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Empirical analysis on the factors influencing national and regional carbon intensity in China

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ABSTRACT

To explore the means of achieving carbon intensity targets in China, this research empirically studied key factors influencing carbon intensity at both national and eight economic regional levels. The results showed that: economic level of activity was negatively correlated to carbon intensity on both national and regional levels. The proportion of secondary industries was generally beneficial to a reduction in carbon intensity (except in Northeast and Yangtze River models). Although there was a positive effect of urbanisation on carbon intensity, non-significant relationships existed between level of urbanisation and carbon intensity in regional models (except in the Northwest). Foreign direct investment also showed a non-significant influence on national and most regional models. Coal consumption increased carbon intensity in Northeast, East Coast, Yellow River, Yangtze River, and Southwestern areas. Based on these empirical findings, policy recommendations were provided as to how to reduce carbon intensity. Each region should consistently develop its low-carbon economy. The North Coast, East Coast, South Coast, Yellow River, Yangtze River, Northwest, and Southwest should decrease the proportion of secondary industries. The East Coast and Southwest should invest more in low-carbon technologies. The Northeast, East Coast, Yellow River, Yangtze River, and Southwest should attach greater importance to the exploitation and utilisation of clean energy and renewable energy.

Contents

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1. Introduction

With global population growth and economic development, greenhouse gas concentrations in the atmosphere are increasing: this influences climate (the main performance indicator being temperature increase). To tackle climate change, in-depth international discussions have been held: the United Nations Conference on the environment and development was held in Rio de Janeiro in 1992. Around 180 countries and 102 heads of states or governments attended the conference. At the meeting, more than 150 countries signed the *United Nations Framework Convention on Climate Change* (hereinafter referred to as *the Convention*). *The Convention* aimed to reduce greenhouse gas emissions, reduce the harm of human activities to the climate system, slow down climate change, enhance the adaptation of ecological systems to climate change, and ensure food production and sustainable economic development. As one of the Parties to *The United Nations Framework Convention on Climate Chang* and *The Kyoto Protocol*, China has always been committed to promoting the implementation of *The convention* and *The Kyoto Protocol*, and to fulfil her obligations thereto. From 1990 to 2010, carbon dioxide emissions *per* unit GDP (carbon intensity) in China dropped by more than 40% (see Fig. 1). At a conference in Copenhagen in 2009, the Chinese government made a promise to cut carbon intensity by 40–45% by 2020. Reducing carbon intensity by such a large amount needs much effort. The target emissions reduction will be a binding force in the medium- and long-term plan for national economic and social development, ensuring that its implementation can be supervised by laws and public opinion.

Due to the broad expanse of land, uneven distribution of geographical resources, and different social and economic histories of different regions, the economic levels of different regional are obviously not balanced [1,2]. Their different carbon intensities reflect different economic structures, energy structures, and levels of technical advancement: many scholars thought that carbon intensity may vary considerably between countries at different times [3]. Wei et al. analysed the relationship between carbon dioxide emissions and economic development at different stages, and respectively studied the relationship between carbon dioxide emissions and real *per capita* worldwide GDP for typical developed countries and representative developing countries. Their research objectively reflected the differences in regional carbon intensity [4].

Furthermore, the present studies that discuss the regional carbon intensity in China mainly provide a simple and geographical based method on the region partition. Majority of studies directly divided the mainland China into East, Middle, and West, and discuss the difference between the three regions [39]. Some other studies take provincial division to evaluate the regional carbon intensity [40,41]. However, the Development Research Centre of The State Council of China claimed that the domain partitioning method of China into East, Middle, and West has already been inappropriate[1]. There is a limit in the carbon intensity literature on considering social and economic development other than geographical indicator in regional partition. During the period of the eleventh five-year, the Council proposed that the mainland be divided into Eastern, Central, Western, and Northeast regions which were further sub-divided into eight comprehensive economic regions: Northeast, North Coast, East Coast, South Coast, Yellow River, Yangtze River, Southwest, and Northwest[2]. Due to the various differences between regions, the regional decomposition of carbon intensity needs considering more with regards the development of each regional situation, and carbon intensity targets for each region should be set by taking these characteristics into account. Thus, how to set regional carbon intensity targets accurately, meaningfully, and effectively has become an important problem. As the factors that influence regional carbon intensity have not yet been determined, it is hard to set meaningful carbon intensity targets. Thus, a study of the factors influencing regional carbon intensity is necessary.. To the best of our knowledge, this is the first paper that empirically discuss the regional carbon intensity of China by application of sub-division of eight economic regions, and built national and regional models to empirically study how these factors can influence carbon intensity in different regions. Finally, conclusions and policy implications were drawn.

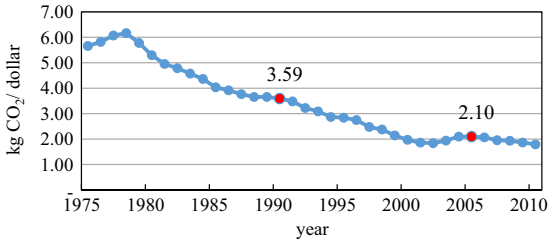

Fig. 1. Carbon intensity of China in 1975–2010 (in 2005 price). Note: Date is from International Energy Agency.

2. Literature review

The carbon dioxide emission is generally defined as a linear function of fossil fuel combustion and cement manufacturing [42]. There have been a number of studies exploring ther factors that influence CO_2 emissions [43,44]. The main factors driving China's environmental emissions were found to be pressures from population, urbanisation, industrialisation, GDP per capita and energy intensity [45]. Research on carbon intensity could be dervied from the studies about the factors influencing carbon emissions. Although there are some similarities in the influencing factors between carbon intensity and carbon emissions, there are also many differences. In particular, the difference in elastic coefficient, which may cause critical effects in forecasting and policy recommendations for carbon intensity limits.

Decomposition method is an important tool employed in exploring the determinants of carbon intensity [46,47].Particularly, the logarithmic mean divisia index (LMDI), proposed by Ang has been widely used to study the decomposition of carbon intensity [5,6]. Based on LMDI, Bhattacharyya and Ussanarassameean analysed Thailand's industrial energy intensity and carbon intensity from 1981 to 2000. The results show that the energy intensity, energy structure, and industry structure have different impacts on carbon intensity [7]. Using the LMDI method, Liu et al. studied the carbon dioxide emissions of Chinese industries and found that changes in carbon emissions from China's industrial sector from 1985 to 2005, were mainly caused by its energy intensity and industrial activities [8]. Zhu et al. used the LMDI method to analyse the carbon intensity of Shanghai from 1995 to 2008 and showed that the reduction of energy intensity is the main reason for the decline of carbon intensity in Shanghai, however the adjustment of energy structure and industrial structure are minor reasons behind the decline in carbon intensity [9]. Similar study was also conducted by Fan et al. on carbon intensity in China. It is shown that, from 1997 to 2008, the decline of energy intensity was the dominant factor driving the reduction of carbon intensity across most regions, however the change of industry structure over years

[1] This is referred to the report named Characteristics of Regional Social and Economic Development, which is available at http://www.drc.gov.cn/gzzlhqyjjyjb/20021213/144-224-30474.htm.

[2] The information is available at http://www.docin.com/p-96851451.html&endPro=true.