Analysis of the Eco-Efficiency Change of Chinese Provinces: An Approach Based on Effect Matrix Analysis

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ABSTRACT
Eco-efficiency, being a matter of concern all over the world, is gaining increasing attention in the fields of economic and environment. This paper just investigates the relationship between economic development and environmental sustainability in Chinese provinces focused on the eco-efficiency calculation. In this paper, by the index of eco-efficiency into economic effect (e_r) and environment effect (e_e), thus an effect matrix is framed; and a new method that can analyze the relationship between the economic development and environment sustainability is outlined and applied to evaluate the eco-efficiency change of 31 provinces of China during 2006-2010. Empirical results show that Beijing city is found to be the only one that has improved its eco-efficiency in the absolutely strong sustainability paradigm at all three environmental impacts; while most of other areas have taken on a paradigm of weak sustainability at some specific environmental impact; the country as a whole presents a weak sustainability paradigm for its solid waste production and the absolutely strong sustainability one both in its waste water and SO_2 emission production. The effect matrix analysis constitutes a new way to assess the change of the eco-efficiency in an area, which seems very promising to judge the state of an area’s eco-efficiency change toward sustainability and provides the sound foundation to support policy making.

Keywords: Chinese Provinces, Eco-Efficiency, Rebound Effect, Strong Sustainability, Weak Sustainability

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1. INTRODUCTION

The Chinese economy has advanced aggressively during last decades of new century resulting in severe environmental pollution and an acute shortage of energy supply. According to the Statistical Review of World Energy 2011, China has become the largest energy consumer with replacing the US and contributing to 20.3% of global energy consumption. To construct a resource-conserving and environment-friendly society, Chinese 11th five-year plan stipulates that all government divisions must reduce energy consumption by 20% and reduce primary pollution by 10% till 2010. However, the environmental efficiency, an indicator of the environmental cost of economic development, was not determined in this report. Although Chinese economy has advanced aggressively during last decades of new century, yet it results in severe environmental pollution problems and an acute shortage of energy supply, such as low resource utilization, environmental pollution, and weak technological innovation and so on. The extensive mode of economic growth, characterized by high-input, high-consumption, high-emission and high-pollution, has not yet been fundamentally transformed. Vigorously improving the environmental efficiency and realizing the ecological transformation has come to be a very important and urgent strategy adopted by the central government. The main direction of Chinese economic development is to build resource-conserving and environment-protecting society through ecological transformation. In this process, scientific assessing methods are required for comprehensive evaluation, which can provide a scientific way for government officers’ decision making. Eco-efficiency that relates the economic performance with environmental performance together is an important means and tool, which can fit the government itself into a sustainability agenda.

Although having been popularized by World Business Council for Sustainable Development (WBCSD) for almost 20 years, eco-efficiency still seems a popular buzzword rather than a practical (McDonough, 1998), well defined and reliable concept for most government officers and corporate managers especially in China. Hahn et al. (2010) considers there are two main shortcomings behind it, one is that corporate eco-efficiency is mostly expressed as a ratio that is hard to interpret by non-environmentally trained managers; the other is that the drivers and reasons behind changes in eco-efficiency over time are not evident to corporate decision makers (Hahn et al., 2010). In recent years, more sophisticated methods to evaluating the eco-efficiency have been developed, including those of sustainable value added, benchmarking techniques and activity analysis or Data Envelopment Analysis (DEA) techniques, which mainly focusing on economic efficiency, environmental efficiency and energy efficiency (Figge and Hahn, 2004, 2005, 2008, 2009; Hahn et al., 2007; Kousmanen and Kortelainen, 2005, 2009, Andrés et al., 2012).

In this article, a method based on the effect matrix analysis is proposed to assess the dynamic change of an entity’s eco-efficiency, which provides an appreciated way familiar to government officers or corporate managers. To the best of our knowledge, no attempts have been made to assess changes in eco-efficiency changes in regions of China by using the method of effect matrix framework proposed by this article. Our contribution to the existing literature in this field of research is two-fold. First, although some recent papers such as Andres et al. (2012) and Camarero et al. (2013) have assessed eco-efficiency using aggregate data at sector or regional levels, no current papers have addressed the assessment of eco-efficiency changes at pressure-specific and province level, as we do in our paper. Second, building on previous work by Hahn et al. (2010), we contribute to this burgeoning literature by using effect matrix to address the results of regional eco-efficiency changes related with the sustainability paradigms (Zhang, 2010).
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