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European Energy Markets’ Overview: Energy Product Inflation and Convergence Process

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Abstract

Energy as a commodity and economic figure constitutes one of the most discussed issues in the contemporary world containing under that "umbrella term" some of the most compelling questions of our time. Ranging from the finite character of fossil fuels along with the respective development paradigm, the environmental impact of energy production even in some considered innocent forms like hydroelectricity, the geostrategic independence of greater regions, to social issues like energy poverty, sustainability or the use of nuclear power, energy and the subcategory of energy economics are a developing academic area aspiring to provide useful answers or at least tools to advocate them in favor of well-planned solutions.

This dissertation has the ambition to address some of those issues with main target to assess the impact on inflation imposed by the change in energy prices among all (27) EU member countries and to evaluate the process and rate of homogenization in the European Union by utilizing statistical tools.

In the first chapter a general introduction of the subject is presented by explaining some key energy figures and the reasons of utilization of open public data and statistical methods.

In the second chapter a presentation of the EU countries' energy market, infrastructure and framework is taking place, which will be used afterwards.

In the third chapter are presented the results of the statistical software package for the impact on inflation caused by energy prices, as well as attempts of interpreting that figure.

In the fourth chapter are presented the regression lines and the computations for the rise in energy prices' time series and their associations especially with international oil prices' trend.

In the fifth chapter we used clustering methods for classifying the EU members in two different points of time by using both quantitative and qualitative figures and attributes and then we compared the level of similarity.

In the sixth chapter are expressed the final conclusions of this dissertation regarding the homogenization target set by the EU as step for the further economic unification.

For the elaboration of the dissertation were used solely public data, maintained and published by institutions and services of the European Union or of its member states. The statistical software used was Minitab and XLSTAT.

Keywords: Energy Economics, European Union, Eurostat, Energy Markets, Inflation, Oil Prices, Energy Intensity, Descriptive Statistics, Inferential Statistics, Linear Regression Models, Time Series, Clustering, Harmonization Process, Open Data

Περίληψη

Η ενέργεια ως προϊόν και οικονομικό μέγεθος αποτελεί ένα από τα πιο πολυσυζητημένα θέματα στο σύγχρονο κόσμο, περιέχοντας κάτω από αυτό τον ευρύ όρο, μερικά από τα πιο συναρπαστικά ερωτήματα της εποχής μας. Ξεκινώντας από τον πεπερασμένο χαρακτήρα των ορυκτών καυσίμων καθώς και το αντίστοιχο πρότυπο ανάπτυξης, τον περιβαλλοντικό αντίκτυπο της παραγωγής ενέργειας ακόμη και για ορισμένες μορφές που θεωρούνται αθώες όπως η υδροηλεκτρική ενέργεια, τη γεωστρατηγική ανεξαρτησία ευρύτερων πριοχών, και φτάνοντας μέχρι σε κοινωνικά ζητήματα, όπως η ενεργειακή φτώχεια, η αειφορία ή η χρήση της πυρηνικής ενέργειας, τόσο η ενέργεια, όσο και η υποκατηγορία των οικονομικών της ενέργειας είναι ένας αναπτυσσόμενος ακαδημαϊκός τομέας που φιλοδοξεί να δώσει χρήσιμες απαντήσεις, ή τουλάχιστον εργαλεία προς όφελος άρτια σχεδιασμένων λύσεων.

Η παρούσα μεταπτυχιακή εργασία έχει τη φιλοδοξία να αναμετρηθεί με ορισμένα από τα ζητήματα αυτά με κύριο στόχο να αξιολογήσει τον αντίκτυπο στον πληθωρισμό που προκαλείται από τις αλλαγές των τιμών της ενέργειας στις χώρες μέλη της ΕΕ (27), καθώς και να αξιολογήσει τη διαδικασία και το ρυθμό της ομογενοποίησης στην Ευρωπαϊκή Ένωση κάνοντας χρήση στατιστικών εργαλείων.

Στο πρώτο κεφάλαιο γίνεται μια γενική εισαγωγή στο θέμα εξηγώντας κάποια βασικά στοιχεία για την ενέργεια και τους λόγους της αξιοποίησης των ανοικτών δημόσιων δεδομένων και στατιστικών μεθόδων.

Στο δεύτερο κεφάλαιο λαμβάνει χώρα η παρουσίαση της αγοράς ενέργειας, των υποδομών και του πλαισίου των χωρών της ΕΕ, η οποία θα χρησιμοποιηθεί στη συνέχεια.

Στο τρίτο κεφάλαιο παρουσιάζονται τα αποτελέσματα του στατιστικού πακέτου λογισμικού για τις επιπτώσεις στον πληθωρισμό από τις τιμές της ενέργειας, καθώς και οι προσπάθειες της ερμηνείας του.

Στο τέταρτο κεφάλαιο παρουσιάζονται οι γραμμές παλινδρόμησης και οι υπολογισμοί για την άνοδο των χρονοσειρών των τιμών της ενέργειας και η συσχέτισή τους, ιδίως με τις διεθνείς τάσεις των τιμών του πετρελαίου.

Στο πέμπτο κεφάλαιο χρησιμοποιήθηκαν μέθοδοι ομαδοποίησης σε συστάδες για την κατηγοριοποίηση των μελών της ΕΕ για δύα διαφορετικά χρονικά σημεία χρησιμοποιώντας ποσοτικά και ποιοτικά στοιχεία και χαρακτηριστικά και στη συνέχεια συγκρίναμε τα επίπεδα ομοιότητας.

Στο έκτο κεφάλαιο εκφράζονται τα τελικά συμπεράσματα της παρούσας μεταπτυχαικής εργασίας σχετικά με το στόχο της ομογενοποίησης που έθεσε η ΕΕ ως βήμα για την περαιτέρω οικονομική ενοποίηση.

Για την εκπόνηση της διατριβής χρησιμοποιήθηκαν αποκλειστικά δημόσια δεδομένα, που διατηρούνται και δημοσιεύονται από τα θεσμικά όργανα και υπηρεσίες της Ευρωπαϊκής Ένωσης ή των κρατών μελών της. Το στατιστικό πακέτο λογισμικού που χρησιμοποιήθηκε ήταν Minitab και XLSTAT.

Λέξεις Κλειδιά: Οικονομικά της Ενέργειας, Ευρωπαϊκή Ενωση, Eurostat, Ενεργειακές Αγορές, Πληθωρισμός, Τιμές Πετρελαίου, Ενεργειακή Ένταση, Περιγραφική Στατιστική, Επαγωγική Στατιστική, Γραμμικά Μοντέλα Παλινδρόμησης, Χρονοσειρές, Συσταδοποίηση, Διαδικασία Εναρμονισμού, Ανοιχτά Δεδομένα

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Introduction

The incentive of this dissertation is to combine three major issues of the contemporary public discourse and its purpose is to provide a fruitful example of the aforementioned combination. The main stimulus and reference upon which it is based is a paper published under the title “The Deregulation Process of Electricity and Gas Markets in the European Union and the Influence of Energy Prices on Inflation” [1] and its subject comprises the areas of:

i) Energy as a Commodity, with its prices either shaped by the market forces or institutionally defined,
ii) Public Databases as the realization of the democratic principle of transparency and evaluation of public policies by the electoral body
iii) The increasing use of Statistical Science for analyzing the continuously rising amounts of raw data which are collected both manually or automatically

As a consequence, the data used for statistical inference are associated with the general subject under the title Energy and were acquired by public databases maintained by public services and institutions, mainly international, such as Eurostat, European Central Bank and International Energy Agency.

Energy as a Commodity

a. World

The increase of energy consumption was considered, during most of the decades of the 20th century, a constant of the contemporary way of life and was often associated with the positive concepts of economic development and modernization. However, this situation ended abruptly during the last quarter of the century on the one hand due to the two Oil/Energy Crises in 1970s and the following steep rise of energy prices, whilst on the other hand due to the environmental issues which arose a little later and the consequent strengthening of ecological conscience in the developed countries. As a result Energy and its various parameters became a popular subject of the public discourse and also one of the academic research community. Sustainability and fossil fuel reserves’ prospects, international dependence of countries and greater regions, the relationship to economy and industrial productivity, as well as impacts health and environmental impacts of energy-intensive activities are some of the most frequent topics related to the subject.

The first graph depicts the huge increase in world energy consumption that has taken place in roughly the last 200 years. The usage is divided into different categories with reference to the source and as it can be observed, this increase derives primarily from increased fossil fuel use.

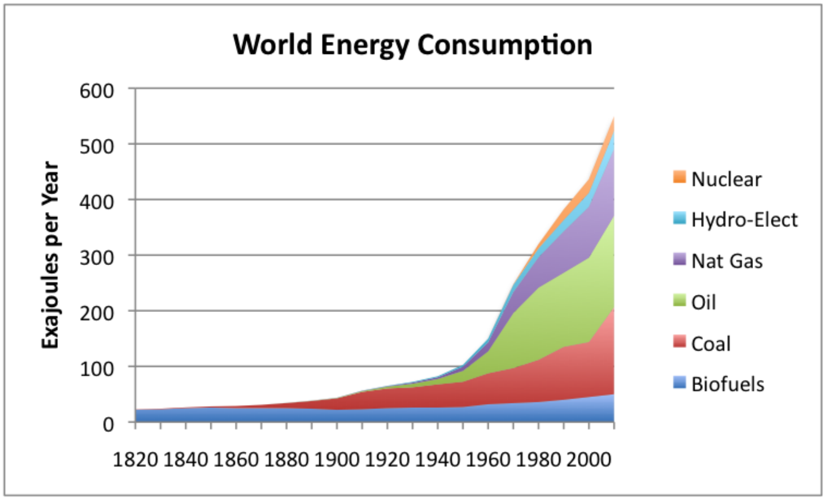


Figure 1
Source: www.theoildrum.com

Apart from the total amount of energy consumed worldwide, another important figure is the per capita energy consumption. This figure indicates that the increase is not primarily caused by the population soaring during the previous century, but from the changes of lifestyle and the incorporation of modern technical invention to production and to households, through the consumer goods.

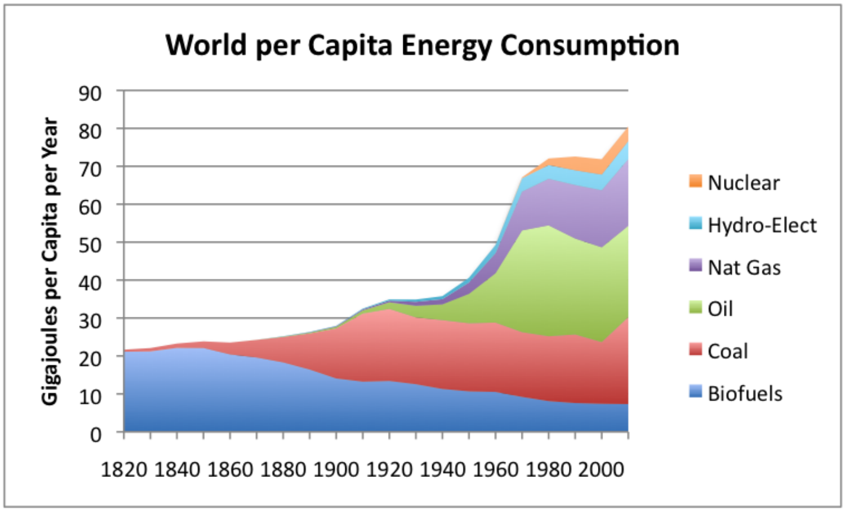


Figure 2
Source: www.theoildrum.com

(This conclusion could also be drawn due to the absence of a linear relationship between the increase in human population and energy consumption.)

As it can be easily observed, this curve comprises inflection and saddle points which indicate respective economical and historical periods (such as the Interwar Period, Post World War II development, the Dissolution of USSR etc.) and are connected to the Energy Intensity[1] and the level of economic and technological development.

Finally, the growing importance of Energy is also reflected in the current tendency of certain economical school of thought which regards energy as a factor of production, in comparison to mainstream economists who consider it an intermediate product of land, labor and capital, attributing it an indirect role in the theory of production and growth [2].

b. European Union

Those historical trends require the appropriate political interventions – both in global and regional scale – in order to shape our energy future according to long-term perspectives. The major world players have developed the distinct strategies that fit to their pursuits, according to their primary resources, energy and economic capacities, geopolitical role and ambitions, as well as their social priorities and the level of respect of democratic demands and human rights.

The EU has adopted the “20-20-20” package, which stands for the three key objectives of:

- A 20% reduction in EU greenhouse gas emissions from 1990 levels;
- Raising the share of EU energy consumption produced from renewable resources to 20%;
- A 20% improvement in the EU's energy efficiency.

Those targets – subject to many retractions – represent the commitment to a low-carbon economy transition, with the core idea of a reduction of energy intensity and greater incorporation of green economy jobs and industries. Actions like continuous monitoring and quantitative assessment constitute an integral part of this effort and are conducted by the special institutions such as Eurostat and European Environment Agency.

[1] By definition Energy Intensity is a measure of the energy efficiency of a nation's economy. It is calculated as units of energy per unit of GDP.

c. Integration and Harmonization

The prime objective in the field of the internal energy market is to liberalize and integrate the electricity and natural gas markets. The most important challenge here is to apply the competition rules of the Treaty to the monopolies for transmission and distribution of gas and electricity, even though these are entrusted with the operation of services of general economic interest.

For the achievement of the aforementioned targets, the EU has issued some intermediate goals regaridng the level of framework compatibility between the countries and the structural issues which derive from it. The process of harmonization is by definition the “Adjustment of differences and inconsistencies among different measurements, methods, procedures, schedules, specifications, or systems to make them uniform or mutually compatible”, which in the case of European Energy markets refers to the legal framework.

Though harmonization is a political process referring to the law systems, it indirectly addresses structural issues which affect economic and technological parameters in the energy market due to their profound correlation with the institutional structure[2]. This has as a result the establishment of complex and costly systems of regulation to enforce competition as imposed by the 2009/72 and 2009/73 directives for electricity and gas markets respectively.

“The Directives lay down the rules relating to the organization and functioning of the electricity and gas sectors, access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorizations and the operation of systems. The respect of the public service requirements is a fundamental requirement of these Directives. They specify common minimum standards to be respected by all Member States, which take into account the objectives of common protection, security of supply, environmental protection and equivalent levels of competition in all Member States. Public service obligations may relate to security, including security of supply, regularity, quality and price of supplies, and environmental protection, including energy efficiency and climate protection. However, the public service requirements are interpreted on a national basis, taking into account national circumstances, subject to the respect of European law” [3].

[2] The Energy Markets in many EU countries are natural monopolies specifically in level of the electrical grid and natural gas networks, so the Commission promotes vertical unbundling as a method for liberalization.

The other attribute of the present dissertation is the fact that it is based on large datasets publicly available for downloading and process, which is a growing contemporary trend regarding not only the academics, but also private sector businesses and individuals.

a. Big Data emergence

Initially, there is a need to identify the reasons which enable and contribute to that trend, both technological and social. On the technological aspect of the explanation lie a number of factors fueled by technical innovations such as the increase of cheap storage capacity, the augmentation of processing speed, the expansion of communications (especially the wireless ones), the growing usage of mobile devices and their respective interconnections, the geographic information systems and last but not least the modern phenomenon under the title "social media". All of them contribute to a greater or lesser extent at the exponential growth of information created and stored worldwide as seen in the following graph and the respective emergence of certain fields of academic research like data science/mining and big data analytics. Furthermore, the production of smaller, lighter and more accurate and energy efficient sensors constitutes the ground upon which the "Internet of Things"[3] notion will be based, as an extensive realization of those scientific innovations [4].

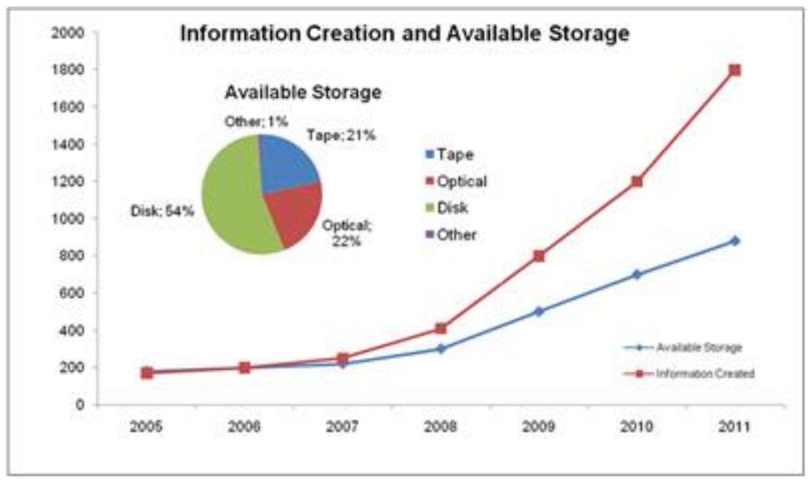


Figure 3
Source: International Data Corporation

At the antipodes of technical reasons lie the social ones of this trend, as well as certain dangers which lurk in the latest technological capabilities. These dangers have to do with the growing numbers of evidence about individuals' lifestyle and choices and especially in situations where these pieces of information come into possession of inappropriate authorities of individuals. However, the benefits overwhelm the possible dangers and offer the opportunity of increasing accountability and citizen participation through greater transparency and additionally generate more effective crowd-sourced solutions to public problems.

Finally, a point should be made about the paradigm shift that is taking place in the way which scientific reasoning is promoted. Due to the rapid technological change there is a plethora of tools – not available until recently – which enable the utilization of Big Data and a transition to a mostly computational approach [5]. Generally, this shift expresses a greater move from deductive towards inductive reasoning, thus the growing importance and evolution of Statistics, as *"the practice or science*

[3] A proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data.

of collecting, analyzing, interpreting and presenting numerical data in large quantities, especially for the purpose of inferring proportions in a whole from those in a representative sample".

b. Eurostat

A special reference has to be made to Eurostat, the Directorate-General of the European Commission, whose main responsibilities are to provide statistical information to the institutions of the European Union (EU) and to promote the harmonization of statistical methods across its member states, candidates for accession and European Free Trade Association countries, thanks to the provision of the data largely used as a case study in the present dissertation.

Eurostat originates from the Statistics Division of the European and Steel Community founded in1957 and according to the official website its mission is to "be the leading provider of high quality statistics on Europe […] that enable comparisons between countries and regions", because "Democratic societies do not function properly without a solid basis of reliable and objective statistics. On one hand, decision-makers at EU level, in Member States, in local government and in business need statistics to make those decisions. On the other hand, the public and media need statistics for an accurate picture of contemporary society and to evaluate the performance of politicians and others" [6].

Thus it is regarded as an integral part of the promotion of democratic institutions the maintaining of a public data archive and the daily publication of those via press or the official site. Additionally, researchers are given the opportunity to obtain through strict application procedures confidential anonymized datasets of microdata for free, as a means of promoting science.

Energy Market related Figures

In this part some key figures in the energy markets of the examined EU member countries are presented. The following volumes and percentages are a snapshot of the situation in 2010 [7] except when explicitly is stated a different year. At that time EU had 27 member states, the current composition, but without Croatia which became member in 2013. Since there are no sudden changes through the years, due to the long term nature of strategic energy and economic planning, the following data are a rather accurate description of the whole period under examination and are able to convey a general idea about the special characteristics of each and every country.

Facts about the “inertia” of those energy markets can be found by the coefficient of variation ($c_v = \frac{\sigma}{\mu}$) which is for the most countries (per figure) below 10% with the notable exceptions of the countries with a more recent accession to the European Union (e.g Baltic countries, Bulgaria, etc.), due to economic and structural reforms connected with their admission.

The following pieces of information include the Energy Dependence[4], the share between Renewables[5] and Fossil Fuels (i. Solid Fuels, ii. Crude Oil & Petroleum Products, iii. Natural Gas) in the Gross Inland Consumption[6], Renewables’ share of the Gross Electricity Generation, the Energy Intensity of the economy, the Market Share of the Largest Generator in Electricity Market and the status (binary) of nuclear power production in the country[7] accompanied with comments about the regulatory framework and the evolution of primary energy composition.

[4] Energy dependency shows the extent to which an economy relies upon imports in order to meet its energy needs. The indicator is calculated as net imports divided by the sum of gross inland energy consumption plus bunkers. Negative numbers signify exporting countries.

[5] Large scale hydro-electric power plants are considered “Renewables” by Eurostat, inasmuch the primary energy source is undepletable, even though there is a discourse whether it should be categorized distinctly due to the permanent damage they inflict to ecosystems.

[6] The total energy demand of a country or region. It represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration and it covers: a. consumption by the energy sector itself, b. distribution and transformation losses, c. final energy consumption by end users.

[7] The use of nuclear power in the energy mix is subject to strategic political decisions and the extent of its use is mainly influenced by factors not relative to short-term economic figures.

Austria (AT)

Energy Intensity (toe/m€)				*132.2*
Energy Dependence (%)				*62.2*
Gross Inland Consumption	**Renewables** (%)			*26.2*
	Fossil Fuels	i.	**Solid Fuels** (%)	*9.8*
		ii.	**Crude Oil & Petroleum Products** (%)	*37.8*
		iii.	**Natural Gas** (%)	*23.7*
Residential Sector Final Energy Consumption (%)				*24.7*
Industrial Sector Final Energy Consumption (%)				*32.3*
Electricity Prices (per kWh)			**Residential**	*0.1427*
			Industrial	*0.0922*
Gross Electricity Generation – Renewables' share (%)				*67.9*
Market Share of the Largest Generator in Electricity Market (%)				*55.3 (y2011)*
Use of Nuclear Power Plants				*n*

Belgium (BE)

Energy Intensity (toe/m€)				*189.6*
Energy Dependence (%)				*78.2*
Gross Inland Consumption	**Renewables** (%)			*4.2*
	Fossil Fuels	i.	**Solid Fuels** (%)	*5.2*
		ii.	**Crude Oil & Petroleum Products** (%)	*41.7*
		iii.	**Natural Gas** (%)	*27.6*
Residential Sector Final Energy Consumption (%)				*24.0*
Industrial Sector Final Energy Consumption (%)				*31.3*
Electricity Prices (per kWh)			**Residential**	*0.1449*
			Industrial	*0.0943*
Gross Electricity Generation – Renewables' share (%)				*8.3*
Market Share of the Largest Generator in Electricity Market (%)				*79.1*
Use of Nuclear Power Plants				*y*

Bulgaria (BG)

Energy Intensity (toe/m€)				*668.8*
Energy Dependence (%)				*39.6*
Gross Inland Consumption	**Renewables** (%)			*8.0*
	Fossil Fuels	i.	**Solid Fuels** (%)	*38.6*
		ii.	**Crude Oil & Petroleum Products** (%)	*22.6*
		iii.	**Natural Gas** (%)	*12.6*
Residential Sector Final Energy Consumption (%)				*25.4*
Industrial Sector Final Energy Consumption (%)				*29.0*
Electricity Prices (per kWh)			**Residential**	*0.0675*
			Industrial	*0.0639*
Gross Electricity Generation – Renewables' share (%)				*13.8*
Market Share of the Largest Generator in Electricity Market (%)				*60*
Use of Nuclear Power Plants				*y*

Cyprus (CY)

Energy Intensity (toe/m€)				*178*
Energy Dependence (%)				*100.9*
Gross Inland Consumption	**Renewables** (%)			*3.7*
	Fossil Fuels	i.	**Solid Fuels** (%)	*0*
		ii.	**Crude Oil & Petroleum Products** (%)	*96.3*
		iii.	**Natural Gas** (%)	*0*
Residential Sector Final Energy Consumption (%)				*17.2*
Industrial Sector Final Energy Consumption (%)				*12.2*
Electricity Prices (per kWh)			**Residential**	*0.1597*
			Industrial	*0.1483*
Gross Electricity Generation – Renewables' share (%)				*0.7*
Market Share of the Largest Generator in Electricity Market (%)				*100*
Use of Nuclear Power Plants				*n*

Czech Republic (CZ)

Energy Intensity (toe/m€)				*374.5*
Energy Dependence (%)				*25.5*
Gross Inland Consumption	**Renewables** (%)			*6.1*
	Fossil Fuels	i.	**Solid Fuels** (%)	*40.3*
		ii.	**Crude Oil & Petroleum Products** (%)	*20.4*
		iii.	**Natural Gas** (%)	*17.5*
Residential Sector Final Energy Consumption (%)				*26.0*
Industrial Sector Final Energy Consumption (%)				*33.9*
Electricity Prices (per kWh)			**Residential**	*0.1108*
			Industrial	*0.1022*
Gross Electricity Generation – Renewables' share (%)				*7.6*
Market Share of the Largest Generator in Electricity Market (%)				*73*
Use of Nuclear Power Plants				*y*

Germany (DE)

Energy Intensity (toe/m€)				*140.5*
Energy Dependence (%)				*60*
Gross Inland Consumption	**Renewables** (%)			*9.7*
	Fossil Fuels	i.	**Solid Fuels** (%)	*22.9*
		ii.	**Crude Oil & Petroleum Products** (%)	*34.0*
		iii.	**Natural Gas** (%)	*21.8*
Residential Sector Final Energy Consumption (%)				*28.7*
Industrial Sector Final Energy Consumption (%)				*27.5*
Electricity Prices (per kWh)			**Residential**	*0.1381*
			Industrial	*0.0921*
Gross Electricity Generation – Renewables' share (%)				*17.8*
Market Share of the Largest Generator in Electricity Market (%)				*28.4*
Use of Nuclear Power Plants				*y*

Denmark (DK)

Energy Intensity (toe/m€)				*97.5*
Energy Dependence (%)				*-16.1*
Gross Inland Consumption	**Renewables** (%)			*20.5*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*20.0*
		ii.	**Crude Oil & Petroleum Products** (%)	*36.2*
		iii.	**Natural Gas** (%)	*23.3*
Residential Sector Final Energy Consumption (%)				*32.4*
Industrial Sector Final Energy Consumption (%)				*15.9*
Electricity Prices (per kWh)			**Residential**	*0.1168*
			Industrial	*0.0848*
Gross Electricity Generation – Renewables' share (%)				*40.4*
Market Share of the Largest Generator in Electricity Market (%)				*46*
Use of Nuclear Power Plants				*n*

Estonia (EE)

Energy Intensity (toe/m€)				*551*
Energy Dependence (%)				*13.7*
Gross Inland Consumption	**Renewables** (%)			*13.3*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*61.4*
		ii.	**Crude Oil & Petroleum Products** (%)	*16.5*
		iii.	**Natural Gas** (%)	*8.8*
Residential Sector Final Energy Consumption (%)				*35.3*
Industrial Sector Final Energy Consumption (%)				*19.8*
Electricity Prices (per kWh)			**Residential**	*0.0695*
			Industrial	*0.0573*
Gross Electricity Generation – Renewables' share (%)				*8.1*
Market Share of the Largest Generator in Electricity Market (%)				*89*
Use of Nuclear Power Plants				*n*

Greece (EL)

Energy Intensity (toe/m€)				*148.3*
Energy Dependence (%)				*69.1*
Gross Inland Consumption	**Renewables** (%)			*7.6*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*27.8*
		v.	**Crude Oil & Petroleum Products** (%)	*53.2*
		vi.	**Natural Gas** (%)	*11.4*
Residential Sector Final Energy Consumption (%)				*24.3*
Industrial Sector Final Energy Consumption (%)				*18.3*
Electricity Prices (per kWh)			**Residential**	*0.0975*
			Industrial	*0.0855*
Gross Electricity Generation – Renewables' share (%)				*18.4*
Market Share of the Largest Generator in Electricity Market (%)				*85.1*
Use of Nuclear Power Plants				*n*

Spain (ES)

Energy Intensity (toe/m€)				*137*
Energy Dependence (%)				*76.8*
Gross Inland Consumption	**Renewables** (%)			*11.5*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*6.0*
		v.	**Crude Oil & Petroleum Products** (%)	*46.4*
		vi.	**Natural Gas** (%)	*23.9*
Residential Sector Final Energy Consumption (%)				*19.0*
Industrial Sector Final Energy Consumption (%)				*24.1*
Electricity Prices (per kWh)			**Residential**	*0.1417*
			Industrial	*0.1110*
Gross Electricity Generation – Renewables' share (%)				*33.2*
Market Share of the Largest Generator in Electricity Market (%)				*24*
Use of Nuclear Power Plants				*y*

Finland (FI)

Energy Intensity (toe/m€)				*225.8*
Energy Dependence (%)				*48*
Gross Inland Consumption	**Renewables** (%)			*24.5*
	Fossil Fuels	**vii.**	**Solid Fuels** (%)	*18.6*
		viii.	**Crude Oil & Petroleum Products** (%)	*27.8*
		ix.	**Natural Gas** (%)	*10.4*
Residential Sector Final Energy Consumption (%)				*21.6*
Industrial Sector Final Energy Consumption (%)				*43.4*
Electricity Prices (per kWh)			**Residential**	*0.0998*
			Industrial	*0.0667*
Gross Electricity Generation – Renewables' share (%)				*30.0*
Market Share of the Largest Generator in Electricity Market (%)				*26.6*
Use of Nuclear Power Plants				*y*

France (FR)

Energy Intensity (toe/m€)				*150.7*
Energy Dependence (%)				*49.1*
Gross Inland Consumption	**Renewables** (%)			*7.8*
	Fossil Fuels	**vii.**	**Solid Fuels** (%)	*4.5*
		viii.	**Crude Oil & Petroleum Products** (%)	*31.1*
		ix.	**Natural Gas** (%)	*15.8*
Residential Sector Final Energy Consumption (%)				*27.6*
Industrial Sector Final Energy Consumption (%)				*19.6*
Electricity Prices (per kWh)			**Residential**	*0.0940*
			Industrial	*0.0687*
Gross Electricity Generation – Renewables' share (%)				*14.7*
Market Share of the Largest Generator in Electricity Market (%)				*86.5*
Use of Nuclear Power Plants				*y*

Hungary (HU)

Energy Intensity (toe/m€)				*294.1*
Energy Dependence (%)				*58.1*
Gross Inland Consumption	**Renewables** (%)			*7.7*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*10.5*
		ii.	**Crude Oil & Petroleum Products** (%)	*26.3*
		iii.	**Natural Gas** (%)	*37.8*
Residential Sector Final Energy Consumption (%)				*34.6*
Industrial Sector Final Energy Consumption (%)				*17.4*
Electricity Prices (per kWh)			**Residential**	*0.1349*
			Industrial	*0.1037*
Gross Electricity Generation – Renewables' share (%)				*8.1*
Market Share of the Largest Generator in Electricity Market (%)				*42.1*
Use of Nuclear Power Plants				*y*

Ireland (IE)

Energy Intensity (toe/m€)				*92.5*
Energy Dependence (%)				*86.5*
Gross Inland Consumption	**Renewables** (%)			*4.4*
	Fossil Fuels	**x.**	**Solid Fuels** (%)	*13.9*
		xi.	**Crude Oil & Petroleum Products** (%)	*50.4*
		xii.	**Natural Gas** (%)	*31.1*
Residential Sector Final Energy Consumption (%)				*27.4*
Industrial Sector Final Energy Consumption (%)				*17.9*
Electricity Prices (per kWh)			**Residential**	*0.1589*
			Industrial	*0.1118*
Gross Electricity Generation – Renewables' share (%)				*13.7*
Market Share of the Largest Generator in Electricity Market (%)				*34*
Use of Nuclear Power Plants				*n*

Italy (IT)

Energy Intensity (toe/m€)				*123.2*
Energy Dependence (%)				*84.3*
Gross Inland Consumption	**Renewables** (%)			*10.3*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*8.1*
		v.	**Crude Oil & Petroleum Products** (%)	*40.2*
		vi.	**Natural Gas** (%)	*38.8*
Residential Sector Final Energy Consumption (%)				*25.4*
Industrial Sector Final Energy Consumption (%)				*25.1*
Electricity Prices (per kWh)			**Residential**	*0.1397 (2011)*
			Industrial	*0.1145 (2011)*
Gross Electricity Generation – Renewables' share (%)				*26.6*
Market Share of the Largest Generator in Electricity Market (%)				*28*
Use of Nuclear Power Plants				*n*

Lithuania (LT)

Energy Intensity (toe/m€)				*306.8*
Energy Dependence (%)				*81.8*
Gross Inland Consumption	**Renewables** (%)			*16.8*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*3.2*
		ii.	**Crude Oil & Petroleum Products** (%)	*40.7*
		iii.	**Natural Gas** (%)	*39.2*
Residential Sector Final Energy Consumption (%)				*33.5*
Industrial Sector Final Energy Consumption (%)				*18.9*
Electricity Prices (per kWh)			**Residential**	*0.0955*
			Industrial	*0.0991*
Gross Electricity Generation – Renewables' share (%)				*29*
Market Share of the Largest Generator in Electricity Market (%)				*35.4*
Use of Nuclear Power Plants				*n*

Luxembourg (LU)

Energy Intensity (toe/m€)				*141.7*
Energy Dependence (%)				*97*
Gross Inland Consumption	**Renewables** (%)			*2.9*
	Fossil Fuels	**xiii.**	**Solid Fuels** (%)	*0*
		xiv.	**Crude Oil & Petroleum Products** (%)	*62.6*
		xv.	**Natural Gas** (%)	*26.1*
Residential Sector Final Energy Consumption (%)				*11.7*
Industrial Sector Final Energy Consumption (%)				*17.1*
Electricity Prices (per kWh)			**Residential**	*0.1433*
			Industrial	*0.0956*
Gross Electricity Generation – Renewables' share (%)				*35.4*
Market Share of the Largest Generator in Electricity Market (%)				*85.4*
Use of Nuclear Power Plants				*n*

Latvia (LV)

Energy Intensity (toe/m€)				*382.4*
Energy Dependence (%)				*44.3*
Gross Inland Consumption	**Renewables** (%)			*34.6*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*2.4*
		ii.	**Crude Oil & Petroleum Products** (%)	*28.5*
		iii.	**Natural Gas** (%)	*32.2*
Residential Sector Final Energy Consumption (%)				*35.8*
Industrial Sector Final Energy Consumption (%)				*18.2*
Electricity Prices (per kWh)			**Residential**	*0.0954*
			Industrial	*0.0890*
Gross Electricity Generation – Renewables' share (%)				*54.9*
Market Share of the Largest Generator in Electricity Market (%)				*88*
Use of Nuclear Power Plants				*y*

Malta (MT)

Energy Intensity (toe/m€)				*172*
Energy Dependence (%)				*99.1*
Gross Inland Consumption	**Renewables** (%)			*0*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*0*
		v.	**Crude Oil & Petroleum Products** (%)	*100*
		vi.	**Natural Gas** (%)	*0*
Residential Sector Final Energy Consumption (%)				*14.2*
Industrial Sector Final Energy Consumption (%)				*11.2*
Electricity Prices (per kWh)			**Residential**	*0.1615*
			Industrial	*0.1800*
Gross Electricity Generation – Renewables' share (%)				*0*
Market Share of the Largest Generator in Electricity Market (%)				*100*
Use of Nuclear Power Plants				*n*

the Netherlands (NL)

Energy Intensity (toe/m€)				*157.7*
Energy Dependence (%)				*30.4*
Gross Inland Consumption	**Renewables** (%)			*3.4*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*8.8*
		v.	**Crude Oil & Petroleum Products** (%)	*40.8*
		vi.	**Natural Gas** (%)	*45.7*
Residential Sector Final Energy Consumption (%)				*21.4*
Industrial Sector Final Energy Consumption (%)				*26.5*
Electricity Prices (per kWh)			**Residential**	*0.1229*
			Industrial	*0.0865*
Gross Electricity Generation – Renewables' share (%)				*9.5*
Market Share of the Largest Generator in Electricity Market (%)				*N/A (low)*
Use of Nuclear Power Plants				*n*

Poland (PL)

Energy Intensity (toe/m€)				*328*
Energy Dependence (%)				*31.2*
Gross Inland Consumption	**Renewables** (%)			*7.2*
	Fossil Fuels	i.	**Solid Fuels** (%)	*53.7*
		ii.	**Crude Oil & Petroleum Products** (%)	*26.0*
		iii.	**Natural Gas** (%)	*12.6*
Residential Sector Final Energy Consumption (%)				*31.8*
Industrial Sector Final Energy Consumption (%)				*23.0*
Electricity Prices (per kWh)			**Residential**	*0.1049*
			Industrial	*0.0929*
Gross Electricity Generation – Renewables' share (%)				*7.3*
Market Share of the Largest Generator in Electricity Market (%)				*17.4*
Use of Nuclear Power Plants				*n*

Portugal (PT)

Energy Intensity (toe/m€)				*153.2*
Energy Dependence (%)				*75.1*
Gross Inland Consumption	**Renewables** (%)			*22.5*
	Fossil Fuels	vii.	**Solid Fuels** (%)	*6.8*
		viii.	**Crude Oil & Petroleum Products** (%)	*50.8*
		ix.	**Natural Gas** (%)	*18.4*
Residential Sector Final Energy Consumption (%)				*16.4*
Industrial Sector Final Energy Consumption (%)				*30.1*
Electricity Prices (per kWh)			**Residential**	*0.1090*
			Industrial	*0.0896*
Gross Electricity Generation – Renewables' share (%)				*53.2*
Market Share of the Largest Generator in Electricity Market (%)				*47.2*
Use of Nuclear Power Plants				*n*

Romania (RO)

Energy Intensity (toe/m€)				*394.6*
Energy Dependence (%)				*21.9*
Gross Inland Consumption	**Renewables** (%)			*16.3*
	Fossil Fuels	i.	**Solid Fuels** (%)	*19.5*
		ii.	**Crude Oil & Petroleum Products** (%)	*25.8*
		iii.	**Natural Gas** (%)	*30.1*
Residential Sector Final Energy Consumption (%)				*35.9*
Industrial Sector Final Energy Consumption (%)				*30.5*
Electricity Prices (per kWh)			**Residential**	*0.0856*
			Industrial	*0.0850*
Gross Electricity Generation – Renewables' share (%)				*33.5*
Market Share of the Largest Generator in Electricity Market (%)				*33.6*
Use of Nuclear Power Plants				*y*

Sweden (SE)

Energy Intensity (toe/m€)				*157.1*
Energy Dependence (%)				*36.6*
Gross Inland Consumption	**Renewables** (%)			*33.9*
	Fossil Fuels	iv.	**Solid Fuels** (%)	*4.9*
		v.	**Crude Oil & Petroleum Products** (%)	*28.3*
		vi.	**Natural Gas** (%)	*2.6*
Residential Sector Final Energy Consumption (%)				*22.2*
Industrial Sector Final Energy Consumption (%)				*35.8*
Electricity Prices (per kWh)			**Residential**	*0.1195*
			Industrial	*0.0800*
Gross Electricity Generation – Renewables' share (%)				*58.2*
Market Share of the Largest Generator in Electricity Market (%)				*42*
Use of Nuclear Power Plants				*y*

Slovenia (SI)

Energy Intensity (toe/m€)				*230.5*
Energy Dependence (%)				*49.4*
Gross Inland Consumption	**Renewables** (%)			*14.4*
	Fossil Fuels	**iv.**	**Solid Fuels** (%)	*19.6*
		v.	**Crude Oil & Petroleum Products** (%)	*64.7*
		vi.	**Natural Gas** (%)	*11.6*
Residential Sector Final Energy Consumption (%)				*25.1*
Industrial Sector Final Energy Consumption (%)				*25.8*
Electricity Prices (per kWh)			**Residential**	*0.1057*
			Industrial	*0.0917*
Gross Electricity Generation – Renewables' share (%)				*30.0*
Market Share of the Largest Generator in Electricity Market (%)				*56.3*
Use of Nuclear Power Plants				*y*

Slovakia (SK)

Energy Intensity (toe/m€)				*369.3*
Energy Dependence (%)				*62.9*
Gross Inland Consumption	**Renewables** (%)			*8*
	Fossil Fuels	**vii.**	**Solid Fuels** (%)	*22*
		viii.	**Crude Oil & Petroleum Products** (%)	*20*
		ix.	**Natural Gas** (%)	*28*
Residential Sector Final Energy Consumption (%)				*20.0*
Industrial Sector Final Energy Consumption (%)				*37.8*
Electricity Prices (per kWh)			**Residential**	*0.1277*
			Industrial	*0.1161*
Gross Electricity Generation – Renewables' share (%)				*22.7*
Market Share of the Largest Generator in Electricity Market (%)				*80.9*
Use of Nuclear Power Plants				*y*

United Kingdom (UK)

Energy Intensity (toe/m€)				*111.3*
Energy Dependence (%)				*28.3*
Gross Inland Consumption	**Renewables** (%)			*3.2*
	Fossil Fuels	**i.**	**Solid Fuels** (%)	*14.3*
		ii.	**Crude Oil & Petroleum Products** (%)	*34.8*
		iii.	**Natural Gas** (%)	*39.9*
Residential Sector Final Energy Consumption (%)				*31.6*
Industrial Sector Final Energy Consumption (%)				*19.5*
Electricity Prices (per kWh)			**Residential**	*0.1321*
			Industrial	*0.0947*
Gross Electricity Generation – Renewables' share (%)				*7.6*
Market Share of the Largest Generator in Electricity Market (%)				*21*
Use of Nuclear Power Plants				*y*

Impact of Energy Prices on Inflation

In order to specify the impact of energy prices on inflation the data from tables provided by Eurostat will be used, which show the Total Price Index – TPI, the Energy Price Index – EPI and the Price Index Excluding Energy – PIEE. Those data are monthly and cover the period from January 1996 to December 2013, unless explicitly stated otherwise. The base year is 2005 and the indices are HICP (Harmonised Index of Consumer Prices), which are calculated per country.

The aim is to illustrate to what extent the TPI is influenced by EPI through the use of linear correlation and the computation of the respective coefficients. By default the Total Price Index can be resolved into the following two components: Energy Price Index and Price Index Excluding Energy, so at the process the constant was omitted and the R-sq were 100% (as it can be proved, it is not of statistical importance).

Variables of the Model Applied

Variable	Name	Description	Category
TPI	Total Price Index (TPI)	The total index that represents the general level of prices	Regressand
EPI	Energy Price Index (EPI)	The Index that represents the level of energy prices	Independent
PIEE	Price Index Excluding Energy (PIEE)	The Index that includes all parameters that contribute to TPI, excluding energy	Independent

Linear Equations

Austria

Regression Equation:
TPI = 0.082815*EPI + 0.916834*PIEE

Impact on Inflation (%):
8.28

Predictor	Coef	SE Coef	T	P
EPI	0.082815	0.000278	297.68	0.000
PIEE	0.916834	0.000285	3220.49	0.000
S= 0.0512142				

Belgium

Regression Equation:
TPI = 0.109843*EPI + 0.889342*PIEE

Impact on Inflation (%):
10.99

Predictor	Coef	SE Coef	T	P
EPI	0.109843	0.000460	239.00	0.000
PIEE	0.889342	0.000479	1855.61	0.000
S= 0.116894				

Bulgaria *(December 1996 – December 2013)*

Regression Equation: TPI = 0.17725*EPI + 0.82356*PIEE

Impact on Inflation (%): 17.71

Predictor	Coef	SE Coef	T	P
EPI	0.17725	0.00123	144.62	0.000
PIEE	0.82356	0.00114	722.23	0.000
S=	0.220688			

Cyprus

Regression Equation: TPI = 0.098582*EPI + 0.900775*PIEE

Impact on Inflation (%): 9.86

Predictor	Coef	SE Coef	T	P
EPI	0.098582	0.000474	208.1	0.000
PIEE	0.900775	0.000498	1808.34	0.000
S=	0.207698			

Czech Republic *(December 1999 – December 2013)*

Regression Equation: TPI = 0.129806*EPI + 0.869901*PIEE

Impact on Inflation (%): 12.98

Predictor	Coef	SE Coef	T	P
EPI	0.129806	0.000545	238.03	0.000
PIEE	0.869901	0.000610	1425.77	0.000
S=	0.112027			

Germany

Regression Equation: TPI = 0.109837*EPI + 0.889697*PIEE

Impact on Inflation (%): 10.99

Predictor	Coef	SE Coef	T	P
EPI	0.109837	0.000257	427.85	0.000
PIEE	0.889697	0.000263	3387.83	0.000
S=	0.0722963			

Denmark

Regression Equation: TPI = 0.110037*EPI + 0.889600*PIEE

Impact on Inflation (%): 11.01

Predictor	Coef	SE Coef	T	P
EPI	0.110037	0.000367	300.04	0.000
PIEE	0.889600	0.000370	2406.49	0.000
S=	0.0628147			

Estonia *(December 2000 – December 2013)*

Regression Equation:
TPI = 0.121952*EPI + 0.875734*PIEE

Impact on Inflation (%):
12.22

Predictor	**Coef**	**SE Coef**	**T**	**P**
EPI	0.121952	0.000702	173.69	0.000
PIEE	0.875734	0.000823	1064.53	0.000
S=	0.207711			

Greece

Regression Equation:
TPI = 0.069582*EPI + 0.930690*PIEE

Impact on Inflation (%):
6.96

Predictor	**Coef**	**SE Coef**	**T**	**P**
EPI	0.069582	0.000341	204.07	0.000
PIEE	0.930690	0.000403	2311.41	0.000
S=	0.143147			

Spain

Regression Equation:
TPI = 0.096473*EPI + 0.904164*PIEE

Impact on Inflation (%):
9.64

Predictor	**Coef**	**SE Coef**	**T**	**P**
EPI	0.096473	0.000338	285.21	0.000
PIEE	0.904164	0.000369	2447.69	0.000
S=	0.0777799			

Finland

Regression Equation:
TPI = 0.072118*EPI + 0.927912*PIEE

Impact on Inflation (%):
7.21

Predictor	**Coef**	**SE Coef**	**T**	**P**
EPI	0.072118	0.000539	133.84	0.000
PIEE	0.927912	0.000564	1645.79	0.000
S=	0.128626			

France

Regression Equation:
TPI = 0.088091*EPI + 0.911769*PIEE

Impact on Inflation (%):
8.81

Predictor	**Coef**	**SE Coef**	**T**	**P**
EPI	0.088091	0.000282	311.97	0.000
PIEE	0.911769	0.000292	3123.60	0.000
S=	0.0527738			

Hungary *(December 2000 – December 2013)*

Regression Equation:
TPI = 0.128791*EPI + 0.870767*PIEE

Impact on Inflation (%):
12.88

Predictor	Coef	SE Coef	T	P
EPI	0.128791	0.000211	610.50	0.000
PIEE	0.870767	0.000244	3574.65	0.000
S=	0.0440673			

Ireland

Regression Equation:
TPI = 0.085364*EPI + 0.915193*PIEE

Impact on Inflation (%):
8.53

Predictor	Coef	SE Coef	T	P
EPI	0.085364	0.000241	354.36	0.000
PIEE	0.915193	0.000261	3501.91	0.000
S=	0.0710642			

Italy

Regression Equation:
TPI = 0.077517*EPI + 0.922764*PIEE

Impact on Inflation (%):
7.75

Predictor	Coef	SE Coef	T	P
EPI	0.077517	0.000321	241.77	0.000
PIEE	0.922764	0.000336	2743.27	0.000
S=	0.0527939			

Lithuania

Regression Equation:
TPI = 0.14019*EPI + 0.85545*PIEE

Impact on Inflation (%):
14.08

Predictor	Coef	SE Coef	T	P
EPI	0.14019	0.00139	614.50	0.000
PIEE	0.85545	0.00125	112.57	0.000
S=	0.533182			

Luxembourg

Regression Equation:
TPI = 0.108027*EPI + 0.892473*PIEE

Impact on Inflation (%):
10.80

Predictor	Coef	SE Coef	T	P
EPI	0.108027	0.000515	209.90	0.000
PIEE	0.892473	0.000517	1727.06	0.000
S=	0.110422			

Latvia

Regression Equation:
TPI = 0.117951*EPI + 0.880753*PIEE

Impact on Inflation (%):
11.81

Predictor	Coef	SE Coef	T	P
EPI	0.117951	0.000260	453.46	0.000
PIEE	0.880753	0.000312	2819.76	0.000
S=	0.0977383			

Malta

Regression Equation:
TPI = 0.052514*EPI + 0.947228*PIEE

Impact on Inflation (%):
5.25

Predictor	Coef	SE Coef	T	P
EPI	0.052514	0.000072	731.36	0.000
PIEE	0.947228	0.000081	11758.97	0.000
S=	0.0275965			

Netherlands

Regression Equation:
TPI = 0.102692*EPI + 0.897433*PIEE

Impact on Inflation (%):
10.27

Predictor	Coef	SE Coef	T	P
EPI	0.102692	0.000248	413.99	0.000
PIEE	0.897433	0.000243	3691.80	0.000
S=	0.0570319			

Poland

Regression Equation:
TPI = 0.142759*EPI + 0.855262*PIEE

Impact on Inflation (%):
14.30

Predictor	Coef	SE Coef	T	P
EPI	0.142759	0.000780	183.08	0.000
PIEE	0.855262	0.000384	1026.02	0.000
S=	0.195266			

Portugal

Regression Equation:
TPI = 0.105879*EPI + 0.895399*PIEE

Impact on Inflation (%):
10.57

Predictor	Coef	SE Coef	T	P
EPI	0.105879	0.000289	179.82	0.000
PIEE	0.895399	0.000623	1437.09	0.000
S=	0.130797			

Romania *(December 2000 – December 2013)*

Regression Equation:
TPI = 0.18676*EPI + 0.81134*PIEE

Impact on Inflation (%):
18.71

Predictor	Coef	SE Coef	T	P
EPI	0.18676	0.00138	135.78	0.000
PIEE	0.81134	0.00149	545.47	0.000
S=	0.231495			

Sweden

Regression Equation:
TPI = 0.125373*EPI + 0.873724*PIEE

Impact on Inflation (%):
12.55

Predictor	Coef	SE Coef	T	P
EPI	0.125373	0.000441	284.02	0.000
PIEE	0.873724	0.000440	1986.45	0.000
S=	0.0970925			

Slovenia *(December 1999 – December 2013)*

Regression Equation:
TPI = 0.125428*EPI + 0.874079*PIEE

Impact on Inflation (%):
12.55

Predictor	Coef	SE Coef	T	P
EPI	0.125428	0.000263	477.75	0.000
PIEE	0.874079	0.000292	2998.04	0.000
S=	0.0607224			

Slovakia

Regression Equation:
TPI = 0.195162*EPI + 0.803429*PIEE

Impact on Inflation (%):
12.55

Predictor	Coef	SE Coef	T	P
EPI	0.195162	0.000647	301.69	0.000
PIEE	0.803429	0.000647	1242.36	0.000
S=	0.198100			

United Kingdom

Regression Equation:
TPI = 0.077392*EPI + 0.921893*PIEE

Impact on Inflation (%):
19.54

Predictor	Coef	SE Coef	T	P
EPI	0.077392	0.000370	209.26	0.000
PIEE	0.921893	0.000428	2153.50	0.000
S=	0.143824			

The same figures are also presented for the aggregations of the European Union and the Euro Area for comparison reasons. Both of them have changing compositions during the period under examination (January 1996 – December 2013) following the respective accession procedures.

European Union

Regression Equation:	**Impact on Inflation (%):**
TPI = 0.096484*EPI + 0.903463*PIEE	9.65

Predictor	Coef	SE Coef	T	P
EPI	0.096484	0.000104	924.00	0.000
PIEE	0.903463	0.000110	8181.08	0.000
S=	0.0255183			

Euro Area

Regression Equation:	**Impact on Inflation (%):**
TPI = 0.093468*EPI + 0.906409*PIEE	9.35

Predictor	Coef	SE Coef	T	P
EPI	0.093468	0.000152	615.50	0.000
PIEE	0.906409	0.000158	5734.32	0.000
S=	0.0346499			

In the following diagram are presented the results for every EU member states along with the corresponding ones of EU and EA. The new member states[8] are indicated by different color to stress the striking difference between newer and older member states.

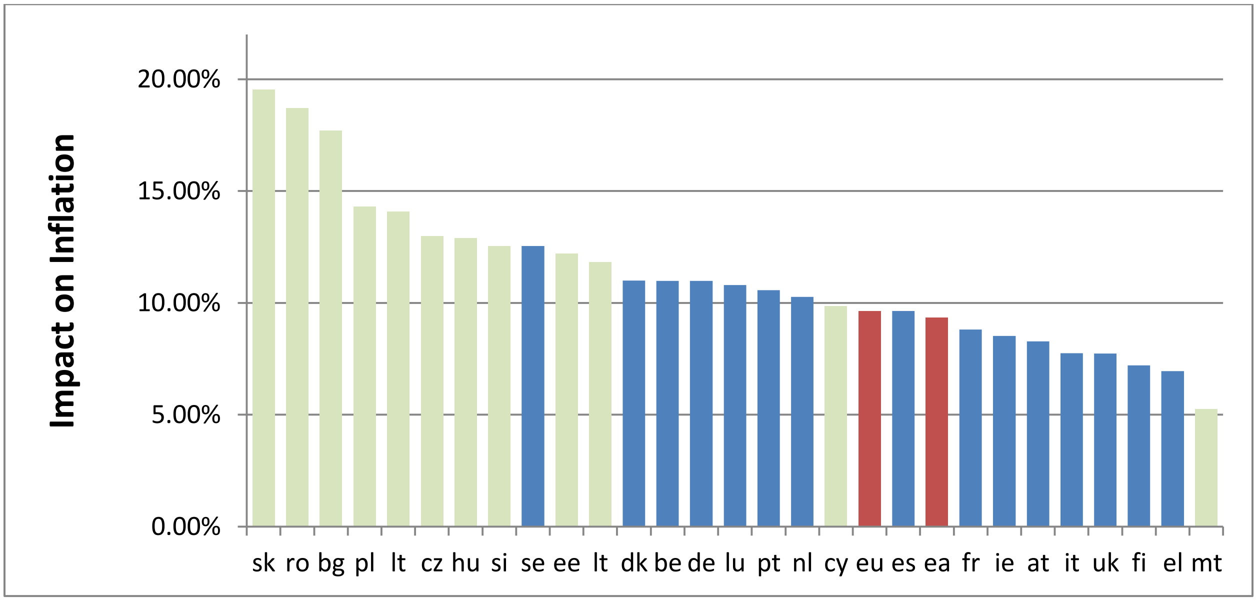


Figure 4

Dark red: EU and EA, Blue: Old Member States, Light Green: New Member States

[8] Date of accession after 1.1.2004

An interpretation of this difference lies in the Energy Intensity Indices which by definition show the amount of energy consumed per million euros of GDP, hence the greater the index the more the contribution of energy prices to the total inflation. However, we can further observe that there is also a totally different behavior between the groups of "new" and "old" EU member countries as it is depicted in the following scatterplot.

Old EU members seem to form a rather coherent group in the scatterplot (blue dots). Their Energy Intensity Indices range from a little below 100 (DK – 96.44) up to a quarter of the hundred above 200 (FI – 224.73) while their Impact on Inflation figure varies significantly irrespective of the Energy Intensity and as a result the regression line is flat indicating the unimportance of the correlation. The differences are to be attributed to constant characteristics of the economies, the energy infrastructure and principally the framework of the energy market, as well as the structural changes taking place during that period.

On the other hand new EU members form a diverge group with the common attribute of generally larger Energy Intensity (cause) figures and consequently greater Impact on Inflation (causality). The majority of them originate from the "Eastern Bloc" having an industrial tradition still echoing to the structure of the economy, consequently occupying certain positions in the intra-European division of labor[9][8]. Cyprus and Malta, two small insular states, constitute an exception to this rule, because of the structural character of their economies (large finance and tourist sectors), their historical associations (financially, historically and politically connected to the "Western European countries") and the structural characteristic of a monopoly in the electricity market (both have a single electricity company which institutionally dominates the market – market share 100%).

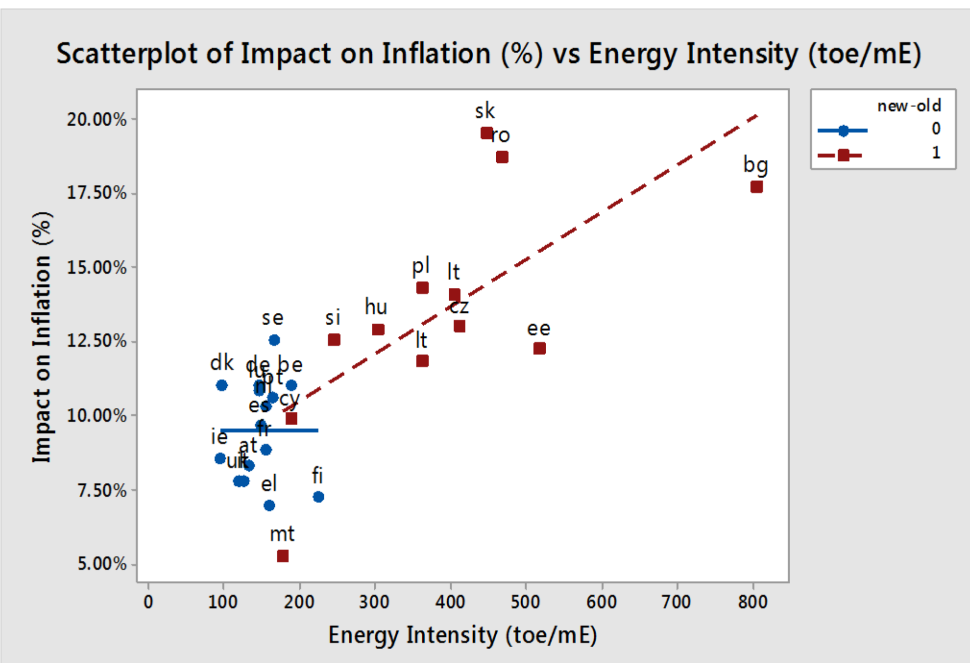


Figure 5
Scatterplot by Minitab

[9] According to the "Employment in knowledge-intensive service sectors" table of Eurostat. http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsc00012&plugin=1

The regression process for the whole group of EU member states regarding Impact on Inflation gives the following results. Even though the R-sq is rather low (57.89%) the coefficients are statistical significant according to the T and P values.

```
Model Summary

        S    R-sq  R-sq(adj)  R-sq(pred)
0.0231268  57.89%     56.20%      47.47%


Coefficients

Term                 Coef  SE Coef  T-Value  P-Value   VIF
Constant          0.07180  0.00826     8.69    0.000
energy intensity  0.01594  0.00272     5.86    0.000  1.00

Regression Equation

impact on inflation = 0.07180 + 0.01594 energy intensity
```

In a further attempt to identify the factors which contribute to the volume of impact on general inflation, some extra figures where added, such as "Average Heating Degree Days", the "Price Ratio" between 1/2001 and 12/2010, the distinction between "old and new EU members" (binary variable) and the "Market Share of the largest Generator in Electricity Market", to be stepwisely tested for addition of significantly determining variables. Interestingly, by the results only "Market Share" has proved to be significant, having though a negative coefficient with a small absolute value, implying that "stronger" players in electricity market (oligopoly with a single price maker[10] or monopoly) are associated to less instability in the general Inflation. A short explanation is their statal status, which in certain cases is associated with slower and weaker responses to the shaping forces of the energy market.

```
Model Summary

        S    R-sq  R-sq(adj)  R-sq(pred)
0.0228082  60.68%     57.40%      45.98%


Coefficients

Term                             Coef   SE Coef  T-Value  P-Value   VIF
Constant                       0.0819    0.0112     7.29    0.000
Energy Intensity (toe/mE)    0.000165  0.000027     6.08    0.000  1.03
market share                -0.000212  0.000162    -1.31    0.204  1.03

Regression Equation

Impact on Inflation = 0.0819 + 0.000165 Energy Intensity (toe/mE) -
 0.000212 market share
```

[10] Market participants that have market power, namely can set the level of prices in a market

The previous results with the intense contradiction between new and old EU member states presented a great opportunity of putting to test the environmental Kuznets curve (EKC) hypothesis. The original object of the Kuznets curve is the association of the Economic Inequality between the highest and the lowest earning households of an economy and the level of Development of an Economy, having Gini Coefficient[11] as a standard figure of measuring the Economic Inequality. According to the KC hypothesis there is an opposite U shape in the curve formed by the Income per capita and Inequality axis, however that is merely a qualitative approach since the empirical data produce a neither smooth nor symmetrical curve. The KC implies as a first prerequisite the expectation of continuous economic growth and as a second the respective distribution of the produced wealth within the members of an economy, therefore there is a strong critique against the adaptation of this hypothesis.

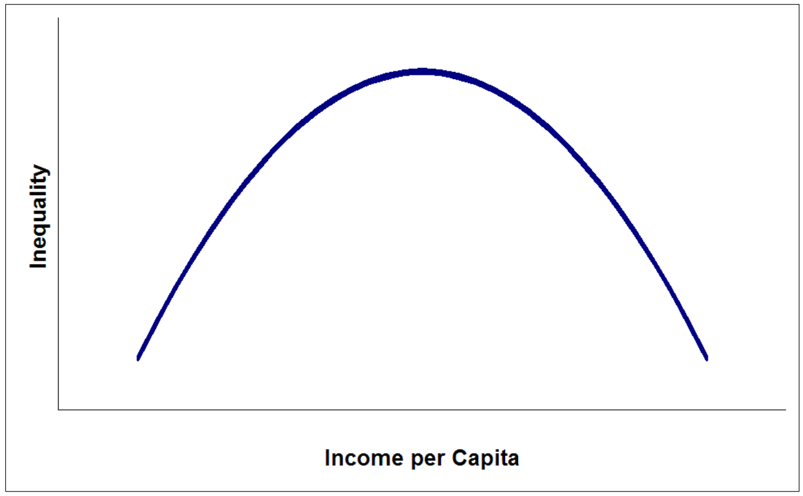


Figure 6
Kuznets Curve - Source: Wikipedia.org

There is a derivative hypothesis expressed in the area of energy economics which substitutes the Inequality dimension with the Energy Intensity, thus implying that in the process of the development of an economy there is period of ascending energy Intensity levels followed by a period of descending ones. The interpretation of those figures is the description of structural transition of an economy from agricultural to services, with the intermediate industrial character phase. However, this assumption does not take into consideration the international division of labor and the specialization of an economy, despite the global trend for augmentation of the service sector with the presumed consequent produced economic space for the developing countries.

[11] The Gini Coefficient is actually a measure of statistical dispersion which constitutes a comparison to the uniform distribution. It calculates the “distance” from a perfectly distributed wealth for instance.

In order to confirm the EKC, data from 2006[12] were used for two reasons. a. The global financial crisis had not yet outburst which caused violent changes of economic figures (especially GDP per capita), b. the integration process for the new countries was still in the beginning therefore the differences were more obvious. For statistical purposes Luxembourg was omitted, due to the extraordinary value in "GDP per Capita" (270) and the insignificant gravity for the EU averages, inasmuch it is special area in matters of history and economic role in the Union. We can assume that the graph above presents second, namely descending, the part of curve. Besides, every country member in the EU is rated with an above average worldwide GDP per Capita.

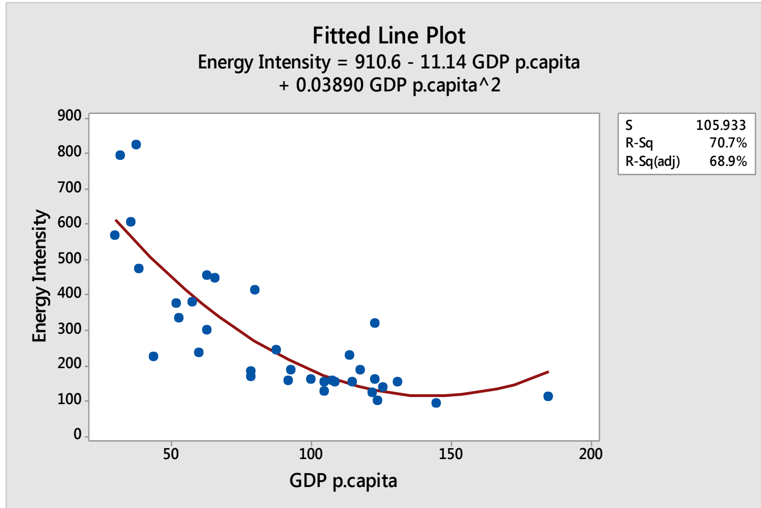


Figure 7
Scatterplot and Fitted Line form MInitab

[12] Unfortunately our data were limited only to year per year observation, because Eurostat assesses the GDP per capita every year according to the general average within the EU countries, thus changing absolute value each year.

Comparison of Energy Prices' Change Rate

In the present chapter a detailed view to the energy prices and their change rate per country was made. The initial aim was to compare the speed at which each country's energy products rise, namely the inflation in the energy market, and the correlation of that speed to the desired integration and homogenization process. Unfortunately, a direct comparison of prices between countries cannot be made because the data are in a HICP (base year = 100) form thus only the growth rates could be the comparable object. Moreover, an assessment of the oil price weighting coefficient to the general energy prices was attempted in order to discover which economies are affected in a more severe manner by periods of international instability and price fluctuations.

For both targets Linear Regression Models were used in order to specify the respective figures. However the model produced cannot be considered reliable per se despite the large R-sq values (above 90% for single variable and above 95% for dual variables), due to the existing trends (Augmented Dickey-Fuller and KPSS tests) in the provided time series of international oil and general energy prices per country. So their results are only used in a comparative way between the countries.

The data regarding energy prices in EU member countries come from the Eurostat database for energy prices, are HICP and monthly. Next, the data used for the oil prices come from European Central Bank, their magnitude is measured in Euro currency and the type of oil is Brent[13]. The period examined is from January 1996 to December 2013, unless explicitly stated otherwise, and the base year is 2005.

Linear Regression Models

	EU	**EPI = 59.045 + 0.40622*t**		**EA**	**EPI = 60.138 + 0.37695*t**
1.	AT	EPI = 66.222 + 0.31956*t	15.	IT	EPI = 67.073 + 0.32425*t
2.	BE	EPI = 59.110 + 0.39328*t	16.	LT	EPI = 40.110 + 0.67400*t
3.	BG (Dec.96-Dec.13)	EPI = 32.870 + 0.60484*t	17.	LU	EPI = 55.380 + 0.38806*t
4.	CY	EPI = 31.720 + 0.60550*t	18.	LV	EPI = 32.320 + 0.79070*t
5.	CZ (Dec.99-Dec.13)	EPI = 72.922 + 0.48830*t	19.	MT	EPI = 41.980 + 0.58170*t
6.	DE	EPI = 56.454 + 0.39885*t	20.	NL	EPI = 52.393 + 0.38231*t
7.	DK	EPI = 64.455 + 0.32142*t	21.	PL	EPI = 43.154 + 0.52461*t
8.	EE (Dec.00-Dec.13)	EPI = 55.810 + 0.88680*t	22.	PT	EPI = 58.395 + 0.38876*t
9.	EL	EPI = 44.860 + 0.59630*t	23.	RO(Dec.00-Dec13)	EPI = 43.944 + 0.90541*t
10.	ES	EPI = 59.670 + 0.41260*t	24.	SE	EPI = 61.405 + 0.34013*t
11.	FI	EPI = 62.600 + 0.37571*t	25.	SI (Dec.99-Dec.13)	EPI = 60.485 + 0.59349*t
12.	FR	EPI = 67.335 + 0.30995*t	26.	SK	EPI = 23.190 + 0.59758*t
13.	HU(Dec.00-Dec.13)	EPI = 61.630 + 0.79570*t	27.	UK	EPI = 51.700 + 0.56280*t
14.	IE	EPI = 51.610 + 0.44558*t			

[13] Petroleum production from Europe, Africa and the Middle East flowing West tends to be priced relative to this oil, i.e. it forms a benchmark.

The majority of the Linear Regression Models produce an opposite "s" shape in normal probability plot, thus they are heavy-tailed, mainly fat tailed due to the impact of steep oil price fluctuations, but also long-tailed especially for countries with initially low prices and rapid change rate.

The next step was to associate the previous findings with the absolute value of energy prices, in order to identify whether there is a certain tendency towards price homogenization within the EU. As X-axis variable the electricity prices of 2005 were used (weighted average of medium size industries' and medium sized households' prices with coefficients according to the final energy consumption per sector in 2005) and as Y-axis variable the change rate of each country. The reasons for those choices, was a. the rather independent character of electricity prices in each country and the weaker and slower response to price shocks by oil prices, due to technical and institutional reasons and b. the fact that for every country the change rate functions as a lever with (2005, 100) as a leverage point. In the following diagram can be observed the obvious distinction between the "new" and the "old" member states in the EU in matter mainly of change rate.

The interpretation of the diagram's results proves the gap between the EU countries' energy markets regarding the pace at which they move towards a direction of more expensive energy products. Though those two groups are not dense and coherent (R-sq is significantly low) their centers of masses lie in a significant distance.

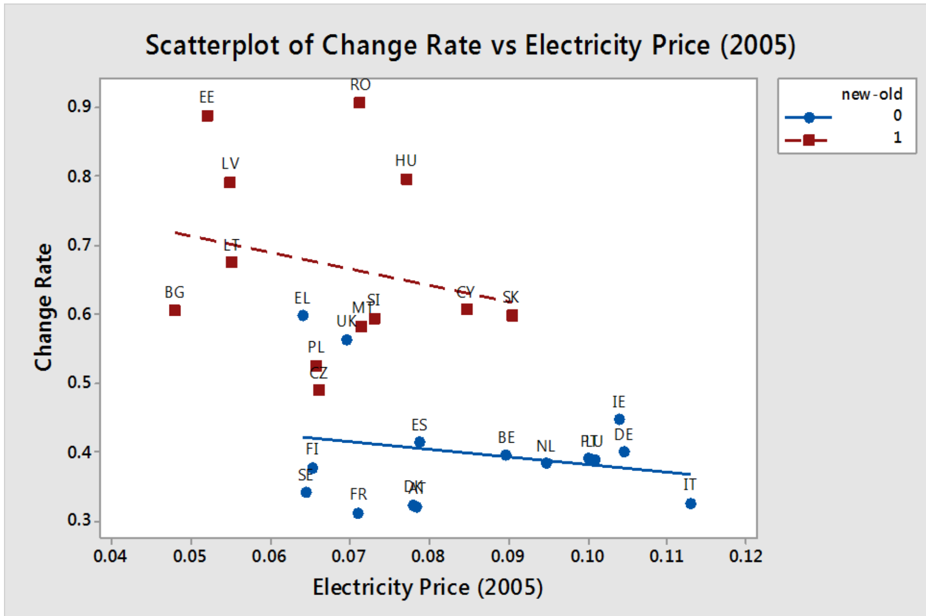


Figure 8
Scatterplot and Linear Regressions form MInitab

In general, the only two old members found within the area of the new ones are Greece and United Kingdom for different reasons. The Greek case is mostly influenced by the imposition of bigger electricity and oil prices institutionally (rise in taxation of petroleum products, greater VAT and rise in electricity prices approved by the Greek Regulatory Authority for Energy), as a result of the Memorandum deal the international economic and fiscal control enforced by EU, ECB and IMF since 2010. In United Kingdom the reasons according to a publication by the parliament are "declining UK output, increased reliance on international markets, increased global demand, links between oil and gas markets, actions of some supplying countries, taxation and policies aimed at cutting carbon emissions" [9], with also a growing critique to the oligopoly that resulted from 1990s privatizations [10].

According to the data collected by Eurostat, Oil is both the most consumed fuel, as well as the least produced in matter of quantities by the EU members. As a result it constitutes the most significant factor of price changes regarding energy products in general. There are a number of direct and indirect reasons which contribute to that.

Since the majority of the technology is oil-oriented[14] the impact of oil prices fluctuations is imminent both to residential, as well to industrial users. However, it must be said that through the years there has been change in the technological "monopoly" of oil, resulting in an expansion of natural gas as fuel and also at a change in the usual price ratio [11], which from 10:1 turned to 6:1.

Moreover, the natural gas prices are connected to the oil prices [12] in the long-term, because they are substitutes in the consumption (positive cross elasticity) and complements in the production, namely the technological changes affect equally both fuels.

Finally, since the vast majority of petroleum products are imported, the percentage of added value in Europe is not significant, thus price fluctuations cannot be absorbed.

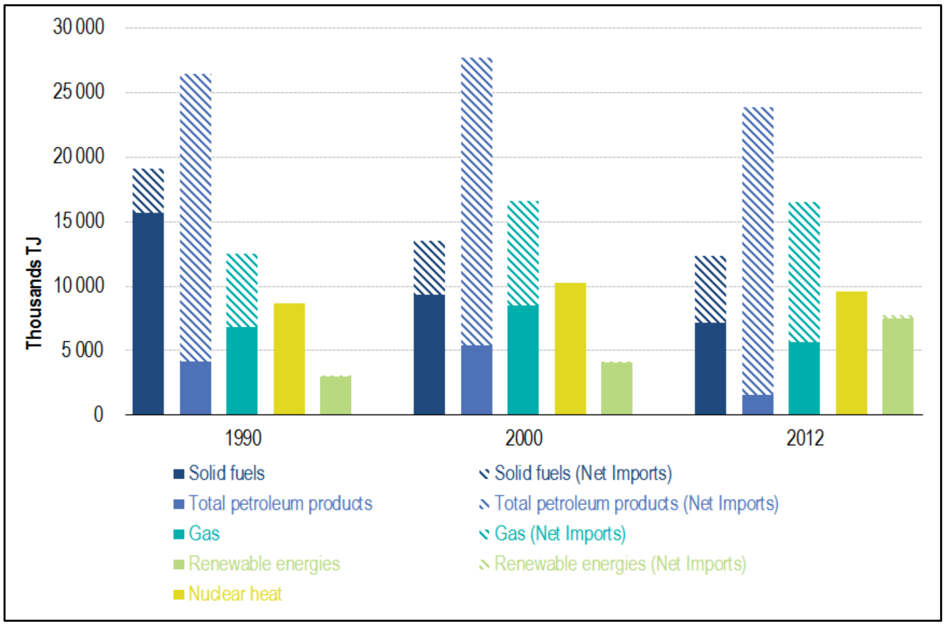


Figure 9
EU Energy Dependence per Fuel - Source: Eurostat

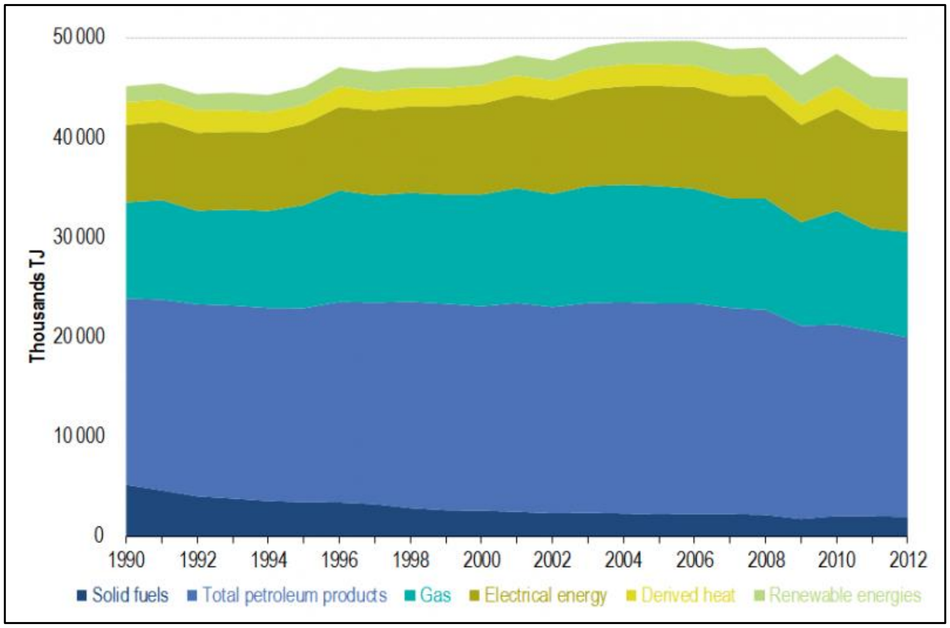


Figure 10
EU Energy Consumption per Fuel - Source: Eurostat

[14] Oil-oriented technology describes the capital and consumer products which use the as fuel products derivatives of crude oil, such as petrol, gasoline etc. (eg. Transport means, heating infrastructure)

The following table presents the weighting coefficients computed for the Regressions. The data used for the level of energy prices are the same as in the previous regression, with the addition of oil prices after their harmonization (2005 =100). The period of reference is form January 1996 to December 2013, unless explicitly stated otherwise.

Linear Regression Models - Multivariate

	EU	**EPI= 56.561 + 0.20130*month + 0.25650*oil_price**
	EA	**EPI= 57.619 + 0.16909*month + 0.26012*oil_price**
1.	AT	EPI= 63.569 + 0.10068*month + 0.27391*oil_price
2.	BE	EPI= 55.698 + 0.11160*month + 0.35260*oil_price
3.	BG (Dec 1996 –Dec 2013)	EPI= 31.365 + 0.51410*month + 0.10880*oil_price
4.	CY	EPI= 26.738 + 0.27650*month + 0.41170*oil_price
5.	CZ (Dec 1999 –Dec 2013)	EPI= 50.340 + 0.39180*month + 0.10880*oil_price
6.	DE	EPI= 54.562 + 0.24272*month + 0.19539*oil_price
7.	DK	EPI= 62.949 + 0.19722*month + 0.15542*oil_price
8.	EE (Dec 2000 –Dec 2013)	EPI= 06.310 + 0.71570*month + 0.17770*oil_price
9.	EL	EPI= 39.110 + 0.12170*month + 0.59390*oil_price
10.	ES	EPI= 56.120 + 0.11950*month + 0.36690*oil_price
11.	FI	EPI= 59.689 + 0.13570*month + 0.30040*oil_price
12.	FR	EPI= 64.624 + 0.08630*month + 0.27988*oil_price
13.	HU (Dec 2000 –Dec 2013)	EPI= 17.030 + 0.65270*month + 0.14850*oil_price
14.	IE	EPI= 48.847 + 0.21720*month + 0.28580*oil_price
15.	IT	EPI= 64.604 + 0.12050*month + 0.25500*oil_price
16.	LT	EPI= 37.940 + 0.48880*month + 0.23080*oil_price
17.	LU	EPI= 51.797 + 0.09258*month + 0.36977*oil_price
18.	LV	EPI= 28.730 + 0.48980*month + 0.37580*oil_price
19.	MT	EPI= 39.160 + 0.34920*month + 0.29100*oil_price
20.	NL	EPI= 51.433 + 0.30310*month + 0.09910*oil_price
21.	PL	EPI= 42.175 + 0.45850*month + 0.08530*oil_price
22.	PT	EPI= 55.780 + 0.17300*month + 0.27000*oil_price
23.	RO (Dec 2000 –Dec 2013)	EPI= -8.830 + 0.86620*month + 0.04070*oil_price
24.	SE	EPI= 60.616 + 0.27505*month + 0.08140*oil_price
25.	SI (Dec 1999 –Dec 2013)	EPI= 33.324 + 0.40120*month + 0.21690*oil_price
26.	SK	EPI= 23.110 + 0.59110*month + 0.00810*oil_price
27.	UK	EPI= 48.890 + 0.30270*month + 0.32050*oil_price

Some useful conclusions can be drawn from the table, since they coexist a number of different energy market profiles. There is a first group, comprised mainly of new member states, in which the ratio of month to oil coefficients is very high. This represents the violent adaption to the EU legal framework with the consequent rise in energy prices. The other groups comprise mainly of the old EU members and their division is made according to their dependence on oil, consequently their stronger response to oil prices, as shown by the oil price coefficients.

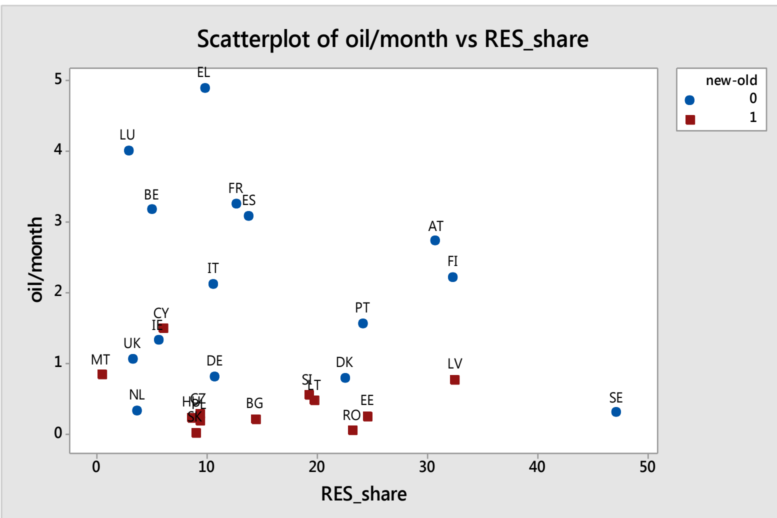


Figure 11
Scatterplot from Minitab

Interestingly, though not surprisingly, there is no direct connection between low dependence on oil and Renewable Energy Sources penetration, as can be observed by the following scatterplot. Apart from the new members whose oil to month coefficient ratio is low for the reasons stated above, there are examples of countries not being affected heavily by oil price fluctuations due to their reliance on alternative fossil fuel energy sources, mainly domestically produced. As an example, both the Netherlands and United Kingdom use natural gas as largest primary energy source (45,7% and 39.9% respectively), which is produced in the natural gas fields of Groningen and the North Sea.

In the last part of the sub-chapter are presented the results of the ADF and KPSS test conducted to the monthly differences of Oil Prices, though they contradict.

Summary statistics:

Variable	Monthly differences
Observations	216
Obs. with missing data	0
Obs. without missing data	216
Minimum	-14.794
Maximum	10.257
Mean	0.311
Std. deviation	3.297

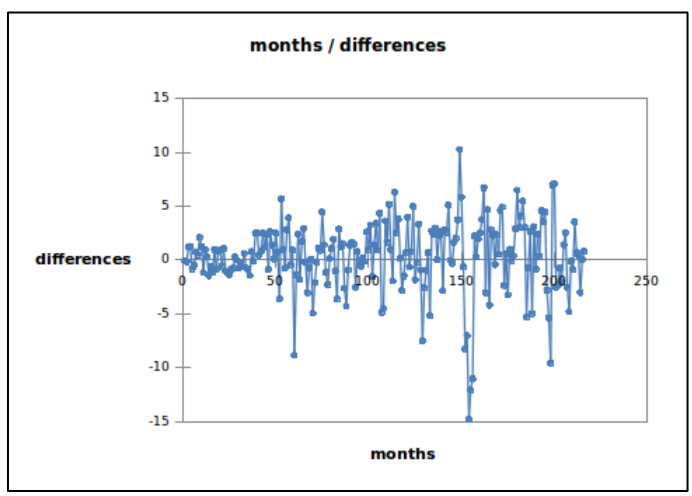


Figure 12
Time Series from XLSTAT

Dickey-Fuller test (ADF(stationary) / k: 5 / differences):

Tau (Observed value) -6.775
Tau (Critical value) -0.877
p-value (one-tailed) 1.000
alpha 0.05

Test interpretation:
H0: There is a unit root for the series.
Ha: There is no unit root for the series. The series is stationary.

As the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 99.98%.

KPSS test (Trend / Lag: Short / differences):

Eta (Observed value) 0.023
Eta (Critical value) 0.145
p-value (one-tailed) 0.976
alpha 0.05

Test interpretation:
H0: The series is stationary.
Ha: The series is not stationary.

As the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 97.57%.

As it is clearly depicted above, the two unit-root tests produce contradictory results. However, it was preferable for integrity reasons to avoid the use of the absolute coefficient assessed values, but only in matters of comparison.

The Oil Price time series are considered a scrutinized topic since their behavior affects the economic growth rates with the consequent impact at the directly associated business sectors. Therefore there is a great amount of literature dedicated to this subject, trying to identify the seasonal variations or patterns which they rely on. In this effort, it is attempted to assess the general trend and the autocorrelations of the distinct points in the series for applying the appropriate interpretation. For instance, in the diagram are shown the original time series, the trend and the fits according to a periodicity of 12 months. Obviously, neither the linear trend, nor the 12-month lagging autocorrelation are sufficient to describe the price changes, moreover a choice of lengthier period autocorrelation could not provide better results (namely smaller MAPE, MAD and MSD values). As a result the international Oil Prices remain a field mainly affected by the international macroeconomic figures (such as growth with the prominent example of the 2008 price surge which was a consequence of the unexpected growth rates in the emerging economies [13]), as well as matters of international politics like the embargoes imposed by the OPEC leading to the 1970s' Oil Crises.

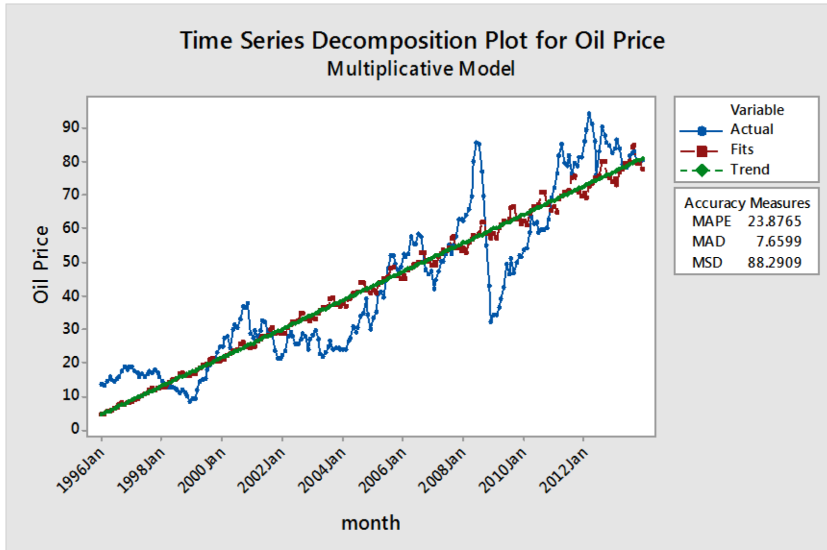


Figure 13
Time Series from Minitab

Finally, a Time Series plot comprising the Oil Prices, the Energy Prices in Cyprus and the Energy Prices in the Netherlands is included, as a graphic example of the Oil Price impacts[15]. Cyprus is the country most affected by the Oil Price volatility, due the inclusive use of oil as primary energy price until recently (with the exception of a high penetration of solar water heating systems [14]), whereas on the contrary the Netherlands are least affected, due to the use of domestically produced natural gas and a higher costs of labor which undermines the significance of the primary product's price changes.

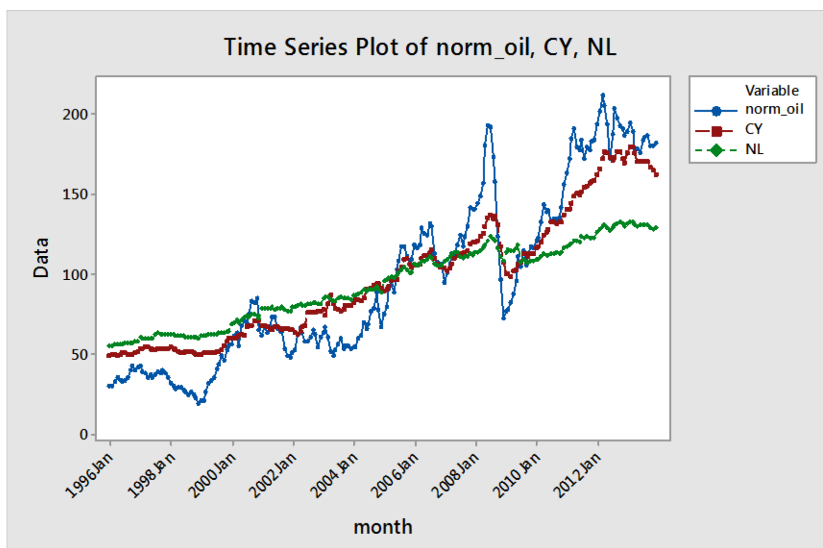


Figure 14
Time Series from Minitab

[15] For every figure applies that year 2005 is considered as base year.

Integration and Harmonization Process Overview

The aim of this dissertation is to draw conclusions about the speed and success of the integration process taking place inside the European Union. The aforementioned process has two interconnected, though distinct parts.

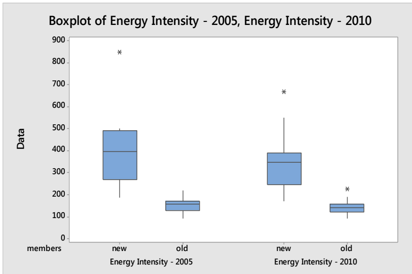
- The first one consists of the legal and institutional framework harmonization and cannot be directly addressed by the science of Statistics, so the European Commission issues directives specifically for the obligations which must be undertaken by the EU member countries.
- The second one has to do with the presumed consequent structural, economic and technological convergence among the EU member countries. Direct and indirect assessments are made by the recording of either quantitative or qualitative variables.

Both parts constitute explicitly stated targets of the European Commission and are continuously monitored and controlled with respective interventions by the appropriate public mechanisms, nonetheless in the present chapter only the second part will be dealt by measuring and comparing some values which provide an overview of the energy markets infrastructure of every country.

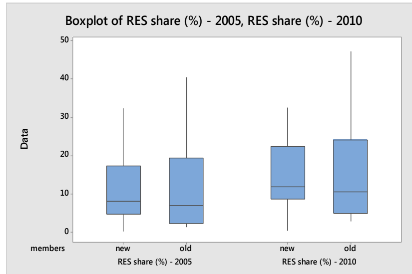
Comparison between a pick of annual data

In this part are presented important statistical facts about some critical aspects of the Energy Markets in EU member states. Those facts comprise the Energy Intensity, the RES share in total energy production, the Electricity Prices (households and industry), the Market share of the Largest Electricity Generator, the Energy Dependence, the Combined Heat and Power Generation (CHP) and finally the percentage of Residential and Industrial Consumption. The data are compared in two different points of time as snapshots, in order to identify underlying tendencies. The years chosen are 2005 and 2010, because on the one hand this period reflects the changes taking place during the first years of accession in the EU for the new members states and on the other hand the figures are not yet severely affected by the impacts of the economic crisis in Eurozone (since 2009), thus it presents the already existing trends.

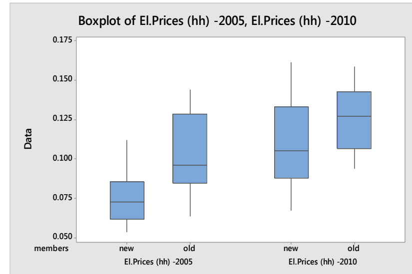
Variable	Mean	St. Deviation	Mean Diff.	StDev. Diff.
Energy Intensity – 2005	265.4	174.2	-28.1	-30.4
Energy Intensity – 2010	237.3	143.8		
RES share (%) – 2005	11.57	10.4	3.67	0.94
RES share (%) – 2010	15.24	11.34		
Electricity Prices (Households) – 2005	0.0915	0.02483	0.02697	0.0017
Electricity Prices (Households) – 2010	0.11847	0.02653		
Electricity Prices (Industry) – 2005	0.06432	0.01323	0.03117	0.01188
Electricity Prices (industry) – 2010	0.09549	0.02511		
Market Share (%) – 2005	59.93	28.35	-3.72	-0.22
Market Share (%) – 2010	56.21	28.13		
Energy Dependence (%) – 2005	56.03	32.97	-0.7	-4.17
Energy Dependence (%) – 2010	55.33	28.8		
CHP Generation (%) – 2005	14.12	12.24	1.43	0.71
CHP Generation (%) – 2010	15.55	12.95		
Residential Consumption (%)	24.87	6.29	0.8	0.47
Residential Consumption (%)	25.67	6.76		
Ind. Consumption (%) – 2005	27.63	9.11	-3.12	-1.03
Ind. Consumption (%) – 2010	24.51	8.08		



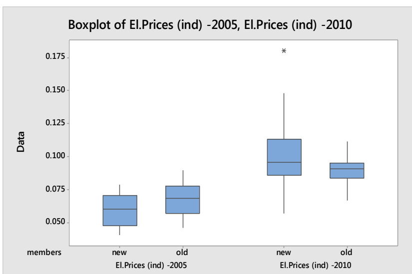
Energy Intensity:
2005 (new-old) and
2010 (new-old) respectively



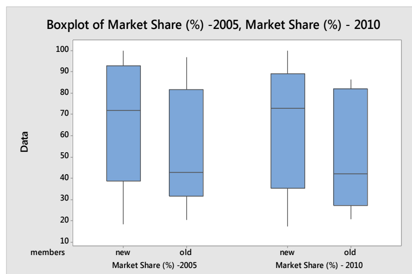
RES share in Energy Production:
2005 (new-old) and
2010 (new-old) respectively



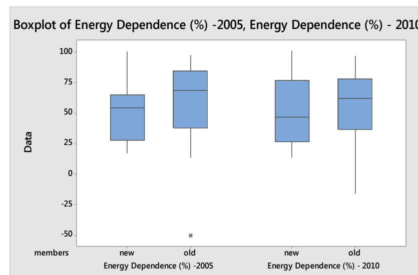
Electricity Prices (households):
2005 (new-old) and
2010 (new-old) respectively



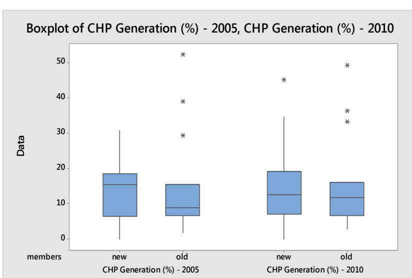
Electricity Prices (industry):
2005 (new-old) and
2010 (new-old) respectively



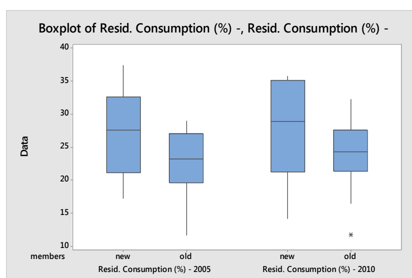
Market Share of Largest El. Gen:
2005 (new-old) and
2010 (new-old) respectively



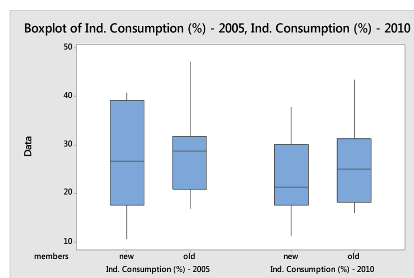
Energy Dependence:
2005 (new-old) and
2010 (new-old) respectively



Combined Heat – Power Gen:
2005 (new-old) and
2010 (new-old) respectively



Residential Consumption:
2005 (new-old) and
2010 (new-old) respectively



Industrial Consumption:
2005 (new-old) and
2010 (new-old) respectively

The indices and graphs above are offered for quick view and evaluation of the general trends, as well as the coherence of the group comprised of the EU member states. In the next phase clustering methods will be used as complementary approach to an overview.

Finally, two different clustering methods were used for the classification of different Energy Market Profiles and their distance measurement. Those clustering methods were used for both 2005 and 2010, as a means of the integration process' speed quantification.

a. Dendrograms

Centroid Linkage of the Euclidean Distance was used for the classification of the observations, both for 2005 and 2010 with data acquired by Eurostat. As it can be easily deducted by the following dendrograms, there is a greater similarity among the members of the groups of new and old member countries separately[16]. However, the differences seem to retreat in the course of time, since the similarity levels of the conjunction points are significantly lower in 2010 than in 2005.

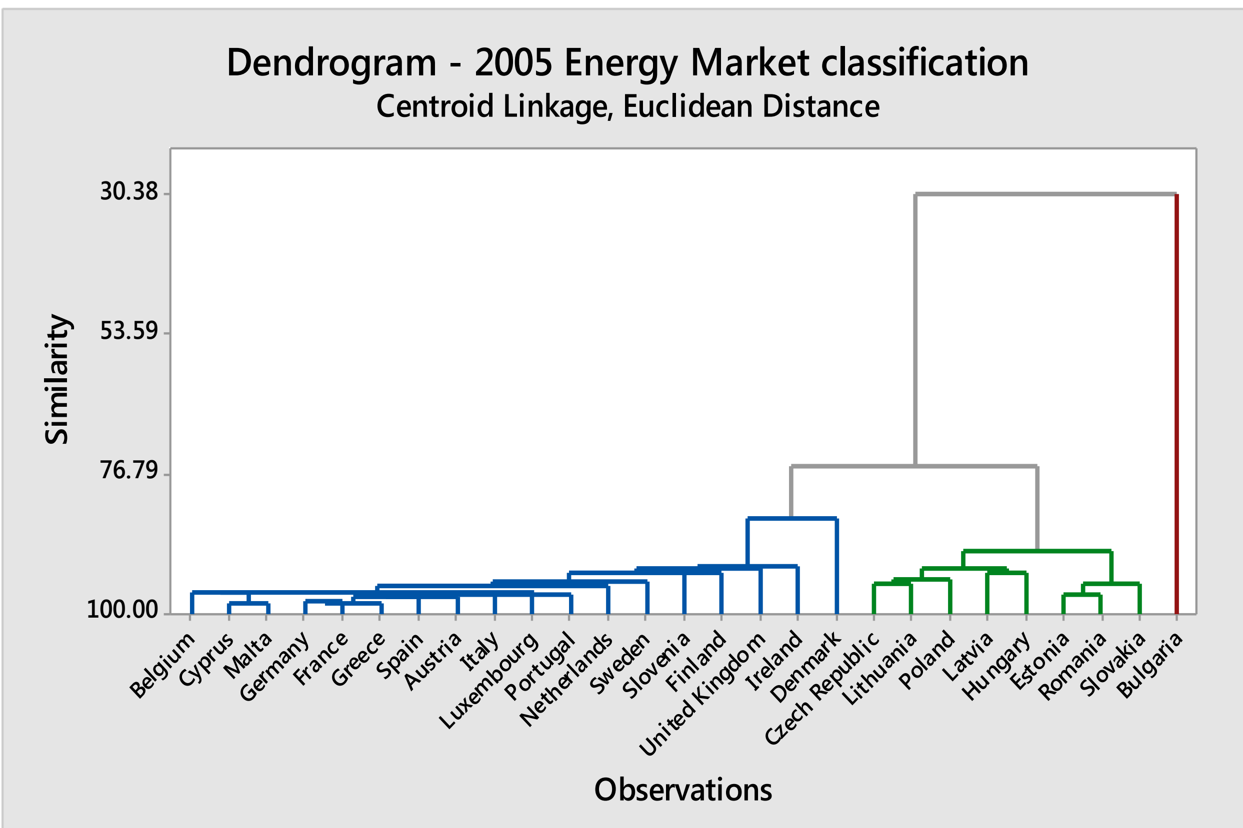


Figure 15
Dendrogram from Minitab

[16] The only countries that defy that rule are Cyprus, Malta and Slovenia. All of those countries have strong bonds and dependence on some core EU countries.

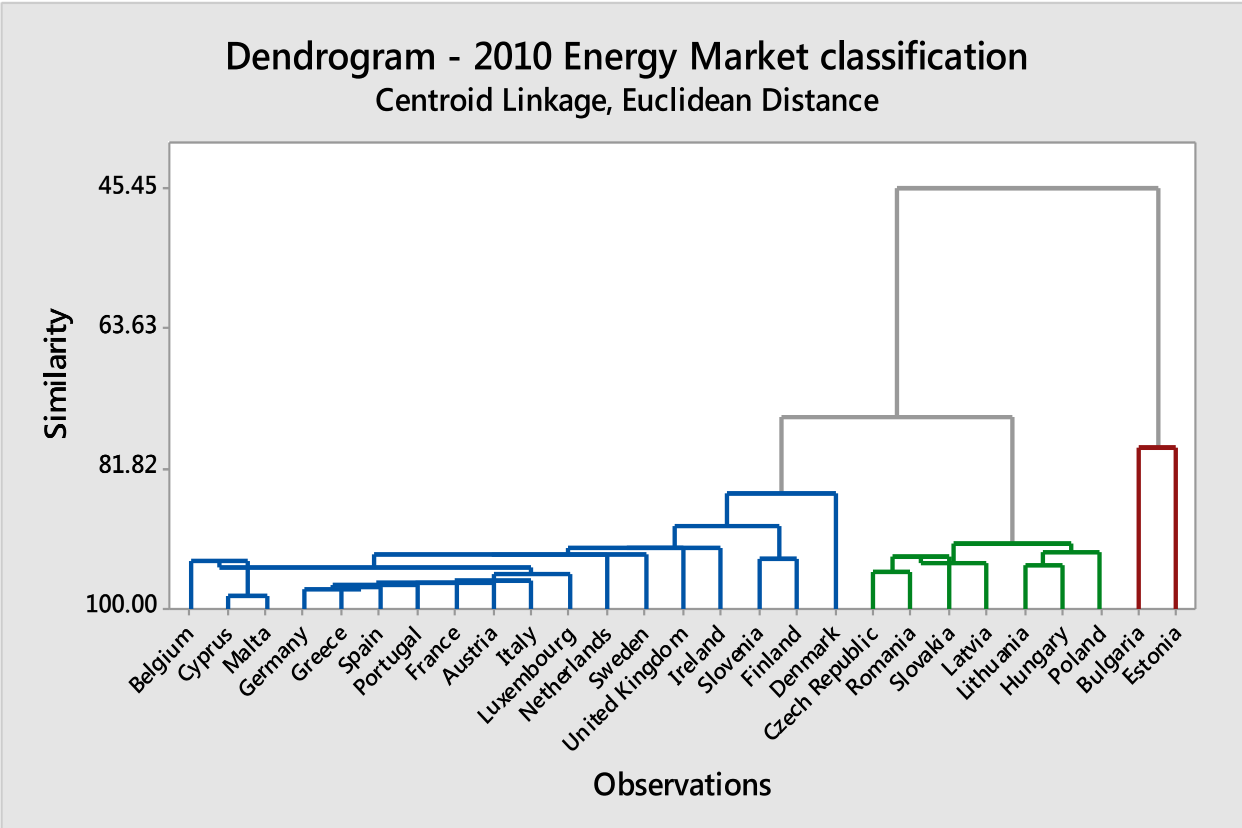


Figure 16
Dendrogram from Minitab

The key figure for this classification is probably Energy Intensity, which is also actually the underlying cause of various differences underlined in previous chapters and a critical structural index of an economy in general. As long as there is a lack of convergence in this element, the various differences in other aspects of the Energy Markets will be maintained as a byproduct of this inequality.

b. K-means Clustering

Additionally, K-means clustering is used for a more perspicuous computation of the homogenization process. The number of clusters was 3 (as it is indicated by the dendrograms) and the data used were the same as above.

Distances Between Cluster Centroids – 2005

	Cluster1	Cluster2	Cluster3
Cluster1	0	686.5955	260.2251
Cluster2	686.5955	0	427.4188
Cluster3	260.2251	427.4188	0

Distances Between Cluster Centroids – 2010

	Cluster1	Cluster2	Cluster3
Cluster1	0	459.2095	198.7787
Cluster2	459.2095	0	261.0732
Cluster3	198.7787	261.0732	0

It is obvious in the results that the distances have shrunk during the second half of 2000s.

Conclusion and Suggestions

The present dissertation aspired to offer an accurate description of the situation in the Energy Markets of EU member countries and furthermore the European orientation towards an integrated, harmonized and more coherent intra-European Energy Market. In this attempt public data collected and maintained by Eurostat, European Central Bank and European Environment Agency were used and the goal was to extract information, about the underlying factors which cause the distance between the statistical objects, as well as any indirect and general trends. However, as EU comprises of countries very divergent in matter of economy, institutions, geography and political traditions, it was considered appropriate to begin with a compact presentation of their Energy Market and Infrastructure key figures.

After the that presentation, it was assessed the level of influence that the Energy Products exercise on the Total Price Index, in order to evaluate the importance of those products for either the economy as a whole, or for the households. Next, the price trends in the course of time and their correlation with international oil prices for each country separately, in order to identify similarities or differences among the various profiles. Finally, a classification was made with the data provided by institutions and the previous findings using clustering methods, which supported and strengthened the view about the separating line which divides the EU member countries.

From the beginning of the dissertation it was more than obvious, that the countries that are parts of the last two accession procedures prior to 2010 (2004, 2007) have different economic profiles and energy market structure from the countries of “old Europe”. Of course there is not a causality relationship between the year of accession and the respective profiles, but both of them derive from the divergent economic and political past of the recent historical period. Apart from some striking exceptions (insular countries), the prominent characteristic of that differentiation is the level of the secondary sector of the economy and presumably the lack of technological modernization, which consequently offers a good example of Environmental Kuznets Curve. However, there were also some other features that are connected mainly with the legal framework and are related to the institutional monopolies and the inexistence of RES supporting policies in those countries.

Finally, the descriptive comparison of the key figures and the following clustering confirmed our hypothesis of those differentiating attributes, with a contradictory trend for augmentation of similarity level though. On the one hand there is a convergence in some figures such as Energy Intensity, Industrial Consumption, Energy Dependence and Market Share of the Largest Electricity Generator, whereas on the other hand these was not the case for the Electricity Prices (both Industrial and Residential), where the Industrial Electricity Prices soared for the “newcomers”[17].

An interpretation of the above conclusions is that the accession in the EU deteriorated the conditions for the secondary sector prospects of the new countries, resulting in reduction of the Energy Consumption share and also having as consequences the reduction of Energy Intensity and a loosening for more competitive Industrial Electricity Prices. Furthermore, a critique should be addressed to the liberalization processes and their results that do not comply with the Commission’s expectations and on the contrary have probably contributed to a wave of growing revalorization.

[17] While the prices skyrocket in some cases (e.g Bulgaria), the GDP per Capita did not follow at the same rate. Even though there is trend for convergence (the difference of Means between new and old members in GDP per Capita shrank during that five year period), this was caused mainly by the steep fall of that figure for the PI^{2}GS and to a much lesser extent by the bettering of the conditions for the new countries.

Greek case

Apart from the big European picture a special reference must be made to Greece and the specific transformations taking place during this 5-year period. In Greece, all indices with reference to the structural features of the economy are changing towards a “greener” direction indirectly associated with improvement in quality of life (Energy Intensity is falling, whereas RES and CHP share are increasing significantly). On the contrary, consumers have experienced deterioration of the pricing policies in electricity (households +53% - industry +33%), even though there is a reduction in the GDP per Capita (from 91 to 89 – cross country comparison) as measured by the EU averages and an increase in unemployment (from 9.9 to 12.7). Additionally, in the course of those 5 years the Market Share of the Largest Generator shrank 12%. Both of these constitute parts of the national policies imposed in the energy sector, which embraced the liberalization doctrine with controversial results[18]. Last, the levels of Energy Dependence remained fairly the same, while both Residential and Industrial Consumption fell in favor of Transport and Services sector.

Greece constitutes a special case due to the specific fiscal policy programs adopted from 2010 and then, so later studies must be devoted in order of the assessment of that period complementary to the general European trends.

Further Examination

A further examination of the subject: a. should measure and compare the results for the next five years (step = 5 years), b. attempt to identify the reasons for the transformation of the industrial sector in new member countries with an emphasis in Energy Intensity and c. make an evaluation of the liberalization process and its results for the European citizens.

[18] Those results also differ from the setting fashioned in the Telecommunications’ sector during 1990s.

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