FONDAZIONE ENI ENRICO MATTEI

secure
Security of Energy Considering its Uncertainty, Risks and Economic implications

SEVENTH FRAMEWORK PROGRAMME

Energy efficiency in Europe to improve security of supply

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Outline

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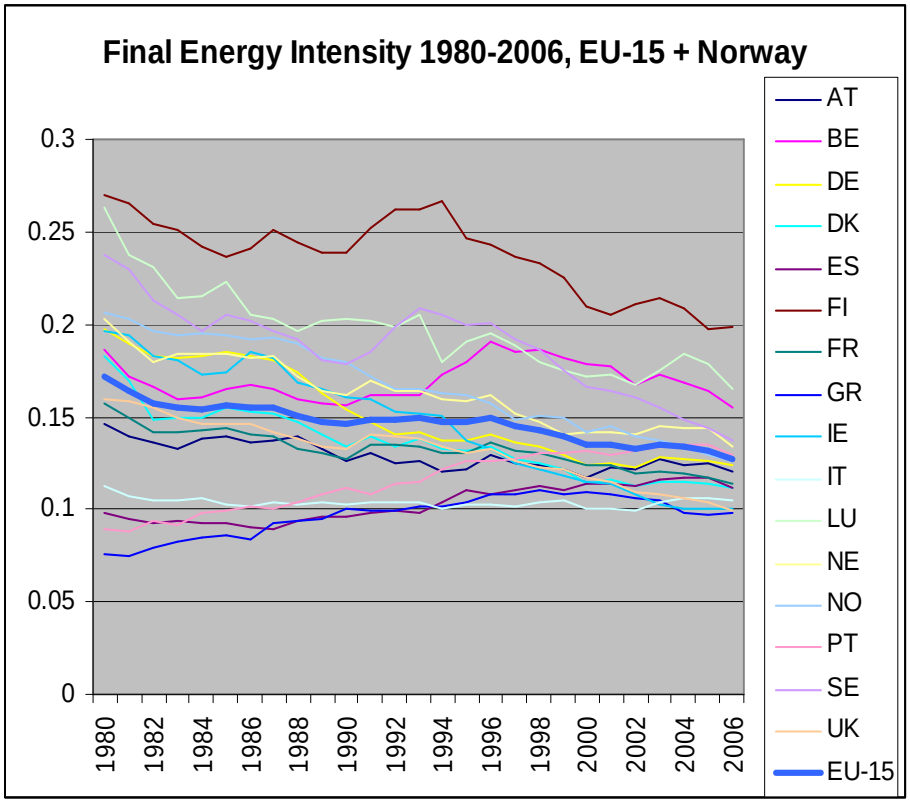
Motivation

- Direct observation of energy intensity trends in Europe suggests that EU countries have converged toward lower energy intensity over the last decades.
- Since the 90's, the EU and its member States have implemented energy policies and measures to reduce energy consumption and carbon emissions.
- POLES strong policy scenarios (EA and GR) prescribe a reduction of 10-20% of primary energy consumption by 2050 in EU 27 compared to baseline. This calls for a more efficient use of energy in the future.
- In recent decades, increasing demand for energy, fluctuating oil prices, uncertain energy supplies and global warming made the EU-citizens realize that secure and safe supplies of energy can no longer be taken for granted.
- It can be argued that one way to reduce the dependence from external energy sources, or the exposure to energy prices volatility and increase, is simply to reduce the demand for energy.
- We check econometrically whether policies and measures that affect indicators of energy efficiency performance have analogous effects on security of supply indicators, both at the whole economy level and within the main sectors of energy use, in the EU15 countries + Norway.

Energy efficiency indicators

- *Energy Intensity:* ratio between final energy consumption and Gross Value Added (GVA). It is an economic measure of the energy requirement that a country, or one of its industries, needs to fulfil for its production;
- *Energy Efficency* is measured as the variation of energy consumption for unit of product with respect to a base year. A downward trend indicates a progressive improvement of the country's energy efficiency.
- *Carbon Intensity* is the ratio of CO_2 emission equivalents generated (in terms of Mton of CO_2) to the indicator of economic activity, GVA. It measures the degree of carbonisation of an economy or of a given productive sector.



Unit of measure: ktoe/00$ppp

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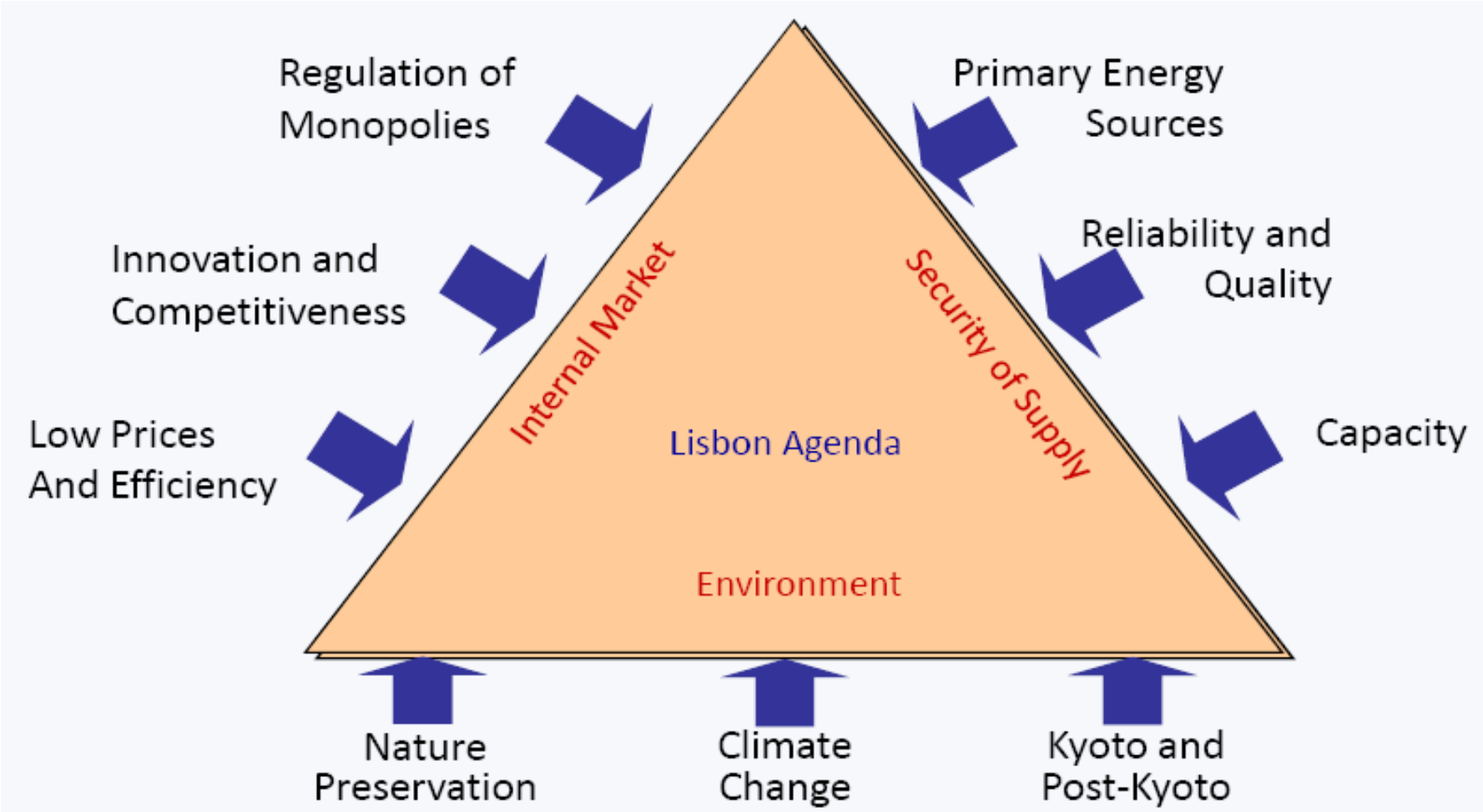
Energy Security: many possible indicators

	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 Policy in the EU (1/2)



Source: Bellmans (2009)

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Energy Policy in the EU (2/2)

Security of supply, sustainability and competitiveness are not independent objectives.

The Green Paper (2006) “A European strategy for sustainable, competitive and secure energy” [COM(2006) 105 final]:

- Identifies priority areas and lists proposals to meet and fine-tune three core objectives:
  1. Increasing **security** of supply;
  2. ensuring the **competitiveness** of European economies and the availability of affordable energy, and;
  3. promoting environmental **sustainability** and combating climate change.

The “20-20-20” objectives : By 2020

- 20% reduction in CO_2 emissions
- 20% increase in renewable source share in TPES
- 20% increase in energy efficiency

EU policies promoting energy saving and efficiency

- Energy efficiency is identified as a key ingredient to improve self-sufficiency and reducing GHG emissions.

1992	*European Directive on labeling of the energy consumption's household*
2000	*Action Plan for Energy Efficiency 2000-2006*
2002	*European Directive on building's efficiency*
2005	*Eco-Design Directive concerning all new products outside of the transport sector*
2006	*European Action Plan for Energy Efficiency (2007-2013)*
2008	*Climate Action and Renewable Energy Package*

Key energy savings policies in the EU. *Source: ADEME*

GP on "Energy Efficiency or doing more with less" (2005):

- to cut energy consumption by 20% by 2020.
- to reduce the dependency on imported oil and gas
- to reduce the energy bill by an estimated 100 billion euro every year.

The EU has proposed directives and regulations concerned with areas where there is potential for energy savings:

- End-use Efficiency & Energy Services;
- Energy Efficiency in Buildings;
- Eco-design of Energy-Using Products;
- Energy Labeling of Domestic Appliances;
- Combined Heat and Power (Cogeneration).

Panel analysis: data and structure (1/2)

Data sources:

The energy indexes (dependent variables) are computed from IEA, Eurostat, Enerdata and OECD data.

The policies were obtained from the MURE database.

The economic time series per country were obtained from Eurostat, the World Development Indicators (WDI) and IEA databases.

Dependent variables:

Energy intensity (EI), energy security (ES) and carbon intensity (CI) indexes calculated for the whole economy, and for Industry, Other (agriculture + tertiary + households) and Transport sectors.

Energy efficiency index (EE) for Households and Transport.

CO_2 emissions for Households.

Panel analysis: data and structure (2/2)

Countries: EU15 + Norway.

Time dimension: 1980 to 2006.

Number of observations: 416

Models: static fixed effect models (dynamic models did not yield stable results).

Dummies per policy sub-type: the dummy variable equalled 1 if any of the policies of the same sub-type was in place in the country in a given year.

Estimation strategy: include all potential determinants and policies with their lags and excluding from the model those variables with coefficients not statistically significant. The process was repeated until we obtained a set of statistically significant variables and policies with the expected signs. In the case of P&Ms coefficients we expect a negative sign, that is, when the policy is in place (dummy=1) it implies EE / EI improvements.

Goals:

- assess the economic variables which could have a significant effect in improving the energy intensity, energy efficiency, energy security and carbon intensity and to identify the policies and measures (P&M) implemented in European countries which have been effective for the same purpose;
- compare the significant drivers resulting from regressions, in order to understand whether there are some policies which affect both energy intensity and energy security

Panel analysis: results (1/3)

The effect of macro drivers:

The price of energy has a small but significant effect on most indicators in all sectors. It has a relatively larger effect on household energy efficiency. In the transport sector it only influences energy intensity. This suggests that market regulation may also help to improve efficiency.

The effects of increases in GDP are mixed. In some cases GDP increases result in more efficiency and lower intensity, carbon content and higher security; in other cases the reverse holds. There is a moderate prevalence of beneficial effects (60%).

The effects of R&D expenditure on most indicators are disappointing. We do not generally find improvements when R&D increases. In some cases, it appears to be detrimental.

Panel analysis: results (2/3)

Sectors in which P&Ms are implemented	EFFECTIVE P&Ms
CROSS-CUTTING POLICIES	General cross cutting policies (for example energy plans) EE, promotion of renewables or climate change mitigation Marked based instruments
RESIDENTIAL POLICIES	Mandatory standards for electrical appliances Grants / subsidies Loans / Other
INDUSTRY POLICIES	Information, education and training
TERTIARY POLICIES	Tax exemptions / reduction Soft loans, grants / subsidies and information initiatives
TRANSPORT POLICIES	Cross cutting policies with sector specific characteristics

Legend: **ES only** **EI & ES** **EI only**

Panel analysis: results (3/3)

Sectors in which P&Ms are implemented	EFFECTIVE P&Ms	
CROSS-CUTTING POLICIES	General cross cutting policies	
RESIDENTIAL POLICIES	Mandatory standards for electrical appliances	
	Cooperative measures	
	Cross cutting policies with sector specific characteristics	
	Loans / Other	
INDUSTRY POLICIES	Legislative and informative measures	
TERTIARY POLICIES	Cooperative measures	
	Soft loans, grants / subsidies and information initiatives	
TRANSPORT POLICIES	Cross cutting policies with sector specific characteristics	

Legend: **ES only** **ES & CI** **CI only**

Conclusions (1/2)

Quite a number of policies had a beneficial impacts on energy efficiency and carbon efficiency, at the aggregate level. However only one category of these policies (general cross-cutting policies), has proven also useful to improve aggregate energy security indicators.

Restricting our analysis to specific sectors does not lead to sharper or more encouraging conclusions in terms of co-benefits on energy security of energy efficiency policies.

Between energy intensity and carbon intensity there is more policy interaction, and also some sector specific policies improve the performance of both indicators. This is hardly surprising, given the high correlation between the two indicators, and holds in particular for the household sector, but also cooperative measures in the industry sector affect both carbon and energy intensity at the aggregate level.

Main conclusion: no silver bullet. Energy efficiency policies in the EU do work, but none can successfully address different policy objectives, unless it is so general that naturally encompasses different sectors and modes of energy use. Thus only broadly defined cross cutting policies seem to have this double effect.

Conclusions (2/2)

The other seemingly surprising lesson is that there are policies, designed to improve energy efficiency, that are more effective in terms of improving energy security than in terms of their original goal. This may have to do with our choice of energy security indicators: we may have focused on the consumption of fuels that are more sensitive to certain policies, but may have not enough weight to improve the efficiency of the overall or sectoral energy mix.

What seem to work is the policy mix rather this or that policy in insulation: the good news then are that currently in Western Europe a policy menu is in place that has produced significant improvements in energy efficiency, has reduced the amount of carbon emissions generated by the economic system, and has contributed to a more secure energy supply for Europe. There is however potential for further improvement.

Further research directions:

- more countries (too few data for NMCs panel analysis),
- continuous, instead of binary, policy variables and the role of the intensity of energy policy.

Thanks for your attention!

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