \mathbb{R}_+$

  a convex function.

3. The dataset.

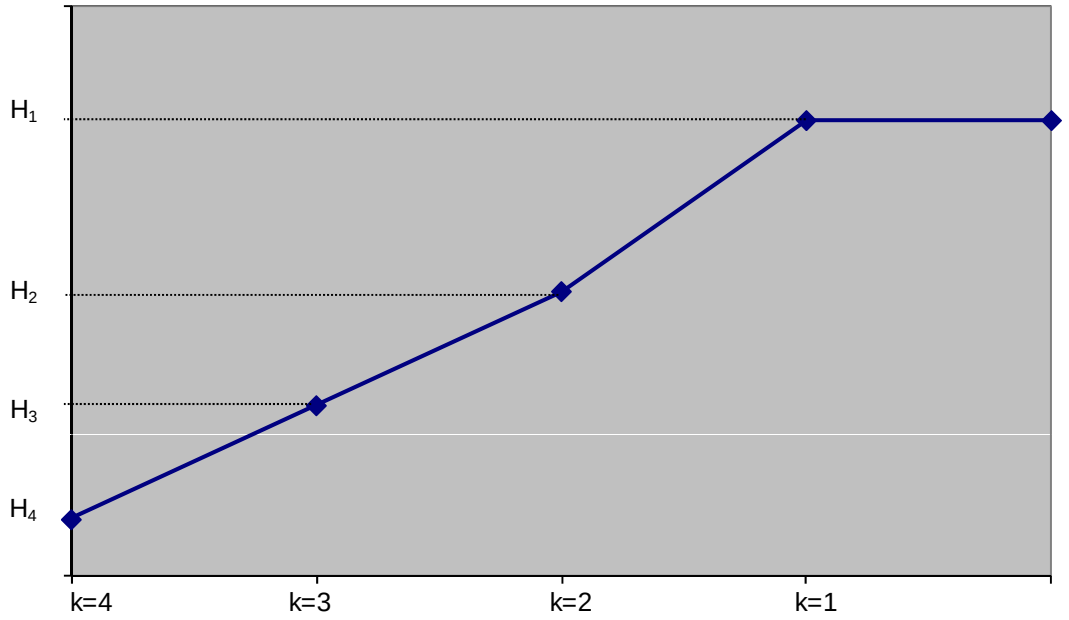
- We employ the longitudinal household survey (ENCEL) collected to assess the impact of Mexico's *Oportunidades* programme.
- In the end, we get a panel dataset for the period 1997-2007, containing information about **19,194 rural households**.
- We have selected eight dimensions in which to assess deprivation:
    1. If household head had ≤ 6 years of schooling.
    2. If household didn't have access to water in premises.
    3. If household didn't have access to toilets (or a sewage system).
    4. If residence had earthed floor.
    5. If household didn't have any kind of livestock or poultry.
    6. If household didn't have any kind of vehicle.
    7. If household didn't have any kind of household asset .
    8. If household didn't have land.

4. FD-curves: the headcount ratio.

$$c = (4,3,3,2,2,1,1,1,0,0)$$

	$k=4$	$k=3$	$k=2$	$k=1$
$H(k)$	0.1	0.3	0.5	0.8

FD-curve



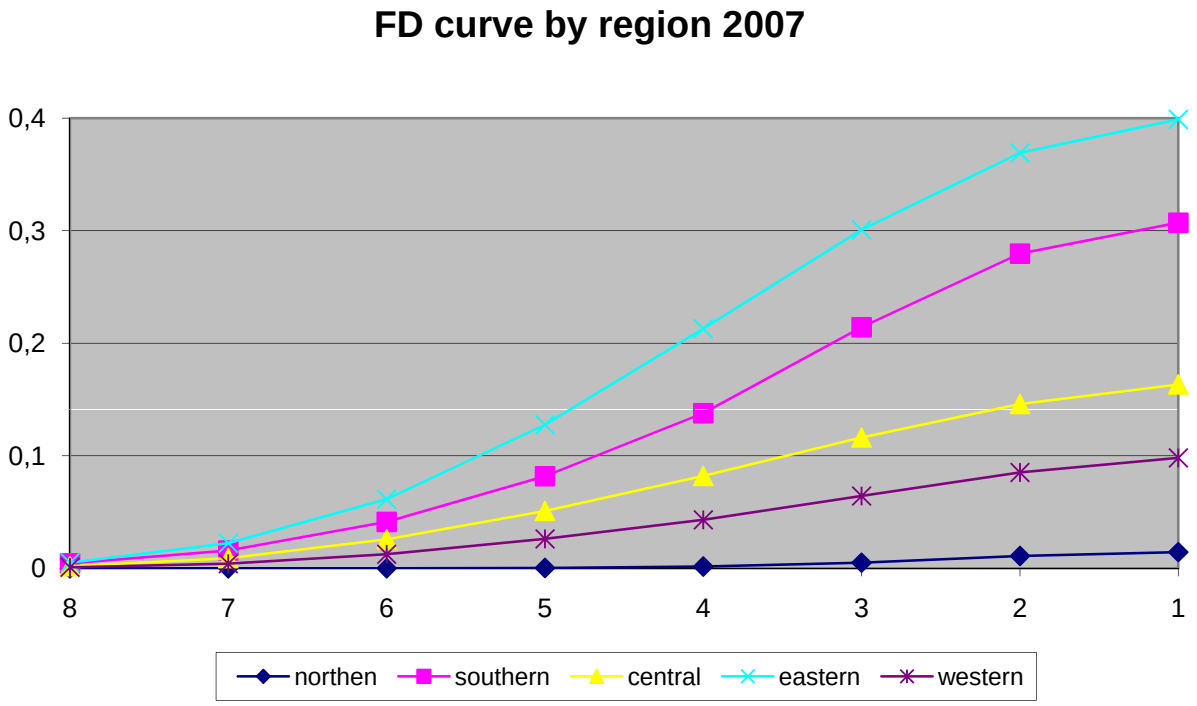
4. FD-dominance.

FD-dominance:

Given two vectors of deprivation counts c and c', we say that

c' *FD dominates* c if $FD(c';p) \geq FD(c;p)$

and the strict inequality holds at least once.



4. FD-dominance.

Proposition 1.

c' FD dominates c

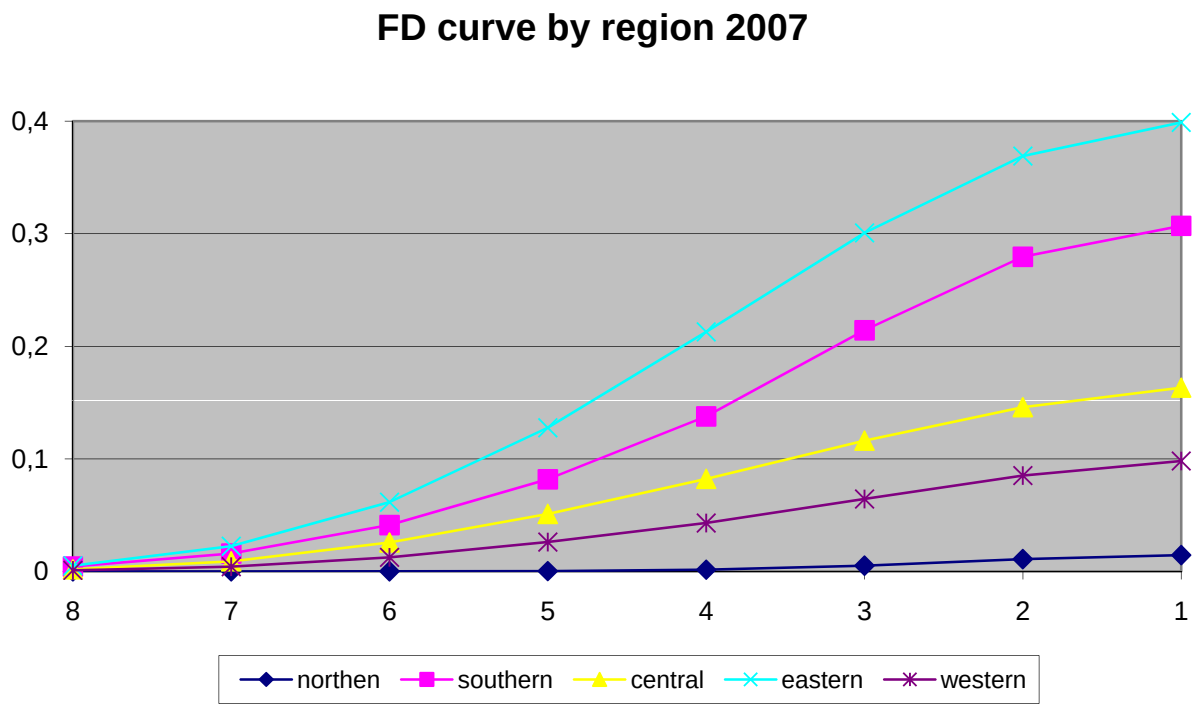
if and only if

$P(c'(k)) \geq P(c(k))$

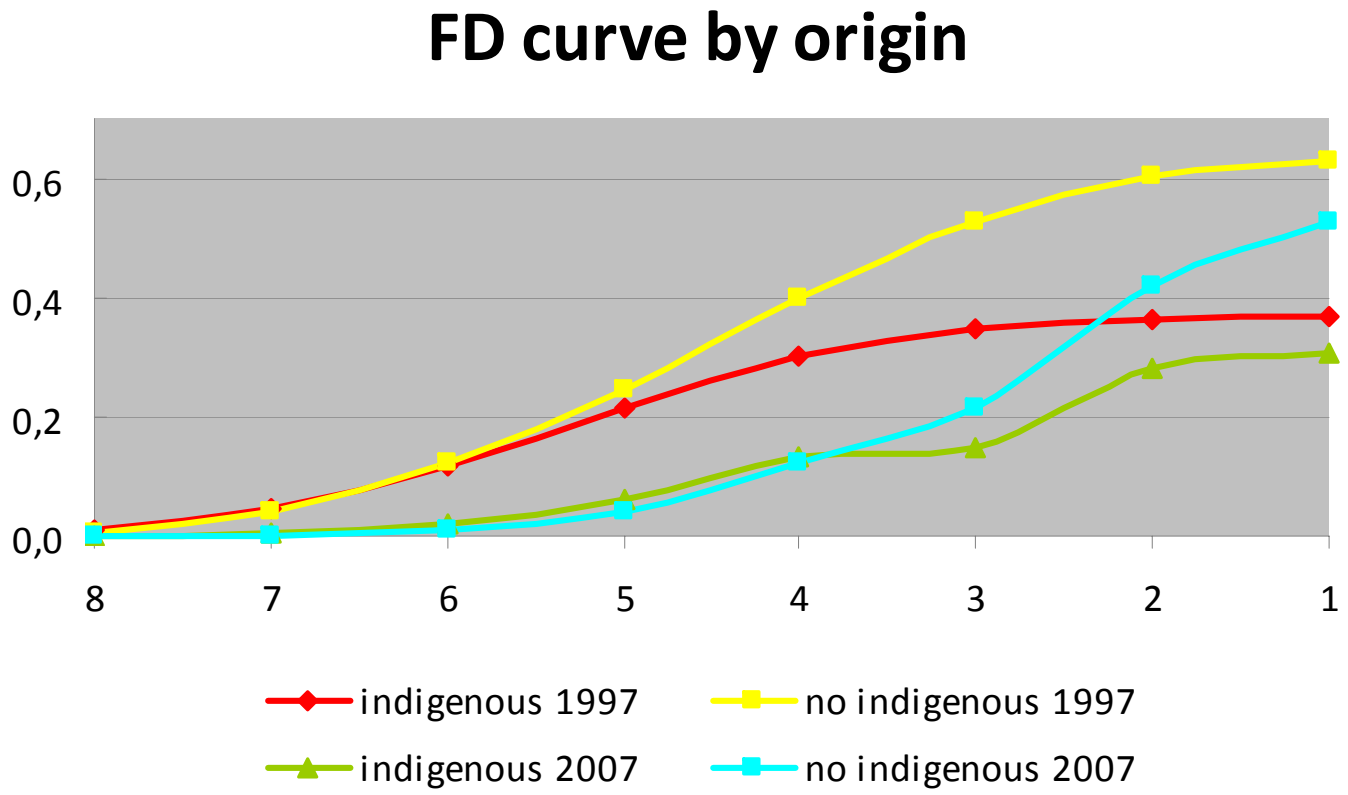
for all P_k *that satisfies F, S, RI and M*

and for all identification cut-offs k

4. FD-dominance.



4. FD-dominance.

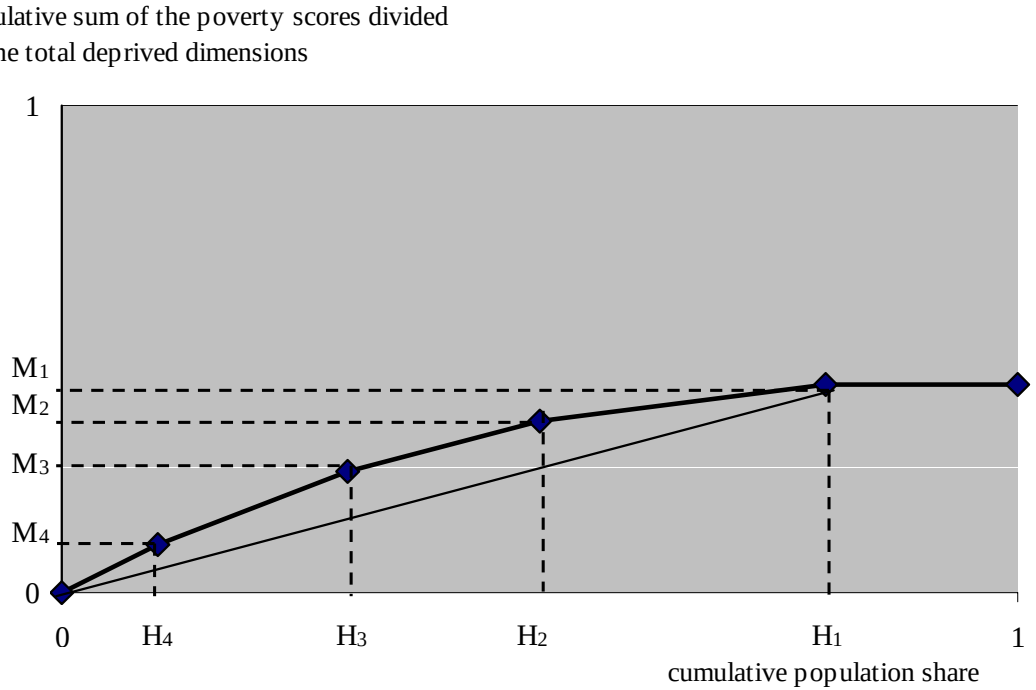


5. SD-curves: the headcount ratio and the adjusted headcount ratio.

$$c = (4,3,3,2,2,1,1,1,0,0)$$

	$k=4$	$k=3$	$k=2$	$k=1$
$H(k)$	0.1	0.3	0.5	0.8
$M(k)$	0.1	0.25	0.35	0.425

SD-curve



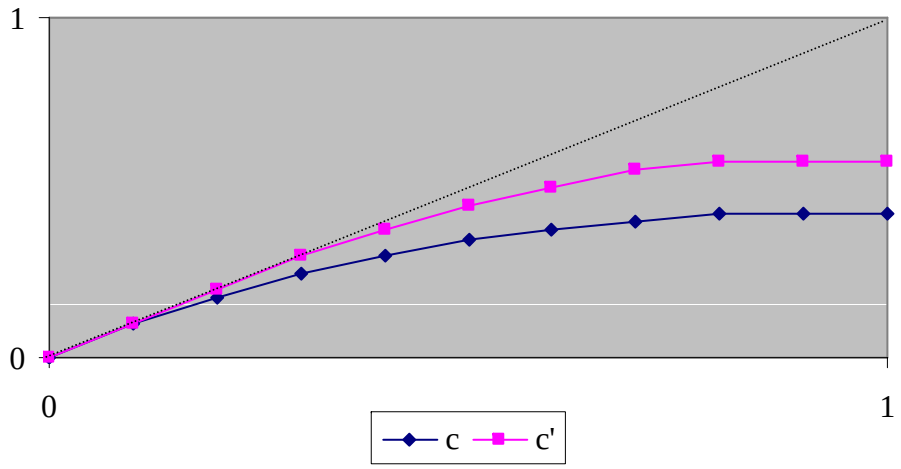
5. SD-dominance.

SD-dominance:

Given two vectors of deprivation counts c and c', we say that

c' *SD dominates* c if $SD(c';p) \geq SD(c;p)$

and the strict inequality holds at least once.



5. SD-dominance.

Proposition 2.

c' SD dominates c

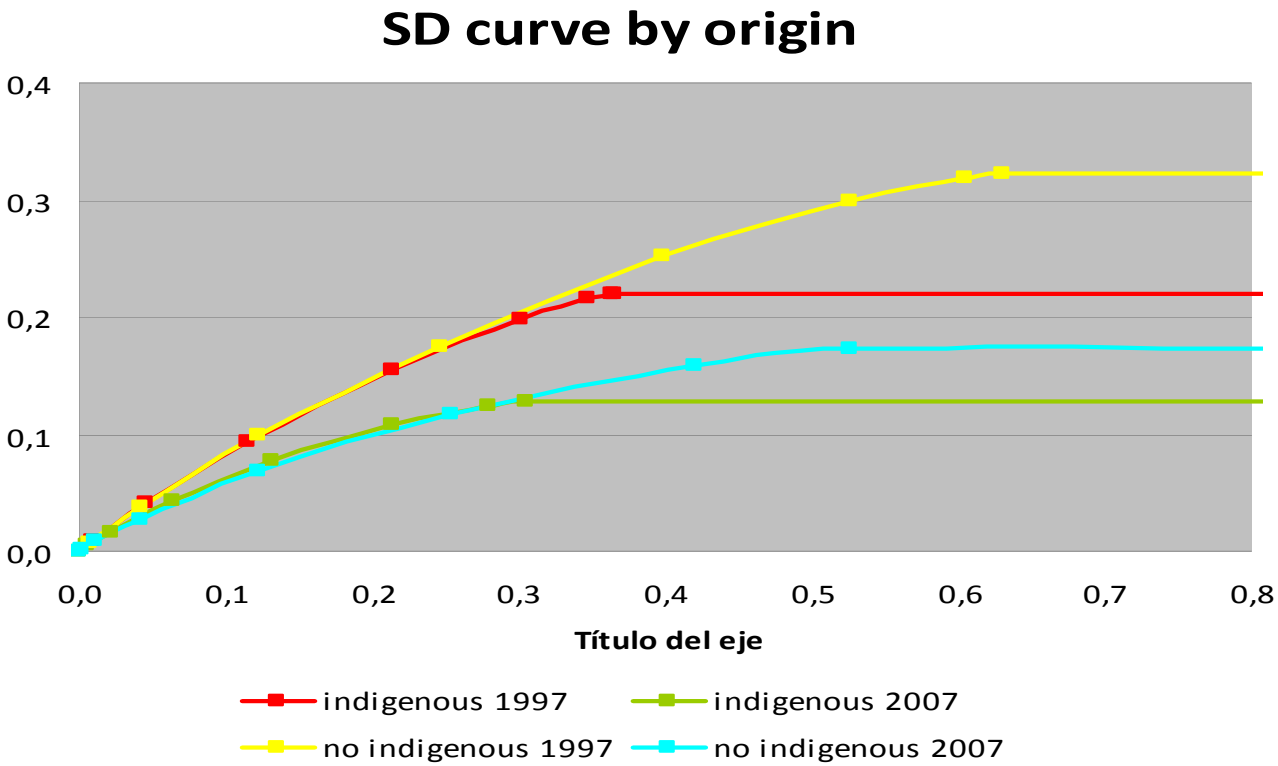
if and only if

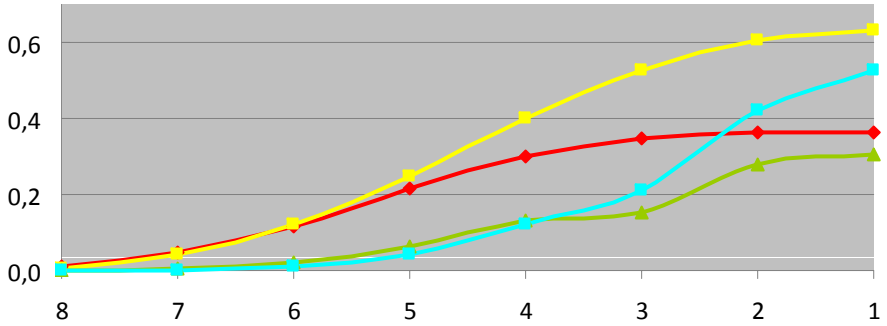
$P(c'(k)) \geq P(c(k))$

for all P that satisfies F, S, RI, M, ***DS***

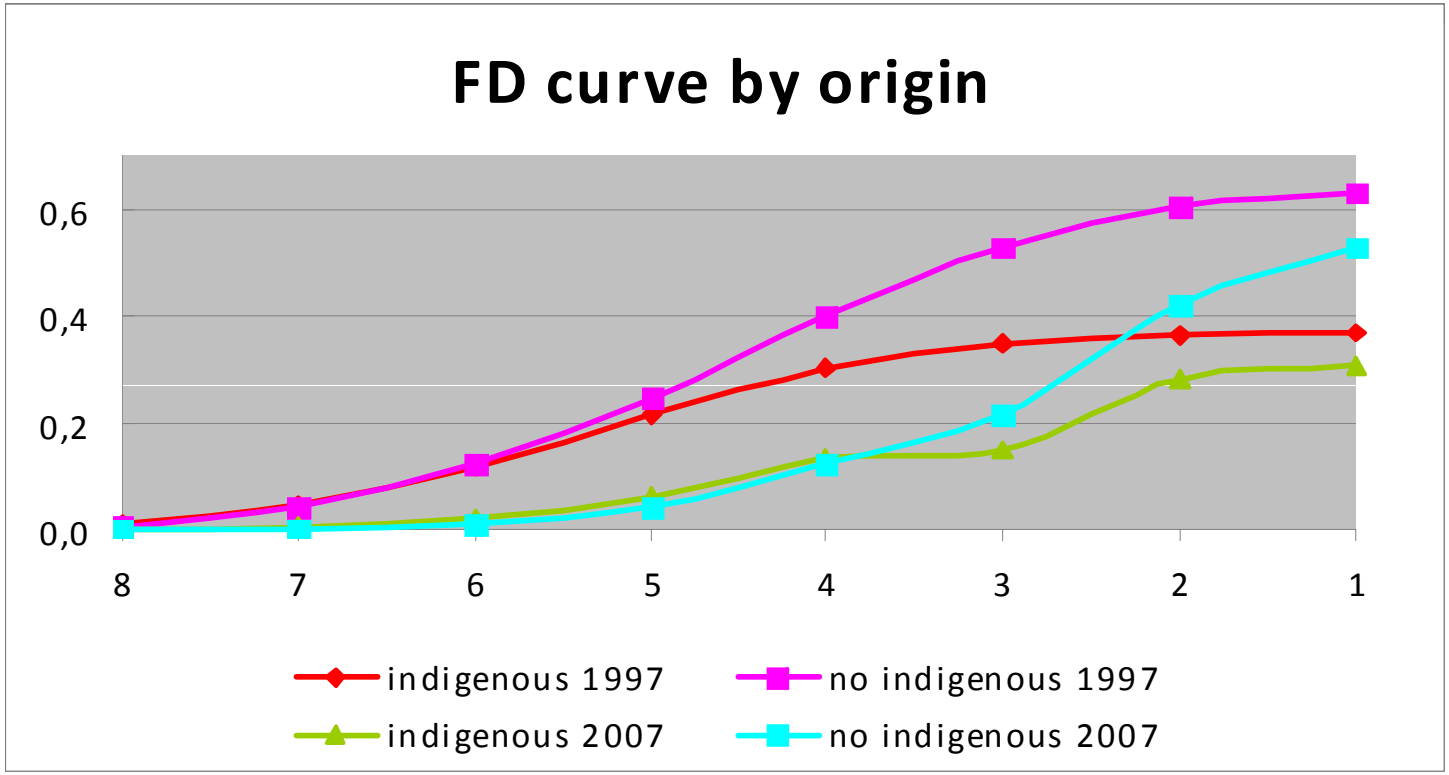
and for all identification cut-offs k.

5. SD-dominance.





5. SD-dominance.



Conclusions and further research.

- The deprivation curves provide a graphical representation of the headcount ratio, the adjusted headcount ratio.

- They also provide a tool for checking unanimous orderings according to a wide class of poverty measures and to a range of identification cut-offs.

- Weighted dimensions may be incorporated in the analysis.

- Statistical inference tests may be implemented.

Thank you for your attention!!

3. The dataset.

- We employ the longitudinal household survey (ENCEL) collected to assess, through a randomised experiment, the impact of Mexico's *Oportunidades* programme.
- The experiment was based on a sample of 506 treatment communities, randomly selected using probabilities proportionate to the size of 6400 communities. Of the 506 experimental communities, 306 were randomly assigned to the treatment group, scheduled to receive benefits starting in April 1998. The remaining communities in the control group started to receive benefits in December of 1999.
- Between 1997 and 2000, evaluation surveys with detailed information on many indicators including education, health, housing conditions, assets , etc were applied to households in both groups every six months. After 2000, two additional waves were collected in 2003 and 2007.
- In the end, we were able to get a panel dataset for the period 1997-2007, containing information about **19,194 rural households**.

3. The data: dimensions of deprivation (in %)

	1997		2007	
	Deprived	No deprived	Deprived	No deprived
≤ 6 years of schooling	62	38	52	48
No access to water	63	36	35	56
No access to toilets	41	59	33	67
Residence with earthed floor	59	41	34	66
No livestock or poultry	60	40	18	82
No access to vehicle	91	8.3	67	33
No household assets	22.1	77	12	88
No access to land	35.1	65	22	78

3. The dataset: Correlation coefficients between deprivations (1997).

	Dep edu	Dep floor	Dep water	Dep toilet	Dep livestock	Dep vehicles	Dep assets	Dep land
depedu	1							
depfloor	-0.0836	1						
depwater	-0.0062	0.2139	1					
deptoilet	-0.0911	0.1064	0.0658	1				
deplivestock	-0.0275	0.079	0.0198	0.041	1			
depvehicles	-0.036	0.2433	0.1237	0.0751	0.0928	1		
depassets	-0.1206	0.2523	0.1366	0.1606	0.152	0.1515	1	
depland	-0.0259	0.042	0.0235	0.1148	0.295	0.0844	0.0495	1

3. The dataset: Correlation coefficients between deprivations (2007).

	Dep edu	Dep floor	Dep water	Dep toilet	Dep livestock	Dep vehicles	Dep assets	Dep land
depedu	1							
depfloor	-0.0417	1						
depwater	-0.0412	0.1595	1					
deptoilet	-0.0534	0.0824	0.0984	1				
deplivestock	-0.0621	0.0254	0.0018	-0.036	1			
depvehicles	-0.0721	0.1625	0.0847	0.018	0.0637	1		
depassets	-0.1219	0.2217	0.1322	0.073	0.0889	0.1733	1	
depland	-0.0646	0.0349	-0.0036	-0.0421	0.5318	0.0723	0.0779	1