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Energy–growth conundrum in energy exporting and importing countries: Evidence from heterogeneous panel methods robust to cross-sectional dependence

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ABSTRACT

This article uses the panel methods for energy exporting and importing countries that discuss the heterogeneity and cross sectional dependence in investigating the linkages between energy consumption and economic growth. The findings of the study suggest that the energy consumption is an important input not only in the energy importing but also in energy exporting countries. Furthermore, the results of the present paper suggest that the policy options should be different for the different countries in the back drop of heterogeneous slope coefficients.

1. Introduction

The literature on energy economics provides a lively debate on the linkages between energy consumption and economic growth over the last three decades which shows that the energy is a more important factor of production than it is considered by the researchers (Ayres et al., 2013). The proponents of energy led growth theory argue that all production activities involve energy as an indispensable input; therefore, it is a key factor in economic growth. On the other hand, conventional growth theories consider capital stock, labor and residuals as the major contributing factors in economic growth of an economy and dispel the belief that energy consumption plays any important role in economic growth. Both schools have their arguments and draw on different data, models and methodologies to support their stance.

A major chunk of literature considers that energy consumption determines the level of economic growth.[1] However, it is taken for granted that energy is an important input in only energy importing countries. These studies do not consider the importance of energy consumption in energy exporting countries for determining the level of economic growth. The energy endowment and high subsidization on energy inputs lead to low energy prices and therefore make energy as a cheap factor of production in energy exporting countries (Damette and Seghir, 2013). This further leads to distribution state benefits of energy endowments for the welfare of population and eventually contributes to economic growth of energy exporting country. Keeping recent increase in demand for energy and energy-intensive industries in view, it can be safely claimed that energy exporting countries are the energy-intensive countries as well (Damette and Seghir, 2013).

Additionally, huge exports of energy resources and domestic utilization of energy would lead to the rapid depletion of energy resources which may hit the level of economic growth of these countries in near future. Furthermore, Chen and Galbraith (2011) note that when energy resources deplete and technological cost increases, more financial resources are consumed which crowds out other economic activities. Therefore, discussing the energy exporting countries along with energy importing countries is the need of the hour.

Despite the above mentioned facts, the researchers have not yet seriously explored the panel studies of energy exporting countries. There are few studies, for example Al-Iriani (2006), Mehrara (2007) and Damette and Seghir (2013) that analyze the panel of oil exporting countries. The studies are based on single homogenous slope assumption and produce mixed results. Moreover, Al-Iriani (2006) and Mehrara (2007) note that causality runs from economic growth to energy

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[1] The reverse causality, bidirectional causality and neutrality hypothesis is also reported in the literature (see Jalil and Feridun, 2014; Ozturk, 2010).

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consumption. Damette and Seghir (2013), using heterogeneous panel data, document that the pace of economic growth sets the consumption of energy in short run and vice versa in long run. Importantly, none of these studies take structural breaks into account despite using the longer time series panel data. Furthermore, we may expect that the results are sensitive to the selection of econometric technique. Therefore, taking heterogeneity of slope and structural breaks into account may alter the findings of Al-Iriani (2006), Mehrara (2007) and Damette and Seghir (2013).

The linkages between energy consumption and economic growth are explored in several studies, for example Lee (2005), Al-Iriani (2006), Mehrara (2007), Lee and Chang (2008), Mahadevan and Asafu-Adjaye (2007), Lee and Chang (2008), Huang et al. (2008), Narayan and Smyth (2008), Lee and Chang (2008), Apergis and PayneJ (2009) and Ozturk et al. (2010) by using panel data and present inconclusive empirical findings. But almost all of them assume homogenous slope parameters in the panel. This implies that the single slope parameter will be generalized for the whole sample space of the study. The implications of single slope parameter may be more severe in the presence of inconclusive findings on the energy–growth nexus. In addition, since the policies in oil importing and oil exporting countries are different in relation to the nature of the macroeconomic determinant of the economic growth, therefore, the homogeneity condition may lead to misleading results for the countries. Furthermore, the patterns of economic growth and energy consumption are not homogeneous in different regions of the world; hence, the assumption of slope homogeneity is not very attractive in this case. Keeping this drawback in view, the theoretical studies of Pesaran and Smith (1995) and Pesaran et al. (1999) provide an opportunity for estimating the heterogeneous slopes of regression. Thus, the energy–growth nexus should be revisited in the context of heterogonous panel data.

Furthermore, Lee (2005), Al-Iriani (2006), Mehrara (2007), Lee and Chang (2008), Mahadevan and Asafu-Adjaye (2007), Lee and Chang (2008), Huang et al. (2008), Narayan and Smyth (2008), Lee and Chang (2008), Apergis and Payne (2009) and Ozturk et al. (2010) don't consider cross section dependence. The possibility of cross sectional dependence cannot be denied in the present macroeconomic, financial and trade integration. Specifically, this is a more relevant argument in the backdrop of common global shocks like oil crises and financial crises, shared institutions like International Monetary Fund and World Trade Organization, and the spillover effects among the regions and countries (Liddle and Lung, 2014). Therefore, Kapetanios et al. (2011) note that the validity of conventional econometric tools, like first generation panel unit root tests, the cointegration tests and the estimators which estimate the cointegration vector, which are based on the assumption of cross section independence, become questionable. In addition to this, the existence of structural breaks may lead to misleading inferences regarding the order of integration, that is, a stationary series may be taken as non-stationary and can bias the examination of cointegration (Narayan and Smyth, 2008).

In this backdrop, this study separates itself from the existing literature in many respects. First, we shall test the energy–growth nexus for energy exporting countries as well as the energy importing countries. Several studies like Damette and Seghir (2013) and Mehrara (2007) consider the oil exporting countries as energy exporting countries, however, Ayres et al. (2013) note that coal and natural gas along with oil have become an important input in the last two decades, therefore, we shall take the net energy exporting and the net energy importing countries into consideration. Secondly, the article tests the cross sectional dependence and concludes that the first generation panel unit root tests and cointegration tests invalidate the findings of previous studies, therefore, we shall consider second generation panel unit root tests and Westerlund (2007) tests of cointegration. Thirdly, we test slope homogeneity condition through Swamy (1970) test and conclude that the slope homogeneity condition is violated in a panel of long time series (T), therefore heterogeneous panel data estimators like mean group estimators and pooled mean group estimators are more appropriate in our case. Finally, the issue of structural breaks is taken into account in estimating the unit root and cointegration testing procedures. Importantly, according to the best of our knowledge, none of the studies on the energy–growth nexus tests the slope homogeneity condition in panel data and provides the heterogeneous slope parameters for the short run.[2]

Although, there are numerous investigations regarding the energy–growth nexus but there is controversy among the researchers. It may be due to the subject/country selections, data time spans, empirical econometric model settings or other explanatory variable selections. Therefore, it can be further investigated by taking the heterogeneity, structural breaks and cross sectional dependence into account. The empirical results will show how energy–growth relationship is affected by these factors. This study finds that most of the data series are stationary at first difference with and without structural breaks. The null hypothesis of slope homogeneity is clearly rejected; therefore, we prefer the heterogeneous panel methods for the estimation of our specified models. We find that energy consumption, capital stock, investment flows, level of employment and trade openness have a positive impact on the economic growth of both energy net exporter and importer countries.

The conventional style is followed for the organization of the article, that is, Section 2 will present the brief literature review, Section 3 will discuss estimation strategy, data and variable construction will be presented in Section 4, Section 5 will discuss the empirical results and Section 6 will conclude the article.

2. Literature review

The empirical investigation on energy–growth nexus can be traced back to Kraft and Kraft (1978). Since then a plethora of research provides inconclusive results based on the different samples of countries, data, estimation techniques and variables. Lee (2006), Zachariadis (2007) and Ozturk (2010) provide the excellent reviews on the subject. Importantly, Ozturk (2010) reviews the four possible hypotheses in the context of energy–growth nexus, that is, *growth hypothesis*, *conservation hypothesis*, *feedback hypothesis* and *neutrality hypothesis*.

The major chunk of the literature advocates the growth hypothesis which implies that the energy consumption determines the level of economic growth of an economy. For example Yu and Choi (1985), Masih and Masih (1996), Asafu-Adjaye (2000), Yang (2000), Lee and Chang (2005), Soytas and Sari (2003), Altinay and Karagol (2005), Shiu and Lam (2004), Morimoto and Hope (2004), Oh and Lee (2004), Narayan and Smyth (2008), Squalli (2007), Ho and Siu (2007), and Belloumi (2009) document that energy is the vital input in the production of a country. Therefore, the limitations of energy consumptions may hurt the process of economic growth.

The conservation hypothesis implies that the economic growth drives energy consumption not the other way round. Even Kraft and Kraft (1978), the pioneer study on the subject, document that the increase in income is a cause of increased energy consumption. Then Cheng (1998), Cheng (1999), Chang and Wong (2001), Soytas and Sari (2003), Narayan and Smyth (2005), Zamani (2007), Ang (2008) and Zhang and Cheng (2009) find unidirectional causality from economic growth to energy.

The Erol and Yu (1988), Hwang and Gum (1991), Hondroyiannis et al. (2002), Glasure (2002), Soytas and Sari (2003), Jumbe (2004), Masih and Masih (1996), Paul and Bhattacharya (2004), Ghali and El-Sakka (2004), Zachariadis and Pashouortidou (2007), and Erdal et al. (2008) document that the energy consumption and economic growth jointly determine each other. Ozturk (2010) termed this line of research as feedback hypothesis.

[2] Recently, Damette and Seghir (2013) and Liddle and Lung (2014) use the heterogeneous panel data but these studies don't speak on the heterogeneous coefficients in the short run.