Study the Causal Relationship between Economic Growth and EnergyConsumptions in Energy (Oil) Exporting and Importing Countries Sample Countries Applicable Iran, Saudi Arabia, Turkey, South Korea, Malaysia, India and Pakistan

MasoudYazdani & Maryam Faaltofighi

Department of Management, Ardabil Branch, Islamic Azad University, Ardabil, Iran

Abstract: The importance of energy in the process of economic growth, particularly in advanced countries, is a visible fact in today life. Energy, as the most important production factor as well as one of the most necessary marginal products has become the main source in improving man's life standard which in turn has given a special place to it in the economy of countries. This reveals the great importance of the relationship between energy consumption and economic growth and studying that relationship is an important tool in adopting suitable policies in energy field. By admitting the above-mentioned matters, the researcher has discussed the causal relationship between economic growth and energy consumption in sample countries. In order to study the confirmation or non-confirmation of the research hypothesis, the statistical society was selected from oil exporter countries (Iran and Saudi Arabia) and oil importers (Turkey, South Korea, Malaysia, India and Pakistan). In the descriptive statistics part, the statistics and information released by International Institute of Energy and the Energy Balance Sheet of Iran during 1980 to 2007 were used. In the inferential statistics, the Eviews software, the Levin, Lin and Chu (LLC) unit root test, the Im, Pesaran and Shin (IPS) unit root test, Panel convergence Test- Pedroni Method and Panel Causal Relations Test have been applied. The results showed that there exists a one-sided (unilateral) casual relations that goes from energy consumption to economic growth in the oil exporting countries (Iran and Saudi Arabia); however, in oil importingcountries (Turkey, South Korea, Malaysia, India and Pakistan), it is the economic growth that acts as energy consumption factor. In another word, there is a unilateral causal relationship that goes from GDP to energy consumption in that group.

Key words: GDP, Economic Growth, energy, Final Energy and Energy Intensity

INTRODUCTION

Economic growth is a process the main core of which is the gross domestic production (GDP). Development is planned with the aim of mobilizing national facilities and resources towards more production of necessary goods and services; nonetheless, efforts towards more and better production- while making reforms and corrections in production factors organizing- should be associated with vaster and most intensive use of all sources including human resources, physical capital and natural resources. In this respect, the relationship between economic growth and different energy carriers consumption in various sectors as important factors in production have attracted the attention of many economic analysts (Tavakoli, A, 1998, Gharebaghian M, 1992, Tafazoli F, 1997).

Energy carriers are among the most important factors in various production sectors of all countries and this has given them a special place in global economy. Energy consumption affects the economic-social growth and development of countries, living standards and in general, life quality of people. Definitely, the vital role of energy in today world has close ties to the destiny of global economy and the highly close relationship has made the issue of energy and its consumption as one of the critical and important factors in the making decisionand adopting policies in economy of all countries around the world (Maleki, R. 1998, Haghani, M. 2007, Taheri Fard A, 1998, Rahimi E, 1993).

Optimized use of energy sources could help the economic development of countries and in case of failure in optimized and efficient use of those resources, there might be a risk that energy sector, as a sector with no compliance with other economic sectors, actually cause economic imbalance (Lee, C.C. 2005, Mehrara, M. 2007 and V and Oh, W., 2004).

With respect to the above-mentioned subject, it seems necessary to study the relationship between energy consumption and yields and production in any country. If it is proved that there exists a ratio between energyconsumption and GDP and no facilities have been provided to have more utilization from each one of the sources parallel to growth introduction, the production will face a hard strait. It should be noted that main goal in any direction taking in economic development area, including policy making for energy sector is to improve the capability of series of goods and services production in countries and therefore, reducing energy consumption is justified only if it is proved that reduction would not jeopardize the realization of the main goal

Corresponding Authors: MasoudYazdani& Maryam Faaltofighi, Department of Management, Ardabil Branch, Islamic Azad University, Ardabil, Iran
E-mail: Masoudyazdani1354@yahoo.com

of welfare and improvement of livingstandards. On the other hand, if there is no proportion between energyconsumption and GDP, then the saving policies with noundesirableimpacts on economy could be used (Haji Norouzi, Sh. 2006 and Abbas Mohsen E and Nadjarzadeh R, 2003).

In answering the question of provided that the increase in energy price is effective on general levels of prices and the entire economics, then,"what is the degree and quality of those impacts?" if we plan to search the answer from distinguished theories which have been presented in micro and macroeconomics, then we could claim that although energy shocks, especially increase in oil price do have impacts on the general level of prices, the production costs and the entire economy of major oil importers, those impacts could not be too severe and perhaps, a part of vast propaganda of western countries after oil shocks could be regarded as baseless. Nevertheless, one could not deny the impacts of (increase in oil price) on the economic situations of those countries (Sharzei, Gh, 2000, Masih, R 1996, Asafa, J, 2000). Professor William Hogan and Alan Manne described the relationship between energy and macro-economic by using the Fable of Elephant and Rabbit; that is, if the stew (total yield of macroeconomic) is a mixture of a rabbit (energy sector) and an elephant meats (other factors), now, does the stew more taste as elephant meat or rabbit meat? By using this metaphor, the question is that whether or not omitting rabbit would have considerable impacts on the taste and flavor of the stew (Abosadra, 1991 and Yu, E.S. 1985).

The probable answer is that, production function is not flexible and only a fixed ratio of energy factors and other (non-economic) factors are necessary for production in which case, by the increase in energy costs, the GNP energy costs will be decreased exactly in the same ratio and the share of GNP to be allocated to the energy increases in same degree. However, if combination of production factors has more flexibility, the increase in energy expenses might reduce consumed energy and the impact might be lower in which case, GNP will face less reduction in proportion (Brandt, E.R. 1975).

In any event, decrease in GNP of major oil importer (industrial) countries during an increase in price depends on the share of consumed oil expenses in total costs and if that share is a significant amount, the GNP reduction will be too high; likewise, if the share of oil consumption cots is a small percent of total costs, the increase in its price will have less impacts on GNP of those countries. In practice; however, the oil consumption cost has a little share in total GNP of industrial countries. In 1973, this share in the United States was around 1.8 percent of GNP and in maximum conditions, it reached to around 5 percent in 1983. Obviously, the important point in this approach is the very feasibility and substitution speed of other factors to replace energy place in GNP (Stern, D.L, 1993 and Ayres, R.U. 1984).

MATERIALS AND METHODS

In many empirical studies, econometric methods are inseparable part of research methodology. By an increasing expansion of econometric disciplines, especially since 1980, new approaches towards dynamic patterns to link the short-term relations with the long-term relations and predicting possible impacts and shocks to economic systems have become highly important. The changes created for improving patterns and their advancements are evidences of this claim (Ashrafzadeh, H 2008 and Guajarati, D, 1998).

For studying the causal relations between economic growth and energy consumption, this research has used the two variables of GDP of each country and its energy consumption. The information and statistics which have been used in the present research have been obtained from the statistics and information of International Energy Institute and the Iranian Balance Sheet of Energy. The period subject of study is between 1980 to 2007 (Vafi Nadjar, D, 2006). Seven Asian countries have been selected as samples and were divided into two groups of oil exporters and importers as follows:
- Oil exporter countries: Iran and Saudi Arabia
- Oil Importer countries: Iran, Saudi Arabia, Turkey, South Korea, Malaysia, India and Pakistan

Analysis of Data:

This research has used consolidated data which is one of the important statistical data in empirical analysis as well as statistical tests and econometric of variables which are applied in assessing the model. The Eviews software has been used to analyze the model and drawing research diagrams. (Noferesti, M, 2005)

Advantages Of Using Consolidated Data Than Time And Cross Sectional Series:

1. The consolidated data is able to measure impacts that are not easily detected by time series and cross section data.

2. The mere cross sectional data and mere time series do not consider individual heteroscedasticity; therefore, they might give biased assessment, while, consolidated data is able to consider this heteroscedasticity by considering the special individual variables.

3. The consolidated data enables us to study the most difficult complicated behavioral models

4. The consolidated data provides more informing information, higher variety or changeability, less co-linearity among variables, more freedom degree and better efficiency. While time series are tied with col-linearity, in consolidated data, as it is a combination of time series and cross sectional series, the cross sectional dimensions increases changeability or very high variety and by having that information, more reliable assessments could be carried out.

5. The consolidated data is collected from smaller units such as individuals, firms and families. Many variables could be measured with more precision in small scales and the deviations caused by accumulation of individuals or corporations are omitted.

6. The consolidated data lowers bias by providing large number of data (Akarc, A. T and Long, T.V. 1979)

-   Panel single root tests
-   For GDP and energy consumption test, the two tests mentioned below have been used:
1. The Loin, Lin and Chu (LLC) root test
The LLC test assumes the single root process is the same in all sectors and in this approach, it takes assumption zero based on single root (Levin, A. Lin, C.F., Chu, C.S, 2002)

2. Im, Pesaran and Shin (IPS) test
The IPS test is on the basis that the single root could differ among sectors (Im, K.S., Pesaran, M.H., Shin, Y. 2003)

-   Panel Co-accumulation test
By using the data in single root test, the long term relation of convergence between the two variables of GDP and energy consumption is studied through Panel Convergence Test- Pedroni Method (Pedroni, P. 2004).

-   Assessment of Panel Long-term relation
If a long-term relation exists, the long-term convergence vectors are assessed by using the ordinary minimum squares adjustment method of the panel (PFMOLS)

-   The causal test in the template of panel data:
The panel error correction model (based on Angle- Granger 1987) is used to test the causal relation even if no convergence exists.

Results:

Based on the results from performing LLC and IPS tests, there is mainly an implication of existence of a single root in 99 percent importance level for variable values on surface. On the other hand, the assumption of existence of single root for differentiation of above-mentioned variables is rejected. The results which are obtained show the existence of convergence of first degree for variables.

With respect to the results obtained from convergence tests, most statistics confirm the zero assumption based on convergence existence. In this way, it could be concluded that there are signs of long-term relations between energy consumption and actual GDP value.

Since the convergence has been found in this panel group and the long-term relation is assessed by PFMOLS, the estimation parameter could be used as income trend in long-term. The income trend in most countries is positive and in statistical term, it has 5% importance level. The value quantity of income of the group in elasticity power term is 0.87 that is almost equal to 1 and the specific elasticity values range from 0.05 to 1.56. Those results show that in general state, one percent increase in income causes one percent increase in energy consumption.

The results show that in oil export countries, the assumption of "no relationship between economic growth (going) to energy consumption" is accepted and the causal relations is from energy consumption to GDP. In another word, increase in energy consumption in this group of countries increases GDP and reduction in energy consumption lowers economic growth in this group of countries; however, in oil importing countries, the results imply that the causal relation is "from GDP to energy consumption"; that is, increase in GDP causes increase in energy consumption and therefore, saving policies could be used in those countries without destructive impacts on their economic growth.

Discussion:

Energy is considered as one of the most important production factors in countries and special attentions have been paid to its important role in economy in recent decades. Energy carriers have various and abundant application, one of the basic applications of it is to use energy as a production input. From viewpoints of different economic schools, the most important factors in economic growth include capital, workforce, raw

materials, technology and energy. In fact, in recent decades, energy; too, has been included in production functions; nonetheless, its importance is not the same in different models and production functions and might differ in accordance with the economic conditions of each country. As energy is used both as a consumable good and a production factor, it has high sensitivity. The energy importer countries have paid attention to the role of energy as production input more than a consumable good and have made more efforts in using energy in production process than exporting countries. In addition, in recent years, they have taken some measures to reduce the dependence of production to energy consumption through lowering energy spending and improving the efficiency of energy. Using efficient technologies along with new and recyclable energies, rational management of energy demand and employing energy saving policies have decreased the intensive dependence of those countries to the oil and gas of oil exporting countries. On the other hand, in energy exporting countries, energy is more used as a consumable good than a production input and disregarding energy saving policies has led to increase in energy-cost in those countries. Therefore, the role of energy in energy exporting countries has basic differences with its role in energy importing countries.

The major goal of this study was to survey the causal relations between the variables of energy consumption and GDP in panel ground for seven selected countries of Iran, Saudi Arabia, Malaysia, Turkey, India, South Korea and Pakistan during 1980 to 2007 and it only studied the effects of energy consumption on economic growth by ignoring the effects of other production factors such as capital ad work force. Therefore, for future researches it is suggested:

1- To include capital and work force variables in analytical model as well, the alternative effects of capital and work force effects with energy consumption should be surveyed.

2- If possible seasonal data should be used in place of annual data to increase the precision of assessment and improve the analysis power.

REFERENCES

"Energy Development" 1997. Taken from special reports of the Energy International Surveys Institute, Journal of Energy Economics, Spring.

"Energy Perspectives to Year 2020" Journal of Energy Economics, January 2001, 29th Ed.

Abbas Mohsen, A and R. Nadjarzadeh, 2004. Relationship between Energy Carriers Consumption and Growth of Economic Sectors in Iran, periodic of Energy Economic Studies, pp: 2.

Abosadra and Baghestani, 1991, "New Evidence on the causal relationship between United State energy consumption and GNP" , Journal of Energy and Development, 14: 284-92.

Ahmadian, M., 1999 "The Theoretical and Applied Economy of Oil" Economics Research Center Publication, Tarbiat Modaress University

Akarc, A.T. and T.V. Long, 1979. Energy and employment : a time – series analysis of the causal relationship, Resources and Energy, 2: 151-62.

Al-Iriani, M.A., 2006. "Energy-GDP relationship Revisited: an example from GCC countries using panel causality" , Energy Policy, 34: 3342-3350.

Asafa, J.A., 2000. "The relationship between Energy consumption, Energy Prices and economic growth: time series evidence from Asian developing countries" , Energy Economics, 22: 25-615.

Ashrafzadeh, H and M. Mehregan, 1999. "Data Panel Econometrics" Tehran University Press

Ayres, R.U. and I. Nair, 1984. "Thermodynamics and Economics". Physics Today, 37: 62-71. Reprinted in: A survey of ecological economics (1995), edited by R. Krishnari, J. M. Harris and N. R. Goodwin. Covelo NY: Island press.

Cheng, B.S., 1995. "An investigation of co integration and causality between energy consumption and economic growth" , Journal of Energy and Development, 21: 73-84.

Brendt, E.R. & D.O. Wood, 1975. Technology, Prices and the Derived Demand for Energy. Review of economics and Statistics, 57: 259-268.

Cheng, B.S. and T. Weilai, 1997. "An investigation of co integration and causality between energy consumption and economic activity in Taiwan", Energy economics, 19: 44-435.

Craft, J. and A. Craft, 1987. "On the relationship between Energy and GNP" , pp: 2483.

Energy balance sheets of different years

Engle, R.F., C.W.J. Granger, 1987. Cointegration and error correction: representation, estimation and testing. Econometrica., 55: 251-276.

Erick, Anderson, Oil theory.com, 2000.

Erol, U. and E.S.H. Yu, 1987. On the causal relationship between energy and income for industrialized countries , Journal of Enrgy and Development, 13: 113-22.

EVIEWS 6, Econometric Software Package, Quantitative Micro Software, CA, USA.

Gharebaghian, M., 2001. "Study the Economic Growth Sources in Template of an Econometric Model" Tehran, Deputy of Economic Affairs, Ministry of Economy and Finance

Ghobadi, N., 1997, "Study the Causal Relationship between Energy Consumption and Economic Growth" Second National Conference on Energy in Iran

Glasur,Y.L., 1997. "Co integration, error-correction, and relationship between GDP and energy", Resource Energy Economic, 20: 17-25.

Guajarati, D., 1998, Hamid Abrishami, "Fundamentals of Econometrics" Institute of Publication and Press-Tehran University.

Haghani Rizi, M., 200, "Study the Causal Relations between Energy Consumption and GDP of Iran" M.A. Thesis, Tehran University

Haji Norouzi, S.h., 2006. "Comparative Study between Economic Growth and Energy Consumption in Developing and Developed Countries: M.A. Thesis, Alzahra University

Im, K.S., M.H. Pesaran, Y. Shin, 2003. Testing for unit roots in heterogeneous panels. Journal of Econometrics., 115: 53-74.

JaruwanChontanawat. 2010. "Modelling the Causal Relationship between Energy Consumption and Economic Growth in Asia" , Energy Economics, 32: 185-196.

Javadi, A., 1999. "A Review on Energy Changes in 20th Century" Journal of Energy Economics,

Johanson, S., 1988. Statistical analysis of cointegration vectors , Journal of Economic Dynamics and Control, 12: 231-54.

Khalatbari, F., 1994. "Fundamentals of Oil Economics" Elmi Farhangi (Scientific and Cultural)Publication of Tehran

Lee, C.C., 2005. Energy consumption and GDP in developing countries: a cointegrated panel analysis. Energy Economics., 27: 415-427.

Lee, C.C., C.P. Chang, 2007. Energy consumption and GDP revisited: a panel analysis of developed and developing countries. Energy Economics., 29: 1206-1223.

Levine, A., C.F. Lin, C.S. Chu, 2002. Unit root tests in panel data: asymptotic and finite-sample properties. Journal of Econometrics., 108: 1-24.

Maleki, R., 1999. "Study the Causal Relations between Energy Consumption and Economic Growth in Iran" M.A. Thesis, Shahid Beheshti University

Masih, R.M and R. Masih, 1996. "Energy consumption, Real income and temporal causality", Energy economics, pp: 83-165.

Mehrara, M., 2007. Energy consumption and economic growth: the case of oil exporting countries. Energy Policy, 35: 2939-2945.

Mostafaei, A. and H. Abrishami, 2001. "Study the Relationship between Economic Growth and Consumption of Main Oil Products in Iran" Journal of Knowledge and Development (Danesh va Tosseh), No. 14.

Noferesti, M., 1999, "Single Root and Accumulation in Econometrics" Tehran, Rasa Publication

Oh, W. and K. Lee, 2004. Causal Relationship Between Energy consumption and GDP Revisited: The Case of Korea 1970-1999, Energy Econometrics, 26: 51-59.

Pedroni, P., 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory, 20: 597-625.

Rahimi, A. 1993. "Quantitative Relations between Economic Growth and Energy Demand" M.A. Thesis, Tehran University

Role of Energy Sector in the Economic Development of the Country, Ministry of Economy and Finance Affairs, Deputy of Economic Affairs, 1st Ed. Summer 1997, Tehran

Romer, M., 2004, Mehdi Taghavi, Advanced Macroeconomics" I.A.U. Sc. & Research Branch, 1.

Sherazei, Gh and Vahidi, Mohammadreza, 2001. "Study the Relationship between Energy Consumption and Real Income; and, General Prices Levels in OPEC Member Countries" Third National Conference on Energy

Stern, D.L., 1993."Energy and Economic Growth in the USA, Amultrvariate Approach", Energy economics, 15: 137-150.

Tafazoli, F., 1986. "Relationship of Population Growth and Economic Growth and Development from Classic Economists' Viewpoint" Periodic of Plan and Development, 8th Ed.

TaheriFard, A. and A. Rahmani, 1997. "Relationship between Economic Growth and Energy Consumption in Iran" Second National Conference on Energy in Iran

Tavakoli, A., 1999 "Applied Econometrics" Isfahan, Mani Publication

Vafi, Nadjar, D., 2005. "Statistical Analysis and Study the Granjeric Causal Relations of GDP and Energy Consumption and Calculation of energy Input Trend by Using Production functions" Periodic Journal of Energy Economic Studies, 2nd Year, pp: 5.

Yang, H.Y., 2000. A Note on the Causal Relationship Between Energy and GDP in Taiwan. Energy Economics, 22: 309-317.

Yu, E.S.H and J.Y. Choi, 1985. "The causal relationship between Energy and GDP: an international comparison" , Journal of Energy and Development, 12: 240-72.