Competitiveness challenges
Measuring for success

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Benchmarking

- An essential part of strategic management
- Comparison with others
- Monitoring progress
- Identifying success factors

- What is the relationship between
  - e-Readiness
  - Research and Development intensity in Information Sciences
  - Competitiveness
Open data - we are benchmarked ...

- UN - eGovernment Readiness Index
- WEF - Networked Readiness Index
- WEF - Global Competitiveness Index

- For research intensity - number of publications referenced in ACM’s Digital Library
Data availability

- Available for most countries
- Span period since 2002 ... 2005 depending on the index
- For Central and Eastern European countries they look like this
Global Competitiveness Index
UN eGovernment Readiness

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WEF Networked Readiness Index
Number of publications per 1M inhabitants
How do we compare?

- Rankings change from year to year
- By looking at cross-sectional data we lose information on the dynamics of the development process
- Need a way to summarize meaningfully indices as functions of time
Functional Data Analysis

• Specifically designed to enable analysis of functional data

• Functional Principal Component Analysis enables to
  ▪ recognize typical change patterns - one or more characteristic common harmonics of the index as a function of time across different countries
  ▪ estimate proportion of variance explained by the harmonics
  ▪ estimate country scores representing variation among the countries related to each of the harmonics
  ▪ reduce dimensionality while retaining most of the information from the whole time period analyzed
Mean GCI shows steady growth until 2006, and then levels off with slight variations.
1. harmonic - 87.9% of variation - general size
2. harmonic - 7.3% of variation - speed of growth in competitiveness
GCI - Country scores
Mean NRI also shows faster growth in the first part of the period. Form of the curve close to the endpoints of the period should not be interpreted.

1. harmonic - 94.4% of variance - general size
2. harmonic - 2.8% of variance - variation in the period 2007-2010, highest variation in 2009 - how the countries coped with crisis
NRI - Country scores

FPCA scores - NRI

PCA score 2

PCA score 1

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Mean function over countries show again growth until 2006, and then stagnation

1. harmonic - 89.4% of variance - general size, variation among countries is more pronounced between 2005 and 2008
2. harmonic - 6.5% of variance - highlights variation at the beginning of the period and after 2008
UN eGovernment Readiness - Country scores

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Research output shows similar form - growth and then stagnation, however stagnation starts later - probably due to the publication delay.

1. harmonic - 96.5% of variance - general size with variance between countries increasing with time
2. harmonic - 1.8% of variance - countries with positive score started growth earlier
Research output - Country scores
Network Readiness vs. Competitiveness

FPCA scores on NRI vs. GCI

Score on 1. NRI harmonics vs. Score on 1. GCI harmonics

Countries: AT, EE, SI, LT, HU, SK, CZ, PL, RO, UA, GR, LV, HR

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e-Government Readiness vs. Competitiveness
Research Output vs. Competitiveness

FPCA scores on GCI vs. SCI

Critical point?
Conclusions

• Status
  ▪ There is progress
  ▪ Still large variation between the countries
  ▪ Crisis has slowed the growth

• FDA can help visualize and simplify large sets of longitudinal data.

• Taking into account all data, still more than 90% of variation between the countries is due to the size of the indices, and only 2-7% is due to different slope or lag in growth.

• There appears to be a non-linear association between the research output and competitiveness - a critical mass of research activity may be needed before it can have impact on competitiveness.
Thank you!
Questions?