Does government transparency contribute to improved eco-efficiency performance? An empirical study of 262 cities in China

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ABSTRACT

Considering the properties of environment from the perspective of a public good, this paper aims to examine the relationship between government transparency and eco-efficiency performance (EEP). By applying a conditional slack-based measure (SBM) model, local linear regression (LLR) and a nonparametric significance test, we conduct an empirical analysis based on 262 cities in China during the period of 2005–2012. The results demonstrated that: (1) the overall eco-efficiency of China was low due to the fact that the EEP scores of most of the cities were below 0.5; (2) the eco-efficiency performances of a majority of the municipalities & sub-provincial (M & S) cities were better than those of the prefecture-level cities, and the former showed greater improvements than the latter on eco-efficiency performances, although the M & S cities experienced faster paces of urbanization and consumed more resources; (3) there exists a nonlinear relationship between government transparency and eco-efficiency performance. In other words, if the government information was more transparent, it would be more beneficial to the improvement of eco-efficiency, and the phenomena were more significant in M & S cities such as Shanghai, Beijing and Guangzhou. Policy implications are thus drawn in this paper for promoting eco-efficiency improvement in China's M & S cities and prefecture-level cities.

1. Introduction

China's reform and opening-up policy promoted the country to keep sustained and rapid growth. However, the extensive economic growth comes from the expansion of ordinary inputs of labor, reproducible capital and energy, which has caused serious pollutions (Lin and Li, 2014). Remarkable progress in economic and social development goes hand in hand with environmental degradation. According to BP (2015), the average growth rate of China's primary energy consumption reached up to 8.5% from 2000 to 2013. Air pollution emissions were associated with the resource consumption. In 2012, the emissions of sulfur dioxide were 21.18 million tons in China, nearly 5 times that of the EU-28; the emissions of NO_x in China were 23.38 million tons, 2–3 times those in the United States and the European Union. In recent years, the environmental problems have occurred frequently in China. For example, the frequent fog and haze, weather extremes and climate events implied serious environmental problems. Problems with environmental pollution have become so serious that the public has realized that economic growth must not be pursued at the expense of

environmental pollution and has reached a consensus on sustainable development.

Eco-efficiency, which was coined by the World Business Council for Sustainable Development (WBCSD) in 1992, is achieved through the delivery of "competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity.".[1] The term measures the degrees of harmony between human development (humanity) and environmental protection, as well as natural ecology and human ecology, which is an effective tool to measure the "nature-economy-society" composite system for the sustainable development. Therefore, the eco-efficiency improvement becomes the important breakthrough point to promote the coordinated development of economy and the ecological environment for a country.

Ecological environment is a sort of public good, therefore, companies are likely to ignore the cleaner production due to lack of the self-motivation. In this context, the improvement of the eco-efficiency relies more on the environmental regulatory regimes and legal context (Esty

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and Porter, 2005; Li et al., 2017). Some scholars pointed out that the existence of bureaucracy and corruption to varying degrees in many sectors of environmental regulations, since the bureaucrats could control scarce resources and there would be limited restrictions on their power; therefore, they might well be corrupted for their own personal interests (Damania, 2002; Gundlach and Paldam, 2009). On the one hand, public sector corruption would affect the stringency of the environmental policy formulation of a country; lobbying and bribery aiming at the decision-makers are likely to lead to looser environmental regulations and standards. On the other hand, bribery of public officials would allow polluters to evaded responsibility for pollution in the process of implementing regulations, and would therefore tend to encourage polluting or excessive resource use (Fredriksson and Svensson, 2003; Fredriksson et al., 2004). Decline of the stringency tends to have a negative impact on the eco-efficiency in the process of formulating and implementing the environmental regulations.

Government transparency refers to the extent of disclosure of decision-making processes and relevant government information, which also ensures citizens' access to public information. Open and transparent government information is the prerequisite of ensuring rational allocation of information resources. Transparency increases the effectiveness and accuracy of the market information, and reduces the transaction cost. A lack of transparency would aggravate the principal-agent problems between government and the public on both sides, and would breed corruption and rent-seeking (Kolstad and Wiig, 2009; Williams, 2011). In the light of the importance of eco-efficiency and the particularities of prefecture-level cities in China (He, 2015), this paper aims to empirically investigate whether the transparency of local government would affect the eco-efficiency.

Contributions of this study are summarized as follows: (1) We construct a conditional slack-based measure (SBM) model to estimate eco-efficiency by considering government transparency as an influential variable. The traditional method used to analyze the influencing factors of efficiency is the two-stage approach which takes the influencing factors as exogenous variables. However, Simar and Wilson (2007, 2011) pointed out that the above approach could make sense only if the separation condition was satisfied, that is, exogenous factors must be independent from the input-output production process. In addition, as a result of complexity of estimated efficiencies, the regression in the second stage often tends to appear deviation. Therefore, the model constructed in this paper can overcome such problems. (2) Non-parametric methods including local linear regression (LLR) and a non-parametric significance test are used to explore the role of the government transparency in eco-efficiency performances. (3) To the best of our knowledge, this is the first empirical study exploring the relationship between government transparency and eco-efficiency based on the evidence from 262 municipalities & sub-provincial cities and prefecture-level cities in China during the period of 2005–2012.

The rest of the paper is organized as follows. Section 2 reviews the theory and empirical evidence of the related literature. Section 3 describes methodology. The results and discussion of the empirical study are presented in Section 4. Section 5 concludes the paper and draws policy implications.

2. Literature review

A large number of studies have devoted to the measurement methods on the eco-efficiency and empirical evaluations on eco-efficiency in firms, industries, regions, countries and other fields. According to the definition, eco-efficiency measures the ability of creating more goods and services while minimizing resource use and environmental degradation. In methods such as cost-benefit method,

ecological footprint method and the energy analysis method, the single ratio (the ratio of the value of products and services over the environmental impacts) was used to demonstrate eco-efficiency (Figge and Hahn, 2004; Hahn et al., 2010; Park et al., 2007). In the single ratio method, the values of environmental impacts were measured by consumed material, energy, or money, which are likely to cause distortions of reality due to failure to give decision makers the optimal ratio sets. As a result, the method is more suitable for analyzing an independent and discontinuous object, especially a single technology or project. In view of the complexity of coordinating the society, economy and subsystems in nature, some scholars measured the eco-efficiency level by establishing target system, which includes material consumptions, energy consumption, labor, and environmental impact, etc. Dai and Lu (2005) regarded resource efficiency, energy efficiency and environment efficiency as three indexes in the eco-efficiency evaluation target system for iron and steel industry. Michelsen et al. (2006) selected nine indexes including energy consumption, emission of ozone-layer depleting gases and emissions of heavy metal in environmental dimension. Mao et al. (2010) chose indices such as industrial production, energy consumption and the ratio between those to SO_2, solid waste emissions to measure eco-efficiencies of the Chinese industrial sectors. However, it should be noted that the above index system method also has its flaws. For example, it did not expressed the relationship between environment and economy according to the weight, which is always greatly influenced by the uncertain factors.

Some scholars attempted to overcome the above problems by model methods, such as data envelopment analysis (DEA), a kind of non-parametric statistical method based on the relative efficiency. This method could make an evaluation of several decision making units (DMUs) with multiple-inputs and multiple-outputs on relative validity or efficiency. The method does not need to unify index unit or consider the specific function relationship between the outputs and the inputs, and thus avoids the impact of subjective factors on weights to conduct the evaluation. In recent years, the method has been widely used and further extended in the efficiency research. For instance, Dyckhoff and Allen (2001) added the optimization structure in terms of traditional DEA model; Korhonen and Luptacik (2004) evaluated the eco-efficiency of 24 power plants in Europe using the two kinds of extended DEA method; Zhang et al. (2008) measured the eco-efficiency of China's industrial sector using the DEA method; Picazo-Tadeo et al. (2012) used the directional distance functions and DEA to assess eco-efficiency of Spanish olive-growing farms; and Masuda (2016) combined life cycle assessment and DEA to measure eco-efficiency of wheat production in Japan. However, the radial DEA method used above may cause problems such as "input redundancy", "desirable output shortfall" and "undesirable output excess", and consequently might result in overvaluing the eco-efficiency. The slack-based measure (SBM), which is first proposed by Tone (2001) and developed by Tone (2004) and Zhou et al. (2006), is a non-radial measure allowing for disproportional adjustments of inputs, desirable outputs and undesirable outputs. It has discrimination ability in efficiency evaluation and thus can provide more information on the efficiency of the specific input-output factor as well (Choi et al., 2012). In view of the above advantages, the SBM model is thus chosen in this paper to conduct the empirical analysis.

According to Esty and Porter (2005), environmental performance is the product of a nation's environmental regulatory regimes and policies. Cole and Fredriksson (2009) pointed out that countries with weak environmental institutions will attract pollution intensive production. Strict environmental regulations could induce economic structure to transform to low pollution, and could constantly promote the improvement of environmental performance as well (Yang, 2015). While some scholars suggested that corruption was commonplace in the area