

CAUSAL ANALYSIS ON ENVIRONMENTAL ECONOMICS OF ASIAN COUNTRIES

DR. M. DHANABALAN, DR S JEYARANI

Abstract: We investigate the causal relationship between GDP and different types of energy consumption for the five South Asian Countries; Pakistan, India, Sri Lanka, Bangladesh and Nepal by using Error Correction Model and Toda and Yamamoto(1995) approach. For Pakistan evidence shows that there is unidirectional Granger causality running from coal to GDP, and unidirectional Granger causality running from GDP to electricity consumption and total energy consumption. For India no causality in either direction between GDP and different energy consumption is detected. For Sri Lanka there is unidirectional Granger causality running from GDP to electricity consumption and total energy consumption. For Bangladesh unidirectional Granger causality is detected from GDP to electricity consumption and from gas consumption to GDP. For Nepal causal direction is from petroleum to GDP.

Key words: Economic Growth, Granger Causality, Unit Root and cointegration, Error CorrectionModel and Toda and YamamotoProcedure.

Introduction : Energy is a key source of economic growth because many production and consumption activities involve energy as a basic input. Energy is one of the most important inputs for economic development. From a physical viewpoint, the use of energy drives economic productivity and industrial growth and is central to the operation of any modern economy. Barney & Franzi (2002) argue that energy is responsible for at least half the industrial growth in a modern economy while representing less than one tenth of the cost of production. Some analysts argue that growth in energy use directly causes growth in GDP. The energy crises in the 1970's and high-level energy prices slowed down the economic growth. Since the end of 1970s the relationship between energy consumption and economic growth has been studied extensively using modern advances in the time series econometric. From policy perspective, the causality in either direction between energy consumption and economic growth may have a significant impact upon energy conservation policies. The energy conservation measures may or may not be taken depends on the direction of causality (Rufael, 2006). The objective of this paper is to explore the causal relationship between Gross Domestic Product (GDP) and energy consumption for the five South Asian countries; Pakistan, India, Sri Lanka, Bangladesh and Nepal by using the Error Correction Model of Engle and Granger(1987) and Toda and Yamamoto approach (1995). To investigate the difference in the behaviour of the energy-economic growth relationship across energy types, we disaggregate energy consumption into gas, petroleum, electricity, coal consumption and test for their causal relationship with GDP. We also discuss the possible impact of energy conservation policies in the selected countries

There are very few studies on energy-economic growth relationship for this region as a whole. We have applied Toda and Yamamoto procedure, which avoids bias associated both with unit root testing and cointegration. Most of the previous time series studies are either based on simple Granger causality bivariate analysis or few of them use Error Correction Mechanism.

Energy and GDP relationship in Asian Countries: For India, Pakistan Bangladesh and Nepal, annual data of nominal Energy consumption with its various types (Petroleum, Gas, Coal, Electricity and Total Energy Consumption) are taken from International Energy Agency (IEA), 2005 from energy balance of non- OECD countries (2003 edition). All variables of energy consumption are measured in millions of tones of oil equivalent except for coal consumption of Pakistan which is in ooo metric tonne. GDP series for all the five countries are obtained from CD of International Financial Statistics and converted into real GDP by using GDP deflator for each country. For Pakistan Real GDP is in Billions of Pakistani Rupee, measured at 2000 constant price, Indian Real GDP is in Billions of Indian Rupee with 1995 price, Bangladesh Real GDP is in Billions of Takka measured at 2000 constant price, Sri Lanka GDP is in Millions of Sri Lankan Rupee measured at 2000 constant price and Nepal Real GDP is in million of Nepali Rupee with 2000 constant price level. Knowledge of the direction of causality between GDP and energy consumption is important for making a decision whether energy conservation policies affect economic growth or not.

For Pakistan we find that total energy consumption and GDP are cointegrated and in the long run there is unidirectional Granger causality running from GDP to total energy consumption. This means that continuous growth in GDP simultaneously generates

a continuous increase in total energy consumption and energy conservation may be feasible without compromising on economic growth. But there is no evidence of Granger causality between GDP and petroleum consumption, GDP and gas consumption which implies that energy conservation policies (gas and petroleum sector) may be pursued without adversely affecting income. Moreover there is unidirectional causality running from coal to GDP this means reducing coal consumption may lead to fall in GDP. The evidence of unidirectional causality from GDP to electricity consumption and from GDP to total energy consumption is an indication that rapid growth in GDP is responsible for high level consumption in electricity and total energy consumption. This is exactly what we have been observing in practice in Pakistan that it has become an electricity deficient country from electricity surplus with an increase in GDP over last five six years. Nevertheless, energy conservation policies may be implemented with little adverse or no effect on Economic growth.

For India, there is no evidence of causal relationship between GDP and all types of energy consumption, which means that neither GDP nor all types of energy consumption Granger Cause each other. The neutrality hypothesis implies that reducing energy consumption may not affect GDP and it appears that energy conservation policies may not have significant impact on GDP growth.

For Sri Lanka, our main findings are that electricity consumption and GDP are cointegrated and in the long run there is unidirectional causality running from GDP to electricity consumption. Then this denotes a less energy dependent economy, one where the implementation of energy conservation policies would have little, if any, adverse effect on income. There is evidence of unidirectional causality running from GDP to electricity consumption and from GDP to total energy consumption. This means that increase in economic growth require enormous consumption in electricity and total energy. As economic growth causes expansion in industrial and commercial activities and electricity is used as a basic input, therefore, energy conservation policies do not harm the economic growth.

For Bangladesh coal, petroleum, total energy consumption and GDP are independent which favors

neutrality hypothesis, therefore, energy conservation policies may not effect economic growth. But there is unidirectional Granger causality running from GDP to electricity consumption this means that if economic growth increases, and then electricity consumption also increases. So electricity conservation policies would not adversely affect economic growth of Bangladesh. Evidence of unidirectional causality from gas to GDP implies that an increase in gas consumption can be viewed as a leading indicator of economic growth, this which means that the supply of gas is vitally important to meet the growing electricity consumption to sustain the economic growth. Shortage of gas may cause poor economic performance and that leads to fall in GDP. Such causal relationship between GDP and gas consumption suggests that energy conservation policies are likely to affect the GDP growth. So energy conservation (gas sector) policies should be such that they curtail the consumption without affecting economic growth.

For Nepal there is no cointegrated relation between GDP and various energy consumption variables. But there is unidirectional causality running from petroleum to GDP this means reducing petroleum consumption may harm economic growth. But no evidence of Granger causality between GDP and electricity, coal and total energy consumption indicate that energy conservation policies may be pursued without adversely affecting income.

Conclusions: In general, our results indicate that increase in energy demand is mainly driven by high economic activity in the region. This implies that sustainable growth in GDP can be achieved by judicious energy conservation policies. With all this we would like to say that our results may be sensitive to the choice of sample period, selection of variables and methodology we adopted. This also indicates the sensitivity of Granger causality and that's why results based on Granger causality should be interpreted with care. Finally we suggest that result may suffer from the omission of the other relevant variables. Hence, in future, study can be improved by including more relevant variables such as Energy price, Employment and Capital etc. Panel data analysis of these four countries' data might also lead to interesting findings for the whole region.

References

1. Akarca, A.T. and Long, T.V.(1980). "On the relationship between energy and GNP: a re-examination". *J. Energy Dev.* 5: 326–331.
2. Aqeel, A., Butt, M.S. (2001). "The Relationship between Energy Consumption and Economic Growth in Pakistan". *Asia-Pacific Development Journal* 8(2): 101-109.
3. Asafu-Adjaye, J. (2000). "The Relationship between Energy Consumption, Energy Prices and Economic Growth: Time Series Evidence from

-
- Asian Developing Countries". Energy Economics 22: 615-625.
4. Barney .F, Franzi .P.(2002). "The future of energy From Future Dilemmas: Options to 2050 for Australia's population, technology, resources and environment". CSIRO Sustainable Ecosystems.pp157 – 189.
5. Dickey, D. A. & Fuller, W. A. (1979). "Estimators for autoregressive time series with a unit root", Journal of the American Statistical Association 74: 427-431.

Dr . M. Dhanabalan/lecturer in commerce/Madurai Kamaraj University/Madurai/
Dr S Jeyarani/ Associate Prof Economics/The American College/Madurai/