Energy Trajectory Efficiency In Europe And Eurasia
A Dynamic Panel Data Models Analysis
Efficacité Des Trajectories Énergetiques En Europe Et En Eurasie
Analyse De Modèles De Panneaux Dynmiques

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Abstract: World energy consumption alludes to the aggregate energy utilized by all of human civilization. As per the International Energy Agency (IEA), the worldwide energy consumption has been becoming relentlessly finished the last decade; where it constitutes one of the main parts with the quickest developing on the planet. This investigation examinations the connection between global energy consumption and diverse perspectives. The outcomes demonstrate a noteworthy way, which is a co-integrating connection between energy consumption and the variables package. The outcomes likewise show bidirectional, unidirectional and neutral causality between energy consumption and a few factors, which could be a decent tool to prioritize the allocation of assets crosswise over businesses to guarantee a superior fiery strategy by and large and monetary results.

Keywords: Energy consumption trajectory, Panel co-integration, FMOLS and DOLS estimators, Panel Granger causality, Europe, Eurasia.

JEL Classification : B22. C33. C51, Q41, Q55, O13, Q56, Q53, N70, N74.

Résumé: La consommation mondiale d'énergie fait allusion à l'énergie totale utilisée par l'ensemble de la civilisation humaine. Selon l'Agence internationale de l'énergie (AIE), la consommation d'énergie dans le monde entier s'est progressivement arrêtée au cours de la dernière décennie; où il constitue l'une des parties principales du développement le plus rapide de la planète. Cette enquête examine le lien entre la consommation mondiale d'énergie et diverses perspectives. Les résultats montrent une manière remarquable de créer un lien co-intégrateur entre la consommation d'énergie et le paquet de variables. Les résultats montrent également une causalité bidirectionnelle, unidirectionnelle et neutre entre la consommation d'énergie et quelques facteurs, ce qui pourrait être un outil décent pour hiérarchiser la répartition des actifs de façon transversale par rapport aux entreprises afin de garantir une stratégie de feu supérieure par des résultats financiers et monétaires.

Mots-clés: Trajectoire de consommation d'énergie, Co-intégration du panel, Estimateurs FMOLS et DOLS, Causalité du panel Granger, Europe, Eurasie

JEL Classification : B22. C33. C51, Q41, Q55, O13, Q56, Q53, N70, N74.

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1- Introduction

Although the availability of modern energy is not a panacea for social and economic problems faced by developing countries, it is now widely known that the absence of access to dependable and moderate energy services is a noteworthy obstruction to human, social and financial improvement. Furthermore, energy poverty is a noteworthy obstruction to accomplishing the Millennium Development Goals (MDG) obstacle, since energy services have a big effect on productivity, health, education, potable water and communication services (***UNIDO, 2011***).

Energy has been the foundation of economic developement and is one of the most important sub-dice structural inputs in economic development. The growing interest in this area has been largely caused by the expanding demand for energy in the worldwide, driven mainly by the increased economic activities between countries. A modern society involves increasing use of network information and communication technologies (ICT), with more and more people using the Internet. Other ICT as mobile phones, digital video recorders, digital music players, personal computers, and so on are quite common today. Therefore, companies, households and economies as a whole have a high demand for different kind of energy. This demand is motivated by such important factors as industrialization, extensive urbanization, population growth and rising living standards.

In the last three decades, various investigations have been directed to inspect the interdependence between energy consumption, economic growth and some other variables. The results show, mostly, a solid connection between monetary development and energy consumption. Be that as it may, the reality the attendance of a solid connection between worldwide energy consumption and monetary development or between energy consumption and some different factors does not really infer a causal reliance.

Furthermore, some previous articles contain very controversial results. That is why the previous literature that examined the relationship of cause and effect between energy consumption, economic growth and other aspect was not able to formulate policy recommendations that could be applied in different countries. Researchers say many economists and policy creators were and are still concerned about the causal linkage between energy consumption and different factors since this relationship has essential implications for government energy policy.

A major question is, "A multidimensional dynamic analysis is it required to resolve deep gaps caused in the analysis of the energy trajectory in European and Eurasian countries?" The response to this question is the reason for the categorization of articles published on these relationships, as well as a modelling and an analysis based on the economic aspect, political aspect and also technical-environmental aspect of the energy trajectory. The mainstream literature on the causal relationship between energy consumption and GDP can be divided into four groups. They are of incredible significance for the political energy in general.

1. Literature review and general framework

Theorists have divided the literature review on energy and growth nexus in four competing hypotheses: growth, conservation, feedback, and neutrality. First, the development hypothesis proposes that energy consumption can straightforwardly affect financial development and in a circuitous way as a supplement to work and capital in the creation procedure. The observational help for the development speculation depends on the nearness of one-way causality from energy consumption to financial development. For this situation, energy protection strategies that lessen energy consumption will unfavourably affect financial development. Second, the preservation theory expresses that energy protection approaches intended to lessen energy consumption and waste won't unfavourably affect genuine Gross domestic product. The preservation speculation is upheld if there is unidirectional causality from monetary development to energy consumption. Third, the criticism speculation declares that financial development and energy consumption are interrelated and may fill in as supplements to each other. The criticism theory proposes there is a bidirectional causal relationship between energy consumption and financial development. At long last, the impartiality theory lays on the supposition that energy consumption has a moderately minor part in the monetary development process. The neutrality hypothesis is upheld by the nonattendance of causality between energy consumption and monetary development.

For this situation, the lessening in energy consumption through energy protection strategies won't affect financial development.

The differentiating theories specified above have inspired numerous researchers to explore the causal relationship between energy consumption and monetary development. In the current years, many examinations ware adding to the comprehension of the nexus between energy consumption and financial development.. Detailed investigations of previous studies can be found in(***Ozturk 2010***), (***Payne; 2010***) and (***Pirlogea and Cicea; 2012***). Given the vast volume of studies in the relevant literature, the objective of this section is twofold: on the one hand, to review pioneers studies, and on the other hand to provide a rather comprehensive review of recently published international studies.

A. The work of the pioneers

Since the seminal paper of (***Kraft and Kraft; 1978***), which supported the unidirectional causality from GNP growth to energy consumption in the USA for the period from 1947 to 1974, the causal linkage between energy consumption and economic growth has been broadly inspected in the literature utilizing different techniques and different samples of countries. The paper by Kraft and Kraft has been criticized by (**Akarca and Long; 1980**) who noted that the period chosen was unstable because it included the first oil shock. Coming back to the investigation and receiving a similar strategy, yet this time over a more uniform 1950–1968 period, (***Akarca and Long***) raise doubt about any causal relationship between income and energy. Later, this result was confirmed by (***Yu and Hwang; 1984***) for the United States during the period 1947–1979. From that point forward, experimental examinations have been stretched out to cover different nations utilizing different strategies for econometric investigation. By applying these new methods, a few econometric examinations have shown the prestance of unidirectional or bidirectional causal relationship however they neglected to give a general pattern to nations at various development levels or structure of economy.

B. Multi-country studies on energy consumption–growth nexus

The literature on studies on a panel of countries, it is rich enough, given the large amount of work, we will highlight on some of them, and these studies are recapped below.

(***Guellil; 2016***), analyzes the relationship between Global Energy Consumption and different aspects such as; Economic, Environmental, Political,… in six panels, using the panel co-integration and panel Granger causality tests. The results reveal a significant way, which is a co-integrating relationship between energy consumption and the variables package. The results also indicate bidirectional, unidirectional and neutral causality between energy consumption and some variables, which could be a good tool to prioritize the allocation of resources across industries to ensure a better energetic policy in general and economic outcomes.

(***Ghouali.Y and al. 2015***), analyzed the long-run relationship between the total energy consumption, FDI, economic growth, and the CO2 emission in the BRICS countries, utilising the co-integration tests and panel Granger causality in panel over the period of 1990-2012. The results show significantly that there is a co-integration relationship between CO2 emissions and economic variables. The results also show the presence of a unidirectional causality from CO2 to the independent variables.

(***Ghouali.Y and al; 2014***), investigates the long-run connection between the economic growth and total energy consumption for 13 countries divided into two groups depending on the region: “Maghreb countries (Algeria, Morocco, Tunisia, Libya, Egypt), and Middle Eastern countries (Iran, Bahrain, Saudi Arabia, United Arab Emirates, Qatar, Oman, Lebanon, and Jordan)”, using panel co-integration tests over the period of 1980-2010. They find evidence of co- integration between electricity consumption and economic growth, therefore, the existence of a long-run equilibrium relationship.

(***Coers and Sanders; 2013***) they used a panel of 30 OECD countries over the 40 last years, using panel unit root and cointegration testing and specifies an appropriate vector error correction model to analyse the nexus between income and energy use. their results show some evidence that bidirectional causality exists in the very short term. their results also show a strong unidirectional causality from GDP to energy consumption. In the long term. The authors suggest that policies to reduce energy consumption and promoting energy efficiency are not likely to have a negative effect on economic growth, except in the very short term.

(***Akkemik and Göksal; 2012***) have extended the Granger causality between energy consumption and GDP, considering the heterogeneity of the panel to do this, they used a panel of 79 countries for the 1980-2007 term. They examined four different causal relationships: homogeneous non-causality, causal homogeneous and heterogeneous non-causality and heterogeneous causality. Their results show that nearly seven-tenths of the panel Granger causality bi-directional, two-tenths of the countries demonstrate that there is no Granger causality and a tenth of countries show a unidirectional Granger causality.

(***Ozturk, Aslan and Kalyoncu; 2010***) used data from the energy consumption and economic growth for 51 countries from 1971 to 2005, the authors of the articles were divided countries have 3 groups: low income group, lower middle income group and upper middle income group countries. First, the authors tested the co-integration applying the pedroni technique (1999). Secondly they used causality tests in panel to study the type of causality. Finally, we examine regardless of whether there is a solid or frail link between these factors utilizing the Pedroni method (2001). The empirical results of this study were as follows: GDP and energy consumption are co-integrated for the three groups, the consequences of causality tests in panel reveal a causal link Granger long-term GDP energy consumption for low-income countries and it occurs to be a bidirectional causality between energy consumption and GDP for middle-income countries. The study also showed no strong relationship is established between energy consumption and economic growth for all income groups considered in this study.

(***Zachariadis; 2007***) apply tests of causality between energy and growth in two variables for Canada, Germany, France, Italy, the United Kingdom, Japan and the United States, utilizing global and sectoral data and three different recent econometric technics: VEC model, ARDL model, and The Toda-Yamamoto approach. The results, which are often contradictory or implausible economically explicitly, show that one must be cautious when drawing policy implications using causality tests two variables on small samples. Therefore, it emphasizes the significance of using as large samples as possible and using multivariate models, which are closer to economic theory.

1. Data and Methodology

All data incorporated in this study are annual observations covering the period from 1992 to 2016 gathered from the following sources: U.S. Energy Information Administration (***EIA stat, 2017***), (***UN data; 2017***) (A world of information), (***World statistics; 2017***), (***World Bank Data; 2017***), (***Encyclopedia of the Nations; 2017***), (***Knoema Stat; 2017***). Data of the total primary energy consumption are defined in Quadrillion Btu, GDP - High technology export - Energy price index are defined in US dollars at current prices and current exchange rates respectively in: billion - million - Price index in dollars, Total carbon dioxide emissions (CO2) defined in million metric tons and the population is in millions. Our database includes 33 countries. We classify the countries into two panels depending on the region and continent (Europe and Eurasia):

• European countries: (Austria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Malta, Netherlands, Norway, Portugal, Romania, Spain, Switzerland, Sweden, Turkey, United Kingdom "Great Britain and Northern Ireland"),

• Eurasian countries: (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Latvia, Lithuania, Republic of Moldova, Ukraine);

to examine whether there are structural differences.

In the test of the relationship in long-term panel data, the selection of the suitable technique is an important theoretical and empirical question. Co-integration is the most appropriate method to study the long-run relationship between : Total primary energy consumption, GDP, High technology export, Energy price index, Total carbon dioxide emissions (CO2) and Population. The empirical strategy used in this paper can be classified into 4 main stages. First, unit root tests in panel series are initiated. Second, on the off chance that they are integrated of a similar request, the Board co-integration tests are utilized .Third, if the arrangement are co-integrated, the vector of co-integration in the long run will be estimated by utilizing the (FMOLS) and (DOLS) techniques. Fourth, subsequent to evaluating the long term relationship utilizing FMOLS and DOLS strategies and the investigation of the Impulse-Response graph, we proceed to Panel Granger Causality.

2. Empirical results:

4.1.1 Unit Root Tests : Our analysis begins with the stationarity tests using panel unit root test, the tests results are revealed in the following table:

Table 01:Unit root tests for the variables of Eurasian countries

Null: Unit Root						Null: NO Unit Root	
Methods		Levin, Lin and Chu (LLC)	Im, Pesaran And Shin (IPS) W-stat	MW–ADF Fisher Chi-square	MW–PP Fisher Chi-square	Hadri Z-stat	Heteroscedastic consistent Z-stat
	Variables						
Level	*Log ENR*	*-1.17656 (0.1197)*	*-1.03846 (0.1495)*	*31.1019 (0.1509)*	*32.1944 (0.1222)*	*4.53683 (0.0000)**	*3.44812 (0.0003)**
	Log GDP	*0.66009 (0.7454)*	*4.56435 (1.0000)*	*4.78809 (1.0000)*	*2.24321 (1.0000)*	*5.19355 (0.0000)**	*4.64791 (0.0000)**
	Log HTE	*-2.61084 (0.0045)**	*1.74439 (0.0405)*	*34.0937 (0.0830)*	*32.4344 (0.1166)*	*6.06921 (0.0000)**	*5.09317 (0.0000)**
	Log CO2	*--1.23457 (0.1085)*	*-0.43029 (0.3335)*	*26.5720 (0.3248)*	*34.5477 (0.0754)*	*5.01541 (0.0000)**	*3.84766 (0.0001)**
	Log POP	*0.25131 (0.5992)*	*1.20986 (0.8868)*	*31.4676 (0.1408)*	*10.3011 0.9932)*	*8.86477 (0.0000)**	*7.58737 (0.0000)**
	Log EPI	*-2.79493 (0.0026)**	*2.01687 (0.9781)*	*7.22313 (0.9996)*	*5.21040 (1.0000)*	*4.52419 (0.0000)**	*4.52419 (0.0000)**
First difference	*Δ Log ENR*	*-13.3078 (0.0000)**	*-10.7854 (0.0000)**	*142.733 (0.0000)**	*176.578 (0.0000)**	*2.94065 (0.0016)**	*1.60330 (0.0544)*
	Δ Log GDP	*-6.14081 (0.0000)**	*-3.98540 (0.0000)**	*55.7787 (0.0002)**	*58.4146 (0.0001)**	*1.23607 (0.1082)*	*1.10252 (0.1351)*
	Δ Log HTE	*-9.17141 (0.0000)**	*-8.24238 (0.0000)**	*99.6360 (0.0000)**	*145.996 (0.0000)**	*1.99055 (0.0233)*	*2.15159 (0.0157)**
	Δ Log CO2	*-8.90496 (0.0000)**	*-6.71943 (0.0000)**	*82.4991 (0.0000)**	*102.318 (0.0000)**	*5.33438 (0.0000)**	*8.55090 (0.0000)**
	Δ Log POP	*-0.87485 (0.1908)*	*-6.35719 (0.0000)**	*91.9108 (0.0000)**	*119.156 (0.0000)**	*6.73715 (0.0000)**	*5.57109 (0.0000)**
	Δ Log EPI	*-11.4045 (0.0000)**	*-9.55134 (0.0000)**	*124.578 (0.0000)**	*277.892 (0.0000)**	*1.46175 (0.0719)*	*1.46175 (0.0719)*

* Significance at 5%. Δ is the first difference operator.

Table 02:Unit root tests for the variables of European countries

Null: Unit Root						Null: NO Unit Root	
Methods		**Levin, Lin and Chu (LLC)**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
	Variables						
Level	*Log ENR*	*2.43128 (0.9925)*	*3.37417 (0.9996)*	*35.0576 (0.7673)*	*35.5189 (0.7497)*	*9.13138 (0.0000)**	*8.84268 (0.0000)**
	Log GDP	*-2.06156 (0.0196)*	*2.51174 (0.9940)*	*16.7861 (0.9998)*	*7.69254 (1.0000)*	*4.90629 (0.0000)**	*5.06829 (0.0000)**
	Log HTE	*-2.55422 (0.0053)**	*-0.27346 (0.3922)*	*44.8624 (0.3527)*	*38.0114 (0.6467)*	*6.86160 (0.0000)**	*7.82172 (0.0000)**
	Log CO2	*1.08144 (0.8602)*	*3.48273 (0.9998)*	*30.5301 (0.9055)*	*29.5744 (0.9256)*	*9.34797 (0.0000)**	*8.53268 (0.0000)**
	Log POP	*5.67711 (1.0000)*	*2.42233 (0.9923)*	*76.9835 (0.0008)**	*19.5516 (0.9988)*	*9.72087 (0.0000)**	*9.70793 (0.0000)**
	Log EPI	*-0.23066 (0.4088)*	*5.50696 (1.0000)*	*4.94148 (1.0000)*	*1.71775 (1.0000)*	*6.07662 (0.0000)**	*6.07662 (0.0000)**
First difference	*Δ Log ENR*	*-15.9261 (0.0000)**	*-13.6931 (0.0000)**	*221.239 (0.0000)**	*328.133 (0.0000)**	*3.46338 (0.0000)**	*5.20734 (0.0003)**
	Δ Log GDP	*-9.08479 (0.0000)**	*-8.00360 (0.0000)**	*144.169 (0.0000)**	*171.638 (0.0000)**	*-0.53784 (0.7047)*	*-0.09103 (0.5363)*
	Δ Log HTE	*-13.6731 (0.0000)**	*-12.8235 (0.0000)**	*207.467 (0.0000)**	*279.483 (0.0000)**	*2.26890 (0.0116)*	*4.12906 (0.0000)**
	Δ Log CO2	*-17.2269 (0.0000)**	*-14.9719 (0.0000)**	*239.253 (0.0000)**	*279.125 (0.0000)**	*7.43252 (0.0000)**	*13.3978 (0.0000)**
	Δ Log POP	*-4.82982 (0.0000)**	*-5.62610 (0.0000)**	*142.415 (0.0000)**	*184.028 (0.0000)**	*6.66291 (0.0000)**	*6.74275 (0.0000)**
	Δ Log EPI	*-12.5256 (0.0000)**	*-10.7688 (0.0000)**	*179.712 (0.0000)**	*434.647 (0.0000)**	*2.28003 (0.0113)**	*2.28003 (0.0113)**

* Significance at 1%. Δ is the first difference operator.

From the results of the unit root tests performed for the two panel of the study, we can draw the following conclusions: all statistics are not significant at the 5% level (First Panel) and at the 1% level (Second Panel) for the six variables (ENR, GDP, HTE, CO2, POP and EPI). After differentiation into first-degree of the data, we notice a significant way that all data are stationary for all variables. These results showed a logical way to test the presence or the absence of a long-term relationship between all variables by applying Co-integration test. We can say that all variables are integrated of order one I {(1)}, either for the model with trend and constant, or constant, or neither constant nor trend.

4.1.2 Co-integration :

This step confirms or denies the existence of a long-term relationship, to reveal this, we move to Pedroni panel co-integration test, the achieved results are as follows:

Table03:Co-integration tests for the Eurasian countries

Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
	Test	Statistique	Prob	Test	Statistique	Prob
LOGPIB LOGELEC						
Pedroni (1999)	Panel v-statistic	5.760035	0.0000	Group ρ-statistic	3.381278	0.9996
	Panel rho-statistic	-0.181250	0.4281	Group pp-statistic	-17.34347	0.0000
	Panel PP-statistic	-4.774861	0.0000	Group ADF-statistic	-7.063912	0.0000
	Panel ADF-statistic	-4.697892	0.0000			
Pedroni (2004)(Weighted statistic)	Panel v-statistic	-3.497518	0.9998			
	Panel rho-statistic	2.095704	0.9819			
	Panel PP-statistic	-15.51278	0.0000			
	Panel ADF-statistic	-6.846046	0.0000			

* Significance at 5%.

Table 04:Co-integration tests for the European countries

Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
	Test	Statistique	Prob	Test	Statistique	Prob
LOGPIB LOGELEC						
Pedroni (1999)	Panel v-statistic	-3.598180	0.9998	Group ρ-statistic	4.466939	1.0000
	Panel rho-statistic	2.496201	0.9937	Group pp-statistic	-22.26986	0.0000
	Panel PP-statistic	-17.20748	0.0000	Group ADF-statistic	-10.53057	0.0000
	Panel ADF-statistic	-12.45252	0.0000			
Pedroni (2004)(Weighted statistic)	Panel v-statistic	-2.939673	0.9984			
	Panel rho-statistic	2.559771	0.9948			
	Panel PP-statistic	-14.43868	0.0000			
	Panel ADF-statistic	-9.189092	0.0000			

* Significance at 1%.

The table 03 sums up the results of 7 Statistical Co-integration Pedroni. From the results of Pedroni co-integration tests, we can notice that across the seven statistics four probability values are less than 5%.It is mainly (Panel pp-Statistic) and (Panel ADF-Statistic) regarding Within dimension (***Pedroni; 1999***), Pedroni (2004) (Weighted statistic) », and we have also (Group PP-Statistic) and (Group ADF-Statistic)for testing Between dimension (***Pedroni; 1999***), all this demonstrates that there is a relationship of co-integration between the variables in the model.

Where the fourth table shows us also the results of seven (07) Statistical Co-integration Pedroni, four probability values are less than 1%. It is mainly (Panel pp-Statistic) and (Panel ADF-Statistic) concerning intra-individual tests, and we have (Group pp-statistic) and (Group ADF-Statistic) for testing inter-individual, all this proves that there is a relationship of co-integration between the variables in the model.

The results obtained reveal the relevance and power of panel co-integration tests compared to the time series tests. In this step, we estimate the long-term relationships using FMOLS methods and DOLS estimators proposed by Pedroni, Kao and Chiang and Mark and Sul.

4.1.3 Estimated long-term relationship with DOLS / FMOLS methods:

Having established that all variables exhibit long-run panel co-integration in the previous sub-sections. Now, we now estimate the long-run impact of the set of variables on Total Energy Consumption "ENR" for Eurasian and European countries. The results of panel FMOLS method and DOLS estimators are presented in following tables:

Table 05: estimated long-run relationship for the Eurasian panel.

Dependent Variable	FMOLS					DOLS				
ENR										
Variables	*GDP*	*HTE*	*CO2*	*POP*	*EPI*	*GDP*	*HTE*	*CO2*	*POP*	*EPI*
Within Results	[-2.59699	[3.83334	[5.78189	[-1.4223	[-3.4951	[0.00968	[0.01786	[0.51680	[-0.2581	[-0.0314
	-132.537	84.2604	157.7971	- 312.905	-205.635	0.31539	1.34041	6.527292	- 0.77920	-0.67356
	(0.0000)*	(0.000)*	(0.0000)*	(0.000)*	(0.0000)*	(0.7528)	(0.1817)	(0.0000)*	(0.4368)	(0.5014)
Between Results	[0.010155	[-0.0163	[0.50873	[-1.4653	[0.03359	[-0.0862	[-0.0573	[0.33725	[-2.2392	[0.14077
	0.229798	-0.97276	5.452783	- 2.38352	0.536745	-0.59305	-0.88303	1.084278	- 1.38269	0.91053
	(0.8185)	(0.3319)	(0.0000)*	(0.0181)	(0.5921)	(0.5538)	(0.3783)	(0.2796)	(0.1684)	(0.3637)

*Significance at 5%.

Table 06: estimated long-run relationship for the European panel.

Dependent Variable	FMOLS					DOLS				
ENR										
Variables	*GDP*	*HTE*	*CO2*	*POP*	*EPI*	*GDP*	*HTE*	*CO2*	*POP*	*EPI*
Within Results	[-0.3522	[-0.9847	[-0.4845	[1.48332	[-1.3745	[-0.0769	[0.0039	[0.80493	[-0.0763	[0.07860
	- 19.8491	-47.0660	-21.8308	392.8882	- 99.9709	- 6.93270	1.017250	49.79294	-0.93399	13.1306
	(0.000)*	(0.0000)*	(0.0000)*	(0.0000)*	(0.000)*	(0.000)*	(0.3107)	(0.0000)*	(0.3518)	(0.000)*
Between Results	[-0.0225	[0.02993	[0.59621	[1.19047	[-0.0085	[-0.0212	[0.03143	[0.58381	[1.10232	[-0.0034
	- 1.51261	3.572220	26.21194	8.153216	- 1.13190	- 0.97540	2.587353	17.78062	5.977389	-0.29697
	(0.1312)	(0.0004)*	(0.0000)*	(0.0000)*	(0.2584)	(0.3299)	(0.0100)*	(0.0000)*	(0.0000)*	(0.7666)

* Significance at 1%.

The tables reports the long-run elasticity estimates from FMOLS and DOLS for the two panels (coefficients can be interpreted as elasticity, because the variables are expressed in natural logarithms).

It is intriguing to note that the within-dimension (Intra-individual) results differ from between dimension (Inter-individual) results in some cases.

For Eurasian panel, all of the estimated coefficients of the Within (Pooled) dimension indicate that GDP, POP and EPI are correlated negatively except coefficients of HTE and CO2 which are positively correlated; and have a significant impact on the energy consumption at the 5% threshold.

Overall, the regression results of the explanatory variables: GDP, HTE, CO2, POP and EPI on ENR in Within dimension using the panel FMOLS estimator reveal a strong long-term relationship between the exogenous variables of the model and the endogenous variable ENR, and also show the significance of all these variables to explain the energy consumption in these countries. Unlike using the DOLS estimator in the same dimension we accept at 5% threshold only the significance of CO2 coefficient.

Concerning Between dimension of the long-run relationship, we conclude that in both FMOLS and DOLS estimators, there are only the FMOLS estimator that provides a single coefficient (CO2) which is significantly different from 0.

The results obtained for Eurasian panel indicate that a 1% increase in GDP, HTE, CO2, POP and EPI increases the ENR , respectively -2.59 % ; 3.83 % ; 5.78 % ; -1.42 % ; - 3.49 % for all individuals. It should be noted that Eurasia has negative results and statistically significant at the 1% significance for some variables such as EPI in within dimension. However, for some other variables, coefficients are positive and statistically significant at the 1% significance level and 5% for either FMOLS or DOLS method. These results highlight the contribution of the different variables on the global primary energy consumption, it must be pointed that this same panel has significant tests and sometimes-different passing from FMOLS method to DOLS method, these results should be taken with caution.

Concerning the European panel, the coefficients of the heterogeneous panel in pooled estimation are negative for (GDP, HTE, CO2 and EPI) and positive with EPI and statistically significant at the 1% significance for FMOLS method, unlike the DOLS method, which shows the significance only for GDP, CO2 and EPI. However, the variables are expressed in natural logarithms; the coefficients can be interpreted as elasticity. The grouped estimation whatsoever for FMOLS or DOLS method reveal that the coefficients significance are only for HTE, CO2 and POP and they are positively correlated. Overall, the results of this study show that there is a strong long-term relationship between ENR and the set of explanatory variables.

The results obtained for the all heterogeneous panel in pooled estimation for FMOLS method suggest that a 1% increase in GDP, HTE, CO2, POP and EPI increase the ENR, respectively, -0.3522 %, -0.9847 %, -0.4845 %, 1.48332 % and -1.3745 % these results highlight the involvement of explanatory variables to Energy Consumption.

4.1.4 Panel Granger causality :

Having established that there is a long-run relationship between ENR, GDP, HTE, CO2, POP and EPI, this step is done to objectively examine the causal relationship between these variables, the following table sums up all the results of causality, the optimal structure of delays has been established using the Akaike and Schwarz information criteria.

Table 07: panel Granger causality test results for the Eurasian area.

Lags =2	ENR	GDP	HTE	CO2	POP	EPI
ENR		0.98747 (0.3745)	0.60920 (0.5449)	4.08233* (0.0184)	0.58158 (0.5600)	0.11020 (0.8957)
GDP	0.19889 (0.8198)		1.85552 (0.1592)	0.39456 (0.6745)	0.09400 (0.9103)	2.37455 (0.0959)
THE	2.72980* (0.0508)	0.10004 (0.9048)		0.45585 (0.6346)	1.70177 (0.1852)	1.20170 (0.3030)
CO2	1.44705 (0.2379)	0.52973 (0.5896)	0.53752 (0.5851)		0.80800 (0.4473)	0.21056 (0.8103)
POP	4.84053* (0.0089)	0.29346 (0.7460)	0.07024 (0.9322)	2.36425 (0.0968)		0.00411 (0.9959)
EPI	0.21098 (0.8100)	1.04344 (0.3543)	2.26889 (0.1063)	0.69029 (0.5027)	0.62754 (0.5350)	

* Significance at 5%.

Table 08: panel Granger causality test results for the European area.

Lags =3	ENR	GDP	HTE	CO2	POP	EPI
ENR	✕	4.95653* → (0.0022)	2.99685 — (0.0307)	21.1913* → (1.E-12)	2.39241 — (0.0682)	1.40905 — (0.2398)
GDP	0.92828 — (0.4271)	✕	3.73590 — (0.0114)	1.09718 — (0.3502)	2.97130 — (0.0318)	5.69828* → (0.0008)
THE	3.99787* → (0.0080)	1.35298 — (0.2569)	✕	0.62091 — (0.6018)	1.06217 — (0.3651)	2.99823 — (0.0307)
CO2	5.05224* → (0.0019)	4.72553* → (0.0030)	2.92741 — (0.0337)	✕	0.65922 — (0.5776)	0.12530 — (0.9451)
POP	1.54502 — (0.2025)	7.86258* → (4.E-05)	6.87171* → (0.0002)	2.73864 — (0.0433)	✕	0.18877 — (0.9040)
EPI	4.50827* → (0.0040)	5.54506* → (0.0010)	8.46129* → (2.E-05)	3.75910 — (0.0111)	5.15193* → (0.0017)	✕

* Significance at 1%.

→ : denotes that there is causality.
— : Absence of causality sens.
✕ : means the relationship between each Variable and himself.

Our study aims to illustrate the interactive relationships between all the variables GDP, HTE, CO2, POP, EPI and between ENR, but that does not preclude the study of all possible relationships. From the outcomes of the Panel Granger Causality tests presented in the table above we can deduce the direction of causal relationships that can figured among variables at the critical threshold (error probability) of 5% (Eurasian panel) and 01% (European panel) .

The table 07 of Eurasian countries shows that there is a cause and effect way, summary one-way Granger causality runs from HTE to ENR, from POP to ENR and from ENR to CO2 for different Eurasian area. In other words, the assumption of feedback (bidirectional relationship between these variables pair wise in which the causality goes along in both directions) is not confirmed for this panel. Therefore, the impact of High technology export and Total population will affect the World primary energy consumption and this latter will affect Total carbon dioxide emissions. Regarding other causal relationships between all variables, there is no cause and effect.

The Granger causality test results of European panel mentioned in table 08 shows that the both null hypothesis: “POP does not Granger Cause ENR” and “ENR does not Granger Cause POP” are adopted for the European countries at 1 % level; this suggests that we hold neutrality hypothesis because there is no causality exists between population and total energy consumption. The results indicate also the existence of unidirectional causality, which runs from ENR to GDP, HTE to ENR and EPI to ENR… for the whole panel. Furthermore, we note two cases of bidirectional causality as follows: ENR-CO2 and GDP-EPI for the entire panel.

The findings of this study can be summarized into three main point:

a. Neutrality hypothesis is adopted because there is no causality between population and total energy consumption.

b. High Technology Exports –led- Total Energy Consumption; Energy Price Index-led-Total Energy Consumption,...

c. Feedback hypothesis indicates that there is bidirectional causality between some variables.

3. Conclusion

This paper empirically tests the validity of the Factors affecting Energy Consumption hypothesis for 12 Eurasian countries and 21 European Countries using panel co-integration test and panel Granger causality. Results propose that the Factors affecting Energy Consumption hypothesis has been approved in a meaningful way only for some variables. The FMOLS and DOLS tests have supported the existence of the long-term equilibrium relationship between GDP, HTE, CO2, POP, EPI and between ENR by the estimation of the economic model. As well as many researchers' studies, this study validates the factors influencing Energy Consumption hypothesis of some variables for for 12 Eurasian countries and 21 European Countries. Finally, these consequences are of great importance for policy makers and academics.

These results may help a government to establish priorities regarding to the assignment of the resources for national strategies to economic Growth and development of energy sector. In addition, the results for the uncertainty effects can give information on the impact of news, especially bad news on energy demand. Future research should focus upon the modelling of the relationship between various characteristics of a country that influence energy's contribution to Economic Growth.

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