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THE NEXUS BETWEEN RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT: A PANEL DATA ANALYSİS FOR SELECTED EU COUNTRIES

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ABSTRACT

Provision of efficiency in energy use has a reputation that cannot be ignored in terms of sustainable development. When the depletion of natural energy resources is assessed on the axis of sustainable development, it requires both efficient use of existing natural resources and tending to renewable energy sources. Due to the high cost of renewable energy investments, it can be said that the relevant investments throughout Europe are not at the desired level. When one looks at the sustainability of growth, one of the most important variables in the forefront is the carbon emission levels in the countries concerned. In 2014, greenhouse gas emissions in the EU-28 were down by 22.9 % compared with 1990 levels, representing an absolute reduction of 1 136 million tonnes of CO2-equivalents, putting the EU on track to surpass its 2020 target, which is to reduce GHG emissions by 20 % by 2020 and by 40 % by 2030 compared with 1990.

The literature on energy economics includes a number of studies highlighting the linkages between the use of renewable energy sources and sustainable development. In this study, the relationship between greenhouse gas emissions consumption of renewable electricity energy and growth performance will be addressed in terms of sustainability in selected EU countries (Czech Republic, Slovakia, Slovenia, Poland, Hungary, Malta, Cyprus, Latvia, Lithuania and Estonia). In this framework, a panel data analysis help will be tried to reveal related relationships.

Keywords: CO2, Sustainable Development, Renewable Energy, EU, Green Gas Emission

1. INTRODUCTION

The changes in the world and the increase in the competition in the recent years are driving the countries to different quests in realizing the economic development moves. On the other hand, while the countries achieve the necessary economic development pattern, the other aim is sustainable development. Global warming, pollution and other environmental factors, as well as the so-called traditional sources of both the reduction in the amount of energy resources and sustainable development is controversial whether or not controversies constitute the main area of interest of recent studies. In this context, it is necessary to give priority to renewable energy resources in the development axis of countries.

Renewable energy resources need priority because: 1) the overwhelming scientific evidence that anthropological emissions of greenhouse gases from carbon combustion threaten catastrophic results from rapid climate change; 2) the severe health and environmental consequences from fossil fuel combustion being experienced in every major developing country city; and 3) the high cost, environmental damages and security threats of nuclear power. The aim of this paper is to examine the causal relationship among growth and renewable energy consumption.

Energy represents a vital factor for achieving sustainable economic growth, but the contemporary economic welfare is endangered by circumstances such as increased energy demand driven by the increase of world population which has entailed the quick consumption of traditional energy resources

such as oil, coal, and natural gas, besides energy price rises, and discharging of harmful gases to the atmosphere.

The Renewable Energy Directive establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to fulfill at least 20% of its total energy needs with renewables by 2020 – to be achieved through the attainment of individual national targets. All EU countries must also ensure that at least 10% of their transport fuels come from renewable sources by 2020. On 30 November 2016, the Commission published a proposal for a revised Renewable Energy Directive to make the EU a global leader in renewable energy and ensure that the target of at least 27% renewables in the final energy consumption in the EU by 2030 is met.

2. CONCEPTUAL FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

A review of the multidisciplinary literature on sustainable development reveals a lack of a comprehensive theoretical framework for understanding sustainable development and its complexities (Jabareen, 2004). The review shows that the definitions of sustainable development are vague (Gow, 1992; Mozaffar, 2001); that there is a lack of operative definitions (Villanueva, 1997: 154); that there is disagreement over what should be sustained (Redclift, 1993; Sachs, 1999: 25; Satterthwaite, 1996: 32); that the concept is unclear in terms of emotional commitment (Solow, 1992). Yet, there is no general agreement on how the concept should be translated into practice (Berke and Conroy, 2000). Andrews (1997) further observes that ‘‘sustainable development is primarily symbolic rhetoric, with competing interests each redefining it to suit their own political agendas, rather than serving as an influential basis for policy development’’. Beatley and Manning (1998) argue that there is a general sense that sustainability is a good thing, but that it still requires definition and elaboration. When we look at the studies in the literature we can see four dimension about sustainable development.

First group of studies belongs to various bodies of knowledge across social sciences such as sociology, economy, politics, geography, architecture and urban studies, government and public policy. In addition, the review includes philosophy and ethics, environmental studies, ecology, and transportation. In brief, this study reviews all fields that concern and study sustainable development. Therefore, the study reviews journals and books in fields that cover sustainable development. Most of the reviewed books and articles were published in English mainly after 1987 the year of the Brundtland Report, Our Common Future (WCED, 1987).

Second group studies first aim is to note patterns within the results of the first step. This step looks for similarities or patterns within the sample and codes the results according to categories of meaning. Third group studies creating independent concepts, where each concept has distinctive meanings and represents close ideas. It is important to mention that the mechanism of concept-making is an iterative process and repetitive. When the concept is identified inductively, the researcher then moves into a verification mode, trying to confirm or qualify the finding. This then sets off a new inductive cycle. And the last group studies conceptualizing a theoretical framework of sustainable development and describing the relationship among the derived concepts.

Fang (2011) evaluates the role of both, the amount and share of renewable energy consumption in economic welfare for China from 1978 to 2008, using a production function and a multivariate ordinary least squares (OLS) approach. Apergis and Payne (2010) analyzed causality relationship between renewable energy consumption and economic growth in 13 countries in Europe and Asia for the period 1992-2007 and concluded that there was a two-way causality in both short and long-term. Shafiei et al. (2013) analyzed effects of renewable and non-renewable energy consumption on economic activities in comparison and concluded that both energy sources had an actuator role for economic growth in OECD countries. For a panel of twenty OECD countries, Ohler and Fetters (2014) implement an error correction model to analyze the causal relationship between economic growth and renewable electricity generation disaggregated by renewable energy sources (biomass, geothermal, hydro, solar, waste, and wind) considering data from 1990 to 2008. Inglesi-Lotz (2016) investigates the impact of renewable energy consumption on economic welfare for 34 OECD countries from 1990 to 2010, using a multivariate framework based on the production function.

3. GENERAL ECONOMIC PERFORMANCE OF SELECTED EU COUNTRIES

The end of the Cold War is a real turning point for the European continent. The end of the half-century division was celebrated with enthusiasm throughout Europe. Regardless of their will, the European Central and Eastern European Countries, as well as the European Union and Malta and the Greek Cypriot Administration, began to apply immediately to become a member of the EU. However, the excitement of the early days, the excitement of "reunification of Europe", "the price of expansion should not be deepening, the Union's achievements should not be weakened". The fifth enlargement process, which is very different from the previous enlargements in terms of both the quality and quantity of the candidate countries and the depth reached by the European integration, was also quite painful for the EU from the standpoint of the candidate countries (www.ab.gov.tr).

The general economic performance of selected EU countires given in the Figure 1.

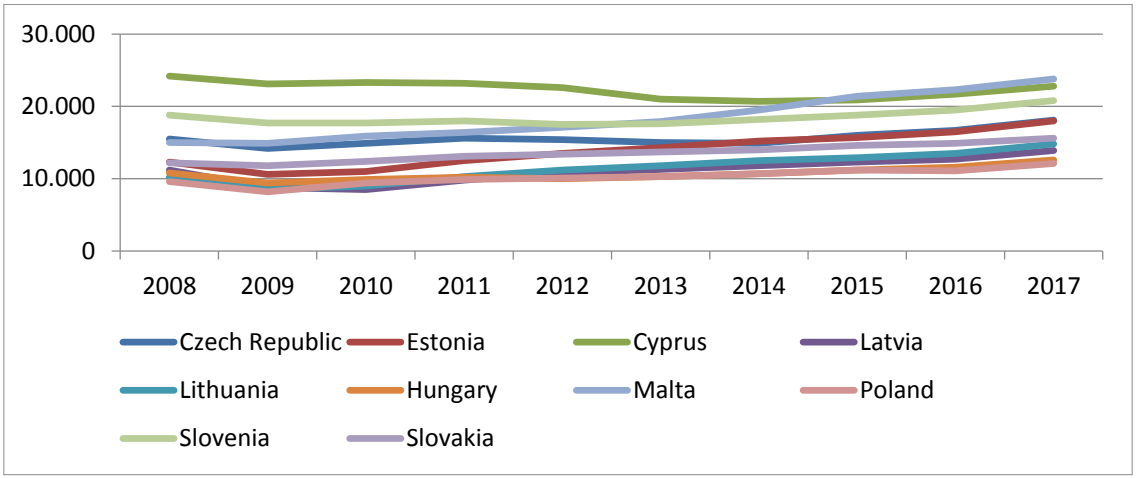

Figure 1: GDP Per Capita In Selected Ten EU Countries (2008-2017)

Source: https://ec.europa.eu/eurostat/data/database

As it is seen in the Figure 1 income per-capita distributes between 10000-25000 dolars in the selected countries.

4. NEXUS BETWEEN RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

Renewable resources hold great promise for meeting the energy and development needs of all countries throughout the world, but particularly for developing countries where in many areas commitment has not been made to fossil fuel dominance and where rural areas may be served more economically than with traditional resources like kerosene and diesel fuel (Ottinger, 2005: 3).

There are many barriers to wider spread use of renewable energy resources; while they can be overcome and have been in many countries, doing so will require a large, concerted, prioritized effort. The main constraints to the more widespread use of renewable resources are (Ottinger, 2005: 9-10):

- Lack of information by the public, and even many government, commercial and industrial energy officials, about the availability, costs and benefits of renewable energy technologies;

- Lack of knowledge by project initiators and managers of the social and energy related needs of rural communities, how to adapt projects to meet these needs, and involvement of the communities in the design of projects. Failure of public involvement may be the most significant barrier. If projects fail to meet the local needs for which they are intended, such failures can impede renewable energy applications for decades. Rural community residents can ill afford unsuccessful experiments;

- Failure to get the prices right, particularly distorting the energy market when heavily subsidized traditional energy is compared to renewable energy options and the failure to value all resources on a life-cycle cost basis taking into account externality costs to society.

- Preference for known fossil resources over newer renewable resources by government, commercial and industrial officials responsible for making energy decisions and by banking and other financing officials;

- Discrimination against intermittent energy sources such as solar and wind power by pool power dispatchers, utilities and government procurement agencies, even though these resources often are available at peak times of power needs. Dispatchers often require commitments of availability with penalties for failure to comply that are unreasonable for intermittent resources. Utilities place unreasonable interconnection requirements such as excessive standby rates, cost recovery through fixed unavoidable charges which lengthen the payback period to intermittent r source providers, and exit fees charged the intermittent generator to compensate for stranded costs that are over-stated or even fictitious. Government agencies also often require excessively burdensome approval requirements for interconnection of intermittent resources. Dispatchers, utilities and government procurement regulators all usually fail to credit intermittent resources with the benefits they provide such as elimination of pollution emissions, prevention of power surges, fuel diversity and absence of fuel costs.

- Huge well-financed sales forces for traditional energy sources and frequently a financial stake by energy decision makers in these sources;

- Paucity of sales forces for renewable energy resources and lack of financial and political clout to promote them effectively;

- Lack of personnel trained in the installation, operation and maintenance of renewable energy equipment;

- Lack of knowledge and personnel trained in financing mechanisms available to support renewable energy projects.

- Import duties on renewable equipment and other barriers to foreign investment generally and as related to renewable energy resources; and

- The small amount of R&D effort and funding being devoted to improving renewable technologies.

5. DATA AND MODEL

In this study, the relationship between per capita income (GDP), renewable energy use and greenhouse gas emissions is investigated. In the EU's 5th enlargement phase, a panel data set for EU economies was created. The definitions for the variables used in the analyzes are presented in Table 1.The data consist of a panel of ten EU countries which participate in to EU in 2004 with the fifth expanding process of EU (Czech Republic, Slovakia, Slovenia, Poland, Hungary, Malta, Cyprus, Latvia, Lithuania and Estonia), covering the period 2005 to 2016; the annual data from 2005 to 2016 are obtained from the World Bank's World Development Indicators and Eurostat database.

Table 1: Definition of Variables

Symbol of Variable	Definition
REN	Share of Renewable Energy in Gross Final Energy Consumption
GDP	GDP per capita growth (annual %)
GGE	Greenhouse gas emissions - tonnes per capita

Thus, the following model may be employed to explore the causal relationships between variables:

$$GDP = \beta_0 + \beta_1 REN + \beta_2 GGE$$

6. ANALYSIS RESULTS

To test the stability of the generated series Levin, Lin & Chu unit root test was used. After than to determine the variables if they act together in long term Co-integration test was used which developed by Johansen. And lastly to determine the causal relationships between variables Granger causality test was used. Among the variables in order to establish a causal relationship, whether or not the variables carry a consistency in themselves. It is important for the significance of the evaluations.

6.1. Unit Root Test

Over the last decade much research has been carried out on unit roots and cointegration in panel-data with integrated time series, due to the availability of new datasets where the time series dimension and the cross-section dimension are of the same order. The analysis of this peculiar panel data set requires new techniques. In the panel unit root test framework, two generations of tests have been developed: a first generation (Levin, Lin and Chu test (2002), Im, Pesaran and Shin test (2003) and Fisher -type tests) whose main limit is the assumption of cross-sectional independence across units; a second generation of tests that rejects the cross-sectional independence hypothesis. Within this second generation of tests, two main approaches can be distinguished: the covariance restrictions approach, adopted notably by Chang (2002, 2004), and the factor structure approach, including contributions by Bai and Ng (2004a), Phillips and Sul (2003), Moon and Perron (2004a), Choi (2002) and Pesaran (2003), among others.

In this study we look the Levin, Lin and Chu criteria and all variables are stationary at the level.

Table 2: Panel Unit Root Test

Variables	Statistic	Prob*
GDP	-2,62	0,0044
REN	-2,45	0,0072
GGE	-2,7	0,0035

*Levin, Lin & Chu , * indicates the significance level % 5

6.2. Panel Cointegration Test

Results of cointegration analysis given in Table 3. Panel PP and Group PP prob values show that there is a cointegration between GDP, REN and GGE in long term.

Table 3: Cointegration Results

Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.218549	0.1115	0.955040	0.1698
Panel rho-Statistic	0.651601	0.7427	0.860803	0.8053
Panel PP-Statistic	-1.704599	0.0441*	-1.021266	0.1536
Panel ADF-Statistic	-1.539280	0.0619	-1.032582	0.1509
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	2.311419	0.9896		
Group PP-Statistic	-2.126260	0.0167*		
Group ADF-Statistic	-1.254682	0.1048		

*indicates the significance level % 5.

6.3. Panel Causality Test

Causality tests results given in Table 4.

Table 4: Panel Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
REN does not Granger Cause GDP	100	0.11949	0.8875
GDP does not Granger Cause REN		2.06746	0.1322
GGE does not Granger Cause GDP	100	0.66618	0.5161
GDP does not Granger Cause GGE		4.46187	0.0141
GGE does not Granger Cause REN	100	1.16190	0.3173
REN does not Granger Cause GGE		1.18325	0.3108

Granger Causality tests show that there is a causality relationship between GDP and GGE. So we can say that the increase in GDP cause an increase in GGE. So the importance of renewable energies can evaluate healthy.

6.4. Fixed Effects Model

Hausmann test applied for which model is appropriate for the analysis. After the results of Hausmann test fixed model is appropriate. The analyses results are given in the Table 5.

Table 5: Fixed Effects Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5282.405	3609.400	1.463513	0.1462
REN	1107.377	86.29353	12.83267	0.0000
GGE	381.6785	291.1294	1.311027	0.1926
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.826595	Mean dependent var		25287.48
Adjusted R-squared	0.808933	S.D. dependent var		5364.438
S.E. of regression	2344.861	Akaike info criterion		18.45248
Sum squared resid	5.94E+08	Schwarz criterion		18.73123
Log likelihood	-1095.149	Hannan-Quinn criter.		18.56568
F-statistic	46.80163	Durbin-Watson stat		0.771682
Prob(F-statistic)	0.000000			

7. CONCLUSION

Renewable energy resources and their utilization are intimately related to sustainable development. For societies to attain or try to attain sustainable development, much effort should be devoted to discovering sustainable energy resources in terms of renewables. In addition, environmental concerns should be addressed. The following concluding remarks can be drawn from this study:

• There are a number of environmental problems that we face today. These problems span a continuously growing range of pollutants, hazards and ecosystem degradation over ever wider areas. The most significant ones are acid precipitation, stratospheric ozone depletion, and global climate change.

• Potentially the most important environmental problem relating to energy utilization is the greenhouse effect. Increasing atmospheric concentrations of greenhouse gases are increasing the manner in which these gases trap heat radiated from the Earth's surface, thereby raising the surface temperature of the Earth and as a consequence risen sea levels.

• Recently, a variety of potential solutions to the current environmental problems associated with the harmful pollutant emissions has evolved. However, renewable energy appears to be one of the most important solutions.

• Renewable energy technologies, in general, are sometimes seen as direct substitutes for existing technologies so that their benefits and costs are conceived in terms of assessment methods developed for the existing technologies. For example, solar and other renewable energy technologies can provide small incremental capacity additions to the existing energy systems with short lead times. Such power generation units usually provide more flexibility in incremental supply than large, long lead-time units such as nuclear power stations.

• Development of advanced renewable energy technologies that serve as cost-effective and environmentally responsible alternatives to conventional energy generation. Technical and market potential exists to significantly increase the current contribution of renewable energy sources to country's energy demands by the year 2000, resulting in employment and economic benefits many times the R&D investment. Many government energy institutions and agencies recognize this opportunity and support their renewable energy industry's efforts to exploit near-term commercial potential.

• In order to attain the energy, economic and environmental benefits that renewable energy sources offer, an integrated set of activities such as R&D, technology assessment, standards development and technology transfer should be conducted as required.

• Sustainable development demands a sustainable supply of energy resources that, in the long term, is readily and sustainably available at reasonable cost and can be utilized for all required tasks without causing negative societal impacts. Supplies of such energy resources as fossil fuels (coal, oil, and natural gas) and uranium are generally acknowledged to be finite; other energy sources such as sunlight, wind and falling water are generally considered renewable and therefore sustainable over the relatively long term.

• The exploitation of renewable energy resources and technologies is a key component of sustainable development due to the facts: (i) much less environmental impact, (ii) more flexibility, (iii) being undepleted, and (iv) decentralization possibility.

• Increasing world population requires the definition and successful implementation of sustainable development.

Biomass affords sustainable growth through decreasing financial and ecological expenditures concerning transport and contributes to national energy security by diminishing the reliance on fossil fuels. In addition, biomass lessens landfills by converting the waste that is detrimental to the environment into somewhat valuable, while the rural development is spurred by agriculture and forestry wastes.

Finally, consistent with EU Directive 2009/28/EC, we acknowledge that EU-28 states did not achieve yet the targets set for the share of renewable energy in gross final energy consumption and for the share of renewable energy in transport fuel consumption. As policy implications, the cooperation mechanisms among EU-28 states, in form of statistical transfers, joint projects, or joint support schemes, should be intensified. In fact, appropriate connections among countries will mitigate the risk of electricity failures, therewith reducing the demand for setting other power plants and enhancing the management of fluctuating solar or wind renewable energies.

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