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Economic Growth and Input Use Efficiency in Low, Upper -Middle and High Incomed Countries (1991-2011): A Data Envelopment Analysis

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Abstract

This paper tries to examine the relationship between the input use efficiency and economic growth for low income, upper-middle income and high income countries over the period 1991 to 2011 using data envelopment analysis (DEA). Input (labor, capital and energy) use efficiency may be defined as the ratio of input use to gross domestic product. However, this ratio or measurement is not a good indicator of input use efficiency. Improvements in input use refer to a reduction in input used for a given output or GDP, then they indicate input use efficiency. Hence, either deterministic (DEA) or non-deterministic (stochastic frontier approach) approaches within the framework of production theory have been used to measure input use efficiency. This paper also aims to make some policy implications on input use efficiency.

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Keywords: Economic growth, input efficiency, low-middle and high- income countries, data envelopment analysis

1. Introduction

Economic growth may cause living standards to improve. Growth is the fundamental objective of a society because it lifts people out of poverty and enhances the quality of their lives. In particular, ensuring steady economic growth is very important to build long term poverty reduction. Briefly stated, positive improvement in macroeconomic indicators are influenced by positive rates of economic growth. However, economic growth may also erode traditional values and lead to exploitation, environmental destruction, and corruption (Case, Fair and Oster, 2011). Therefore, examination of the economic growth across countries has become one of the important study subject over the last decades (Deliktas and Balcılar, 2005).

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Economic growth is mainly depends on having more resources or inputs, using available resources or inputs more efficiently, technological change (or advance), and good governance. Therefore, the main aim of this study is to analyze the relationship between input use efficiency and economic growth for the 36 low, upper-middle, and high incomed countries during the years 1991-2011. The input efficiency and its effect on economic growth have recently received a great deal of attention from academia. Input efficiency analyses are generally studied by academic scrutiny and are aimed to optimize the input use and to address specific research questions on economic growth.

In the literature, the basic economic growth model is based on Solow model. In this model, the causes of economic growth are labor and capital. However, explanation of economic growth with basic model is inadequate. Under today's economic condition, natural resources should especially be examined in the growth models. Beside that, although natural resources have a big impact on economic growth in the recent period, this impact has been unobserved in the growth models. In this context, Solow extends the model and this model explain the possibility of sustainability with exhaustible and nonrenewable natural resources and without costs (Stern, 2011; 34). Add to this, according to neoclassical model capital, labor and energy are considered as inputs on economic growth (Zhou et al, 2012; 197).

The ongoing debate about growth models have been based on the relationship between economic growth and natural resources, especially energy led to the emergence of a new view. The view suggests that energy is the main source of value because labor and capital cannot do without energy (Ghali and El-Sakka, 2004; 225). Although many economists stated the role and importance of energy as an input on growth in their studies during twentieth century, a systematical approach to them has emerged in 21st century (World Energy Outlook, 1998 and 2000). Moreover, in the 21st century, the World Energy Outlooks have suggested the increasing demand to use energy sources and its effect on growth.

Besides that, the roots of input efficiency concept date back to the twentieth century, the quantitative analyses have risen at the beginning of 21st century due to the emergence of the new empirical methods. One of the attempts to analyze input efficiency empirically came from Piesse and Thirtle (2000). This study using the Stochastic Frontier Analysis detects the efficiency level during the period of 1985-1991 for Hungary. Further, Hu and Wang (2006) analyze the input efficiencies of 29 regions in China for the period 1995–2002 using the DEA. Another remarkable study is from Zhou, Ang and Poh (2008), who present a literature survey to show whether the method of DEA is convenient for measuring the input efficiencies or not. Zhang et al (2011) aim to analyze the input efficiencies in 23 developing countries during the years 1980-2005 using the DEA. They employ a Tobit Model to indicate the relationship between energy efficiency and income per capita. This study suggests that there is a U-Shape relationship between the energy efficiency and income per capita. Moreover Zhou et al (2012) use a parametric and nonparametric frontier approach in order to measure input efficiency performance in some OECD countries for the year 2001. This study allows the possibility to compare two different methods. Following this study Song et al (2013) present the input efficiencies of BRICS using the DEA. Add to this, the relationship between energy efficiency and carbon emission is analyzed for the years between 2009 and 2010.

In the recent years, there have been many studies such as, Filippini and Tosetti (2014), Lundgren at al (2014) and Miao and Jin (2014) focusing on OECD countries or national or regional economies for a certain country. All the studies analyze the input efficiency and its determinants by using Stochastic Frontier Analysis or Data Envelopment Analysis.

Following these studies, we present a nonparametric mathematical approach, the DEA, to measure input efficiency in low, upper-middle and high income countries over the period 1991-2011.

The DEA gives us the best-practice production frontier based on explanatory variables, such as capital, labor, and energy and the explained variable, such as the real GDP of each country. The best approach of frontier analyze explains if the countries are on or in the frontier, it shows the efficiency while the gap from the frontier indicates inefficiency. The efficiency level of countries can change in time and the "catch up" effect or the shift effect of