Integrated Management of Low-carbon Economy & Smart Scenic Area Informationization

Chief Editor : Peiyu Ren
Associate Editors : Peng Ge, Maozhu Jin, Yiwei Li

SCIENCE PRESS
Beijing

Integrated Management of Low-carbon Economy & Smart Scenic Area Informationization

Chief Editor: Peiyu Ren

Associate Editors: Peng Ge, Maozhu Jin, Yiwei Li

This work was supported by:

Major International Joint Research Program of the National Natural Science Foundation of China (71020107027)

National High Technology Research and Development Major Program of China (Program 863) (2008AA04A107)

Special Research Fund Program of Higher Education of China for the Doctoral Subject (20110181110034)

985，211 Project of Sichuan university.

Science Press

Beijing

Peiyu Ren
Business School
Sichuan University
Chengdu, 610064, China
Email: renpy.scu@163.com

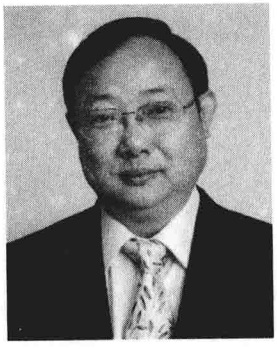
Peng Ge
Business School
Sichuan University
Chengdu, 610064, China
Email: gepeng@scu.edu.cn

Maozhu Jin
Business School
Sichuan University
Chengdu, 610064, China
Email: jinmaozhu@scu.edu.cn

Yiwei Li
Business School
Sichuan University
Chengdu, 610064, China
Email: liyiwei@scu.edu.cn

ISBN: 978-7-03-033887-7

Editors



Dr. Peiyu Ren was born in Chongqing, China. He is a professor, Ph.D. supervisor, former assistant dean of Business School of Sichuan University, and former deputy director of Operations Research Society of Enterprises in ORSC. Prof. Ren is currently acting as the director of Information & Enterprise Management Institute of Sichuan University, the academic and technical leader in Sichuan Province, vice chairman of Chinese Industrial Economic Association, council member of Chinese Industrial Engineering Institute of Chinese Mechanical Engineering Society, the leader of state-owned enterprises performance evaluation team of Sichuan Province, member of senior enterprise managers qualifications review committee, and member of management evaluation group of university teachers' senior positions review committee. He has won both second award and third award of Sichuan Provincial Prize for Progress in Science and Technology twice, and third award of Sichuan Provincial Prize for Philosophy Social Science three times. In recent years, he has presided over and completed five projects of NSFC, one project of State Social Science Found, one key project of Chinese Ministry of Education (Sub-Project), three ministerial and provincial projects and twenty-seven enterprise-fund projects. At present, he is acting as the director of a large amount of projects and presiding over "Research on Low-carbon Scenic Integrated Management Model for Harmony Sustainable Development between Tourism Economy and Ecological Environment of Western Scenics" supported by Projects of International Cooperation and Exchanges NSFC (No.71020107027), "The RFID Technology Based on Navigation Management Mode for Spatiotemporal Separation and Its Application in the Nature Conservation Region and Earthquake Relics Museum" supported by National High Technology Research and Development Program of China (No.2008AA04A107) and "Research on Sustainable Development Strategy and Evaluation System in Western Scenics" supported by Doctoral Fund of Ministry of Education of China (No. 20110181110034). And at the same time he is taking in charge of research of Project 985 and Project 211 of Sichuan University. In total, he has published fifteen monographs and more than one hundred academic papers, including SCI, EI, Management World, China Industrial Economics and so on.

Preface

As the development of low-carbon and green economy is becoming the global trend, governments, academia and business units are focusing on how the innovation of management theory, policy, and technology can adapt to this new environment, to solve the contradiction between the economic development and environmental protection and promote sustainable development.

With such background, the conference of "*Integrated Management of Low-carbon Economy & Smart Scenic Area Information*" is to be launched at Chengdu, Sichuan Province, which was approved by Ministry of Education of the PRC (approval number [2011] NO.97). This international conference is originally based on the project "Research on Low-carbon Scenic Integrated Management Model for Harmony Sustainable Development between Tourism Economy and Ecological Environment of Western Scenics" authorized and supported by National Natural Science Foundation of China (NSFC) with No.71020107027, "The RFID Technology Based on Navigation Management Mode for Spatiotemporal Separation and Its Application in the Nature Conservation Region and Earthquake Relics Museum" authorized and supported by National High Technology Research and Development Major Program of China (863 Program) with No. 2008AA04A107, "Research on Sustainable Development Strategy and Evaluation System in Western Scenics", which was authorized and supported by the Doctoral Fund of Ministry of Education of China (Program 985 of SCU) with No. 20110181110034 and the project "Sustainable Development Strategy of Jiuzhai Valley".

The conference is to be hosted by Sichuan University and organized by Business School and Information & Enterprise Management Institute of Sichuan University, associated by University of Washington and Administration Bureau of Jiuzhai Valley, financially supported by NSFC, and also fully supported by the International Joint Laboratory of Ecological Environment and Sustainable Development of Jiuzhai Valley, Low-carbon Technology and Economy Research Center of Sichuan University, and Application of RFID Technology Research Laboratory.

The conference draws attention of experts at home and abroad. Mr. Heping Xie, an academician of Chinese Academy of Engineering and the Principal of SCU, will be the Chairman of this conference, Academician Jingwen Li will be the Vice Chairman, Professor Peiyu Ren, the project team leader from Business School of SCU , will be the Executive Chairman, Academician Xisheng Feng, Academician Zhongtuo Wang, Academician Jiulin Sun, Professor Thomas, Professor Jingyuan Yu, Professor Qingguo Ma, Professor Guangjin Li and Professor Changzheng He are the members of academic committee presidium. Academician Jingwen Li with other experts and scholars will launch the keynote speeches from different perspectives and fields, and host the group discussion on the theme topics.

The conference attracted lots of experts and researchers in different fields, and got more than 150 pieces of thesis from all over the world. Through the experts' filtering, editing and auditing, about 100 pieces has been collected into this proceeding, which was published by Science Press. We

presented it to the participants as a souvenir as well as for further communications.

The proceeding collected papers on the subjects of low-carbon economy and industrial restructuring, low-carbon tourism management, low-carbon technology and energy restructuring, low-carbon manufacturing and green supply chain, management science and engineering, and information technology and its management application, etc. From the aspects of systems science, complex science, management entropy theory and resource and environment science, sustainable development theory, and low-carbon economy theory and technology, the papers researched on low-carbon management theory and technology in scenic area, the scientific management model and standards for scenic area and policy suggestions for its development, low-carbon industrial model, innovation of low-carbon, etc. Those papers explored on the scientific or pragmatic problems by tracing to the original and front research fields, with integrated structure and efficient elaboration, presented us with profound and extensive outcomes, demonstrated the authors' high level of academic research and their great scientific research accomplishments.

Hereby, on behalf of the project team, the sponsor, the organizer and co-organizer, I would like to express my heartfelt thanks to all the experts and scholars, authors of the papers, Science Press and all those have supported this conference. I wish the conference a complete success!

Professor Peiyu Ren
April, 2012

Contents

Chapter A Environment Protection and Environmental Engineering

Chapter B Low-carbon Economy and Tourism Management

Chapter C Management Science and Engineering

Chapter D Information Technology and Its Application in Management

Chapter A Environment Protection and Environmental Engineering

CO_2 Emissions and Economic Growth in Western China: An Empirical Analysis Based on Panel Data for Western Provinces

Jinrong Jiang[1,a], Shaowei Chen[2], Peiyu Ren[1]

[1]School of Business, SiChuan University, Chengdu, China

[2] School of Economics, SiChuan University, Chengdu, China

[a]181969217@qq.com

Abstract

This paper examines the factors that affect carbon emissions based on the panel data for 9 western provinces in China over the period 1990–2009. Our empirical results show that the output size, industrial structure and energy consumption structure are the main factors affecting carbon emissions, and the income level has a negative effect to carbon emissions. Some policy implications of the empirical results have finally been proposed.

Keywords: Carbon emissions; Panel data model; Western China

Introduction

Global warming and the likely catastrophic effect of climate change has been the major issues that the international community faced with. December 11, 2011, the 17th Conference of Parties (COP17) to the United Nations Framework Convention of Climate Change (UNFCCC) agreed on the second commitment period under the 1997 Kyoto Protocol after hard negotiations. As an indispensable member of international climate negotiation countries, China has played an active and constructive role.

China is the world's largest greenhouse gas emissions country. With rapid industrialization and urbanization, China's energy demand is growing, and the corresponding greenhouse gas emissions are also growing over time. Energy conservation is a long-term task, and is a very difficult task. Currently, China has already issued a lot of energy saving policies and made great efforts on it. With further deepening of the western development strategy, the western region's economic development of China has gradually become a new growth point. Research of what affects the carbon emissions in the western region is of great practical significance for economic development and carbon emissions reduction.

Literature Review

Foreign scholars carry out the most is the relationship among carbon emissions, economic growth, income levels, demographic change and other aspects. Studies have shown that there is a strong correlationship between carbon emissions and economic growth.

Kraft and Kraft (1978)[1] were the first paying close attention to the relationship between economic growth and energy consumption.

Douglas Holtz-Eakin and Thomas M. Selden (1995)[2] used panel data analysis to do empirical analysis on the relationship between carbon emissions and GDP. They found that as economies develops, there was a diminishing marginal propensity to emit CO_2. They certificated that the overall pace of

economic development does not dramatically alter the future annual or cumulative flow of CO_2 emissions by sensitivity analyses.

The concept of environmental Kuznets curve (EKC) for CO_2, which relates CO_2 emissions per GDP with per capita GDP, has also been addressed in some literatures. Galeotti and Lanza (1999) [3] studied the patterns of CO_2 emissions of developed countries with the use of an econometric approach. They described the EKC with more complex Gamma and Weibull function of income.

Théophile Azomahou, François Laisney and Phu Nguyen Van (2006) [4] investigated the empirical relationship between CO_2 emissions and economic development during the period 1960–1996, using an international panel data set of 100 counties. Their study proved the stability of the relationship between CO_2 emissions per capita and GDP per capita over time. Estimation results of the nonparametric panel data model with country-specific effects showed that this relationship is upward sloping.

Pao and Tsai (2010)[5] investigated CO_2 emission, energy consumption and economic growth in Brazil, Russian, India and China, and confirmed that emissions strongly Granger-cause both energy consumption and output.

XuGuangyue (2011)[6] pointed out that the output size, industry structure and energy consumption structure were the major factors that affect China's carbon emissions, and clean energy technology did not play the key role of carbon emissions reduction.

From the research perspective of view, these findings are mostly from the national level, and lack of regional studies. As strong regional differences of China, large gap between the level of regional development, doing research of regional carbon emissions is of practical significance. This paper examines the factors that affect carbon emissions based on the panel data for 9 western provinces in China, and put forward policy recommendations to reduce carbon emissions.

Variables selection and data description

Variables selection. This paper adopts Xuguangyue's idea, examine the output size, industry structure, energy consumption structure, income and other factors on carbon emissions in the western region. CO_2 emissions are measured by Per capita CO_2 emissions. Total amount of carbon emissions of each province are calculated according to the IPCC Fourth Assessment Report (2007), and divided it by the population, then get the per capita carbon emissions. Output size is measured by Per capita GDP. Industry structure is measured by the proportion of secondary industry output to GDP in each province. Energy consumption structure is measured by the ratio of coal consumption to total energy consumption. Income is measured by disposable income of urban residents.

Our dataset is the panel data of 9 provincial administration of Western China for the period 1990–2009.[1] The data is obtained from the China Compendium of Statistic, China Statistical Yearbook 2010 and China Energy Statistical Yearbook.

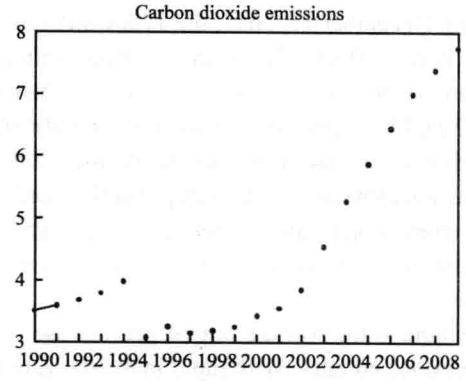


Fig.1 Average carbon emissions of each western province for the period 1990–2009.

1 This paper reference the division of the region of National Bureau of Statistics. The western region include Chongqing, Sichuan, Guizhou, Yunnan, Gansu, Shaanxi, Ningxia, Qinghai, Tibet, Xinjiang 10 provinces and autonomous regions. As there is lack of relevant data of Tibet, we analyze the data of the remaining 9 provinces.

Data description. Fig. 1 clearly indicates the changing trends of the amount of CO_2 emissions of each western province over a period of time. It can be divided into three stages. The first stage is from 1990 to 1994, carbon emissions are greater compared with the average in late 1990s, and it is an increasing trend over time. The second stage is from 1995 to 2001, increasing year by year with slightly fluctuations, the growth rate is gentler. The third stage is from 2002 to 2009, it is the rapid growth stage with extremely fast growth rate. In general terms, the carbon emissions of each province are tend to increase, and significantly grow faster in recent years. It shows that the carbon emissions of western region and economic development are closely related.

The descriptive statistics for main variables are given below in Table 1.

Table 1 Descriptive statistics for the main variables

Variable	Number of samples	mean	Standard deviation	Maximum	Minimum
Per capita CO_2 emissions (metric tons per capita)	180	4.4739	2.8835	15.0228	1.4382
Per capita GDP (yuan)	180	6440.2	5041.9	22920.0	810.00
The proportion of secondary industry Output to GDP (in %)	180	0.4208	0.0475	0.56078	0.3182
The ratio of Coal consumption to Total energy consumption (in %)	180	0.6593	0.1514	1.05997	0.2642
income (yuan)	180	6027.8	3568.3	17191.1	1197.0

Empirical analyses

Panel data analysis is a method of studying multiple phenomena observed over multiple time periods for the same individuals. This method of analysis can reveal changes in laws and individual characteristics based on the total information available for a sample. To confirm the validity of the panel data model estimation, panel unit root tests, panel cointegration tests and dynamic panel causality tests of the variables should be conducted before establishing the panel regression model. [7]

Model. In order to find the relationship between CO_2 emissions, industry structure, energy consumption structure and income for the panel of nine provinces the following model is proposed:

$$CQ = f(Y, STRU, CB, INCOME) \quad (1)$$

CQ is the per capita carbon dioxide emissions in metric tons, Y indicates per capital GDP, indicates industry structure, CB indicates energy consumption structure, and INCOME indicates income.

To eliminate heteroscedasticity, the logarithmic transformation of Eq. (1) is given by

$$\ln CQ_{it} = \omega_i + \alpha \ln Y_{it} + \beta \ln STRU_{it} + \lambda \ln CB_{it} + \gamma \ln INCOME_{it} + u_{it} \quad (2)$$

Where, the subscript i represents i-th province and t represents the time period for each province. Here $\alpha, \beta, \lambda, \gamma$ represents the long-run elasticities of carbon dioxide emissions with respect to $Y, STRU, CB, INCOME$ respectively. ω_i is the fixed effect of i-th province, u_{it} is the random disturbance.

Empirical results. Panel data regression is divided into fixed effect regression and random effect regression. The former believed that the individual unobservable characteristics correlated with the explanatory variables, while the latter is not considered relevant. When the cross-section unit is the overall of all the units, the fixed effect model is considered reasonable. Empirical research generally uses Hausman test to determine the selection of the fixed effect model or random

effect model. We use this method to test the data. Table 2 showed that at 1% significance level, test results reject original hypothesis that random effect is not associated with the explanatory variables, so the fixed effect regression model is accepted. Because there may be heteroscedasticity of cross-section or period if panel data is significant, and it will adversely affect the regression results. This paper uses the Ordinary Least Squares (OLS) and Generalized Least Squares (GLS) which uses White's heteroscedasticity correction to estimate. Results of regression are shown in Table 3.

Table 2 Hausman test of fixed effect and random effect

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	19.379234	4	0.0007

Table 3 Results of model regression

	$\ln CQ_{it}$	
	OLS	GLS
C	0.392237 (0.766891)	-0.079524 (-0.234455)
$\ln Y_{it}$	1.834313*** (12.42613)	1.086886*** (12.30335)
$\ln STRU_{it}$	0.204164 (0.731277)	0.622937*** (4.394306)
$\ln CB_{it}$	0.430145*** (3.727772)	0.318145*** (7.148951)
$\ln INCOME_{it}$	-1.672727*** (-10.30581)	-0.835731*** (-7.584312)
R^2	0.838878	0.914232
Obs	180	180

Notes: *** denote statistical significance at the 1 per cent levels, respectively.

The findings in Table 3 indicate that the significance of GLS is better than OLS. Therefore, we mainly use the GLS estimation results. R^2 of each model is more than 80%, indicating a good model fitting result. Estimation results show that the coefficient of the output size α, the proportion of secondary industry β, the proportion of coal consumption λ are positive, and are significantly different from zero at the 1% significant level , indicating that the output size, the secondary industry proportion and coal consumption proportion has a significant positive effect on carbon emissions. At the same time, the income coefficient $\gamma < 0$, shows the increase in income has a reduction effect. From the factors that affect carbon emissions, an increase in output size, secondary industry proportion, coal consumption proportion by 1% is associated with an increase in CO_2 emissions by 1.08%, 0.62%, 0.32% respectively. An increase in income by 1% is associated with a reduction in CO_2 emissions by 0.83%.

Conclusion

From the data above, the output size, industrial structure and energy consumption structure are the main factors affecting carbon emissions, the growth of these factors led to the growth of carbon emissions, and the output size has the greatest impact. The level of income has a negative effect of carbon emissions, the increase in income will help reduce emissions.

Policy implications

China is the largest developing country who takes important international responsibility, and energy conservation is an inescapable responsibility. As the key of future development of China's economic growth, the western region must not only promote economic development, but also reducing carbon emissions in order to achieve sustainable economic growth. Specific policy recommendations are as follows:

First, impose carbon tax. China is one of the world's few coal-based energy states. Carbon tax is an effective policy to achieve energy conservation measures. It is also an effective economic measure to protect the environment, which should become one of the main policy respond to climate changes.

Impose appropriate carbon tax could promote prices increase of fossil fuels and