



Is energy consumption effective to spur economic growth in Pakistan? New evidence from bounds test to level relationships and Granger causality tests

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ABSTRACT

The present study investigates the relationship between energy (renewable and nonrenewable) consumption and economic growth using Cobb–Douglas production function in case of Pakistan over the period of 1972–2011. We have used the ARDL bounds testing and Gregory and Hansen (1990) structural break cointegration approaches for long run while stationarity properties of the variables have been tested applying Clemente–Montanes–Reyes (1998) structural break unit root test.

Our results confirm cointegration between renewable energy consumption, nonrenewable energy consumption, economic growth, capital and labor in case of Pakistan. The findings show that both renewable and nonrenewable energy consumption add in economic growth. Capital and labor are also important determinants of economic growth. The VECM Granger causality analysis validates the existence of feedback hypotheses between renewable energy consumption and economic growth, nonrenewable energy consumption and economic growth, economic growth and capital.

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1. Introduction

Kyoto Protocol, our environmental responsibilities, volatile energy prices, and energy security are the contemporaneous issues that bind nations to diversify their energy supplies. Kyoto Protocol necessitates its members to maintain the level of greenhouse gas emissions since 1990 to date. It is hoped that this mutual effort, by both the developing and the developed countries, would help to mitigate the detrimental consequences of global warming. In addition, it would also help to dispirit the increasing volume of CO₂ emissions in environment. Of course, the lower level of CO₂ emissions can only be achieved by the lesser consumption of fossil fuels but this solution would also bring severe ailment to economic growth since the economic cost of utilizing the fossil fuels has increased tremendously. Therefore, one cannot overlook the long run consequences of the extensive utilization of the fossil fuels for some short run economic gains.

Volatility in energy prices creates difficulties for oil importing countries in balancing their payments each year. All the major economic recessions are preceded by the rising energy shocks (Hamilton, 1983) and the rise in energy prices invokes the inflationary expectations. Given the commitment of the central bank to the economic stability and to minimize inflationary expectations, central bank raises the interest rate (Harris et al., 2009). As a consequence, although, the overall inflation tends to fall but the rising interest rate also lowers the level of investment

(Leduc and Sill, 2004); resultantly, the growth rate is adversely affected. It is worth mentioning that renewable energy emits lower level of CO₂ in the environment, and is helpful in solving the environmental problems of climate change (Elliot, 2007; Ferguson, 2007).

Energy requirements are rapidly increasing in Pakistan and the primary energy requirements in Pakistan have witnessed 80% increase in the last 15 years; it rose from 34 million TOE in 1994–95 to 61 million TOE in 2009–10. Indigenous natural gas comprises of 45% of the energy mix, oil imports constitutes 35%, hydel power covers 12%, coal 6% and finally nuclear energy constitutes 2% of the energy mix respectively (Government of Pakistan, 2010). Pakistan is heavily dependent on conventional sources of energy to satisfy its energy consumption requirements. Conventional source of nonrenewable energy satisfy more than 99% of the energy requirements (Sheikh, 2010). Nonetheless, Government of Pakistan has assigned the target to the Pakistan Alternative Energy Board to generate 5% of the total installed power through the alternative/renewable energy up to year 2030 (Khalil et al., 2005).

Pakistan is a country blessed with so many natural sources of energy that, if utilized properly may reduce the dependence on foreign aid for oil imports. These available unexplored energy resources in Pakistan have the potential not only to satisfy the domestic energy requirements but these can also be exported to other energy deficit countries. But unfortunately, these resources have not been explored properly.

Pakistan is located on the high insulation belt which gives it the comparative advantage in the creation of solar energy. This source of energy is much cheaper than the fossil fuels because neither it needs refining nor it requires any transportation cost. It is the most attractive substitute of fossil fuels because it adds no pollution in the environment. It

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is employed in rural telephone exchanges, emergency telephones at high ways, vaccine and medicine refrigeration utilized in the hospitals etc. In Pakistan, Sindh and Balochistan provinces are the ideal locations for the production and utilization of solar energy. In Balochistan, 77% of the population lives in villages and 90% of them live without electrification facilities. These villages are located far away from each other; resultantly, there is no scope of the grid stations and solar energy networks are more suitable sources of energy for these location. Recently, a 100 solar energy homes' project has been completed in 9 villages of these provinces which have the potential to enlighten the 26,000 homes (Sheikh, 2010).

The coastal areas of Sind and Baluchistan provinces and the desert areas of Punjab and Sind provinces provide the huge potential for the wind energy. The coastal belt has a 60 km wide and 180 km long corridor with a potential to generate the 50,000 MW of the renewable energy through the wind energy. In addition, there are other sites in these areas as well as in Northern areas which are suitable for the micro wind turbines. Although, these wind turbines have the potential to electrify 5000 village in Pakistan but unfortunately just 18 villages have been electrified with this source of energy (Sheikh, 2010). The Northern areas of Pakistan are rich in waterfalls which makes it a suitable candidate for the hydro energy. In addition to the big plants which have the potential to generate 1 MW of renewable energy or greater, there are other sites suitable for the micro hydro energy plants having the potential to produce 100 KW of renewable energy. Altogether, these micro plants may have the potential of producing 300 MW of renewable energy. These areas are densely populated and fossil fuel power plants for producing non-renewable energy might be costly, therefore these micro hydro plants are more suitable for these areas. The canal networks in Punjab have also such sites which provide a great opportunity for the renewable energy production. It is estimated that Punjab comprises of 300 such sites which can produce 350 MW of renewable energy. Whereas, there are only 228 micro plants which just have the potential to produce the 3 MW of renewable energy to the households and small industrial units (Sheikh, 2010).

Biogas is also one of the important sources of energy which not only increases the land fertility but is also used to fulfill the energy requirements. There are 48 million animals in Pakistan comprising of buffaloes, bullocks and cows, as per livestock census of 2002–03. Keeping in view the daily dung dropping and assuming 50% collectability, it is estimated that 17.25 million m³ of biogas can be produced daily with the help of biogas plants. Cooking requirements of 50 million people can be entertained with it. In addition, it also provides fertility to land through the provision of 35.04 million of bio-fertilizers each year. The formal initiation, for this source of energy, was taken in 1974 and up to 1987, there were 4137 units of biogas plants in the country. Unfortunately, the lack of funds made this project difficult to sustain during 1990s but later on this program was reinstituted with the help of 1700 biogas plants in many villages in the country.¹

Energy (renewable and non-renewable energy consumption) is an important determinant of economic growth like other factors of production such as labor and capital. Existing energy literature provides four competing hypotheses of energy consumption (renewable and nonrenewable energy consumption) and economic growth in case of Pakistan. These competing hypotheses are very important for policy point of view. For instance, reductions in energy would not have adverse impact on economic growth if economic growth Granger causes energy consumption or neutral hypothesis exists between both the variables. If bidirectional causality is found between both the variables or energy consumption Granger causes economic growth then

new sources of energy should be encouraged. Energy is an important stimulus of production process and energy must Granger cause economic growth. An expansion in production is linked with energy demand and economic growth might Granger cause energy consumption. The main objective of present study is to investigate the relationship between renewable energy consumption, nonrenewable energy consumption, capital, labor and economic growth in case of Pakistan of using Cobb–Douglas production function over the period of 1972–2011. In case of Pakistan, this study contributed to energy literature by five folds applying: (i) Clemente et al. (1998) structural break unit root test for stationarity properties of the variables; (ii) the ARDL bound testing approach to cointegration for long run relationship; (iii) Gregory and Hansen (1996) structural break test to check the reliability and robustness of the ARDL results, (iv) OLS and ECM for long run and short run impacts of renewable and nonrenewable energy consumption on economic growth; (v) VECM Granger causality approach to examine causal relationship between the variables.

Our findings reveal that cointegration between renewable energy consumption, nonrenewable energy consumption, economic growth, capital and labor exists in case of Pakistan. Additionally, our empirical evidence also reports that renewable energy consumption and non-renewable energy consumption have positive impact on economic growth. Capital and labor also adds in economic growth. Furthermore, estimated results indicate bidirectional causality relationship between renewable energy consumption and economic growth, non-renewable energy consumption and economic growth, economic growth and capital.

2. Review of literature on energy–growth nexus

Theorists have divided the review of literature on energy and growth nexus in four competing hypotheses such as growth hypothesis, conservation hypothesis, feedback hypothesis and neutrality hypothesis. Growth hypothesis asserts the unidirectional causality running from energy consumption to economic growth, whereas the conservation hypothesis supports the reverse process of the unidirectional causality running from economic growth to energy consumption. Empirical evidence also supports the interdependence between energy consumption and economic growth, and in some cases there is no relationship (Payne, 2010a, 2010b, 2010c). The last two cases are formally known as feedback and neutrality hypotheses respectively. The present study tends to review the literature and report the empirical evidence under these four competing hypotheses.

2.1. Growth hypothesis

Ewing et al. (2007) investigated the correlation between disaggregated energy consumption and real GDP in United States by using generalized variance decomposition approach for empirical analysis. They found that coal, natural gas, and fossil fuels explain the maximum variations in output, whereas renewable energy consumption explains a little variation in output. These estimated results were quite consistent with the growth hypothesis. Later on, Payne (2010a, 2010b, 2010c) employed the Toda–Yamamoto causality tests to examine causal relationship between the biogas energy consumption and real output over the period of 1949–2007 in the US economy. Payne (2010a, 2010b, 2010c) reported unidirectional causality running from biogas consumption to real output confirming growth hypothesis. In case of India, Tiwari (2011a, 2011b) postulated the relationship between renewable energy consumption, economic growth and CO₂ emissions by applying Johansen–Juselius (1990) long run and structural innovative accounting approach (IAA) within framework of VAR (vector autoregression) to test the direction of causal relationship between these variables. The empirical evidence reported no cointegration between renewable energy consumption, economic growth and CO₂ emissions during the study period of 1965–2009. Furthermore, results

¹ The information regarding the renewable energy potential has been borrowed from various reports, available on the official website of Alternative Energy Development Board, Ministry of Water and Power, Government of Pakistan.

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