The approach of improving environmental quality for the industrial interactive development of producer services and manufacture industry

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Abstract

The influence analysis of the interactive association between the manufacture industry and producer services was conducted. On this basis, the factors including energy consumption, capital and labor are selected to construct the STIRPA model concerning stochastic impacts of regression on population, affluence, and technology. The environmental effects of the two industries' interaction are analyzed. The results confirm that the structural differences of carbon productivity improvement of industrial development in economically developed eastern and central regions in China is greater than that of other regions, while the latter mainly depends on manufacture industry and producer services to achieve environmental protection growth, so the labor factor should be combined with capital to promote the improvement of carbon productivity.

Keywords: SOFC; Manufacture Industry; Producer Services; Interactive Development; Environmental Quality; Carbon Productivity

1Introduction

With the reduction of profit margins in manufacture industry caused by intensifying global competition, Chinese enterprises gradually involve from manufacturing profit into efficiency improvement and innovation of factor combinations. This leads to the industry demands on service and specialized producer services for manufacture industry. Meanwhile, the industrial interaction between producer services and manufacture promotes the development of modern industrial system, and reduces environmental pollution and relevant resource consumption while lifting efficiency. However the introduction of producer services to manufacture industry leads to the decrease of factor input. Meanwhile, factors are transferred to a certain degree in producer services. The manufacturing behaviors of producer services and corresponding factors combinations also result in new problems of emission and environmental treatment under the interactive background.

2. Literature Review

For the promotion of industrial interaction and economic growth, Francois&Reinert [1], Raa&Wolff [2] and Gu Naihua considered that manufacture industry, as the basis of producer services, promoted and accelerated the configuration of regions for producer services factors, so as to bring a new round of manufacture industry growth, and then the formation of industrial interaction; Gao Chuansheng et al. thought that two industries' interaction was positive correlative to the economic growth of corresponding regions. Jiang Xiaojuan[3] believed that producer services generally in China was still not perfectly matched with the high-speed growth in the labor-intensive industry context, but the boosting function of industrial interaction on economy and even the contribution rate mechanism of environmental improvement need to be further studied. Binhocker[4], Fan Ling and Wang Dong[5] held that carbon emission refers to the carbon releasing to the environment, and two-carbon productivity could be applied to measuring the environment dissipation of industry development from macro-view, medium-view and micro-view; while they also approved the fact that carbon productivity is used to assess the environmental quality of multi-industry development; while Yin Feng and Xu Guquan adopted decomposition model to explain the economic and environmental improvement increasing contribution of interactive industries, but their researches merely determined environmental improvement contribution of single industrial carbon productivity, lacking of the applicability of dynamic determination under the context of complex industrial interaction.

With respect to the influential factors and mechanism of carbon emission of industrial interaction, demographic components, per capita GDP and energy factor input of industry with the background of industrial interaction, Halicioglu F [7] indicated in his work, the Environmental Kuznets Curve also further explained that producer services and manufacture industry promoted the environmental improvement contribution of carbon productivity under optimal allocation of elements when producer services were introduced into manufacture industry.

Concerning the carbon productivity association of industrial interaction of economic growth, Liu Qiyun et al. [9] verified that the carbon emission of economic growth during Chinese industrial transformation, population and

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production labors show high relevance; Benz [10] held that the industrial adjustment of newly economies represented mainly by China was closer to monotonic increasing, but not the U-type carbon productivity mode. Wang Kai [11] confirmed with LMDI that Chinese labors' interaction migration was the main reason for the increase of carbon productivity of industrial interaction, while the energy utilization and structural light-duty were the key factors leading to the improvement of carbon production environmental efficiency.

In general, the existing literatures mainly focus on the introduction of the services of manufacture industry to mechanism and interactive influences. However these documents are merely limited to the carbon productivity measurement of environmental quality in the context of single industrial development. Few studies have been made on the environmental improvement of economic growth by industrial interaction. Meanwhile these researches have less research supports of improving environmental performance of carbon productivity by industrial interaction and effective practical measures. To improve the carbon productivity efficiency, this study is to select the manufacture industry with factor explanatory power and carbon productivity efficiency association to verify, and improve the carbon productivity efficiency to effectively conduct prediction, so as to enrich the research mode of environmental quality assessment in the context of regional complicated industrial structure adjustment. Besides, it provides the references for the environmental improvement study and practice of industrial interaction in perimeter zones.

3. Research Process

3.1 MODEL CONSTRUCTION

According to the above analysis, the STIRPAT model for the stochastic impact of the regression on population, affluence, and technology is constructed to further assess and predict the environmental improvement of carbon productivity through industrial interaction. The contribution of each factor on the environmental improvement is

$$E_t = aEC_t^{\alpha_1} IC_t^{\beta_1} LF_t^{\beta_2} \quad (1)$$

In formula (1), EC_t, IC_t, LF_t and E_t correspond to the energy factor consumption, independent capital investment, labor mobility, carbon productivity prediction in the t^{th} timing year, respectively; the partial least square method is used to perform the parameter estimation to STIRPAT model. The detailed steps are as the followings:

Firstly, the original sample data are adopted to construct the sample matrix X, Y, so the standard matrix is described as:

$$x_{ij}^* = \frac{x_{ij} - \overline{x_j}}{s_j}, y_i^* = \frac{y_i - \overline{y}}{s_y} (i = 1, 2, \ldots 20; j = 1, 2, 3) \quad (2)$$

From formula (2), the corresponding in formula (2) means of independent variable and dependent variable, standard deviation $\overline{x_j}$, s_j, $\overline{y}$ and y should be the relevant matrix.

Secondly, select the base sample E_0 and perform appropriate principal component analysis and regression analysis as follows:

$$t_1 = E_0 \omega_1;$$

$$\omega_1 = E_0^T F_0 / \left\| E_0^T F_0 \right\|;$$

$$E_0 = t_1 p_1^T + E_0, F_0 = r_1 t_1 + F_1 \quad (3)$$

In formula (3), $p_1 = E_0^T t_1 / \|t_1\|^2, r_1 = F_0^T t_1 / \|t_1\|^2$. So the corresponding regression residual matrix should be:

$$E_1 = E_0 - t_1 p_1^T, F_1 = F_0 - r_1 t_1 \quad (4)$$

Furthermore, based on the multiple parameter-variations timing regression in formulas (2), (3) and (4), the product results are obtained, and then the formulas are linearized, combining with the product results. Next, there is a formula as the following:

$$\hat{F}_0 = \sum_{i=1}^{n} r_i t_i = \sum_{i=1}^{n} r_i E_0 \psi_i^* \quad (5)$$

Hereinto, the matrix is mainly constructed in accordance with the principle component differences and regression coefficients, expressed by ψ_i^*,

$$\psi_h^* = \prod_{j=1}^{h-1} (I - \psi_j p_j^T) \psi_j .$$

Thus, the interconnection influence of carbon productivity produced by interactive development between Chinese manufacture industry and producer services can be predicted, and meanwhile the relevant timing regression of principal component is got, shown as the follows:

$$\hat{y}^* = \sum_{i=1}^{3} \alpha_i x_i^* \quad (6)$$

Where the principal component composition x_i^* of parametric variable contains corresponding component factor $\alpha_i = \sum_{h=1}^{n} r_h \psi_{hj}^*$, the prediction based on the interaction of manufacture industry and producer services is the regression of dependent variable based on formula (6) to principal component.

Finally, to prove the reliability of this study, the regression of principal component mainly refers to that the effective difference is introduced in the explanation of variables, but the parameter R_m^2, which is characterized by certain quadric regression, is used. Therefore when the current periodic corresponding value is small, the general model explanatory capability cannot be acquired. So the parameter's principal component interpretation iteration is selected in this study so as to obtain the STIRPAT estimation after intercrossing iteration based on partial least squares. The iterated conditions are set as $E_0 = E_m, F_0 = F_m$, and crossing path is the error variance predicted through all samples, which is:

$$SS_m = (y_1 - \hat{y}_{m1})^2 + (y_2 - \hat{y}_{m2})^2 + ...(y_{20} - \hat{y}_{m20})^2 \quad (7)$$

Meanwhile, by removing the sample information in the current K-th year, the total fitted regression equation of the second and third steps under the k-th timing year's iteration can be obtained, and the corresponding fitted value is error variance $PRESS_m$ while the predicted iterative-crossover availability is

$$PRVES_m = \sum_1^{20} (y_i - \hat{y}_{i(-k)})^2, Q_m^2 = 1 - \frac{PRVES_m}{SS_{m-1}} \quad (8)$$

3.2 FACTORS SELECTION

The capital input in model is mainly based on the annual average balance of the total fixed assets. Considering the different product concentration degrees of manufactures industries in each regions and great differentiation, for the flat researching data, the product price is performed the price index deflator according to the factory price of concrete products, And all the data come from the price statistical data in the current year provided by Price-Fixing Bureau of every city.

The labor input in the model mainly comes from the statistical data of the employed persons provided by Human Resource Security of each city.

The input amount data with direct meaning is not acquired through the introduction of the input variable of producer service and manufacture industry. In this study, the input-output method is used to calculate the corresponding labor, capital and energy consumption in relevant industry, and finally the carbon productivity of interactive development between manufacture industry and producer services in STIRPAT model is calculated.

3.3 DATA SOURCES

The total carbon emissions of manufacture are conducted conversion. The data are from *China Statistical Yearbook* from 2000 to 2013. After converting, the carbon productivity of the manufacture industries based on carbon product in Chinese Eastern and central regions, after being brought in producer services, is 0.093, 0.097 and 0.087, while the carbon productivity of corresponding manufacture industry is 2.133, 2.131 and 2.117.

According to the model and above analysis, if the mean square error during the interactive development of manufacture industry and producer services is lower than the set level (1-095^2) 0.0975, the new round of intercrossing iteration of principal component is needed to obtain the final prediction of carbon productivity.

TABLE 1 PLS verification results extraction of STIRPAT model

composite	R^2	R^2 accm	Q^2
comp 1	0.846167	0.846167	0.836671
comp 2	0.0814667	0.9351171	0.48561
comp 3	0.0364918	0.9643152	0.469919

As shown in the table, the coefficient of the former two principal component regressions is 93.51% in introduction, but the iterative value is set as 0.0975. In corresponding research, the ignored result on the interaction between manufacture industry and producer services is : $\hat{y} = 1.579713 - 0.0568x_1 + 0.271x_2 + 0.89x_3$.

Meanwhile, compared to the actual fitting value, the RMS error of relevant RMSEA is only 0.0646245, so the relative stable fitting and predicting result is presented

$$E_t = 4.87352 EC_t^{-0.0568} IC_t^{0.271} LF_t^{0.89} \quad (9)$$

It is concluded that labor mobility is the main factor causing the high interaction carbon productivity during the interaction between manufacture industry and producer services; however the joint development of manufacture industry and producer services in China also depends on the cooperation of the above factor.

4 Countermeasures

On the basis of the points of increasing development of industry in economic development and the ways of improving the environmental quality during the interaction between industry and producer services, by taking improvement of carbon productivity as representative explained variable, this study aims to verify the measures of effectively improving production and economic efficacy for manufacture industry and producer services with the same carbon productivity, which means to the new environmental protecting industry economy with low energy consumption. For the extensive random environmental impact assessment based on partial least squares, there is industry dependence for the improvement of environmental protection in the process of industrial interaction in each region of China. In Central and Eastern regions, the improvement of environmental protection depends mostly on the energy consumption of in producer services of manufacture industry, while it mainly concentrates on remarkable the producers services to manufacture industry in Western regions. In addition, the STIRPAT model prediction confirms that the mobility of capital and labor contributes to the reduction of environmental consumption during industrial interaction in each region, and a more environmental and ecological developing structure of industrial interaction is formed.

Based on the analysis of existing researches, several suggestions of improving environment of carbon productivity during the interactive development between manufacture industry and producer services are proposed in this study as follows:

Firstly, supporting policies promote the optimization of environmental quality

At present, the producer services depend on manufacture industry in China. The implementation of regulation measures regarding the structure energy input are required to focus light type or strengthened other production , and promote positively service to drive manufacture industry . Furthermore, the manufacture industry is adopted to promote the gradual integration of producer services for forming the medium and long term industrial structure adjustment matching in our province. Local government with the primary responsibility for regional environmental-protection industry restructure is expected to get rid of the collusive GDP performance concept, instead of "green GDP" concept. The industrial cluster, innovation network and block economy are combined with the global development opportunity of the relative remarkable export-oriented economy in Central and Eastern regions; moreover, producer services consultation, and manufacture industry based professional service should be extended and fully jointed; the supporting measures require to transform from passive to active adaptation, and simplify the examination while raising the unitization utilization of human resource; the individual enterprise in the development of industrial interaction should obtain the professional separation space of products' source design and after-sale service of continuous production, and utilize the sharing mechanism of cluster resource to construct the low-carbon consumption supporting frame. Besides, the construction of the development mode for new low-carbon market and industrial interaction needs to be promoted through separate-type outsourcing.

Secondly, tax adapts the carbon productivity of industrial interaction

The carbon productivity in the context of industrial interaction does not only associate with environment, resources' utilization and protection, but also the macro application of national taxation adjustment in scientific industrial distribution. So the graded tariff of resource tax can be used to adapt configuration of input-output and services factors, and the formed effect is applied to supplement the relative inefficient part in environment pollution improvement produced during industrial interaction, Thus the secondary adaption of the profit tax can efficiently improve the carbon productivity in the adjusting process of industrial distribution and structure.

Thirdly, enterprise innovation promotes the carbon productivity during the industrial interaction

In the research, the carbon productivity in manufacture industry and producer services is not also related with the energy investment, but also labor and talent structure. So, it is suggested that the manufacture industry of private capital is totally peeled and evolves into the regional economy by virtue of resources and operation experience, especially the advantages of cluster and block economic resource network to go into producer services market; meanwhile, the outsourcing producer services can be possibly applied to improve the manufacturing, management and marketing abilities of core products of manufacture industry; the private capital in all forms are encouraged to select the specialized management of manufacture industry and producer services as individual adaptation breakthrough of industrial adjustment, solving reversely, with the operation mode of industrial environmental governance, the problems arising from high carbon productivity in the interaction of manufacture industry and producer services in current developing stage, China. Certainly, the background characteristics of Chinese private enterprises' constitution demand that the improvement of carbon productivity in industrial interaction needs more enterprises' active participation. The micro enterprises are suggested to seize the interaction opportunity of producer services and complete the relocation of product innovation and two industries' integration and competition in current stage through form adjustment and the innovation of brand constructing channel by the combination of industry in market. In this way, the new strategic system of low-carbon green independent competition can be formed in the market.

Fourthly, both capital and talents should be brought into making up the environmental consumption of industrial interaction

At present, the dependency of manufacture industry on producer services in Zhejiang Province is less preferable, feasible transmission mechanism is needed to remarkably improve carbon productivity through capital growth and the variation of talent structure. The more private capitals are encouraged to further enter industrial interaction by specialization, and motivate the existing industrial interaction by virtue of recapitalization and talents' directional flow. Hence, the benign environmental effect of interactive development between producer services and manufacture industry in China can be achieved.

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