

The Effects Study of Government Decentralization, Informal Economy on Carbon Emissions

Rong Zhao and Lixiang Zhao

Abstract—This paper focuses on the effects on the carbon emissions of government decentralization, the informal economy and the interactions in 2007-2017, using static fixed-effects model and dynamic system GMM, and threshold regression methods. The study finds that there is a threshold effect of fiscal decentralization and marketization decentralization, which have a negative impact on carbon emissions. The informal economic scale and the coefficient of interaction are further indicating that China's carbon emissions are indirectly increased due to the expansion of the informal economy. In the regional study, the impact of fiscal decentralization on carbon emissions is quite different. In the static situation of the eastern and central regions and the dynamic situation in the west, it shows a significant carbon increase effect. The impact of marketization on carbon emissions is greater in the central region than in the east and west.

Index Terms—Government decentralization, informal economy, carbon emission, GMM method.

I. INTRODUCTION

According to the 2018 Global Environmental Performance Index jointly released by Yale University and Columbia University, China ranks 177. The World Carbon Budget Report also announced that China's carbon emissions in 2017 accounted for about 28% of the global total, and it is currently the world's largest carbon emitter. The above data shows that China's current environmental contradictions are prominent, and the pressure on carbon emission reduction is significant. This is in stark contrast to China's 40 years of reform and opening up, with its economic aggregate ranking second in the world and an average annual growth rate of 9.5%, the promotion of industrialization and urbanization is the fuse. In reality, local governments rely on the extensive development, unreasonable industrial structure and energy structure and many other economic growth problems. The application of such development pattern is partly due to the governance structure of China's political centralization and economic decentralization. Since the 1990s, this pattern has played an important role in sustained economic growth, but its built-in "GDP-only" incentive distortion mechanism has brought about a certain degree of carbon emissions. Therefore, clarifying the relationship between the Chinese-style decentralization model and carbon emissions has important practical significance for the upgrading and adjustment of industrial structure and energy structure and the transformation of traditional development methods.

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Compared with the existing research, this paper has the following characteristics: 1. This paper divides the government's decentralization into fiscal decentralization and the perspective of marketization, and explores the impact mechanism of government decentralization on China's carbon emissions. 2. Introduce the informal economy in the process of exploring the relationship between government decentralization and carbon emissions, and empirically examine the impact of government decentralization, the informal economy, and their interactions impacts on carbon emissions [1], [2]. 3. Considering the heterogeneity problems in the development of different regions of China, and making the conclusions based on the robustness and persuasiveness, this paper divides the sample into three regions: East, Middle and West for more detailed analysis. 4. Replace the informal economy with self-employment rate, explore the size of the informal economy in different service industry, and the extent to which different industries affect carbon emissions, with a view to providing targeted monitoring of the informal economy.

II. MODEL

Based on the STIRPAT model, this paper refers to the research of Yanyu Cai, Zhangetc [3]-[5], and combines the research focus of this paper to construct the following model: Before performing the metrology test, it is first necessary to determine the appropriate panel data model in order to obtain an unbiased and consistent estimate. The system GMM (system moment estimation method) can be used to empirically analyze the panel model. This method is more suitable for the data set of "big N small T" features. At the same time, the system GMM solves the endogeneity problem of the model by using the method of replacing the endogenous variable with the instrument variable which is highly correlated with the endogenous variable and independent of the disturbance term, and the deviation of the system GMM estimation is more than that of the differential GMM. Small, estimated to be more efficient. The research sample of this paper is 30 regions from 2007 to 2017 except Hong Kong, Macao and Taiwan and Tibet (a large amount of data missing). The data used are mainly from the 2008-2018 China Statistical Yearbook, the China Energy Statistical Yearbook, the China Statistics Bureau, the People's Bank of China and the official website of the China Securities Regulatory Commission. The following is a detailed description of the interpreted and explanatory variables.

$$\begin{aligned} \ln I_{ij} = & \ln \alpha + \beta_1 \ln GDP_{ij} + \beta_2 (\ln GDP_{ij})^2 + \beta_3 \ln RD_{ij} \\ & + \theta_1 \ln FIS_{ij} + \theta_2 \ln MAR_{ij} + \theta_3 \ln SE_{ij} + \\ & \theta_4 (\ln FIS_{ij} \times \ln SE_{ij}) + \theta_5 (\ln MAR_{ij} \times \ln SE_{ij}) \\ & + \varphi_1 \ln UR_{ij} + \varphi_2 \ln FDI_{ij} + \varphi_3 \ln EE_{ij} + \varphi_4 \ln SP_{ij} \\ & + \varphi_5 \ln ER_{ij} + \varphi_6 (\ln ER_{ij} \times \ln SE_{ij}) + \ln \mu \end{aligned}$$

Explained variable: Carbon Emissions (I): For the measurement of carbon emissions, refer to the method proposed by the IPCC (United Nations Intergovernmental Panel on Climate Change) in 2016. Considering the accuracy and completeness of the data, the industrial carbon emission energy counted in the paper includes eight types: coal, coke, crude oil, fuel oil, gasoline, kerosene, diesel, and natural gas. The data of energy consumption E is mainly taken from the “China Statistical Yearbook” in each year. The energy offset coefficient is taken from China Energy Statistical Yearbook 2013. The carbon emission coefficient C of energy is derived from the IPCC carbon emission calculation guide.

Explanatory variables: Decentralization of government: Decentralization of government is the core explanatory variable of this paper. Considering the availability and completeness of data, this paper will use two dimensions of government decentralization to explain its relationship with carbon emissions: First, fiscal decentralization (FIS), measured by the ratio of fiscal revenue to fiscal expenditure; second, the government divides the market (MAR), that is, marketization, using the ratio of the income from the main business of non-state-controlled industrial enterprises to the income from the main business of industrial enterprises above designated size. The relevant data comes from the China Statistical Yearbook.

The size of the informal economy (SE): The recessive economy is also known as the underground economy, the shadow economy, and so on. Most of the scholars use MIMIC (multi-indicator multi-cause model) and micro-revenue balance estimating the two techniques, this paper uses the second method. According to the experience of Bai Chongen. According to the model setting, the paper also includes the following seven control variables: GDP, R&D, ER, SP, IND, UR, SER, FDI, EI.

III. EMPIRICAL ANALYSIS

A. Analysis of Factors Affecting Carbon Emissions

Table I reports the regression results of the effects of various variables on carbon emissions. Models (1)–(4) are static fixed-effect models, and (5) and (6) are dynamic system GMM models. In this paper, the per capita income, industrialization level, urbanization level, technological progress and other factors are taken as the control variables, taking into account the possible endogenous problems of the core explanatory variables of government decentralization and the dynamic continuous characteristics of the carbon emissions of the interpreted variables, so the system GMM is adopted. The method estimates the factors influencing carbon emissions. At the same time, dynamic processes can strip out potential influencing factors such as environment, policy, technology, etc., and can correct the deviation of static models. In table 1 models (3)(4)(5) are the estimation

results that do not contain the interaction term respectively, and (1)(2)(6) contain the GMM regression results of the three models of the interaction term. The coefficients of the first-order lag term (Llni) of the carbon emissions as explanatory variables in the model are all significantly positive, indicating that the carbon emission behavior does have significant dynamic persistence.

Specific to the explanatory variable: the estimated coefficient of the financial explanatory (fis) of the core explanatory variable is positive, and the regression results show that the coefficient and significance of the dynamic GMM are higher than the static coefficient, indicating that the fiscal decentralization system has carbon emissions in the long run. The promotion effect is mainly due to four reasons: 1. At this stage, China is still in a stage of rapid development, and many regions still regard GDP growth as a central task. Environmental issues such as carbon emissions are ignored to some extent. 2. Carbon emissions are not included in the performance appraisal mechanism, and therefore manifest as inaction in environmental governance. 3. The implementation of the fiscal decentralization system will inevitably increase the pressure on local finance. If a relatively strict carbon emission management system is implemented at the same time, it will inevitably be detrimental to the local government's investment attraction. Therefore, it will inevitably present a tendency of “emphasizing investment and light environmental governance”. 4. The implementation of the carbon emission reduction system has a certain positive externality or positive spillover effect, while carbon emissions have obvious negative externalities and negative spillover effects. Based on this, the government that attaches importance to carbon emission reduction has preferentially introduced the treatment plan, then the surrounding There will be a “free rider” phenomenon in the region, and the existence of such a game makes it difficult for the government to strive for environmental governance to an optimal level [6].

The estimated coefficient of the marketization (mar) of the second core explanatory variable for measuring government decentralization is positive, but it has only passed the test in the fifth model. The results show that the negative effect brought by the improvement of marketization level is greater than positive. Effect. The reason is mainly to analyze the micro-market entities. 1. The sensitivity of private enterprises and individual economies to carbon emissions is lower than that of state-owned enterprises. Usually, capital investment is insufficient, system norms are lacking, and investment in technological progress and equipment renewal is relatively weak, which may promote carbon emissions. Increase the effect. 2. Environmental quality as a public service, and the enterprise as a micro-subject. The improvement of the level of marketization has made the sense of community interest of the government and enterprises relatively weak, so the self-restraint mechanism of enterprises will be weakened, resulting in an increase in carbon emissions.

The estimated coefficient of carbon emissions in the informal economy is negative in the short term and positively in the long run, indicating that the development of recessive economy is bound to increase the increase of

carbon emissions. This conclusion is in line with the presupposition of this paper. The coefficient of interaction between the informal economy and fiscal decentralization is significantly negative in the short term and positive in the

long run. The coefficient of interaction with the marketization is positive, but does not pass the significance test.

TABLE I: CARBON EMISSION MODEL REGRESSION RESULTS

Var	(1) Individual fixed	(2) Individual time fixed	(3) Individual fixed	(4) Individual time fixed	(5) S-GMM	(6) S-GMM
gdp	0.865*** (0.0277)	0.695*** (0.0414)	0.865*** (0.0276)	0.696*** (0.0411)	0.486*** (0.169)	0.585*** (0.171)
Gdp2	0.0558*** (0.00722)	0.0549*** (0.00774)	0.0562*** (0.00718)	0.0559*** (0.00772)	0.0194 (0.0318)	0.00923 (0.0306)
fis	0.0546* (0.0293)	0.0370 (0.0344)	0.0227 (0.0231)	0.0620** (0.0275)	0.216*** (0.0584)	0.229*** (0.0607)
mar	0.00518 (0.0300)	0.0395 (0.0304)	0.0277 (0.0193)	0.00240 (0.0196)	0.09*** (0.0350)	0.20 (0.127)
se	-0.0123 (0.0376)	-0.00929 (0.0368)	-0.0089** (0.00451)	-0.0117** (0.00557)	0.00587 (0.0067)	0.0330 (0.0415)
N	300	300	300	300	270	270
R2	0.980	0.982	0.980	0.982		

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

From the coefficient of control variables, per capita GDP, technological progress, energy intensity and carbon emission levels are positively correlated; productive service industry agglomeration and environmental regulation have certain carbon emission reduction effects; informal economy, foreign direct investment in static model The medium coefficient is negative, and the coefficient is positive in the dynamic model; the urbanization and industrialization factors have not passed the significance test.

Specifically, the estimated coefficient of GDP per capita is significantly positive, indicating that China's high-speed economic growth at this stage inevitably brings about an increase in carbon emissions. The coefficient of the per capita GDP quadratic term is also significantly positive. The sample in this paper does not verify the "inverted U" relationship described by the EKC Kuznets curve between GDP per capita and carbon emissions. In order to verify whether there is a nonlinear relationship between GDP per capita and carbon emissions, this paper uses the threshold regression model to verify that the single threshold is indeed present. When the per capita GDP is less than 97,000 yuan, the estimated coefficient is 0.99. When the per capita GDP is more than 97,000 yuan, the impact coefficient is 1.03, which further proves that the growth of per capita GDP and economic development will not bring less carbon emissions at this stage, and it is still in a fast climbing stage, showing "J" type [7].

The impact of technological advances on carbon emissions is significantly positive in all six models. The agglomeration of productive services generated the expected carbon reduction effect, but only passed the significance test in the dynamic case. The regression coefficient of environmental regulation is negative, and the dynamic model plays a positive role in carbon emissions at least at a confidence level of 5%, indicating that the carbon emission reduction effect of environmental regulation in the long run is significantly better than the short-term effect. The impact

of foreign direct investment on carbon emissions is negative in the short term and positive in the long run. The reason why the estimation coefficient of urbanization is significantly negative is: First, the acceleration of urbanization will promote the agglomeration and rapid development of the service industry, while the carbon emission effect of the service industry is relatively small compared with industrial enterprises. Second, by the use of various types of public resources, such as in areas with high levels of urbanization, the development of clean transportation networks such as subways, which will inevitably reduce the use of private cars, educing carbon emission.

B. Analysis of the Threshold Effect of the Relationship between Government Decentralization and Carbon Emissions

To further verify the relationship between government decentralization and carbon emissions, the following model will be used to test the threshold: First, the fiscal decentralization and marketization levels are used as threshold variables, and the informal economy is affected by threshold variables. The core explanatory variables test the different effects of the informal economy on carbon emissions in the different intervals. Based on the above settings, we use threshold regression.

From the results, we found that fiscal decentralization has a double threshold effect. According to the regression results, fiscal decentralization as the threshold variable, with the increase of fiscal decentralization, the estimation coefficient of the informal economy is getting smaller and smaller, and the negative effect is gradually weakened, indicating that the strengthening of government intervention will weaken the informality of the adverse effects of the economy. Next, we use marketization as a threshold variable to examine the effects of carbonization on different marketization levels. The market-based threshold effect test shows that there is a single threshold. The regression results show that with the

increase of marketization level, the influence coefficient of the informal economy on carbon emissions is negative and the effect of emission reduction is gradually weakened. The improvement of the level of marketization will be accompanied by the expansion of the scale of the private economy and the individual economy. At the same time, enterprises will get rid of government intervention and excessive support, which will provide the possibility for the development of the informal economy. More pollution, negative effects appear.

In order to further investigate the impact of inter-regional government decentralization on carbon emissions, this paper divides 30 provinces and regions in China into three regions: east, middle and west. Regression analysis is used to explore the influence of different regional explanatory variables on the explained variables. From the regression results of fiscal decentralization, the gap between the three regions is large. In the static situation, the eastern and central regions are positively correlated with carbon emissions at the 1% and 10% significance levels respectively, and the western results are not significant. The system GMM results only passed the test of the western sample, indicating that fiscal decentralization will have a greater negative impact on carbon emissions in the western region in the long run. It may be because the development stages of different regions are different. The western region still pays more attention to capital construction and economic development, while public service such as environmental governance has less consideration. With the increasing attention paid by the eastern and central governments to environmental goals, there will be some improvement in carbon emissions. This mechanism has also been verified at the level of foreign direct investment. The preference of the western region for economic development goals will relatively ease the barriers to entry and attract investment, reduce environmental standards, and bring about environmental problems.

The impact coefficient of marketization is positive, but it has not passed the significance test. It may be because fiscal decentralization will exacerbate the pressure on local governments' fiscal expenditures. To a certain extent, local governments will cultivate market players, improve marketization levels, and bring certain environmental problems[8].

C. The impact of the Informal Economy of Different Types of Services on Carbon Emissions

Studies have confirmed that there is a significant positive correlation between the informal economy and self-employment rate, and the informal economy has the highest proportion in the service industry with obvious policy orientation and high degree of marketization. Taking into account the availability and accuracy of the data, the following will use the self-employment rate of the transportation industry, wholesale and retail industry, accommodation and catering industry, residential services and leasing industry as a substitute indicator for the informal economy to measure carbon emissions in different industries. The impact of the trial is based on statistical information, the self-employment rate from high to low in the order of: residential services, wholesale and retail, accommodation and catering, financial leasing, transportation.

IV. CONCLUSION

This paper firstly uses the IPCC carbon emission calculation method and the micro-revenue difference estimation method to estimate the carbon emissions and informal economic scale of China in 2007-2017. The non-dynamic and dynamic GMM models are used to focus on fiscal decentralization and marketization. We analyze the internal government decentralization and the impact of the informal economy on carbon emissions. The following basic conclusions have been drawn:

- a) From the static and dynamic perspectives, fiscal decentralization and marketization decentralization have a negative impact on carbon emissions. The impact of the size of the informal economy on carbon emissions is positive, that is, the expansion of the recessive economy has brought about the rise in carbon emissions levels. The coefficient of interaction between government decentralization and the informal economy is positive but slightly smaller than the single item, indicating that the informal economy regulations indirectly reduce China's carbon emissions. Further use the threshold regression model to use fiscal decentralization and marketization decentralization as threshold variables, and the informal economy as the core explanatory variable affected by the threshold variable. Fiscal decentralization has a double threshold. As the level of fiscal decentralization increases, it will weaken the adverse effects of the informal economy. The market-level decentralization level has a single threshold, and as the level increases, the positive impact of the informal economy on carbon emissions is gradually reduced, and negative effects begin to emerge.
- b) The self-employment rate of transportation, wholesale and retail, accommodation and catering, residential services and financial leasing is used as an indicator to measure the size of the informal economy. The static fixed model and system GMM are also used for analysis. The results show that transportation and financial leasing, as a productive service industry, have significant carbon emission reduction effects under dynamic conditions. As a traditional low-end service industry, wholesale and retail have a negative impact on carbon emissions. Catering accommodation and residential services, as a typical consumer service industry, show a certain degree of positive emission reduction effects.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Rong zhao and Lixiang zhao conducted the research; Rongzhao analyzed the data; Rongzhao and Lixiang Zhao wrote the paper; all authors had approved the final version.

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