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Business cycle and economic-wide energy intensity: The implications for energy conservation policy in Algeria

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ABSTRACT

Despite the prevalence of voluntary and involuntary energy conservation policies, developing countries in Africa continue to struggle to achieve energy efficiency targets. Consequently, energy intensity levels have risen threatening the security of the energy system. This raises the important question: is there an economic state that induces agents to be energy conscious? In this study, we study the case of Algeria's energy intensity from 1971 to 2010. First, the paper argues that there is a certain economic state that economic agents find investing in energy conservation a viable option. Any state different from that would mean not investing in energy conservation. Second, the paper argues that the economy can do better even with an infinitesimal reduction in fuel subsidy, and that the gains in revenue from the policy can compensate for the negative socio-economic and equity impacts associated with such a policy. Third, the paper argues that, so long as, industrial expansion in the country move parallel with investment in technological innovation, long-term sustainable growth and energy conservation targets are jointly feasible. Fourth, the paper shows that income elasticity evolves with the business cycle, and the absorptive capability of the host country affects how FDI (foreign direct inflows) impact energy intensity.

1. Introduction

On the average, African countries have chopped positive growth rates for a decade now, and this has translated into higher energy consumption in the continent. Consequently, carbon dioxide emissions from energy sources have surged. According to the Energy Information Administration statistics, in 2000, total carbon dioxide emission from energy sources in Africa was 887.0801 million metric tons. The amount of carbon dioxide emissions from energy sources increased to 1048.889 million metric tons in 2005 and to 1156.726 million metric tons in 2010. By the end of 2012, carbon dioxide emissions from energy in Africa reached 1205.705 million metric tons. Though, in relative terms, the rate experienced in Africa is lower compared to other continents in the Asia, South and North America and Europe, the current trend of increase gives a concern to worry about the future environmental ramifications. In order to curtail carbon emissions from energy sources, governments have pursued policies of substitution among energy inputs and various conservation policies (voluntary and involuntary). However, these programmes have been less successful in achieving efficiency targets. As a result, energy intensity in the continent continues to increase; a situation that is worrying to the environment and the future security of the energy system in Africa.

Algeria is one of the major players in the Africa energy market. The country boosts of huge reserves of natural gas, shale gas and oil. The hydrocarbon sector in Algeria contributes about 96% of export earnings and about 46% of GDP. For instance, in 2011, the hydrocarbon sector contributed 98% of export earnings; 78% of budget revenue and 36.7% of GDP (gross domestic product), albeit, the sector continues to experience decline in production levels due to maturing fields. Between 2004 and 2010, the Algerian economy managed an average GDP growth rate of 3.4%, which was mainly driven by the gas and oil sectors. These positive economic developments have translated into higher per capita GDP in the country. Algeria is now among the few countries in Africa with relatively high per capita GDP. According to the World Development indicator database, in 1990, the per capita GDP was US$2544.478. This dropped marginally to US$2487.286 in 2000, but increased significantly to US$3146.719 in 2010 and to US$5360.7 in 2013.

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One would expect that the current economic state will induce technological investment; improve economic-wide efficiency and cause energy intensity to fall. However, we observe the opposite. Energy intensity has increased for most parts of the period not discounting some noticeable fall between 1983 and 1995. Consequently, carbon dioxide emissions from energy sources have increased. According to the Energy Information Administration statistics, in 2000, a total of 83.62691 million metric tons of carbon dioxide emissions came from energy sources. This increased to 90.1413 million metric tons in 2005; 112.7088 million metric tons in 2010 and 133.9213 million metric tons in 2012. The implication is that, if energy consumption levels are not managed efficiently, the amount of carbon dioxide emissions will increase tremendously. This will affect the atmospheric temperature in the country and cause crop failure, health problems, and rising sea levels. The important research question that this phenomenon triggers is: what factors underlie the rising trend of energy intensity in Algeria? The policy relevance of this question is derived from the ability of such studies to devise broad-based energy conservation policies tailored at improving economic-wide energy efficiency. The most probable factors that come to mind, in the case of Algeria, are: the existence of highly subsidised fuel prices (about 77.5% of total cost of total fuel supply on the average[1]); the closed nature of the economy; the restrictive nature of foreign investment policy and changes in economic structure. The high fuel subsidies discourage investment in energy conservation while the restrictive foreign policy and the closed nature of the economy impede the free flow of technological diffusion in the country. The other important point is that the current income state may not be high enough to induce energy conservation behaviour.

Generally, higher incomes will increase technological investment and improve efficiency. According to the rebound effect, the gains achieved via efficiency leads to higher energy consumption. While the author shares in the logical exposition of the rebound effect, the author argues that the rebound effect cannot explain the whole observed behaviour in energy consumption patterns. Let's put this into a perspective with a graphical exposition of Algeria's energy intensity and per capita GDP (see Fig. 1[2]). The data points cover the period from 1971 to 2010. We observe a different pattern (circular region) which is not consistent with the rebound effect explanation of energy consumption patterns. In the loop, we observe that, at lower levels of income, energy intensity increases. This is an obvious result since lower incomes mean lower output and since energy intensity is a ratio it must increase. But for energy intensity to increase would mean that either agents are reducing their energy use by little or not changing their energy use at all. On the one hand, at higher levels of income, we observe a decline in energy intensity. Two things must happen for energy intensity to fall. First, output must increase, and second energy use must fall, but the increase in output must outweigh the fall in energy use. It can also be that both increase, but the increase in output outweighs the increase in energy use. These trends are mirrored in both sides of the circular region, though not very visible as displayed in the loop. On the left side of the loop, we observe periods where rising income increases energy intensity. But because the diffusion of technology into the country in the 1970s and 1980s was less, it will be incorrect to attribute such trend to the rebound effect or gains in efficiency due to technological advancement. To the right side of the loop, we observe similar trend of rising income and rising energy intensity which can be explained by the rebound effect due to

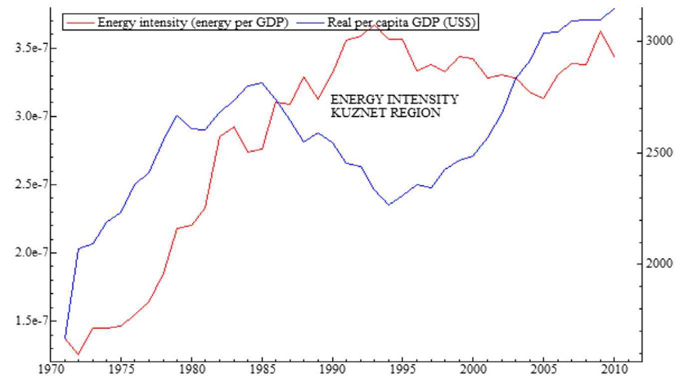

Fig. 1. Energy intensity and per capita GDP (1970–2010).
Data source: World Development Indicator database.

the high technological diffusion into the economy from 2000. On the average, the graph portrays a general picture that, lower income states increase energy intensity, but higher income states reduce energy intensity, for greater part of the period under investigation.

We can provide two possible explanations to the observed behaviour in energy intensity: substitution among energy inputs and investment in energy conservation. In the low income case, the rise in energy intensity suggests that substitution among inputs and investment in energy conservation are not occurring. The possible explanation to this is that, the cost of shifting or investment in energy conservation relative to income is high. In this state, since agents are tied to their energy using appliances and are reluctant to dispose them of, a voluntary conservation policy by government to replace old appliances will not be adhered to. This means that, in this state, involuntary conservation policy will force agents to be energy efficient. In the high income case, both substitution among energy inputs and investment in energy conservation are feasible. This is because the cost of shifting or investment in energy conservation relative to income is low. The observed behaviour suggests that there is a state of income that is compatible with fuel substitution and investment in energy conservation. In a survey, in the U.S, Polk [1] showed that, during the 2007/2008 economic crisis, more than two-thirds of the respondents indicated their intention to keep their car longer than they would have normally done in the absence of the crisis. In the same survey, Polk [1] reports that 70 percent of the respondents indicated their intention of buying second-hand cars in their next automobile purchase. The OECD/International Energy Agency [2] also reports that, in the United States, the sale of hybrid cars fell by 46% during the 2007/2008 crisis.[3]

Clearly, the picture portrayed above shows a possible Kuznet relationship between energy intensity and income per capita. The objective of this study is to analyse the determinants of energy intensity and search for the income state which does not induce energy conservation behaviour among agents. In this regard, the current study offers a novel approach of using the energy intensity Kuznet curve to determine the effectiveness of energy conservation policies both voluntary and involuntary in different economic states. Other novelties are introduced in this study. First, the study argues that the goals of sustainable growth and energy efficiency are not mutually exclusive so long as industrial expansion moves in tandem with investment in technological innovation. Second, the study argues that the economy can do better even with an infinitesimal reduction in fossil fuel subsidy. Third, the study shows that

[1] Data is taken from Energy Information Administration database on fuel subsidy.
[2] Energy intensity is measured on the left vertical axis while real per capita GDP is measured on the right vertical axis.

[3] www.greencarcongress.com.