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Economics

AN EMPIRICAL ANALYSIS OF ECO-EFFICIENT GREEN GROWTH IN INDIAN ECONOMY

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ABSTRACT The present study has tried to estimate the green growth of economy in India. The study has used time series data from 1991 to 2015. The data have checked for stationarity and then transformed the data to their respective order of integration. The study analyzed the eco-efficient green growth of GDP and PCI. It has found from the study Indian GDP is not absolutely green. The growth of GDP is eco-efficient but not cleaned. The growth of Indian PCI is relatively green and clean. Accordingly, the green growth process has been started in India with energy efficiency and use of clean and renewable energy sources. However, the process of green growth is not absolute and significant. Hence, Indian economy needs to go a long way to achieve absolute green growth.

KEYWORDS : Green Growth, Energy Efficiency, Renewable and Clean Energy, Green House Gas Emission.

INTRODUCTION

The concept of green growth is not new to the literature of economics. It was very much exist in the literature in the form of limit to growth, environmental accounting, sustainable development and in many other forms. However, the explicit form of green growth was introduced by South Korea in its green growth model. It has been assumed that the growth will be green if the energy efficiency has increased. It is quite clear from the above statement that as the energy efficiency increases use of energy in the production process will be decreased. And there by there is lesser and lesser dependency on environment and that leads to green growth.

It is also assumed that growth will be green if uses of energy sources are renewable and clean. By the above statement it has clear that the energy source not only renewable it is also necessary to be cleaned in order to have green growth. Because, most of the energies may be renewable but not clean. For example, wood is renewable energy but not clean energy. It emits carbon into environment and leads to degradation of environment. Therefore, if the energy is renewable and clean then only it leads to green growth.

REVIEW OF LITERATURE

Estimating the causality of economic growth on energy consumption was started in the early 70's (Sims, 1972). Most of the early literatures on causation of economic growth on energy consumption have confirmed the causation by using uni-directional Granger- causality Tests (Yu, 1984) (Kraft, 1978) (Lin, 2003) (Soytas, 2003) (Mozumdar, 2007). During late 90's the economists like Nachane and others have employed Engel-Granger Models to estimate the causation of electricity and energy on economic growth (Nachane, 1988) (Masih, 1996) (Glasure, 1997) (Asafu-Adjaye, 2000) (Thoma, 2004) (Hansen, 2002) (Yoo, 2005). Meanwhile, the co-integration techniques were also used to estimate long-run relationship between energy consumption and economic growth. However, some of the researchers identified long-run relationship (Masih A. M., 1996) (Asafu-Adjaye, 2000) and others have failed to prove the long-run relationship (Cheng, 1995) (Yu E. J., 1992). Jumbe and Huang have proved bi-directional relationship between energy consumption and economic growth (Jumbe, 2004) (Huang, 2008). Estimation of multi-dimensional relationship has also proved the role of energy in overall economic development (Tamizan, 2009) (Shahbaz, 2012). Recently, Sadorsky has proved the influence of financial development on energy consumption (Sadorsky, 2010). Very recently, ARDL bounds test was used to prove the causation of energy demand on export (shahbaz, 2013). However, the long-run impact of energy on development has not estimated by previous studies with special reference to India. Hence, the present study will fill the gap.

METHODOLOGY

The time series data have used for green growth analysis of Indian economy. Energy efficiency, renewable energy output and emissions have used to estimate the green growth. The unit root tests have conducted to find the stationarity of selected parameters used in the present analysis. One of the conditions for using time series data that the data should be stationary, to have reliable result. All parameters are found stationary at their level and stationary with first and second differences. Therefore, these parameters have been transformed to their respective order of integration and then they have used for further analysis.

RESULT AND DISCUSSION

The important objective of this paper is to estimate the green growth of economy in India. It is derived from the green growth indicators developed by Korea green growth is the function of efficiency, less emission and clean energy. Using these conceptual frameworks the following model has constructed and expectations from the model also stated. The model has constructed to estimate green growth of the economy.

Model of Green Growth of the Economy

$$Y = \alpha + \beta 1 X_1 + \beta 1 X_2 + \beta 1 X_3 + \beta 1 X_4 + \beta 1 X_5 + e$$
Where,

Y = represents GDP or PCI

X1 = GDP per energy use
X2 = Co2 emission
X3 = Renewable electricity output
X4 = total green house gas emission
X5 = solar energy consumption
α = constant
β = co-efficient for X
e = error

- The growth of the economy will be green if the co-efficient for GDP per energy use is positive. Since the green growth depends on number of independent parameters the significant co-efficient is not expected.
- The growth of the economy will be green if the co-efficient for co2 emission is negative. Since the green growth depends on number of independent parameters the significant co-efficient is not expected.
- The growth of the economy will be green if the co-efficient for renewable electricity output is positive. Since the green growth depends on number of independent parameters the significant co-efficient is not expected.
- The growth of the economy will be green if the co-efficient for

total green house gas emission is negative. Since the green growth depends on number of independent parameters the significant co-efficient is not expected.

• The growth of the economy will be green if the co-efficient for solar energy consumption is positive. Since the green growth depends on number of independent parameters the significant co-efficient is not expected.

Analysis of Green Growth of GDP:
The following model presents results for green growth of GDP.

$$GDP = \alpha + \beta 1\, X_1 + \beta 1\, X_2 + \beta 1\, X_3 + \beta 1\, X_4 + \beta 1\, X_5 + e$$

^ gdp = -0.241	46.702	+ 1034.62	-0.000	-0.004	+0.001
t-ratio: -1.355	0.047	0.254	-0.101	-0.080	0.248
P-value: 0.193	0.962	0.802	0.920	0.936	0.806

R^2: 0.135
Adjusted R^2: -0.118
DW stat : 1.498

Green growth of GDP has been modelled, estimated and presented above. Since, the green growth has been explained by number of factors and the present study has used only limited factors. The model is not fairly good fitted. However, the model does not have any time series related problems. Therefore, the results of the model are reliable. The constant of the model is positive but not significant. Meaning, green growth will not be realized without energy efficiency, less emission and clean energy. The co-efficient for GDP per energy use is positive and it is theoretically expected. Though, it is not significant as energy efficiency increases the growth of GDP will be green. Co-efficient for co2 emission is negative and it was theoretically expected. Though, the co-efficient is not significant as Co2 emission decreases the growth of GDP will be green. The co-efficient for renewable electricity is negative and it was theoretically not expected. Therefore, the renewable electricity output is not contributing for green growth of the GDP. The co-efficient for greenhouse gas is positive but not theoretically expected. Therefore, green growth of GDP has been hampered by green house gas emission. The co-efficient for solar energy consumption is negative and theoretically it was not expected. Therefore, the solar energy consumption has not been contributing for green growth of GDP. Accordingly, Indian GDP is not absolutely green. The growth of GDP is eco-efficient but not cleaned.

Analysis of Green Growth of PCI:
The following model presents results for green growth of PCI.

$$PCI = \alpha + \beta 1\, X_1 + \beta 1\, X_2 + \beta 1\, X_3 + \beta 1\, X_4 + \beta 1\, X_5 + e$$

^ pci = 0.563	-1014.8	+ 2168.8	-0.022	-0.090	+0.004
t-ratio : 1.005	-0.337	0.169	0.922	-0.552	0.362
p-value: 0.327	0.739	0.867	0.368	0.587	0.721

R^2: 0.190
Adjusted R^2: -0.034
DW stat : 1.945

Green growth of PCI has been modelled, estimated and presented above. Since, the green growth has been explained by number of factors and the present study has used only limited factors. The model is not fairly good fitted. However, the model does not have any time series related problems. Therefore, the results of the model are reliable. The constant of the model is positive but not significant. Meaning, green growth of PCI will be negative if there are no

functions of independent variables. . The co-efficient for GDP per energy use is positive and it is theoretically expected. Though, it is not significant as energy efficiency increases the growth of PCI will be green. Co-efficient for co2 emission is negative and it was theoretically expected. Though, the co-efficient is not significant as Co2 emission decreases the growth of PCI will be green. The co-efficient for renewable electricity is negative and it was theoretically not expected. Therefore, the renewable electricity output is not contributing for green growth of the PCI. The co-efficient for greenhouse gas is positive but not theoretically expected. Therefore, green growth of PCI has been hampered by green house gas emission. The co-efficient for solar energy consumption is positive and it was theoretically expected. Therefore, the solar energy consumption increases the growth of PCI will be green. Accordingly, the growth of Indian PCI is relatively green and clean.

Conclusion
The study analyzed the eco-efficient green growth of GDP and PCI. It has found from the study Indian GDP is not absolutely green. The growth of GDP is eco-efficient but not cleaned. The growth of Indian PCI is relatively green and clean. Accordingly, the green growth process has been started in India with energy efficiency and use of clean and renewable energy sources. However, the process of green growth is not absolute and significant. Hence, Indian economy needs to go a long way to achieve absolute green growth.

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