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Regional disparities and influencing factors of Average CO_2 Emissions from transportation industry in Yangtze River Economic Belt

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ABSTRACT

Transportation industry is an important source of CO_2 emissions, and has become the third largest energy consuming industry in China. Most existing researches studied regional disparities and influencing factors of Total CO_2 Emissions from transportation industry, while limited researches studied the average amount specially. Based on the relevant data of Yangtze River Economic Belt from 2005 to 2014, Theil index was utilized to measure the regional disparities of Average CO_2 Emissions from three aspects: CO_2 emissions per capita (CEPC), CO_2 emissions intensity (CEI) and CO_2 emissions per converted transportation turnover (CEPT). Combining with extended Kaya identity, LMDI decomposition method was applied to analyze the influencing factors of CEPC, CEI and CEPT respectively. The empirical results indicate that regional disparities of CEPC, CEI and CEPT do exist and they are on downtrend after 2011. Regional disparity of CEPC is more significant than CEI and CEPT. Energy structure and energy intensity contribute to increasing CEPC and decreasing CEI and CEPT. Added-value per converted transportation turnover has positive effect on increasing CEPC and decreasing CEPT. Transportation intensity inhibits increasing CEPC, while economic level plays the most important positive role in increasing CEPC. The findings implicate that governments should transform the economic development mode, optimize the energy structure, improve transportation efficiency and develop differential policies according to practical situations.

1. Introduction

With the aggravating situation of greenhouse gas emissions (primarily CO_2 emissions), developing low-carbon economy and reducing CO_2 emissions have become globally urgent and critical, especially for China, which has become the largest CO_2 emitter country since 2009 (Li et al., 2015; Yu et al., 2015). As a basic and supporting industry in the national economic system, China's transportation industry is the third largest energy consuming industry with features of high energy consumption and pollution, while it will maintain at an accelerated expansion stage in order to meet the growing transportation demand (Gao, 2013).

China has a vast territory with great differences between regions. Taking the Yangtze River Economic Belt for instance, difference of economic level between Shanghai and Guizhou is tremendous for that the per capita GDP of Shanghai is 3.68 times of Guizhou in 2014. While a multitude of literatures have proven that economic level, population and transportation level, etc. are important

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factors influencing CO_2 emissions from transportation industry (Fan and Lei, 2016). So when studying CO_2 emissions from transportation industry, it is of great importance to take regional disparities into account (Xu and Lin, 2016b). Analysis of regional disparities is conducive to set more reasonable emission reduction goals and implement policies according to local conditions.

Researches about regional disparities and influencing factors of CO_2 emissions from transportation industry have been carried out extensively. Most of these researches focused on the total amount of CO_2 emissions, the average quantity was taken into account by very limited numbers. In our opinion, studying CO_2 emissions from perspective of average quantity is equally important and indispensable. The main reason is that this can be regarded as a complement to a more comprehensive understanding of CO_2 emissions. Generally former literatures concerning Average CO_2 Emissions considered CO_2 emissions per capita (CEPC) and CO_2 emissions intensity (CEI), while the study should not be limited to these. According to Wang (2015), the fundamental nature of transportation industry is to provide transportation services, and physical output of energy consumption is of more practical significance. Referring to these, we regard CO_2 emission per converted transportation turnover (CEPT, ratio of CO_2 emissions to converted transportation turnover) as a representation of Average CO_2 Emissions with more explicit characteristics of transportation industry. Therefore Average CO_2 Emissions from transportation industry is expressed in three forms in this study: CEPC, CEI and CEPT.

In view of the above points, this paper tries to contribute to related researches by highlighting the following issues. First, it conducted a systematic and specialized research on Average CO_2 Emissions from transportation industry which has not been found up to now to the best of our knowledge. Second, we used an index bearing the characteristics of transportation industry – CEPT, which could been seen as a clear distinction from studies on other industries. Third, it explored a detailed study on regional disparities and influencing factors of CEPC, CEI and CEPT respectively.

The rest of this paper is organized as follows: Section 2 reviews the former relevant literatures. Section 3 presents methodology, research area and data sources. Section 4 provides the empirical results. Section 5 concludes the study and provides some policy implications.

2. Literature review

Multiple literatures show concern about CO_2 emissions, scholars studied different aspects (including regional disparities, influencing factors, performance, etc.) of CO_2 emissions from different countries, regions or industries. For instance, Akbostancı et al. (2011) analyzed CO_2 emissions from manufacturing industry in Turkey. Xu and Lin (2016a) examined the driving forces of CO_2 emissions of China's iron and steel industry. Bai et al. (2016) made an inquiry into CO_2 emissions of all industries of China. Lin and Du (2015) and Li and Lin (2017) evaluated provincial CO_2 emissions performance in China. These studies are mainly devoted to Total CO_2 Emissions. In terms of Average CO_2 Emissions, there is no specific concept at present while we think it to be an important issue when mentioning about CO_2 emissions. In line with the theme of this paper, a brief literature review on regional disparities and influencing factors of CEPC and CEI is presented as follows.

To evaluate the regional disparities, different indexes were applied. Hedenus and Azar (2005) applied Atkinson index to analyze the regional disparities of CEPC in different countries. The results suggested that the ratio of CEPC between the top and bottom emitters had decreased from 56 in 1960 to 22 in 1999, and the absolute gap decreased since the 1980s. Clarke-Sather et al. (2011) comprehensively used Theil index, Gini coefficient and Variation coefficient to measure provincial disparities of CEPC in China from 1997 to 2007, and found that disparity level of CEPC was lower than that of income. Wang and Yang (2014) analyzed provincial disparities of CEI. The major findings were: the change in provincial disparities of CEI had visible stage characteristics. Yang and Liu (2012) applies Theil index to study regional disparities of CEPC and CEI, the results showed that regional disparities of CEPC was more obvious than those of CEI. Thus, regional disparities of CEPC and CEI exist more or less in different industries and research areas. Previous researches have provided many mature methods for this study.

To identify the influencing factors of CEPC and CEI, researchers generally applied factor decomposition, co-integration analysis, etc. based on the IPAT model, STIRPAT model, (extended) Kaya identities. Ma et al. (2015) examined the influencing factors of CEPC in China from 1978 to 2010 and found that GDP per capita, energy structure, population, urbanization level, and international trade division had positive effect on CEPC. Greening Lorna et al. (1998) studied the changing characteristics of CEI in the Organization for Economic Cooperation and Development (OECD). Ebohon and Ikeme (2006) compared CEI of oil producing countries and non-oil producing countries in sub Saharan Africa, the results suggested that energy intensity, energy structure, carbon emission coefficient and economic structure were the main factors influencing CEI. Gingrich et al. (2011) used KAYA identity to study CEI of Austria and Czechoslovakia from 1920 to 2000, and found that effects of energy intensity and change of industrial structure were important. Tong and Du (2015) analyzed the influencing factors of Japan's CEI by LMDI. The results showed that economy, industry structure, technology and population were the influencing factors. Chen and Lin (2015) studied on factors affecting CEPC by a case of Tianjin and found that economic output played a positive role in increasing CEPC, while economic structure, energy intensity and energy mix played negative role.

It can be seen that literatures concerning regional disparities and influencing factors of CEPC and CEI from non-transportation industries were abundant. With increasing CO_2 emissions and environmental pressure, research on CO_2 emissions from transportation industry attracts many scholars' attention. Zhang and Nian (2013) applied STIRPAT model to investigate CO_2 emissions in the transport sector at national and regional levels from 1995 to 2010 in China. Xu and Lin (2016b) examined the driving forces of CO_2 emissions in China's transport sector considering regional differences. Xu and Lin (2015) applied a dynamic nonparametric additive regression model to study factors affecting CO_2 emissions in China's transport sector. Liu et al. (2015) explored the influencing factors for CO2 emissions in China's four transport sub-sectors. Fan and Lei (2016) analyzed the energy-related carbon emissions from Beijing's transportation sector by Generalized Fisher Index (GFI) decomposition model and found that economic growth, energy