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Does Regulation on CO2 Emissions Influence Productivity Growth? —The Empirical Test Based on DEA Analysis

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Abstract

In this paper we examine levels and trends in conventional and regulation on CO2 emissions sensitive productivity over the period 1995 to 2007. Firstly, we estimate and compare two type TFP index from regulations on CO2 emissions to no regulations over current levels and test the difference of TFP in two kinds of conditions. The major conclusions are as follows: Under co2 emissions restrictions, the eastern region has the highest TFP Growth rate while the western region has the lowest TFP growth rate .With accounting for convention, sensitive productivity growth for 28 regions on average is slightly higher than that of regulations on CO2, and efficiency change is the main source. Out of 28 regions, eight different regions shifted the frontier at least once. Econometric analysis indicates a number of variables that has important effects on e regulation on CO2 emissions sensitive measures of productivity, including variables relating GDP per capita, technical in efficiency, capital labor ratio, the energy intensity and openness. We find that these variables have different effects. In addition, policy implications are discussed.

Keywords: co2 regulations; TFP; Directional Distance Functions; Malmquist-Luenberger productivity Index

1. Introduction

Although total factor productivity is not a country's economic prosperity, living standards and the only measure of competitiveness, but it is the last 20 years, widely accepted measure (Lall et al.2002). In recent years, resource-saving and environment-friendly, sustainable social development issues have become hot topics of general interest, so a lot of research has been concerned about the environmental controls for the impact of conventional total factor productivity (Jaffeetal, 1995) . traditional method of measuring TFP take into account only the desired output, without considering the undesirable outputs, such as CO2 emissions. Therefore, traditional methods of measuring total factor productivity growth makes the productivity measure has gone wrong. Malmquist productivity index was first used by Caves et al. (1982) defined, post by e et al. (1997) and other scholars continue to improve, to a distance function to

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describe the non-parametric method. Malmquist index defined Shephard input distance function, including two orientation and output orientation. Among them, the output-oriented distance function for input elements in the premise of not increasing production to achieve the maximum expansion ratio, input-oriented distance function seeks to reduce the output elements is not achieved under the premise of the maximum contraction ratio of input. However, if there is undesirable output, Malmquist productivity index can not calculate total factor productivity. To solve this problem, Chung et al. (1997) on the Malmquist productivity index modified and Malmquist productivity index is known as Malmquist-Luenberger productivity index, the measure of the new method considers the output of undesirable the impact of productivity . This method has been widely used in the industrial sector (Fare et al. 2001, regional (Hailu, al. 2001) and the State (Lindenberg, 2004 ; Domazlick and Weber, 2004 [9]; Yoruk and Zaim, 2005 ; Kumar, 200911]; Bing, Wu Yanrui, etc., 2008). At present, the existing research related to this article, only Bing, Wu Yanrui et al (2008), and Bing Wang, Wu Yanrui et al (2008), APEC is the object, this paper attempts from the following three aspects of the existing literature to develop: (1) Using Malmquist-Luenberger productivity index measure and compare the different control of CO2 emissions in the two cases in 28 districts in total factor productivity growth in 1995-2007; (2) test under the control of carbon emissions in all the different TFP differences; (3) impact of carbon controls on total factor productivity growth, an empirical study of factors.

2. Malmquist–Luenberger Productivity Index

This version of the directional distance function measures observations at time based on the technology at time t t 1. Chung et al. (1997) define the ML index of productivity between period t and t t 1 as:

$$ML_t^{t+1}=\sqrt{\frac{(1+\vec{D}_0^{t+1}(x^t,y^t,b^t;y^t,-b^t))}{(1+\vec{D}_0^{t+1}(x^{t+1},y^{t+1},b^{t+1};y^{t+1},-b^{t+1}))}\frac{(1+\vec{D}_0^{t}(x^t,y^t,b^t;y^t,-b^t))}{(1+\vec{D}_0^{t}(x^{t+1},y^{t+1},b^{t+1};y^{t+1},-b^{t+1}))}} \quad (1)$$

The index can be decomposed into two component measures of productivity change:

$$ML_t^{t+1}=\underbrace{\left[\frac{1+\vec{D}_0^{t}(x^t,y^t,b^t;y^t,-b^t)}{1+\vec{D}_0^{t+1}(x^{t+1},y^{t+1},b^{t+1};y^{t+1},-b^{t+1})}\right]}_{MLEFFCH_t^{t+1}}\times\underbrace{\sqrt{\frac{1+\vec{D}_0^{t+1}(x^t,y^t,b^t;y^t,-b^t)}{1+D_0^{t}(x^t,y^t,b^t;y^t,-b^t)}\frac{(1+\vec{D}_0^{t+1}(x^{t+1},y^{t+1},b^{t+1};y^{t+1},-b^{t+1}))}{1+\vec{D}_0^{t}(x^{t+1},y^{t+1},b^{t+1};y^{t+1},-b^{t+1})}}}_{MLTECH_t^{t+1}} \quad (2)$$

The first term, MLEFFCH, represents the efficiency change component, a movement towards the best practice frontier, while the second, MLTECH, the technical change, i.e., a shift. If there have been no changes in inputs and outputs over two time periods, then MLttt1=1. If there has been an increase in productivity, then MLttt1>1, and finally, a decrease when MLttt1<1. Changes in efficiency are captured by MLEFFCHttt1, which gives a ratio of the distances the countries are to their respective frontiers, in time periods t, and t+1. If MLEFFCHttt1>1, then there has been a movement towards the frontier in period t + 1. If MLEFFCHttt1< 1, then it indicates that the country is further away from the frontier in t + 1, and hence has become less efficient. If technical change enables more production of good and less production of bad outputs, then MLTECHttt1>1. Where as if MLTECHttt1<1, there has been a shift of the frontier in the direction of fewer good outputs and more bad outputs (Fa¨re et al., 2001).

3 Empirical Results

According to the research methodology and the data obtained from the analysis software are two cases