Global Energy and Sustainable Development: Introduction

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Abstract
Energy is a very important topic of research driving the modern world. Energy production and consumption are associated with a number of environmental effects that require effective and affordable management. Demanding an enormous amount of energy an immense dispute of energy is scale counted by energy efficiency. Oil and other fossil fuel depletion, reliance on foreign energy sources, energy needs of poorer countries, economic efficiency versus population growth debate, environmental issues like climate change, renewable and other alternative energy sources are some of the issues of concern. This Special Issue contributes to some of the important issues of global energy and sustainability. The applied theoretical and analytical contributions are expected to provide guidance to policy-makers and government officials in designing new policy scenarios for the investigation of the energy consumption and economic growth nexus. The empirical contributions provide also evidence to support and inform current policy debates.

Keywords: Energy; sustainability; development.

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1. Efficiency estimation towards sustainability

Sustainable development demands means of development that utilize less energy and release less pollutants' emissions. Achieving these tasks in the most efficient way has attracted plenty of research interest. Efficiency analyses concentrate on the effectiveness of production processes in converting inputs into outputs. Frontier methods utilize an efficient frontier to recognize the efficiency of individual decision making units (DMUs) in relation to a reference set of other DMUs. Stochastic frontier analysis (SFA) is a *parametric approach* assuming a functional form and using the full set of DMUs to estimate econometrically the parameters of that functional form estimating the efficiencies of individual DMUs.

On the other hand, Data Envelopment Analysis (DEA) is a *non-parametric method* relying on mathematical programming to detect the efficient frontier and create effective units that provide benchmarks for measuring DMUs comparative efficiency (Halkos and Tzeremes 2009; Halkos et al. 2015). SFA may distinguish random noise from efficiency SFA and with regression analysis extracts overall sample-based information. DEA integrates noise as fraction of the efficiency score and extracts unit-specific returns to scale and productivity changes (Cordeiro et al., 2008). DEA permits the measurement of technical efficiency under constant (CRS) and variable (VRS) returns to scale and also the Malmquist index and its components (Bampatsou & Halkos, 2016) and performs scale analysis allowing the determination of the nature of scale inefficiency of each data point. Furthermore order-α and order-m approaches may determine partial frontiers (Bampatsou & Halkos, 2017a).

In this special issue we have the first two papers relying on these two methods for calculating efficiencies. The first paper by Sami Jarboui and Abir Mrabet (2017) determines the incidence of institutional factors on the efficiency of GDP and CO_2

emissions. A stochastic frontier model is applied to assess efficiency in a sample of 10 Gulf and Maghreb countries and for the period 1995 to 2013. The CO_2 emissions and GDP inefficiency due to institutional factors is explained together with the factors explaining inefficiencies. The interrelations among the various inputs like voice and accountability, political stability, government effectiveness, regulation weight, rule of law, corruption control, population and the undesirable (CO_2 emissions) and the desirable (GDP) outputs' efficiency are thoughtfully described. The empirical findings show that institutional quality in Maghreb countries is inadequate, leading to high inflation, unemployment and unattractive environment for investments. Specifically, for CO_2 emissions higher energy efficiency may show the way to environmental performance improvement. In the Gulf countries a better institutional quality like corruption reduction and regulatory quality could contribute towards economic and social outcomes creating better institutional climate towards sustainable development.

Furthermore and in these lines, the second paper by Christina Bampatsou and George Halkos (2017b) uses Data Envelopment Analysis (DEA) for 32 countries classified according to their development level as Developing, BRICS, Developed and G7 for the period 1980 to 2012.[1] With the help of DEA technical efficiency under constant and variable returns to scale as well as the Malmquist index and its components are computed. In a more advanced level and copying with outliers an order-α approach is extended for determining partial frontiers in an output oriented model specification. Initially, labour and capital are used as inputs with GDP as output. Next, energy is included as additional input together with CO_2 emissions as an undesirable output. In this way a comparison of productivity indices permits to draw attention to different levels of productivity, before and after the incorporation of

[1] An earlier version of this paper was presented in the 4th Pan-Hellenic Conference in *Natural Resources and Environmental Economics,* 4-5 November 2016 Volos Greece.

energy and CO_2 emissions as supplementary variables for each group of countries looking for their sustainability gaps.

As expected, from the empirical analysis relying on productivity models, full frontiers are sensitive to outliers and exceed partial frontiers in all four categories of the countries considered. Moreover, the full frontiers of the first model go beyond the full frontiers of the second model in all four categories of countries implying that if energy is not incorporated as additional input together with CO_2 emissions as undesirable output, then productivity growth of countries is overestimated, as it ignores pollution abatement activities of DMUs lower productivity growth. Growth in total factor productivity changes depends on the production technology improvements through innovations in resource saving production methods together with the accomplishment of optimal resource management in the production process.

2. Planning sustainable and secure energy policies

Moving on and apart from the efficiency analysis performed so far, other determinants may also be important in planning sustainable energy policies. Energy is a main determinant in economic development regardless of the negative externalities imposed to the environment. For instance, climate change is a global externality resulting to market failure as, in many cases, pollution sources relying on inappropriate energy mixes do not consider the full cost (including associated social costs) entailed by their actions to others (Halkos, 1992, 2015). But also foreign direct investments (FDI) have a significant part in the international economic growth. Liberalization, rapid development of both international financial markets and of commercial exchanges between countries expand the demand for freight transport affecting energy consumption. Economic growth is strongly and positively influenced by FDI, transports and energy use.

The third study of this SI by Samir Saidi, Rabaa Badri and Sami Hammami explores the effect of various macroeconomic variables on energy use paying attention to the influence of transport and foreign direct investment in 68 countries for the period 2000-2014. Using high, middle and low income panel data and the Generalized Method of Moments (GMM) in a dynamic panel data specification, the empirical findings reveal that energy consumption is influenced positively and significantly by the freight transport in all cases. But the effect of foreign direct investment is positive and significant only in the cases of high and middle countries with the low-income countries showing an insignificant positive effect. Lastly, energy use is positively correlated with growth, capital stock and population with different levels of significance.

Opposing to neoclassical assumption, they find that energy is not neutral to growth. Paying attention to transportation and to reduce negative externalities, Governments should employ economic, fiscal, regulatory and technological instruments to have a power over the main determinants of transport energy consumption and pollutant gas emissions. As the authors propose, Governments may develop urban logistics centers to promote delivery and collection of goods in towns and city centers reducing congestion and environmental negative externalities. They may also encourage sustainable freight transport systems by improving energy efficiency and reducing road transport (approximating 70% of freight ton-kilometers) and the associated emissions. The main measures include switching to more ecological transportation methods like rail and maritime transports at short distances.

Finally it is important in planning energy policies to consider the security in energy supply and the required conditions of guarantying such safety measures. The fourth paper by Andreas Stergiou investigates energy security and whether the

possibilities of cooperation available by hydrocarbon development in Eastern Mediterranean may grant energy supply security for the regional countries.[2] By outlining the current debate on energy security and examining the geopolitical regional design with respect to the long-lasting ethnical and political conflicts over and above some other economic and political factors related to the established energy amounts, it is claimed that current energy discoveries may hardly endow with the long-expected energy security both regional and non-regional players in the anticipated future. The specific area could possibly accomplish its potential as a gas exporter if the local, regional and global circumstances align constructively.

Obviously, policies to manage pollution and the associated energy mixtures must take into consideration both the specific economic situation and the structure of industrial and business sectors of each region (Halkos, 2013). Microeconomic treatment of environmental policy considers the optimal allocation of a given scale of resource flow within the economy, but neglects the scale and composition of economic activity relative to the ecosystem that supports it. An ecological approach to macroeconomics requires the appreciation of physical constraints to economic growth (Halkos & Paizanos, 2016a). To take into consideration the possible variations of fiscal policy effects in line with pollution sources, it is necessary to differentiate between production- and consumption- generated CO_2 emissions with the exact pattern of the effects being a function of emissions sources, fiscal policy scenario implemented and functional class of increased government expenditure (Halkos & Paizanos, 2016b).

[2] An earlier version of this paper was presented in the 4th Pan-Hellenic Conference in *Natural Resources and Environmental Economics,* 4-5 November 2016 Volos Greece.

References

Bampatsou C. & Halkos G.E. (2016). Driving forces of different productivity models. MPRA Paper **75398**, University Library of Munich, Germany.

Bampatsou C. & Halkos G.E. (2017a). Technical efficiency, productivity change and environmental degradation. MPRA Paper **77176**, University Library of Munich, Germany.

Bampatsou C. & Halkos G.E. (2017b). Energy and CO_2 emissions as the determinants of countries' productivity with different levels of economic development. *International Journal of Global Energy Issues,* **40(5)**, 277-293.

Cordeiro J., Sarkis J., Vazquez D. & Dijkshoorn J. (2008). A Stochastic Frontier Analysis of Estimates and Correlates of the Efficiency of Solid Waste Management in Welsh SMEs GIN CONFERENCE 2008 (Leeuwarden, Netherlands). Accessible ***at:*** https://gin.confex.com/gin/responses/2008N/207.ppt

Halkos G.E. (1992). Economic perspectives of the acid rain problem in Europe. University of York.

Halkos G.E. (2013). Exploring the economy-environment relationship in the case of sulphur emissions. *Journal of Environmental Planning and Management*, **56(2)**: 159-177.

Halkos G.E. (2015). Climate change actions for sustainable development. *International Journal of Innovation and Sustainable Development*, **9(2)**: 118-136.

Halkos G.E. & Paizanos E.A. (2016a). The effects of fiscal policy on CO_2 emissions: Evidence from the USA. *Energy Policy*, **88(C)**: 317-328.

Halkos G.E. & Paizanos E.A. (2016b). Environmental Macroeconomics: Economic Growth, Fiscal Spending and Environmental Quality. *International Review of Environmental and Resource Economics*, **9(3-4)**: 321-362.

Halkos G.E. and Tzeremes N.G. (2009). Economic efficiency and growth in the EU enlargement. *Journal of Policy Modeling*, **31(6)**, 847-862.

Halkos G.E., Tzeremes N.G. and Kourtzidis S.A. (2015). Regional sustainability efficiency index in Europe: an additive two-stage DEA approach. *Operational Research*, **15(1)**, 1-23.

Mrabet A. and Jarboui S. (2017). Do institutional factors affect the efficiency of GDP and CO_2 emission? Evidence from Gulf and Maghreb countries. *International Journal of Global Energy Issues,* **40(5)**, 259-276.

Saidi S., Badri R. and Hammami S. (2017). The impact of transport and foreign direct investment on energy consumption: recent evidence from high, middle and low income countries. *International Journal of Global Energy Issues,* **40(5)**, 294-319.

Stergiou A. (2017). Energy security in the Eastern Mediterranean. *International Journal of Global Energy Issues,* **40(5)**, 320-334.