

# 8th Conference of the International Test Commission

**Oral Paper Session** July 3, 11.00-12.30 Room: Clauszaal

## ***Tests for challenging concepts***

*Chair:* April Zenisky

(University of Massachusetts Amherst, USA)

## ***Reducing bias in terms of culture: An eight-country study on Explanations of Unemployment***

**Kostas Mylonas** (University of Athens, Greece)

**Adrian Furnham** (University College London,

University of London, UK)

## A few notes

- **Measurement invariance issue in research and psychological assessment**
- **In Cross-Cultural Psychology such a source can be Culture itself (bias in terms of culture”)**
- **Comparable measures across cultures? Across cultural groups within a country? Across *any* groups within a country?**
- **Comparable factor structures across samples can rule out construct bias**

## A few more notes

- In this study, bias within items is considered only
- Some methods dealing with such bias in C-C research and in general research:
  - Item deletion, or whole country-deletion. Validity levels? Country representativeness?
  - Deletion may be decided on statistical methods (SEM, traditional Regression, Partial correlations) and /or psychometric criteria
  - Methodological attempts have shown that even up to 50% of the items may be biased

## ... and a question

**Could we avoid deleting items when striving for comparable factor structures?**

**To do so we should associate them with the bias source that is with an index measuring overall bias in terms of culture.**

**This index could be computed as each sub-sample's (culture's) eccentricity-deviation from the average multidimensional weights in a multivariate solution.**

**If this holds in a Cross-Cultural study, it should hold for factor structures across whichever groups within countries.**

## **Statistical techniques employed in this study:**

- **Multidimensional Scaling (ALSCAL)**
  - Individual Differences Euclidean Distance Model (8 countries)
  - Weirdness index computed for each country
- **Exploratory Factor Analysis Stage #1**  
(Principal Component Analysis, Orthogonal Rotation)
- **Raw score adjustment (reducing error  $s^2$ ) via the weirdness index**
- **Exploratory Factor Analysis Stage #2 (for the adjusted raw scores)**  
(Principal Component Analysis, Orthogonal Rotation)
- **Covariance Structure Analysis (Muthén, 1994)**  
as Expanded to Factor Analysis by van de Vijver and Poortinga (2002)

**The aim was not to describe the structure *per se* or to arrive at an invariant structure, but to compare across the EFA solutions  
(before and after adjustment of the raw scores)**

## The Explanations of Unemployment Scale (1982, 2007, & 2009)

### **Explanations of Unemployment Scale - Adrian Furnham, 1982**

**Theoretical Dimensions (20 items) in original theory:**

**Individualistic, Societal, Fatalistic - Subsequent studies found different structures across cultures (e.g. Feather, 1985; Ward, 1991)**

**Adaptation stage (pilot studies and a factor analysis one resulted into a 19-item scale with 8 original and 11 new items, Mylonas & Mitsostergiou, 2007). Scoring scale: seven-point Likert type, 7="not the reason for unemployment"**

**The outcomes closely resembled the theoretically proposed structure.**

**2009 onwards study (*my thanks to all country collaborators*):**

**Data from 8 countries (employed and unemployed samples):**

**U.S., U.K., Turkey, Romania, Brazil, Spain, Greece, Poland (N=1,897)**

## Adjusting the raw scores for their association with bias in terms of cultures

**For the Bivariate Normal Distribution:**

$$\mu_{y_j|x} = \mu_{y_j} + \beta(X - \mu_{x_j}) \quad \sigma_{y_j|x}^2 = \sigma_y^2(1 - \rho^2)$$

**From this, for any correlation and a target variable  $X$ , we can derive that:**

$$s' = \sqrt{s^2 - s^2 r^2}$$

**If the correlation  $r$  reflects the association with the bias source, then the adjusted standard deviation can be considered “free” of this bias.**

*The Weirdness index expresses the amount of variance common with dissimilarity across countries, that is, the higher it gets for a country the more the dissimilarity with the average multidimensional weights for all other countries in the solution. In such a sense, this index does not imply common variance across measures, but common variance with multidimensional dissimilarity across cultures, or bias in terms of culture and can be used in the place of  $r^2$  in the formula above.*

**Through z-scores calculation and solving for  $X$  we can compute the adjusted raw scores  $X'$ . Although  $\bar{X}' = \bar{X}$ , correlations among the adjusted variables are affected by the changes in the standard deviations, so the factor structure is expected to differ across the adjustment stages (see also Mylonas, 2009).**

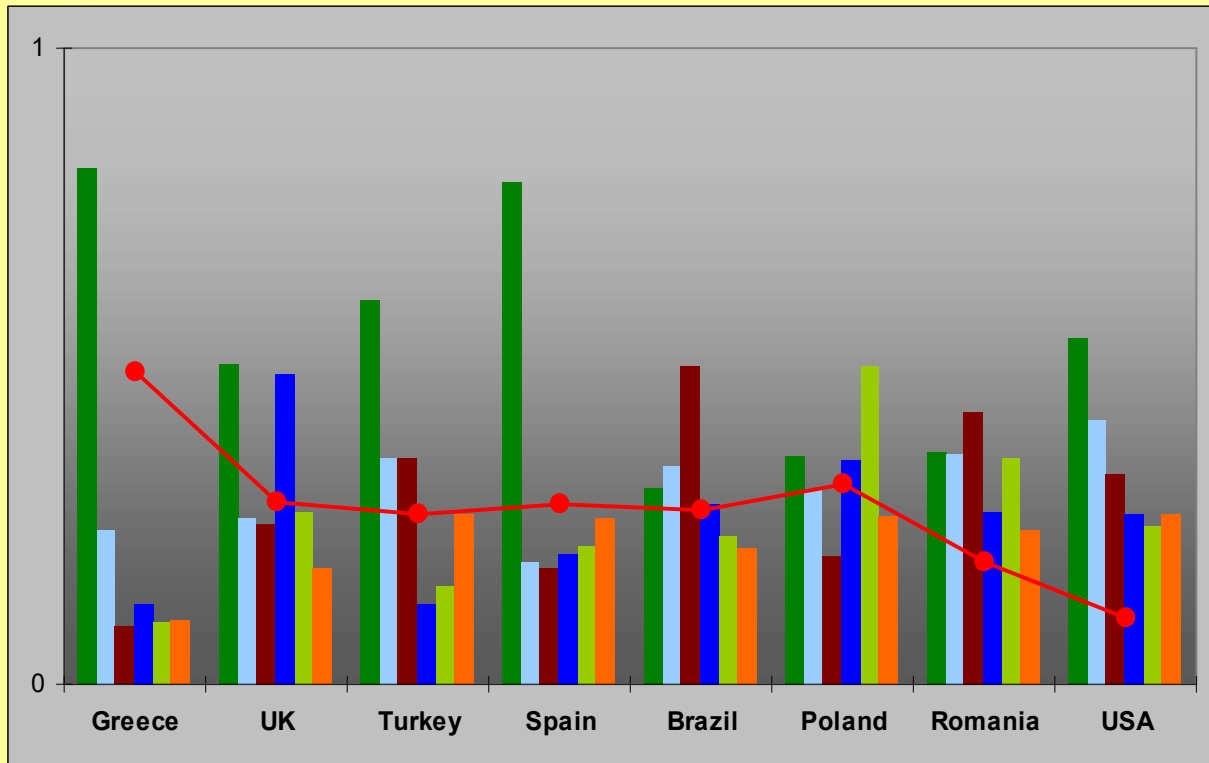
**EFA, stage #1 PCA, orthogonal rotation four-factor solution, non-adjusted scores**

	Component			
	1	2	3	4
<b><u>Percent of variance explained: 59.9</u></b>				
Q1 Incompetent industrial management with poor planning	.35	.06	<b>.57</b>	.26
Q2 Unwillingness of unemployed to move to places of work	.27	.42	.20	<b>.57</b>
Q3 Inability of unemployed people to adapt to new conditions	.23	.46	.28	<b>.59</b>
Q4_N The educational system does not correspond to the current job market	.30	.14	<b>.79</b>	.06
Q5_N Unemployed people lack self knowledge & pursue jobs not corresponding to their qualifications	.16	<b>.50</b>	<b>.55</b>	.15
Q6_N Unemployed people do not qualify for contemporary market needs	.24	.35	<b>.60</b>	.11
Q7 The introduction of widespread automation	<b>.61</b>	.09	.30	.11
Q8_N Lack of vocational guidance and counselling	.47	.19	<b>.56</b>	.00
Q9_N Job positions' overlap and company merging	<b>.68</b>	.01	.25	.17
Q10_N High levels of wages/salaries result into less people employed	<b>.60</b>	.21	.13	.01
Q11_N Production facilities & enterprises have been displaced at other areas or even at other countries	<b>.68</b>	.06	.26	.09
Q12 Unemployed people do not try hard enough to get jobs	.17	<b>.80</b>	.14	.16
Q13 Lack of effort and laziness among unemployed people	.16	<b>.82</b>	.15	.14
Q14_N Employers will easier hire someone without family obligations	<b>.51</b>	.25	.26	-.44
Q15 Unemployed people are too fussy and proud to accept some jobs	.20	<b>.78</b>	.06	-.05
Q16_N Demographic and population changes	<b>.64</b>	.26	.15	.03
Q17_N Enterprises have embraced technology evolution	<b>.72</b>	.18	.25	.06
Q18_N Poor educational system	.33	.17	<b>.75</b>	-.04
Q19 Lack of intelligence and ability among unemployed people	.05	<b>.70</b>	.25	.06

KMO=.94, |D|=.00023, Bartlett's test of sphericity statistically significant, cutoff loading =.50



## Weirdness indices and Procedure-Example



Greece .49

UK .29

Turkey .27

Spain .28

Brazil .27

Poland .32

Romania .19

USA .10

### Numerical example (Polish data)

For  $X_i = 5$  and  $\bar{X} = 2.21$  and  $s = 1.78$ ,  $z\text{-score} = -1.89$ ,  $s' = \sqrt{1.48^2 - 1.48^2 \cdot .32^2} \approx 1.23$

Using  $s'$  and the  $z\text{-score}$  and solving for  $X$ ,  $X' = zs' + \bar{X}$   
 we arrive at an approximate  $X'_i$  of 4.5 which is the adjusted raw score

#### Note:

$\bar{X}' = \bar{X}$  but as raw scores have been adjusted, correlations across items differ → EFA

**EFA, stage #2 PCA, orthogonal rotation four-factor solution, adjusted scores**

	Component			
	1	2	3	4
<b><u>Percent of variance explained: 61.4</u></b>				
Q1 Incompetent industrial management with poor planning	.37	.09	<b>.58</b>	.21
Q2 Unwillingness of unemployed to move to places of work	.30	.40	.21	<b>.59</b>
Q3 Inability of unemployed people to adapt to new conditions	.23	.46	.28	<b>.60</b>
Q4_N The educational system does not correspond to the current job market	.33	.14	<b>.78</b>	.06
Q5_N Unemployed people lack self knowledge & pursue jobs not corresponding to their qualifications	.15	.49	<b>.57</b>	.19
Q6_N Unemployed people do not qualify for contemporary market needs	.24	.34	<b>.61</b>	.14
Q7 The introduction of widespread automation	<b>.58</b>	.10	.36	.03
Q8_N Lack of vocational guidance and counselling	.48	.19	<b>.57</b>	.00
Q9_N Job positions' overlap and company merging	<b>.68</b>	.01	.28	.16
Q10_N High levels of wages/salaries result into less people employed	<b>.62</b>	.18	.13	.11
Q11_N Production facilities & enterprises have been displaced at other areas or even at other countries	<b>.71</b>	.06	.26	.13
Q12 Unemployed people do not try hard enough to get jobs	.17	<b>.80</b>	.15	.16
Q13 Lack of effort and laziness among unemployed people	.16	<b>.83</b>	.16	.13
Q14_N Employers will easier hire someone without family obligations	<b>.53</b>	.25	.27	-.44
Q15 Unemployed people are too fussy and proud to accept some jobs	.21	<b>.79</b>	.06	-.06
Q16_N Demographic and population changes	<b>.65</b>	.27	.16	.04
Q17_N Enterprises have embraced technology evolution	<b>.71</b>	.18	.29	.03
Q18_N Poor educational system	.35	.17	<b>.75</b>	-.03
Q19 Lack of intelligence and ability among unemployed people	.03	<b>.70</b>	.25	.12

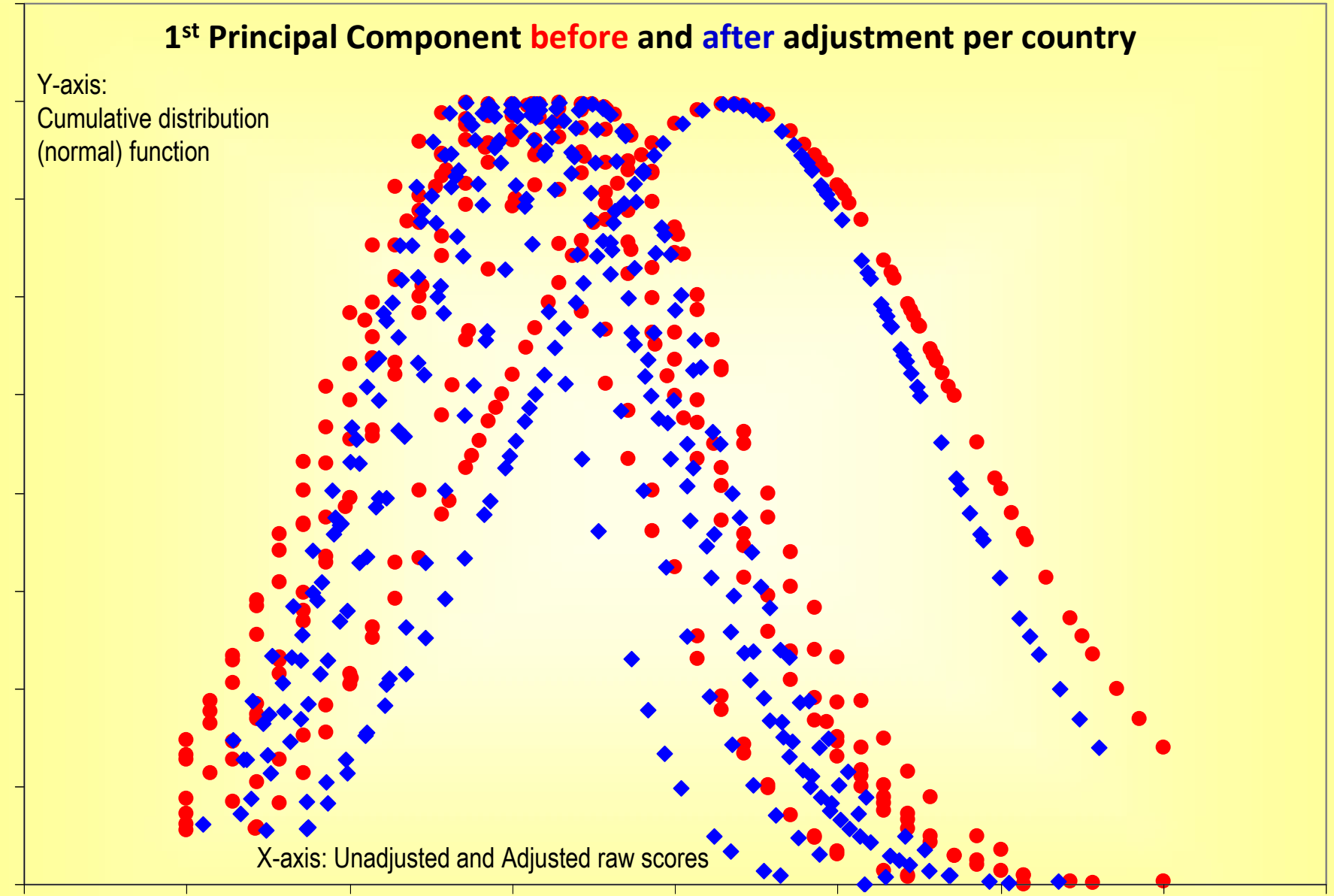
KMO=.94, |D|=.00012, Bartlett's test of sphericity statistically significant, cutoff loading =.50

# 1<sup>st</sup> Principal Component **before** and **after** adjustment per country

Y-axis:  
Cumulative distribution  
(normal) function

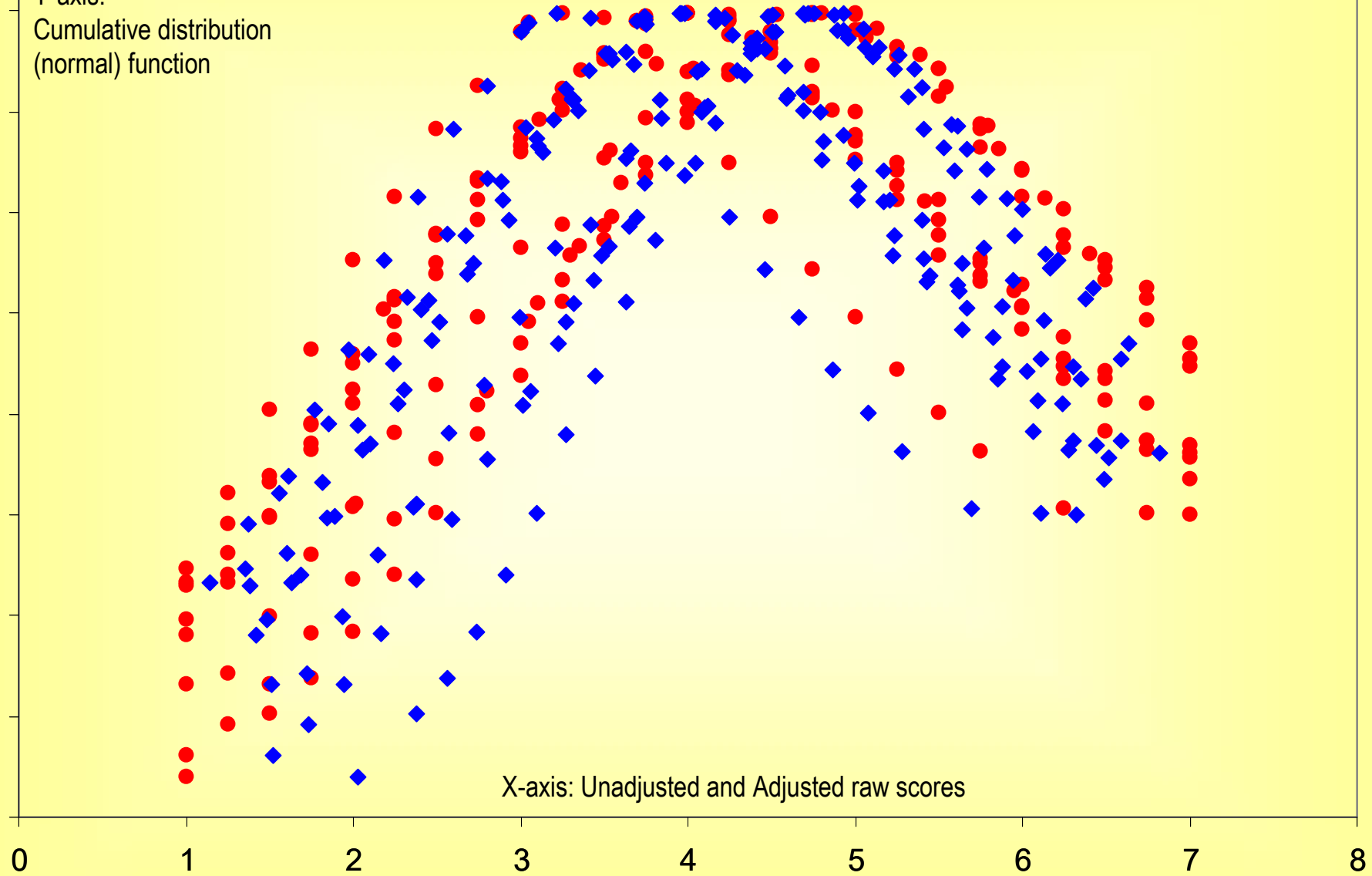
X-axis: Unadjusted and Adjusted raw scores

0 1 2 3 4 5 6 7 8



## 2<sup>nd</sup> Principal Component **before** and **after** adjustment per country

Y-axis:  
Cumulative distribution  
(normal) function

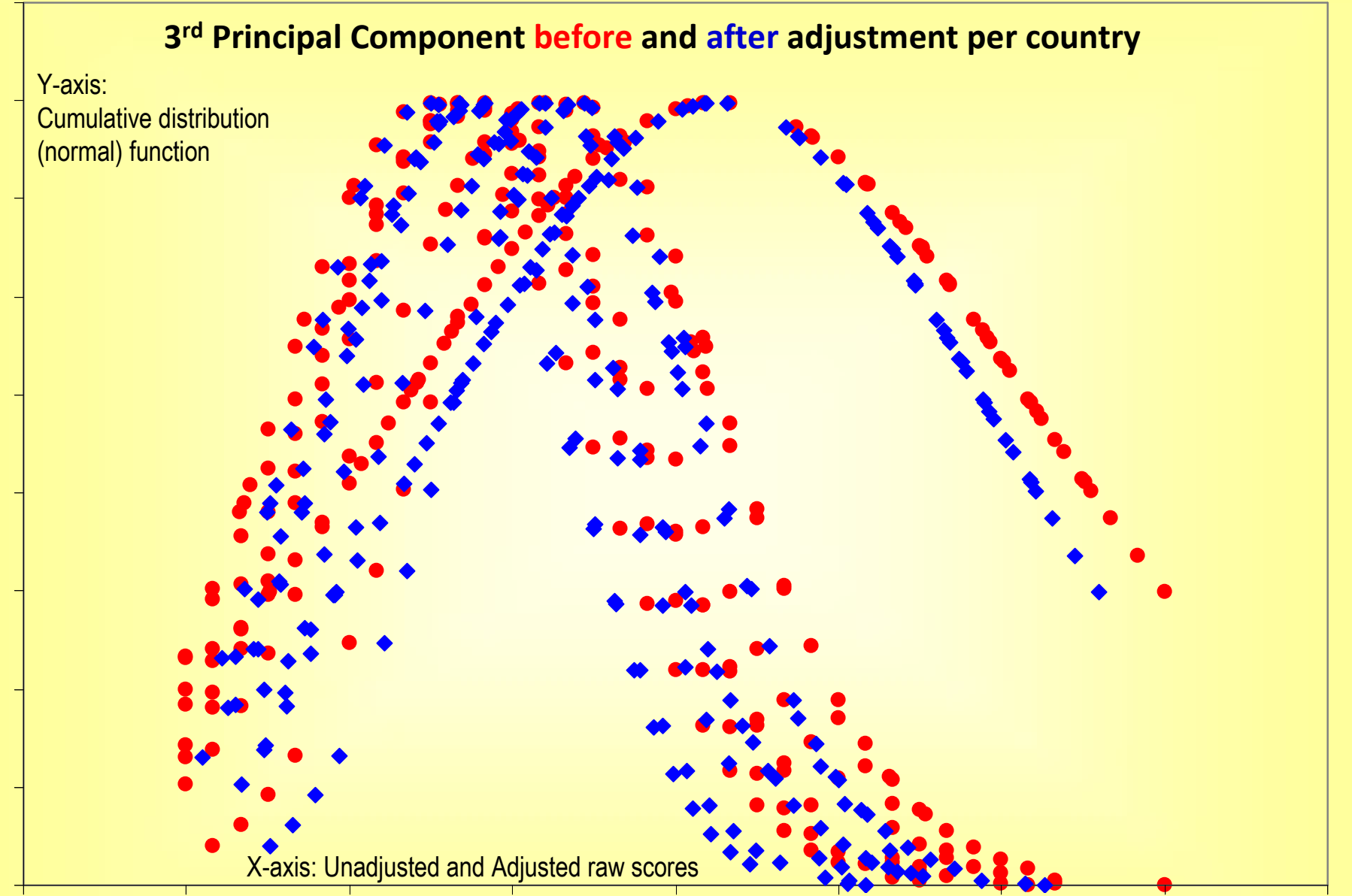


### 3<sup>rd</sup> Principal Component **before** and **after** adjustment per country

Y-axis:  
Cumulative distribution  
(normal) function

X-axis: Unadjusted and Adjusted raw scores

0 1 2 3 4 5 6 7 8



### 4<sup>th</sup> Principal Component **before** and **after** adjustment per country

Y-axis:  
Cumulative distribution  
(normal) function

X-axis: Unadjusted and Adjusted raw scores

0 1 2 3 4 5 6 7 8

## Conclusions

- **Obvious gains, subtle but clear**
- **Kurtosis has been constrained**
- **A source of bias, as depicted in the eccentricity of each sample in respect to the average of all other samples in the study has been eliminated from the original raw data; adjusted raw scores have been re-analyzed having avoided this source of bias**
- **Previous simulation-like studies (Mylonas, 2009) have supported the use of the method, as the second stage results (after the adjustment) are consistently clearer and better identified than the first stage ones**

## Limitations

**The solution reached for the eight countries is a four factor one. This makes no difference in respect to the method proposed, however the component identities should be clarified when factor structure equivalence *per se* will be targeted. Associated to this caveat are the CSA results which were the same across stages and indicated the need for multilevel modeling in future research.**

Thank you.