# Multidimensional poverty and inequality

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# Multidimensionality of well-being is now centre stage

- Alkire & Foster "Counting and multidimensional poverty measurement", Journal of Public Economics 2011

  "Multidimensional poverty *has captured the attention of researchers and policymakers alike due, in part, to the compelling conceptual writings of Amartya Sen and the unprecedented availability of relevant data."*

- *Stiglitz-Sen-Fitoussi Report* for French Presidency

- *Europe 2020 strategy*: Five headline targets for national policies:

  *"Reduction of poverty by aiming to lift at least 20 million people out of the risk of poverty or social exclusion"*

  Risk of poverty or social exclusion → multidimensional

# Does social evaluation be multi-dimensioned? May be not …

- Either a **single variable** can still subsume all dimensions
  - Utility (e.g. revealed by consumption pattern or happiness indicators), Maasoumi's "utility-like function of all the attributes received", income equivalisation, …

- Or **dimensions kept distinct** on philosophical or practical grounds
  - Tobin's *specific egalitarianism*, Ravallion's rejection of ad hoc aggregation and unexplained tradeoffs between domains, …
    → *dashboard approach*

# … or maybe yes – and it can be done

- Intermediate route: **methods for multidimensional measurement of inequality and poverty**
  - main motivation: inequalities in different domains cumulate
- Pattern of association between variables distinguishes multidimensional from unidimensional analysis
  - ***Empirical vs. normative correlations***
- Aim of the paper: unveil underlying measurement assumptions to elucidate their normative content
  - little attention to multivariate techniques in statistical and efficiency analysis

    *valuable, but hesitate to entrust mathematical algorithms with essentially normative task such as summarising well-being*

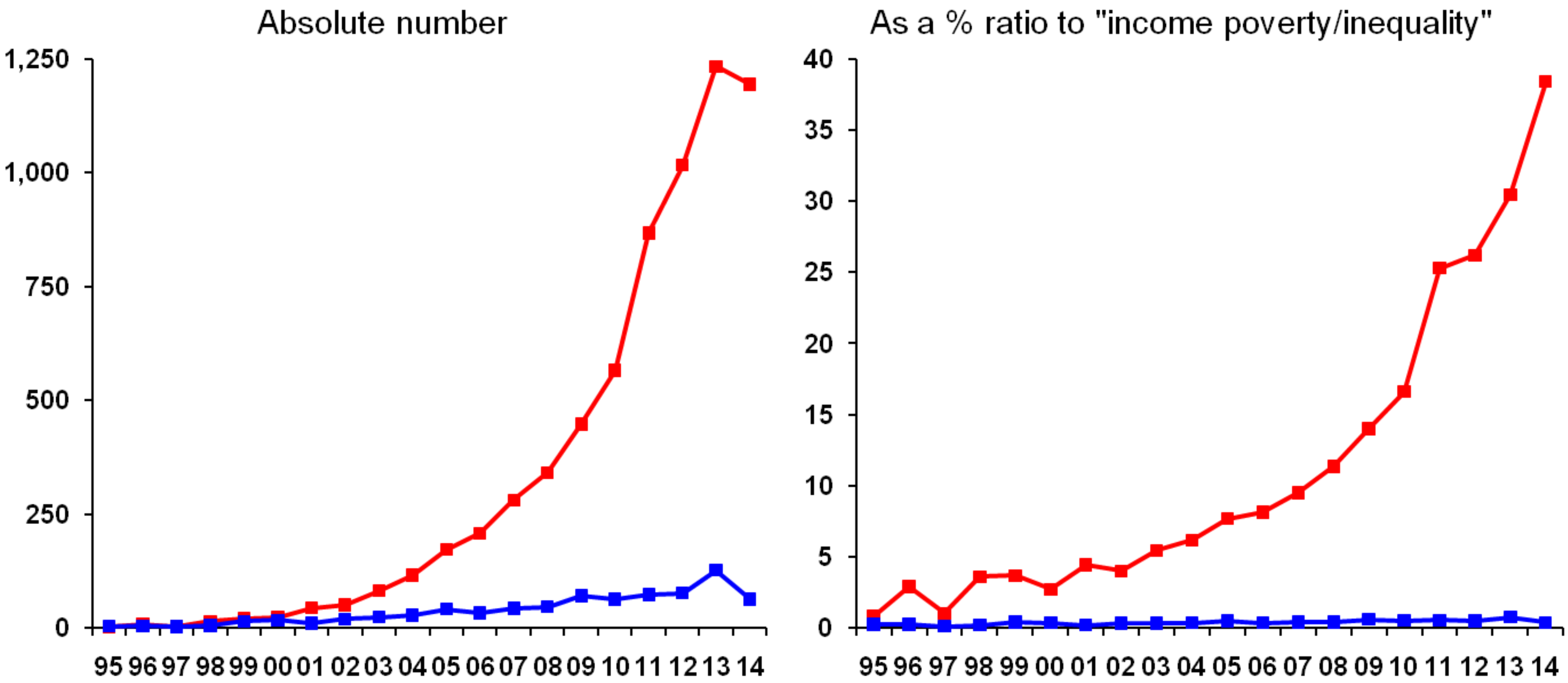
# Not a new topic ...

- F M Fisher, “Distribution, Value Judgments, and Welfare”, Quarterly Journal of Economics 1956

It will be best, then, to begin by discussing exactly what we mean by “distribution.” Of course, we are interested in the real, not the money income of the individual or of the society and this makes things somewhat more complex. Real income is not a scalar but a vector whose components are amounts of commodities. Thus, we

6. Of course, no particular significance attaches to the prices as market valuations of the commodities. Any arbitrary set of weights would do as well.

# ... but with a very recent take-off




multidimensional poverty or deprivation (& ratio to income poverty)

multidimensional inequality (& ratio to income inequality)

Source: authors' search of exact phrases in *Google Scholar*, 16 November 2014.

# Outline

- Preliminaries:
  - Selection of dimensions
  - Indicators to measure achievement
  - Weights
- Counting deprivations
- Poverty measurement with continuous variables
- Dominance criteria
- Conclusions

# Preliminaries

# Selection of dimensions (1)

- **Material hardship**: inability to consume various socially perceived necessities because of lack of economic resources
- **Social exclusion**: failure in achieving a reasonable living standard, a degree of security, an activity valued by others, some decision-making power, the possibility to draw support from relatives and friends (Burchardt et al 1999)
- **Scandinavian approach to welfare**: health and access to health care; employment and working conditions; economic resources; education and skills; family and social integration; housing; security of life and property; recreation and culture; political resources (Erikson 1993)
- **Capability approach**: life; bodily health; bodily integrity; senses, imagination, and thought; emotions; practical reason; affiliation; other species; play; control over one’s environment (Nussbaum 2003)
- **Sen-Stiglitz-Fitoussi Commission**: ...

# Selection of dimensions (2)

- **Wide range and diversity** of domains
- Choice due to:
  - experts – possibly based on existing data, conventions and statistical techniques
  - empirical evidence regarding people's values
- Nature of selected attributes may condition the definition of measurement tools (e.g. transferability of health)

# Indicators to measure achievement

- **Different measurement units**
  - continuous variables (income), discrete (number of durable goods owned), categorical (highest school attainment), bounded continuous ordinal variables (numeracy scores), dichotomous (incidence of specific chronic illnesses)
- Problem of multidimensional analysis: **commensurability of indicators** $\rightarrow$ standardization (see Decancq-Lugo 2013)
- In poverty assessments: definition of deprivation thresholds is same problem as in univariate analysis

# Weighting

- Weights determine contribution of attributes to well-being and their degree of substitution
- **Equal weighting (benchmark)**: lack of information about "consensus" view, but no discrimination
- **Consultations**, with experts or public, or **survey responses** (direct questions, indirectly from happiness equations)
- **Market prices**: non-existing or distorted by market imperfections and externalities, inappropriate for well-being comparisons
- **Data-based weighting**: Frequency-based approaches (weight inversely proportional to share of deprived people) or multivariate statistical techniques

  → ***Different weighting structures reflect different views: normative exercise (Sen: use range of weights)***

# Counting deprivations

# Counting approach (1)

- The **newest (theory)** & the **oldest (empirical practice)**
  - Main poverty statistic adopted by a parliamentary commission of inquiry over destitution in Italy in the early 1950s was a *weighted count of the number of households failing to achieve minimum levels of food consumption, clothing availability, and housing conditions*
- Modern research owes much to Townsend (1979)
  - Townsend's interest largely instrumental:

    *"We assume that the deprivation index will not be correlated uniformly with total resources at the lower levels and that there will be a 'threshold' of resources below which deprivation will be marked"*
- Huge **impact on social policy debate** in Ireland, UK, EU

# Counting approach (2)

- But lack theoretical treatment of **normative bases** until recently
  - see Alkire and Foster (2011), Aaberge and Peluso (2011), Aaberge and Brandolini (2014)
- Atkinson (2003): **difficult reconciliation** with social welfare approach
  - Part of the problem: definition of welfare criteria in terms of the distributions of the underlying continuous variables rather than in terms of the distribution of deprivation scores
  - In counting approach, **distribution of deprivation scores contains all relevant information**, which by construction implies neglecting levels of achievement in original variables

# Counting approach (3)

- Indicators of living conditions: ownership of durables, possibility to carry out certain activities (e.g. going out for a meal with friends)
- **Count number of dimensions in which people fail to achieve a minimum standard**
  - simplest way to embed **association** between deprivations at individual level into an index of deprivation
  - aggregation across dimensions for each individual, then across individuals
- Alternative: **composite index of deprivation**
  - aggregation first across people, then across dimensions
  - advantage: combine heterogeneous various sources
  - disadvantage: if suffering from multiple deprivations has more than proportionate effect, cumulative effect is missing

# The 2x2 case (1)

| | $X_2$=0 | $X_2$=1 | |
|---|---|---|---|
| $X_1$=0 | $p_{00}$ | $p_{01}$ | $p_{0+}$ |
| $X_1$=1 | $p_{10}$ | $p_{11}$ | $p_{1+}$ |
| | $p_{+0}$ | $p_{+1}$ | 1 |

- Two dimensions ($i$=1,2)
  - $X_i$ = 1 if person suffers from deprivation in dimension $i$
  - $X_i$ = 0 if person does not suffer from deprivation in dimension $i$
- $p_{ij}$: probability of $X_1 = i$ and $X_2 = j$

# The 2x2 case (2)

| | $X_2=0$ | $X_2=1$ | |
|---|---|---|---|
| $X_1=0$ | $p_{00}$ | $p_{01}$ | $p_{0+}$ |
| $X_1=1$ | $p_{10}$ | $p_{11}$ | $p_{1+}$ |
| | $p_{+0}$ | $p_{+1}$ | 1 |

- Only marginal distributions known
- **Composite poverty index**: $P = g\,(\,p_{1+}\,,\,p_{+1}\,)$
- Simple average: $P = (p_{1+}+p_{+1})/2$

  *Individuals with two deprivations counted twice: suffering from two deprivations is twice as bad as suffering from one deprivation*

- *Human Poverty Index*: $HPI = \zeta_1(p_1, p_2, \ldots, p_r) = \left( \sum_{k=1}^{r} w_k p_k^3 \right)^{\frac{1}{3}}$

# The 2x2 case (3)

| | $X_2=0$ | $X_2=1$ | |
|---|---|---|---|
| $X_1=0$ | $p_{00}$ | $p_{01}$ | $p_{0+}$ |
| $X_1=1$ | $p_{10}$ | $p_{11}$ | $p_{1+}$ |
| | $p_{+0}$ | $p_{+1}$ | 1 |

| | $X=X_1+X_2$ |
|---|---|
| $X=0$ | $q_0=p_{00}$ |
| $X=1$ | $q_1= p_{10}+p_{01}$ |
| $X=2$ | $q_2=p_{11}$ |
| | 1 |

- Simultaneous distribution known
- Transform LHS distribution into RHS distribution by computing **deprivation score**: $X=X_1+X_2$ (equal weights)
- Who are the poor?
  - **union**: those who fail in either dimension, $P = g\ (\ 1–p_{00}\ )$
  - **intersection**: those who fail in both dimensions, $P = g\ (\ p_{11}\ )$

# General notation

- Deprivation count $$X = \sum_{i=1}^{r} X_i$$

  with cumulative distribution function $$F(k) = \sum_{j=0}^{k} q_j, k = 0,1,...,r$$

  and mean $$\mu = \sum_{k=1}^{r} k q_k$$

- Dominance criteria defined in terms of the distribution *F* of univariate discrete variable *X* – not of underlying variables $X_i$
- Examine:
  1. partial orderings
  2. complete orderings (deprivation indices)

# First-degree dominance

- Definition 1. *A deprivation count distribution* $F_1$ *is said to first-degree dominate a deprivation count distribution* $F_2$ *if*

$$F_1(k) \geq F_2(k) \ \textit{for all}\ k = 0,1,...,r$$

*and the inequality holds strictly for some k*.

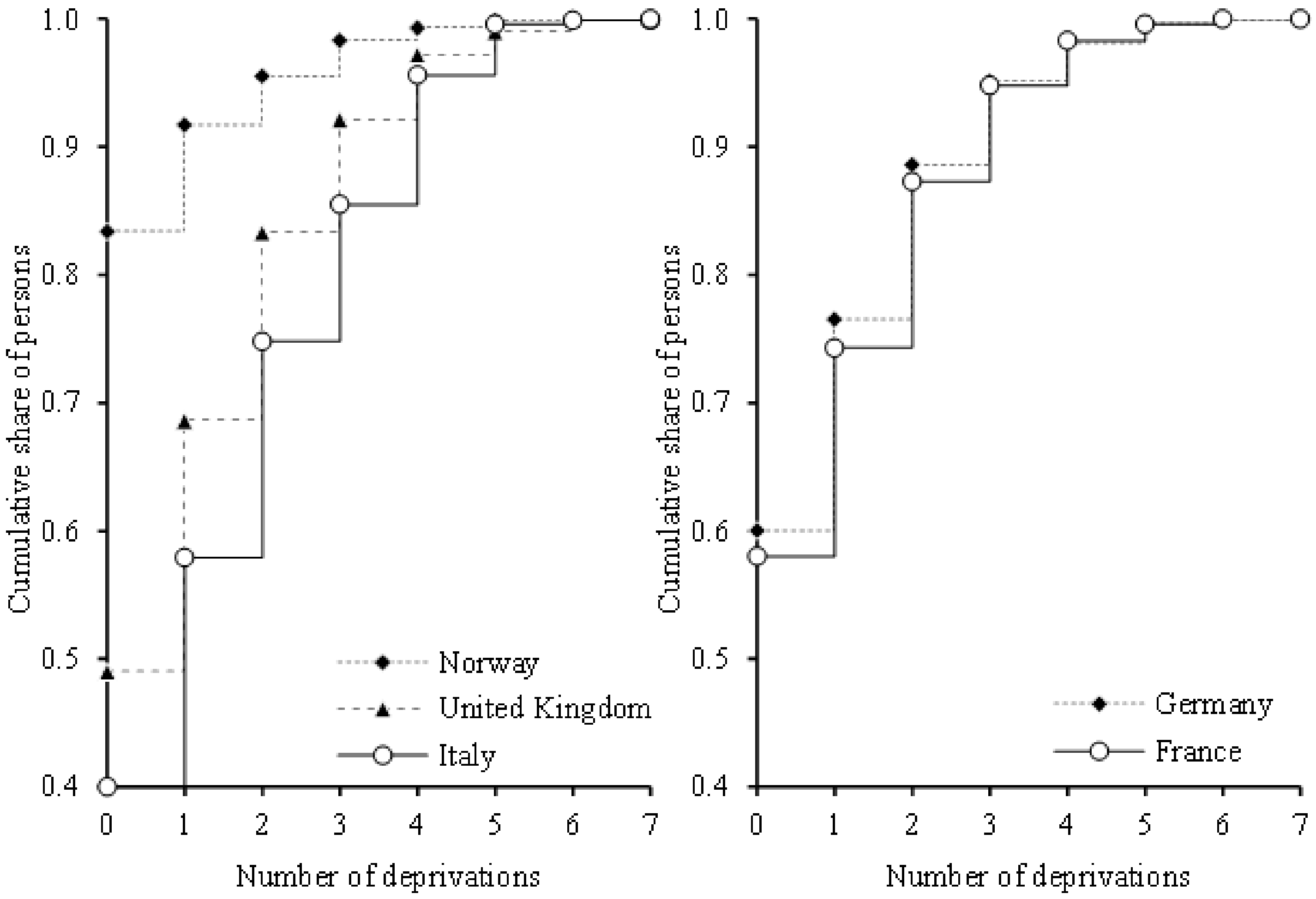
**If *$F_1$* first-degree dominates *$F_2$*, then *$F_1$* exhibits less deprivation than *$F_2$***

# Distribution of material deprivations in some European countries, 2012 (% of total population)

| Number of deprivations | France | Germany | Italy | Norway | United Kingdom |
|---|---|---|---|---|---|
| None | 58.0 | 60.0 | 39.6 | 83.4 | 49.0 |
| 1 item | 16.3 | 16.5 | 18.3 | 8.3 | 19.6 |
| 2 items | 13.0 | 12.1 | 16.9 | 3.8 | 14.7 |
| 3 items | 7.5 | 6.5 | 10.7 | 2.8 | 8.8 |
| 4 items | 3.5 | 3.0 | 10.1 | 1.0 | 5.1 |
| 5 items | 1.3 | 1.5 | 4.0 | 0.6 | 1.8 |
| 6 items | 0.4 | 0.3 | 0.3 | 0.0 | 0.9 |
| 7 items | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 |
| 8 items | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 items | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| All | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Eurostat (2014)

# Cumulative distributions of material deprivation scores in some European countries, 2012




- **NW first-degree dominates UK, IT**

- **No first-degree dominance**

  UK ahead of IT up to 5 items, but behind IT for 6/7 items

  FR and GE also cross

# Second-degree dominance

- First-degree dominance might be too demanding in practice
- Define weaker dominance criteria, i.e. impose stricter conditions on preference ordering of social evaluator
- In counting deprivation account for:
  - **intersection criterion**

    aggregate “from above”, looking first at the proportion of those who are deprived in *r* dimensions, then adding the proportion of those failing in r-1 dimensions, and so forth
  - **union criterion**

    aggregate “from below”

# Second-degree dominance

- Definition 2A. *A deprivation count distribution $F_1$ is said to second-degree downward dominate a deprivation count distribution $F_2$ if*

$$\sum_{k=s}^{r} F_1(k) \geq \sum_{k=s}^{r} F_2(k) \text{ for all } s = 0,1,\ldots,r$$

*and the inequality holds strictly for some s*.

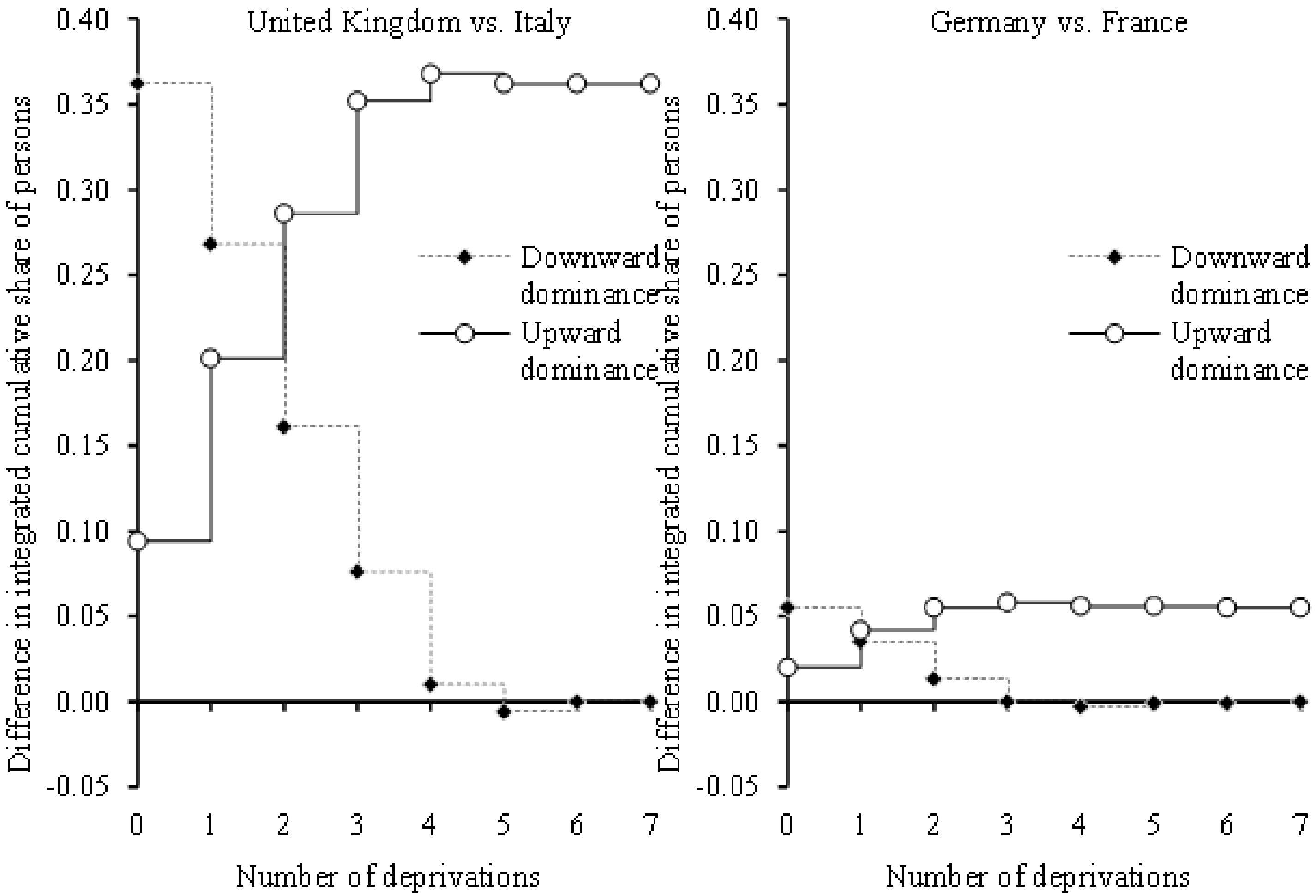
- Definition 2B. *A deprivation count distribution $F_1$ is said to second-degree upward dominate a deprivation count distribution $F_2$ if*

$$\sum_{k=0}^{s} F_1(k) \geq \sum_{k=0}^{s} F_2(k) \text{ for all } s = 0,1,\ldots,r$$

*and the inequality holds strictly for some s*.

**If $F_1$ second-degree dominates $F_2$, then $F_1$ exhibits less deprivation than $F_2$, but at cost of stricter conditions**

# Second-degree dominance for material deprivation scores in some European countries, 2012




- **Agreeing on whether *to go up* (union) or *to go down* (intersection) not sufficient**
- If integrate going up, UK/GE second-degree (upward) dominates IT/FR
- If integrate going down, no country second-degree (downward) dominates the other

# Complete ordering (1)

- Impose an independence axiom for preference ordering $\succeq$
  $\rightarrow$ roughly, weight differently certain parts of the distributions

- Axiom (Independence). *Let $F_1$ and $F_2$ be members of **F**. Then* $F_1 \succeq F_2$ *implies* $\alpha F_1 + (1-\alpha)F_3 \succeq \alpha F_2 + (1-\alpha)F_3$ *for all $F_3 \in$ **F** and* $\alpha \in [0,1]$.

- If overall count deprivation is lower in country 1 than in country 2, so that $F_1$ is weakly preferred to $F_2$, the ranking would not change by adding to the population of either country the same group of migrants, whose deprivation distribution is $F_3$

- **Ordering relation invariant with respect to aggregation of sub-populations across deprivations**

- *NB: alternative Dual Independence axiom*

# Complete ordering (2)

- **Independence Axiom** leads to deprivation measures:

$$d_\gamma(F) = \sum_{k=0}^{r} \gamma(k) q_k = \begin{cases} \gamma(\mu) + \delta_\gamma(F) & \textit{when } \gamma \textit{ is convex} \\ \gamma(\mu) - \delta_\gamma(F) & \textit{when } \gamma \textit{ is concave} \end{cases}$$

where $$\delta_\gamma(F) = \begin{cases} \sum_{k=0}^{r} \left(\gamma(k) - \gamma(\mu)\right) q_k & \textit{when } \gamma \textit{ is convex} \\ \sum_{k=0}^{r} \left(\gamma(\mu) - \gamma(k)\right) q_k & \textit{when } \gamma \textit{ is concave} \end{cases}$$

and , $\gamma(k)$ with $\gamma(0) = 0$, is a non-negative, non-decreasing continuous function of the number of deprivations *k*

- **Deprivation intensity function $\gamma(k)$ : curvature reflects how much we dislike increasingly severe deprivations in <u>convex case</u>, or growingly diffused deprivations in <u>concave case</u>**

# Complete ordering (3)

- **Independence Axiom** leads to deprivation measures:

$$d_\gamma(F) = \sum_{k=0}^{r} \gamma(k) q_k = \begin{cases} \gamma(\mu) + \delta_\gamma(F) & \textit{when } \gamma \textit{ is convex} \\ \gamma(\mu) - \delta_\gamma(F) & \textit{when } \gamma \textit{ is concave} \end{cases}$$

- $\gamma(k) = \mathrm{k}$ for all $k \rightarrow d_\gamma(F)=\mu$

  only mean matters: social preferences ignore deprivation dispersion; same result as with composite index approach

- **When dispersion matters, judgement depends on whether social preferences give more weight to ...**

  **... *s* people with 1 deprivation each (then concave function $\gamma$)**

  **... or to 1 person with s deprivations (then convex function $\gamma$)**

# Complete ordering (4)

- **Independence Axiom** leads to deprivation measures:

$$d_\gamma(F) = \sum_{k=0}^{r} \gamma(k) q_k = \begin{cases} \gamma(\mu) + \delta_\gamma(F) & \textit{when } \gamma \textit{ is convex} \\ \gamma(\mu) - \delta_\gamma(F) & \textit{when } \gamma \textit{ is concave} \end{cases}$$

- Inserting $\gamma(k)=2rk-k^2$ (concave) and $\gamma(k)=k^2$ (convex), the term $\delta_\gamma(F)$ equals the variance
- Inserting $\gamma(k)=(k/r)^\theta$, $d_\gamma(F)$ is analogue of ***FGT* measures** and generalises **Atkinson (2003) counting measure** (defined for $r$=2)

$$A_\theta = 2^{-\theta}\left[p_{1+} + p_{+1} + 2(2^{\theta-1} - 1)p_{11}\right] = 2^{-\theta}\left(p_{1+} + p_{+1}\right) + \left(1 - 2^{1-\theta}\right)p_{11} = 2^{-\theta} q_1 + q_2$$

$A_0=q_1+q_2$ → union: all people with at least one deprivation<br>
$A_1=(p_{1+}+p_{+1})/2$ → mean of headcount rates (as composite index)<br>
$A_\infty=p_{11}=q_2$ → intersection: only people with both deprivations

# Indices of material deprivations in some European countries, 2012

| Index | | Germany | France | Italy | United Kingdom | Norway | Germany vs. France | United Kingdom vs. Italy |
|---|---|---|---|---|---|---|---|---|
| *Linear indices* | | | | | | | | |
| Mean deprivations | | 0.822 | 0.877 | 1.471 | 1.109 | 0.320 | -6.3 | -24.6 |
| *Concave indices* | | | | | | | | |
| $d_\theta^{GA}$ | $\theta \to 0$ | 0.400 | 0.420 | 0.604 | 0.510 | 0.166 | -4.8 | -15.6 |
| | $\theta = 0.1$ | 0.340 | 0.358 | 0.523 | 0.436 | 0.140 | -5.0 | -16.6 |
| | $\theta = 0.5$ | 0.184 | 0.195 | 0.303 | 0.241 | 0.074 | -5.7 | -20.4 |
| | $\theta = 0.9$ | 0.104 | 0.111 | 0.184 | 0.140 | 0.041 | -6.2 | -23.8 |
| $d_2^{V,concave}$ | | 12.550 | 13.399 | 21.883 | 16.747 | 4.914 | -6.3 | -23.5 |
| *Convex indices* | | | | | | | | |
| $d_\theta^{GA}$ | $\theta = 1.1$ | 0.080 | 0.086 | 0.146 | 0.109 | 0.031 | -6.3 | -25.3 |
| | $\theta = 2$ | 0.028 | 0.029 | 0.057 | 0.040 | 0.010 | -5.9 | -30.0 |
| | $\theta = 3$ | 0.011 | 0.011 | 0.023 | 0.016 | 0.004 | -3.6 | -31.6 |
| | $\theta = 4$ | 0.005 | 0.005 | 0.010 | 0.007 | 0.002 | 0.4 | -30.1 |
| | $\theta = 8$ | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 20.6 | -13.5 |
| | $\theta = 9$ | 0.0003 | 0.0002 | 0.0005 | 0.0005 | 0.0001 | 42.8 | 2.3 |
| | $\theta = 20$ | $7.6\times10^{-06}$ | $1.3\times10^{-06}$ | $7.8\times10^{-06}$ | $9.4\times10^{-06}$ | $6.6\times10^{-06}$ | 479.9 | 20.9 |
| $d_2^{V,convex} = r^2 d_2^{GA}$ | | 2.246 | 2.387 | 4.595 | 3.215 | 0.846 | -5.9 | -30.0 |

# Complete ordering (5)

- **Dual Independence Axiom** leads to deprivation measures:

$$D_\Gamma(F) = r - \sum_{k=0}^{r-1} \Gamma(\sum_{j=0}^{k} q_j) = \begin{cases} \mu + \Delta_\Gamma(F) & \textit{when } \Gamma \textit{ is convex} \\ \mu - \Delta_\Gamma(F) & \textit{when } \Gamma \textit{ is concave} \end{cases}$$

where $$\Delta_\Gamma(F) = \begin{cases} \sum_{k=0}^{r-1} \left[ \sum_{j=0}^{k} q_j - \Gamma(\sum_{j=0}^{k} q_j) \right] & \textit{when } \Gamma \textit{ is convex} \\ \sum_{k=0}^{r-1} \left[ \Gamma(\sum_{j=0}^{k} q_j) - \sum_{j=0}^{k} q_j \right] & \textit{when } \Gamma \textit{ is concave} \end{cases}$$

and $\Gamma(k)$, with $\Gamma(0)=0$ and $\Gamma(1)=1$, is a non-negative, non-decreasing continuous function of the number of deprivations $k$

- Inserting $\Gamma(t)=2t–t^2$ (concave) and $\Gamma(t)=t^2$ (convex), the term $\Delta_\Gamma(F)$ equals the Gini mean difference

# Association rearrangements

- Pattern of association across dimensions – key feature of multivariate case

  ***How does social welfare respond to change in distribution of deprivations across people, keeping constant mean deprivations?***

Marginal-free positive association increasing rearrangement

| | $X_2=0$ | $X_2=1$ | |
|---|---|---|---|
| $X_1=0$ | 0.35 | 0.20 | 0.55 |
| $X_1=1$ | 0.20 | 0.25 | 0.45 |
| | 0.55 | 0.45 | 1 |

| | $X_2=0$ | $X_2=1$ | |
|---|---|---|---|
| $X_1=0$ | 0.36 | 0.19 | 0.55 |
| $X_1=1$ | 0.19 | 0.26 | 0.45 |
| | 0.55 | 0.45 | 1 |

- Attributes are **substitute** (one attribute can compensate for the lack of the other) if the deprivation measure increases after a correlation increasing shift; they are **complement** if the deprivation measure decreases
- Helps to refine ranking criteria $\rightarrow$ equivalence results

# Counting deprivations vs. poverty (1)

- Concern with distribution of deprivation counts $\rightarrow$ focus on “aggregation” more than “identification”, in Sen’s distinction
- Contrast between union and intersection criteria suggests there is some leeway in defining “who is poor”
- Union and intersection are extremes: intermediate cases
  - European Union regards as severally materially deprived all persons who cannot afford at least four out of nine amenities
  - Alkire and Foster’s (2011) **“dual cut-off” approach**: dimension-specific thresholds & threshold identifying minimum number of deprivations to be classified as poor

# Counting deprivations vs. poverty (2)

- If a person is poor when deprived in at least $c$ dimensions, 0≤$c$≤1, headcount ratio is uniquely determined by count distribution $F$:

$$\tilde{H}(c) = 1 - F(c-1) = \sum_{k=c}^{r} q_k$$

- Previous analysis carries out replacing F with conditional count distribution

$$\tilde{F}(k;c) = \Pr(X \le k \mid X \ge c) = \frac{F(k) - F(c-1)}{1 - F(c-1)} = \frac{\sum_{j=c}^{k} q_j}{\sum_{j=c}^{r} q_j}, \quad k = c, c+1, \ldots, r$$

with mean $\tilde{\mu}(c) = \dfrac{\sum_{j=c}^{r} j q_j}{\sum_{j=c}^{r} q_j}$

# Counting deprivations vs. poverty (3)

- Alkire and Foster (2011) propose to combine the adjusted headcount ratio

$$\tilde{M}_1(c) = \frac{\tilde{H}(c)\tilde{\mu}(c)}{r} = \frac{1}{r}\sum_{j=c}^{r} jq_j$$

***Ratio of total number of deprivations experienced by the poor to maximum number of deprivations that could be experienced by entire population***

- unequal weights: replace deprivation count for each person by sum of associated weights
- increases if a poor person becomes deprived in an additional dimension (dimensional monotonicity), but indifferent to deprivations of the non-poor as well as to changes in distribution of deprivations across the poor

# Counting deprivations vs. poverty (4)

- *FGT* generalisation accounting for distribution of deprivations across the poor

$$\tilde{M}_{\theta}(c) = \frac{1}{r}\sum_{j=c}^{r} j^{\theta} q_j, \quad \theta > 0$$

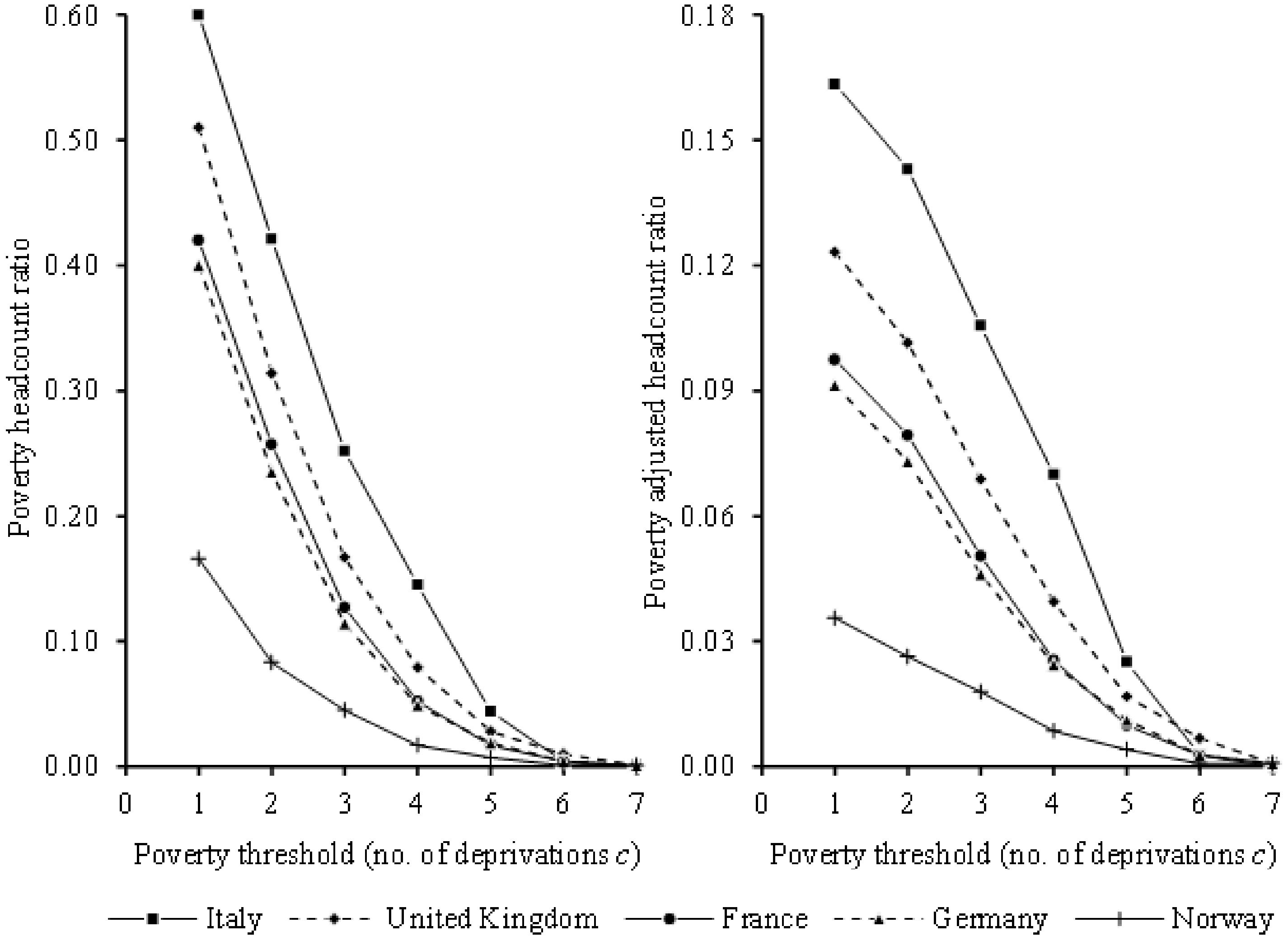
  $\theta$=1 gives Alkire and Foster's measure

  $\theta \to 0$ ignores cumulative effects of multiple deprivations

  As $\theta$ rises, greater weight placed on those who suffer from deprivation in several dimensions

- Alkire and Foster's adjusted headcount ratio has great impact on empirical research and provides theoretical basis for Multidimensional Poverty Index (*MPI*) adopted by the United Nations Development Programme since 2010

# Poverty adjusted headcount ratios for different poverty cut-offs in some European countries, 2012




- Censoring at 4 implies excluding from measured poverty many people suffering from 1, 2 or 3 deprivations ...

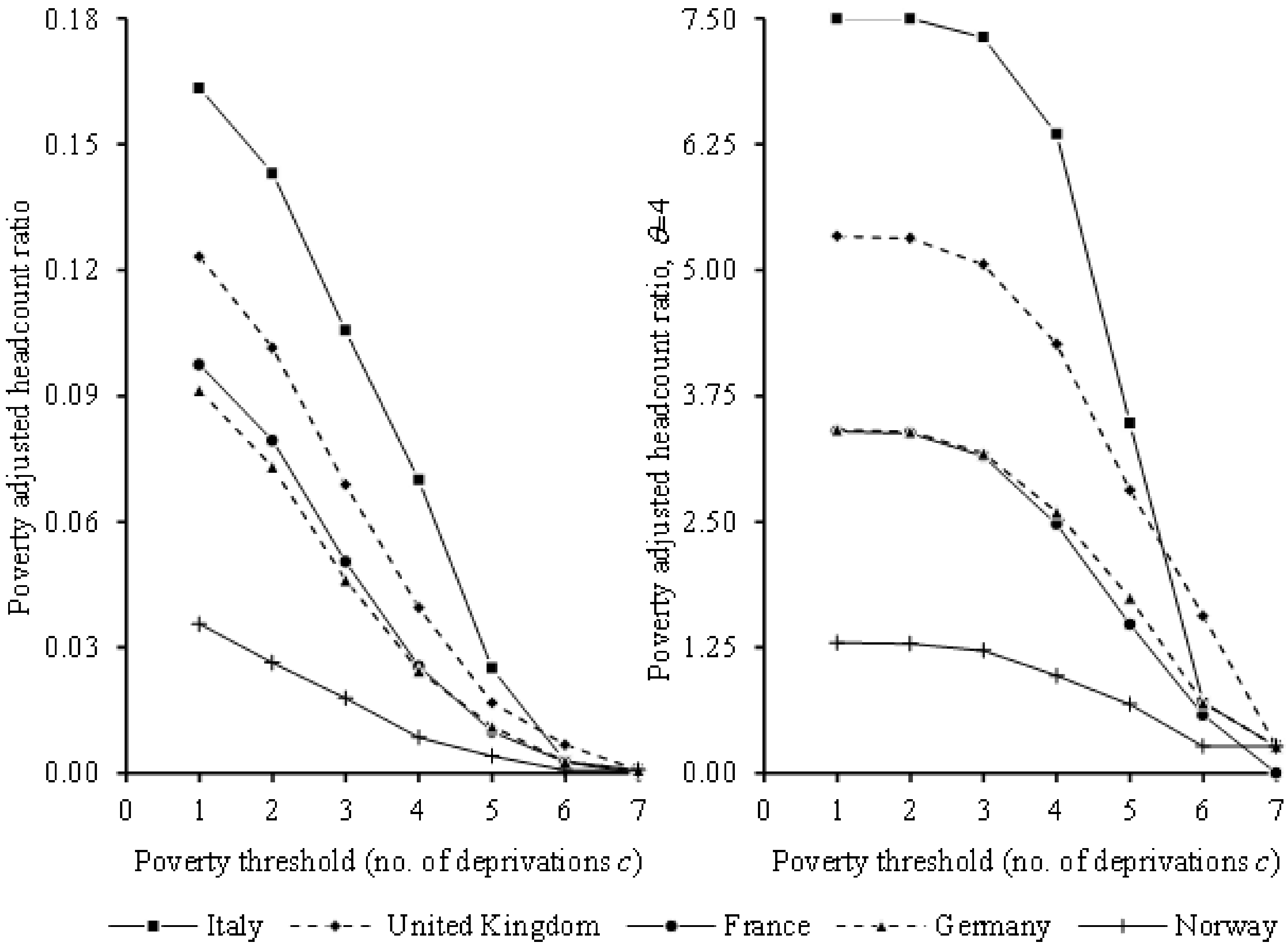
  ... but ranking unchanged

- Ranking changes with cut-off

  at 5: GE and FR reverse order

  at 6: UK country with highest share of poor

# Poverty adjusted headcount ratios for different poverty cut-offs in some European countries, 2012




- Varying poverty cut-off has considerable impact on measured poverty
- Adjusting headcount ratio for deprivations experienced by the poor has minor effects, unless their distribution is taken into account

# Poverty measurement with continuous variables

# Not only counting (1)

- With continuous variables, use measures multidimensional poverty that fully exploit informational richness of available data
  - aggregate first across dimensions, then across individuals → utility-like function
  - axiomatic simultaneous aggregation approach for measuring multidimensional poverty: aggregate individual shortfalls relative to dimension-specific cut-offs
- Bourguignon and Chakravarty (1999)

$$P_\theta(y;z) = \frac{1}{nr}\sum_{i=1}^{n}\sum_{j=1}^{r} a_{ij}\left(1 - \frac{y_{ij}}{z_j}\right)^{\theta_j}, \quad \theta_j > 1$$

where $a_{ij}$ equal to the weight $w_j$ of attribute $j$ if $y_{ij}<z_j$ and 0 otherwise

- Alkire and Foster (2011) also define previous measure but selecting only poor people (deprived in at least *c* dimensions)

# Not only counting (2)

- Not sensitive to association rearrangement interventions
- To account for correlation between attributes Bourguignon and Chakravarty (1999, 2003) introduce a family of non-additive poverty measures for two-dimensional case

$$P^{*}_{\alpha,\beta}(y;z)=\frac{1}{nr}\sum_{i=1}^{n}\left(\sum_{j=1}^{2}a_{ij}\left(1-\frac{y_{ij}}{z_{j}}\right)^{\beta}\right)^{\frac{\alpha}{\beta}}$$

where $\alpha$ and $\beta$ are non-negative parameters

*Effect of an increasing correlation rearrangement depends on whether the attributes are substitutes ($\alpha>\beta$) or complements ($\alpha<\beta$)*

- ***Many more measures***
- ***Then poverty orderings …***

# Conclusions

- Many different strategies
- Alternative strategies differ for extent of manipulation of elementary data
  - the heavier the structure we impose on data, the closer we are to a complete cardinal measure
  - loss of information & sensitivity to measurement hypotheses (tradeoffs)  vs. narrative capability & communicational power

Andrea says hello

and I will thank for your attention!