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Security of Energy Considering its Uncertainty, Risks and Economic implications

Vulnerability to energy supply risks across Europe: revisiting the existing indicators

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SECURE workshop on

New Approaches to Secure Europe's Energy Supplies

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Outline

- Introduction
- Dependence indicators for oil and gas
- Vulnerability indicators for oil and gas
- Summarising indicators' information
- Conclusions

Introduction

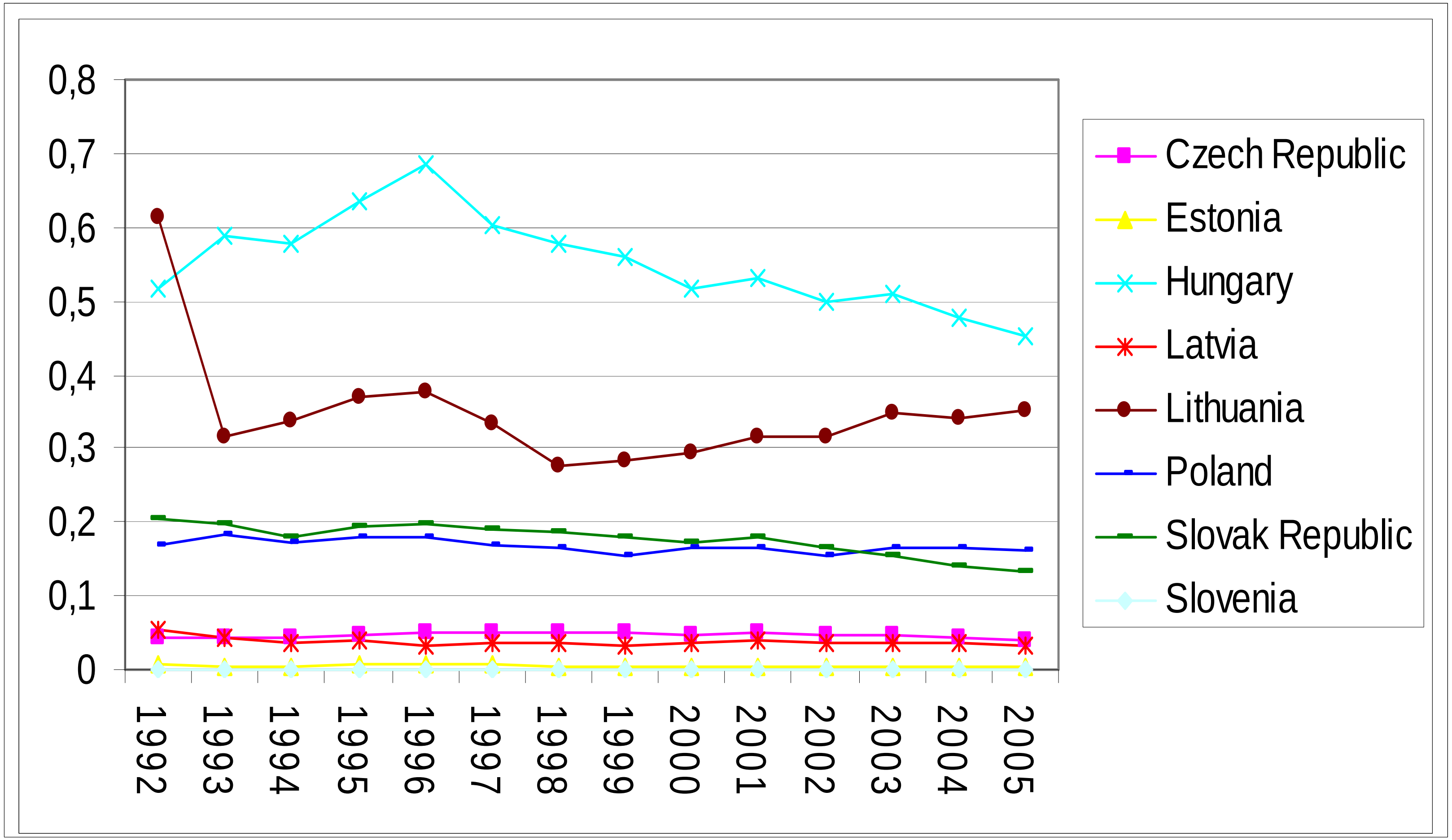
- Indicators for measuring security of energy supply are key instruments for policy-makers in the EU: they help to assess the level of import dependence and economic vulnerability of different European countries.
- However, the available indicators seem to be inappropriate for this purpose.
- A substantial effort to harmonize and fine-tune these indicators is needed to include all energy sources and to integrate both quantitative and qualitative information according to the geopolitical and technical context.
- On the other hand, specificities must not be overlooked

A non exhaustive list of available indicators

	Vulnerability	**Dependence**
Physical Dimension	Imported oil used in transportation (Mtoe)/Total energy used in transportation (Mtoe)	Imports of energy/Total primary energy supply
	Imported Oil and Gas-fired electricity generation (gWh)/Total electricity consumed (gWh)	Country's oil imports/Total oil consumption
	Per capita oil consumption (Ktoe)	Country's gas imports/Total gas consumption
	Degree of supply concentration for oil and gas	
	Shannon-Weiner Index for supply	
	Per capita gas consumption (Ktoe)	
Economic Dimension	Value of oil (or gas) imports/Value of total exports	Oil consumption (Toe) per $ of real GDP
		Gas consumption (Toe) per $ of real GDP

Dependence is a measure of how much the domestic economy relies on sources of energy that are not under its control. **Vulnerability** is a measure of the likelihood of domestic disruption in case some external energy source is reduced or cut off.

Energy dependence indicators in the EU



Gas primary consumption (Ktoe) per MUS$ of real GDP

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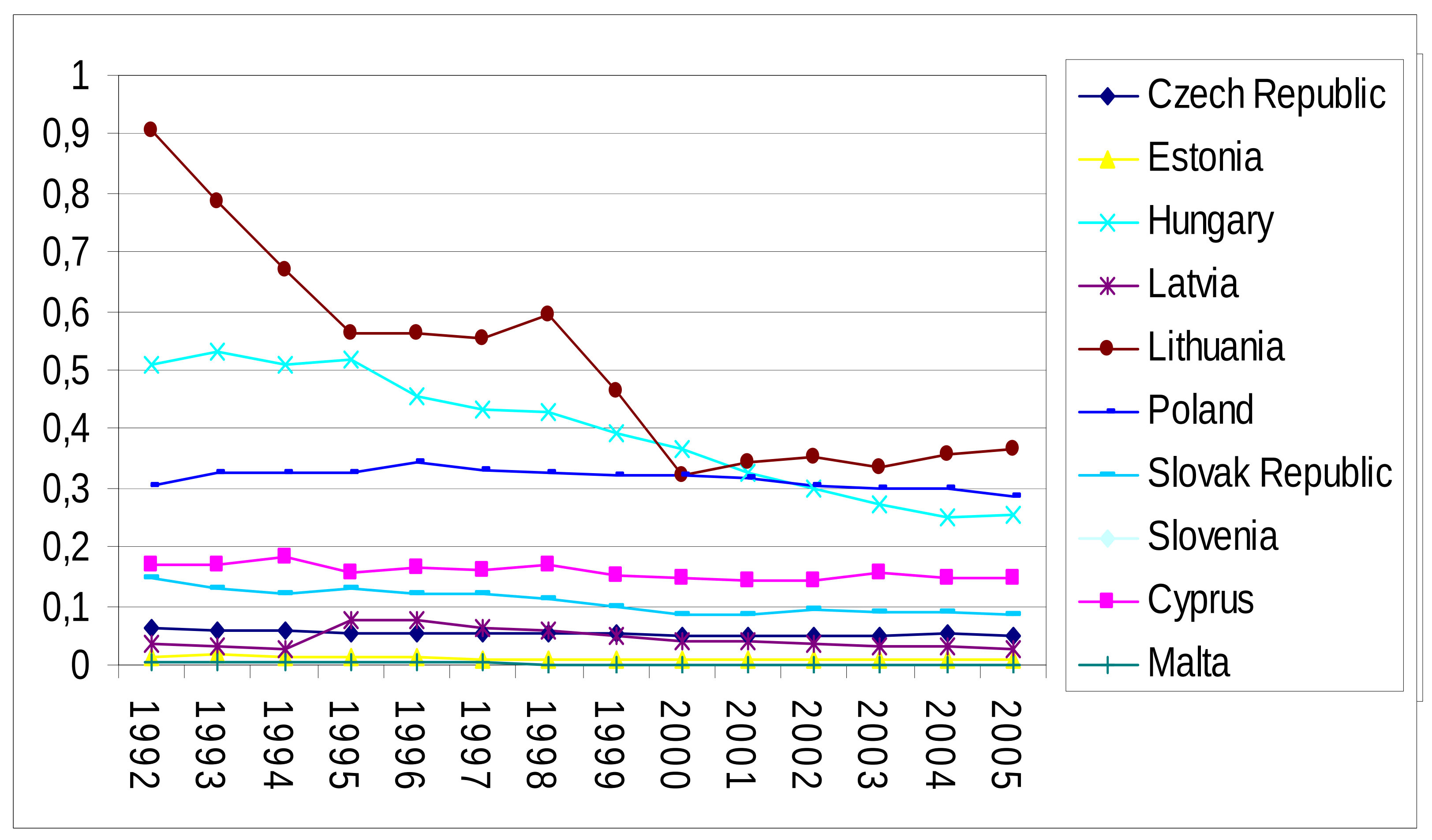
Energy dependence indicators in the EU



Oil Consumption (ktoe) per MUS$ of real GDP

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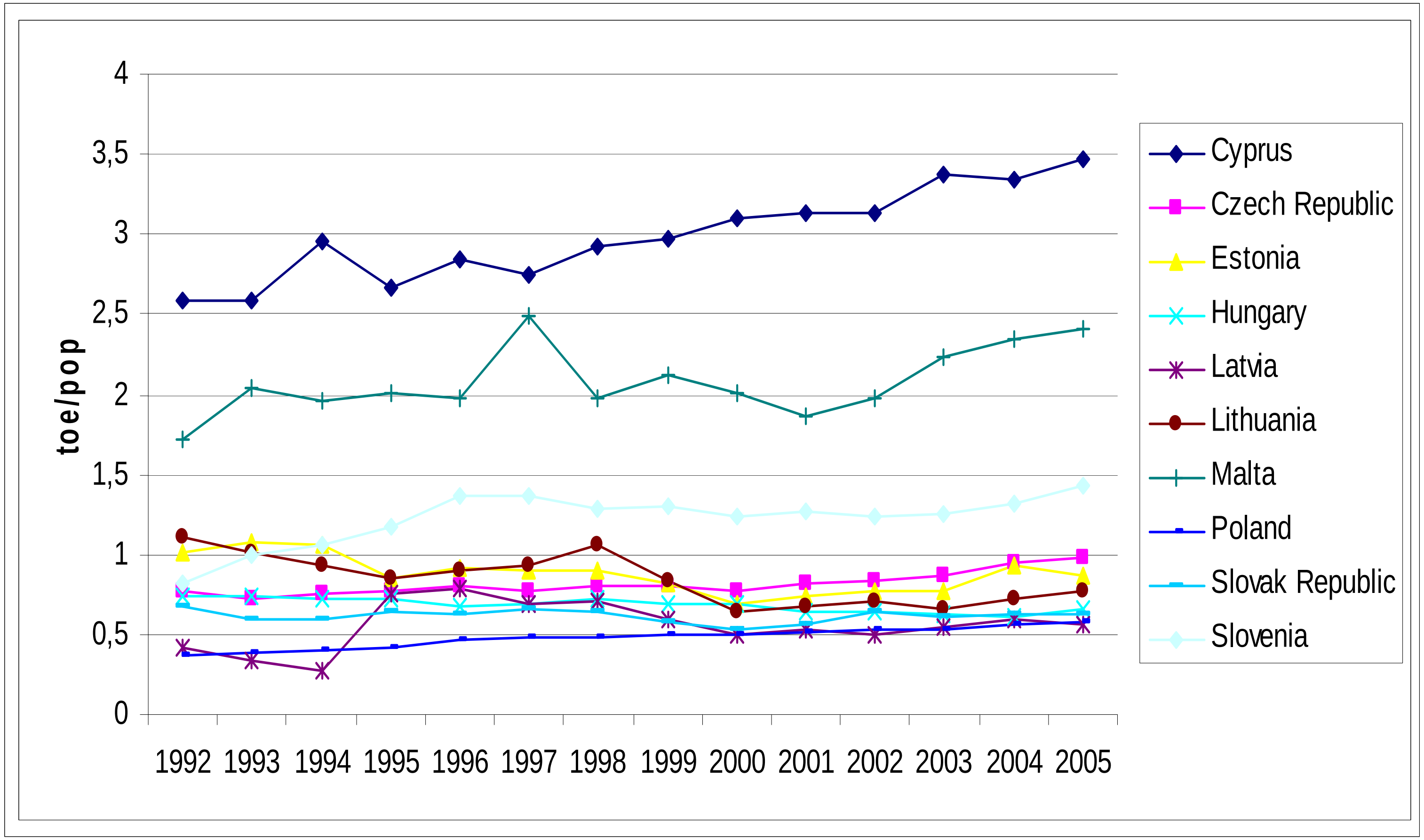
Energy vulnerability indicators in the EU



per capita oil consumption, in selected EU countries (toe/pop)

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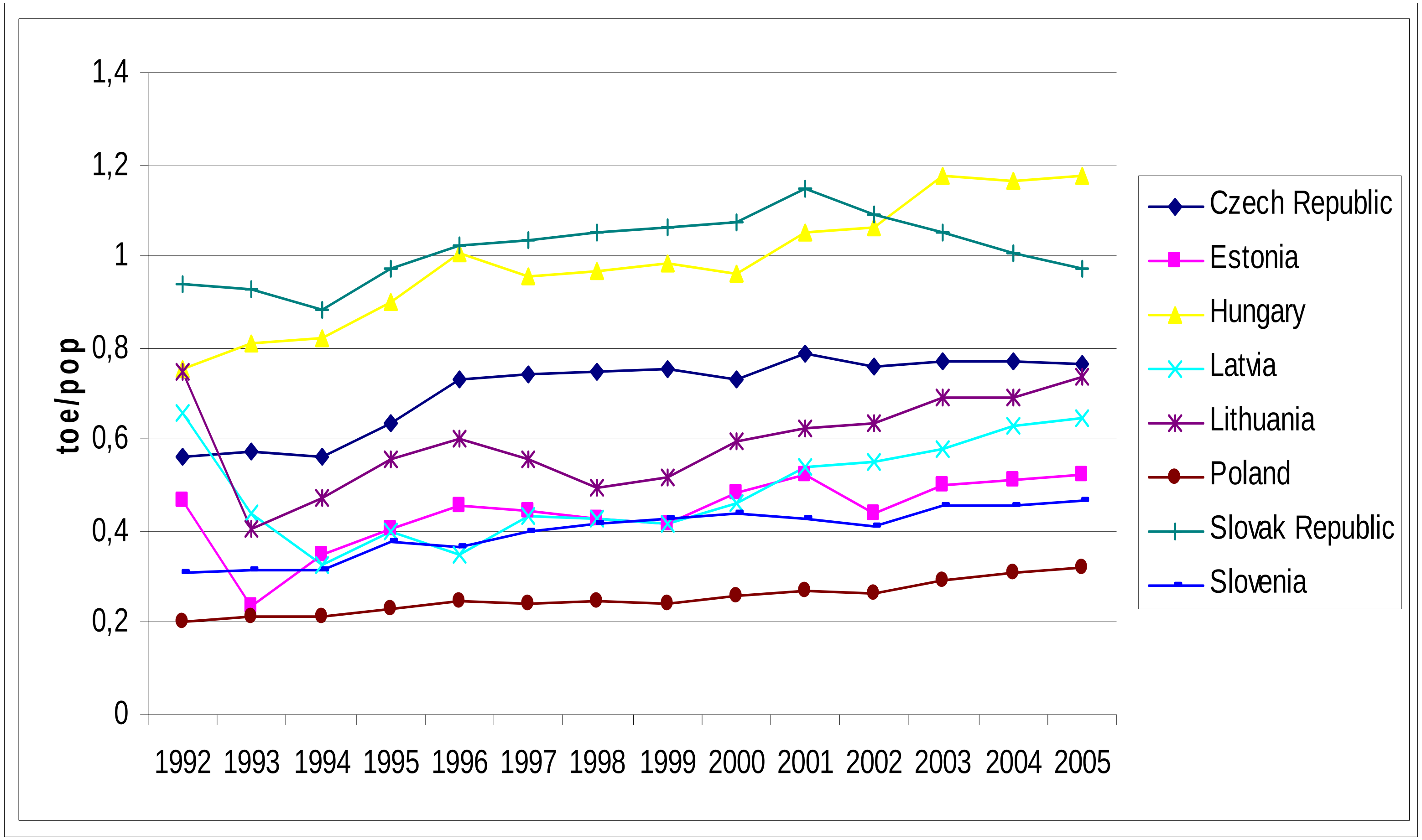
Energy vulnerability indicators in the EU



per capita gas consumption, in selected EU countries (toe/pop)

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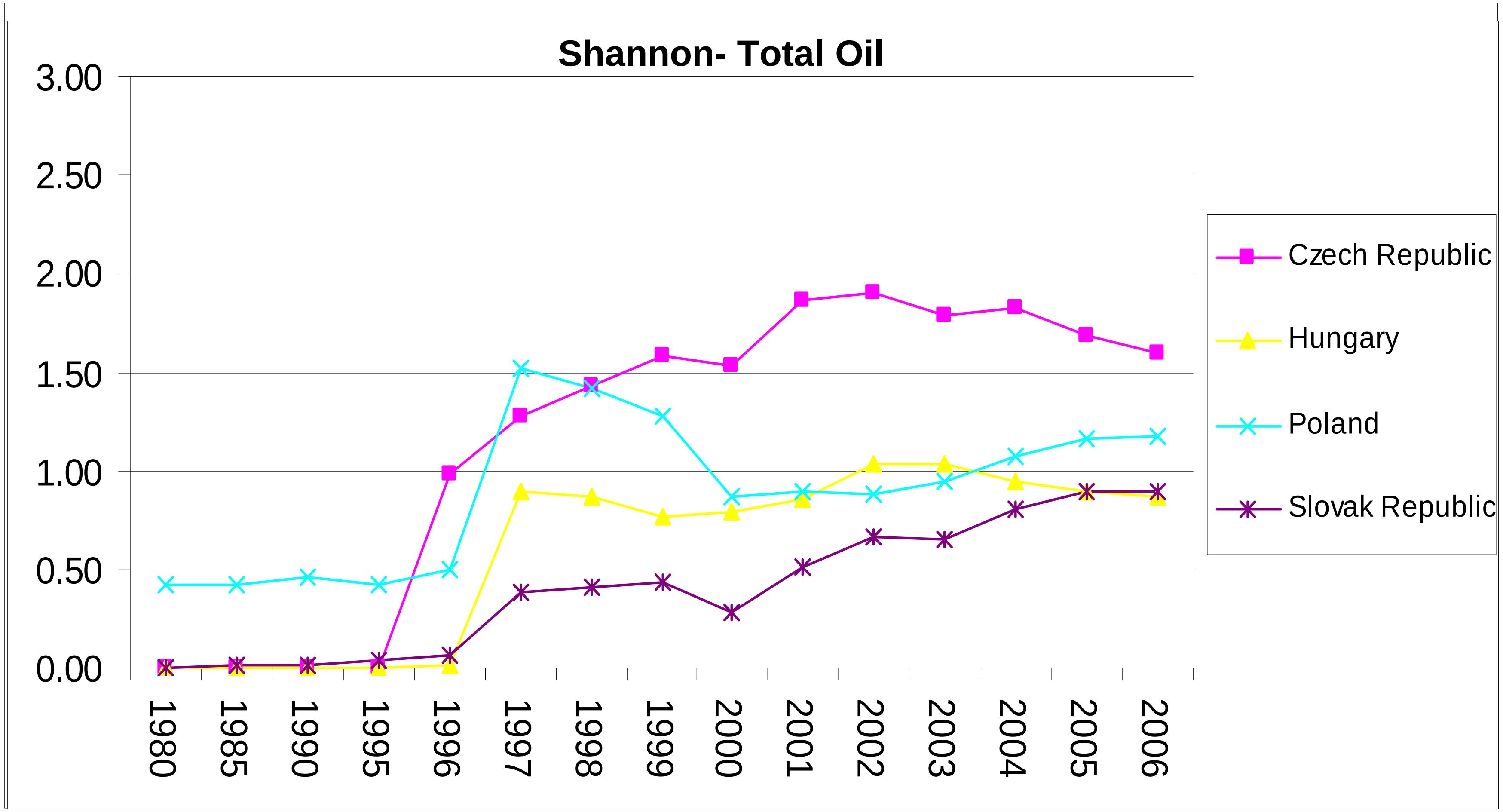
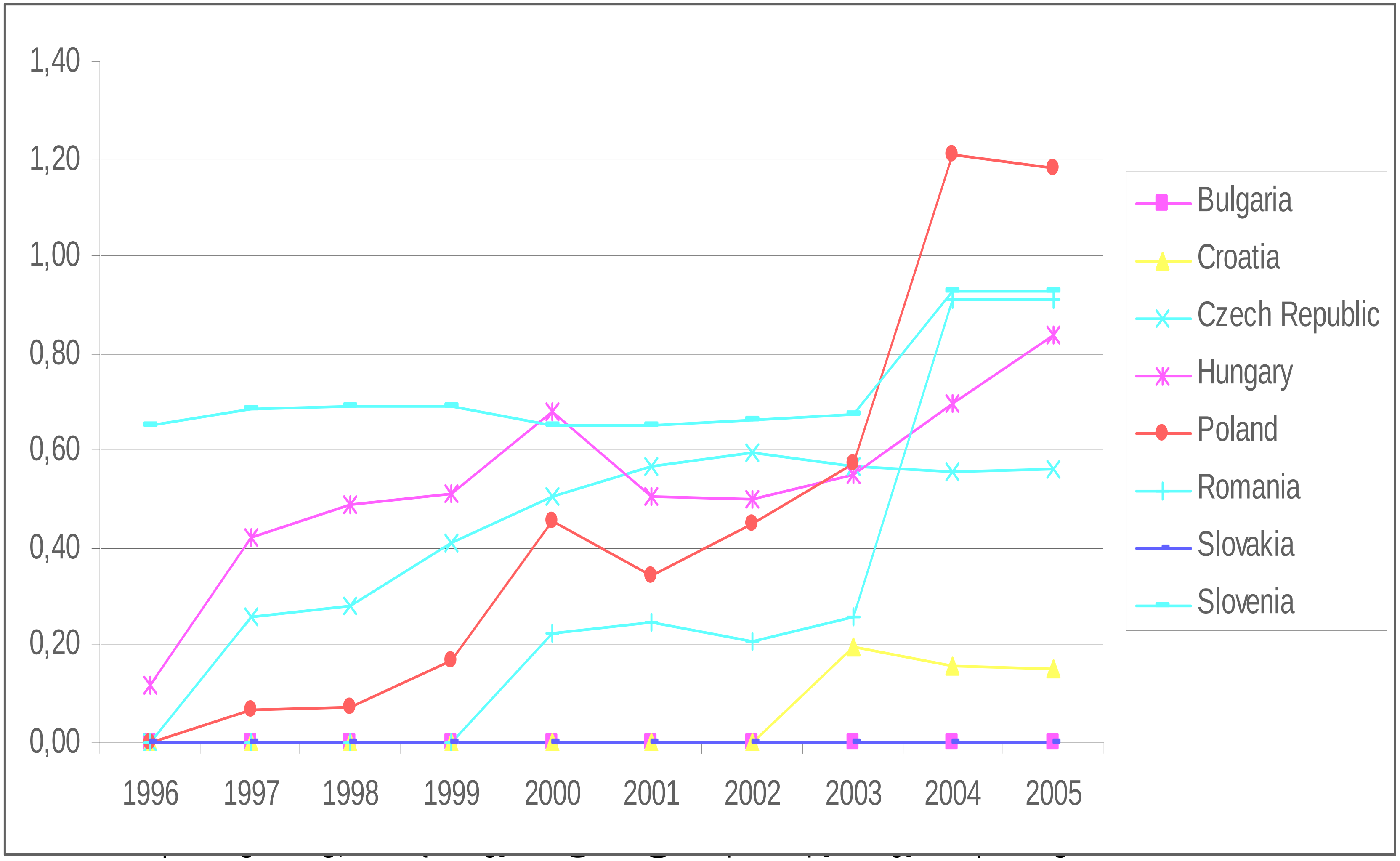
Vulnerability indicators: Shannon -Weiner index



"the higher the better"

Vulnerability indicators: Shannon -Weiner index



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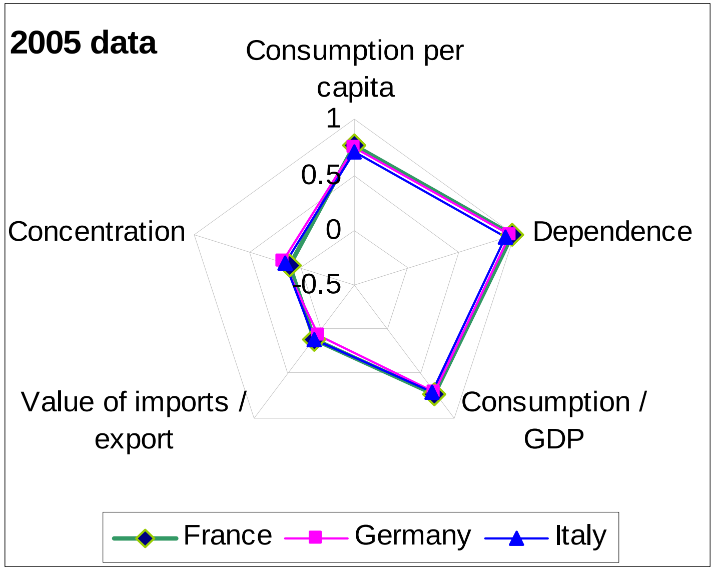
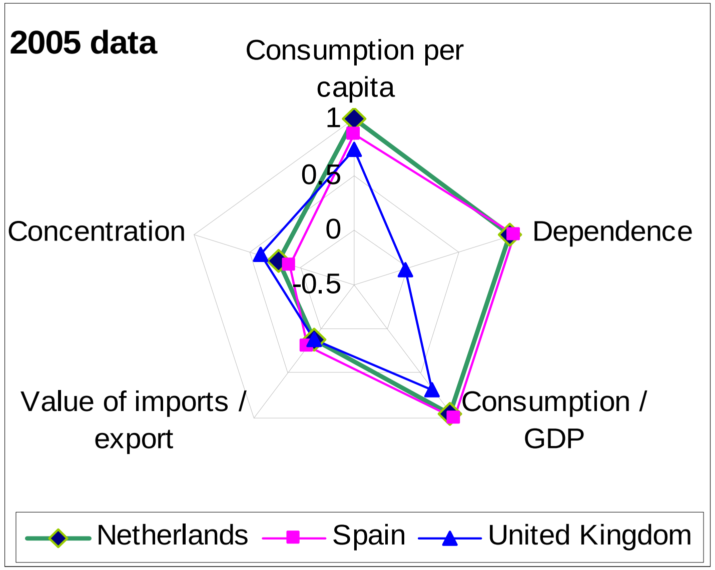
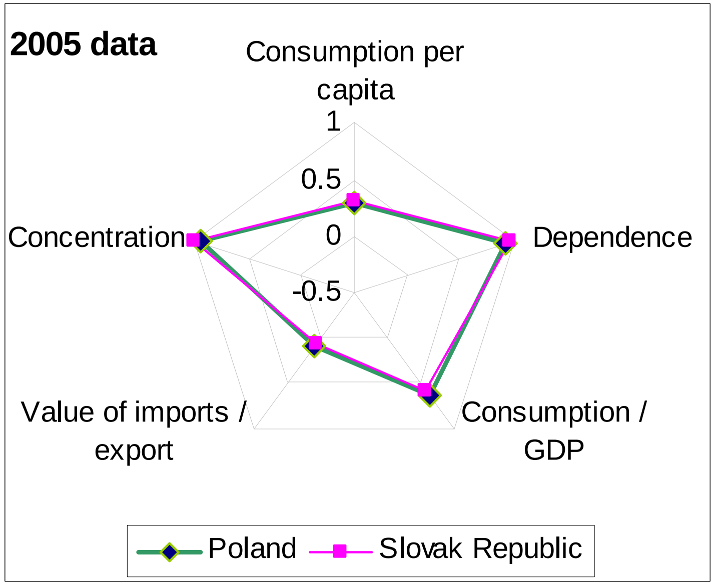
Summarizing indicators' information

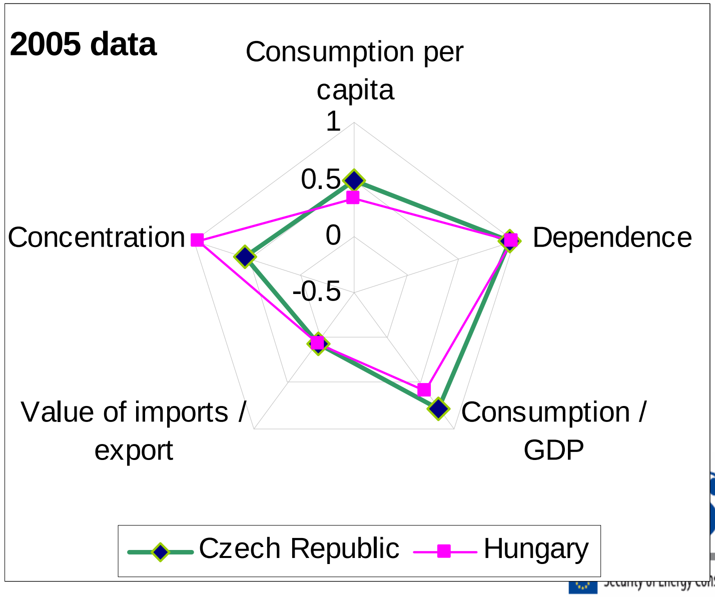
- The amount of information on the various aspects of security of supply that can be conveyed trough the indicators is quite abundant and it can be difficult to get a clear picture of the situation of energy security in Europe.
- This is not unexpected, as different indicators capture different aspects of energy security, which may have different degrees of correlations between each other across Europe.

Summary of main oil indicators in selected countries





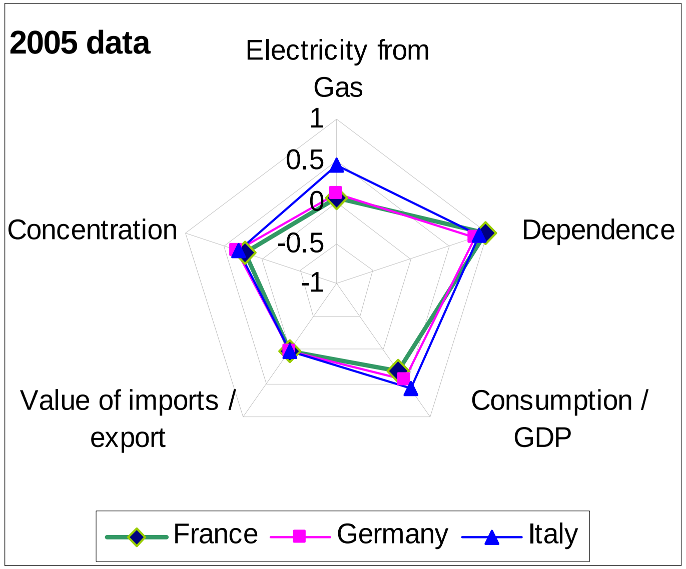


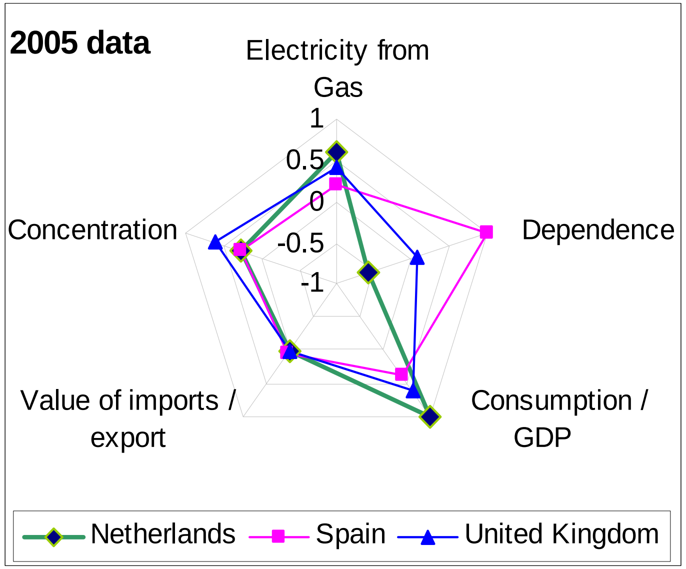


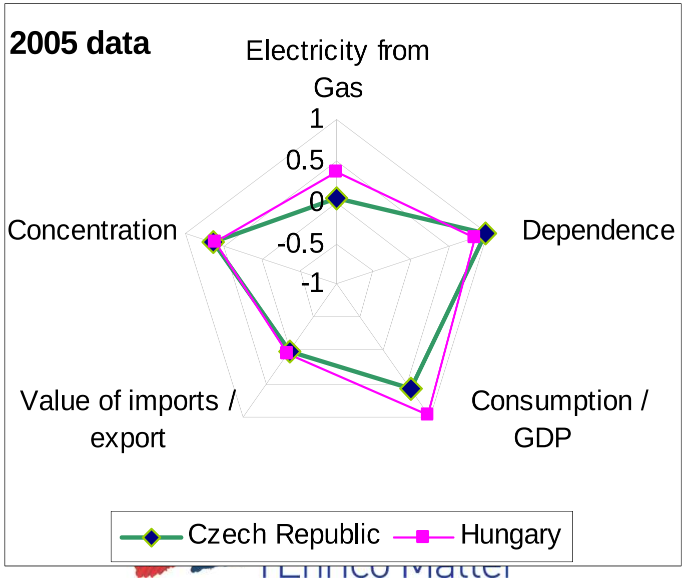
Indicators included:

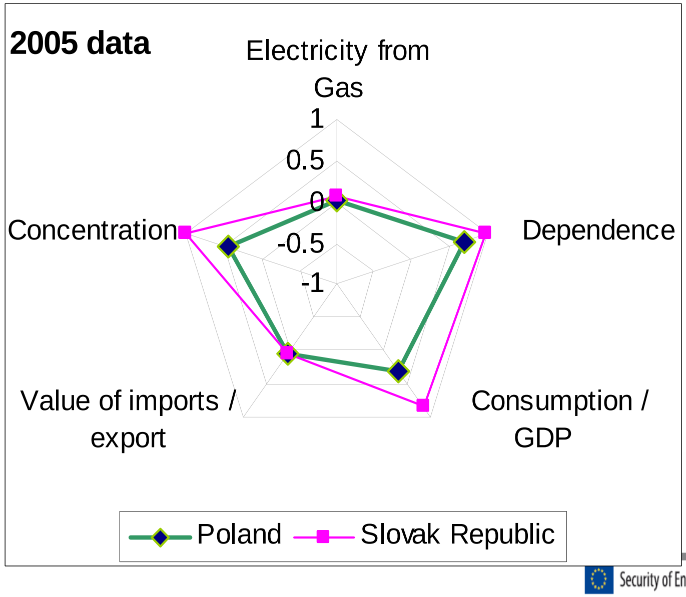
- oil (gas)/gdp;
- oil (gas, energy) dependence;
- per capita oil (gas) consumption; oil (gas) concentration;
- Shannon indexes for oil and gas;
- oil used in transportation;
- oil (and gas) used in electricity generation;
- value of oil (gas) imports /value of total exports

Summary of main gas indicators in selected countries









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Principal components analysis of energy security indicators

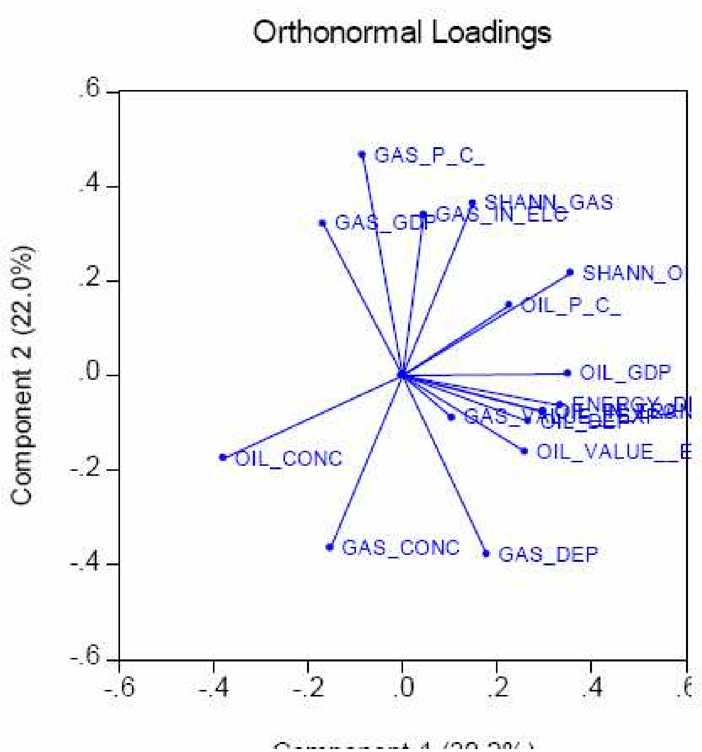
The principal components (PCs) analysis is an econometric technique to single out the main variance trends in a given sample . The outcome is a set of "artificial" variables characterized by the fact that they condense the variation in a handful of uncorrelated variables, which however have no direct economic meaning.

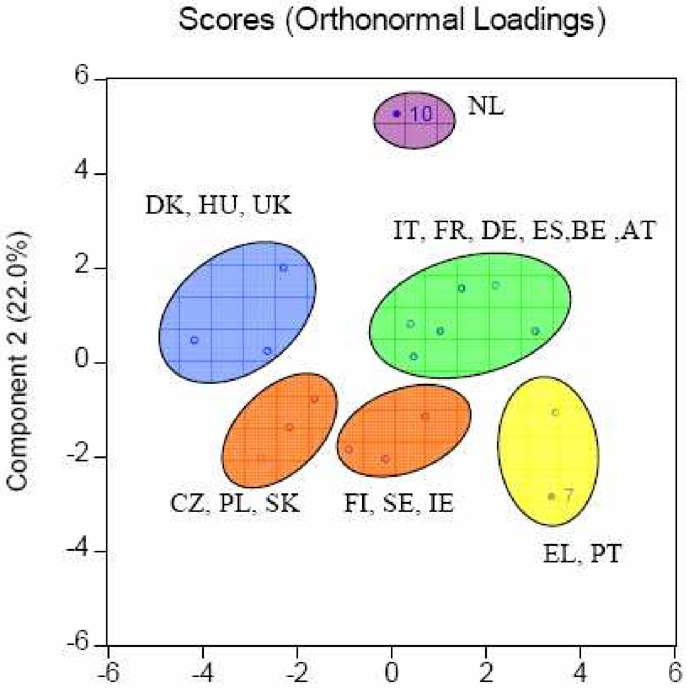
The interpretation of the PCs is given by their correlation with the original variables.

We can use this approach to group indicators that behave more or less in the same way,

- The first principal component (PC1) is negatively correlated with oil concentration (-0.83) and positively correlated with oil/GDP (0.77) and oil Shannon (0,79) indicators. PC2 is negatively correlated with gas dependency (-0.71) and gas concentration (-0.68), while is positively correlated with gas consumption per capita (0.87) and gas Shannon index (0.68).
- In other words, PC1 is related mainly to oil indicators while PC2 is related to gas indicators and this two variables together explain 52% of total variance. This seem to point to a statistically significant difference in the behavior of oil indicators and natural gas indicators.
- **At least in Europe, dependence and/or vulnerability from oil does not imply the same pattern for natural gas, and vice versa.**

Principal component analysis of energy security indicators





Country can be classified in four main categories (distinguished by colors in the graph) according to how they are positioned in the PC space:

- Orange: New accession countries (excluding Hungary) plus Finland, Ireland and Sweden: high level of concentration on imports
- Blue: Denmark, United Kingdom and Hungary: high level of concentration but relative low level on oil and gas dependence and also a low level on oil /GDP indicator
- Green: Main euro-area countries (FR, DE, IT, SP, AT, BE): high level of oil dependence and low level on concentration (imports of oil are diversified)
- Yellow: Greece and Portugal: high level on value of oil imports on total exports (Greece in particular) and high level on oil consumption per unit of GDP

Conclusions

- A common, shared approach is still lacking in the literature about security of supply. Many indicators have been proposed and even though some appear to feature a number of desirable properties (in primis the Shannon-Wiener index), many variants are possible and a number of alternative indicators retain their merits.
- On the quantitative side, there is significant variation among European countries in terms of their dependence from imported fuel and in terms of the vulnerability of their economies, although some clusters of significantly similar countries can be identified.
- The information summarized by means of SoS indicators must not be taken acritically: it is important to frame it organically in its geopolitical and technical context.

Conclusions (cntd.)

- Oil market are global and trade flows can be shifted with relative ease. This implies that the prevalence of a single provider in the oil imports of a given country may be not so much worrying as it may sounds since the provenience and the concentration of oil flows can be modified also in the short run.
- Logistics may play a more relevant role.
- Time horizon: in all major oil crises, production cuts from a producer were eventually compensated by production increases by others, thus leaving global supply scarcely affected in the medium run.
- The situation is more critical in the case of natural gas, for which trade flows are much less flexible and strictly dependent from the available infrastructures.

Conclusions (cont.)

- The challenge of going beyond existing indicators involves
  - combine quantitative information (indicators) with qualitative information
  - harmonise these information within an organic model as far as possible
  - recognise the common elements and the peculiarites of the various energy sectors
  - keep in mind the full picture

Thanks for your attention!

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