Empirical Study on Interaction Evaluation Model of Informatization and Greenization Based on Coupling Theory

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Abstract. This paper contructed an interaction evaluation model of informatization and greenization based on the coupling theory in physics;and gave an empirical test and analysis on the support of Chinese provincial regional data for the year 2014.Study results confirms:the interaction evaluation model of informatization and greenization of this paper contructed is a scientific and comprehensive evaluation model of coincidencing the idea of sustainable development.The model has considerable significance theoretical innovation and practical application value,can evaluat and analyz availably the interaction between informatization and greenization,provide decision references and theory supports for a nation or a region to develop the wisdom economy and green economy,realize sustainable development.

1 Introduction

Informatization and greenization is the two practical way to bring about the drawbacks of the road of industrialization.Informatization and greenization is the two major support for the sustainable development of human society.It is difficult to realize the sustainable development lacking of any party.But the informatization and the greenization of the two theories and their practice is in the form of separate at home and abroad. Therefore,it has a significant theoretical and practical significance to research theory and practice of the interaction of Informatization and greenization,to take on a new road of industrialization and to realize sustainable development for the human society.Based on the above considerations,this paper contructed an interaction evaluation model of informatization and greenization based on the coupling theory in physics;and gave an empirical test and analysis on the support of Chinese provincial regional data for the year 2014.

2 The related research review

2.1 The literatures review of related problems

The related literatures review of **Informatization and Greenization** are as follows.Xie etc.[1] studied the convergence problem of Chinese industrializaion and informatization.Xu etc.[2] explored the evolution mechanism of industrialization,informatization,urbanization,agricultural modernization.At present,the concept of green growth with the highest citation rate is given by OECD[3].Mathews and Reinert[4] researched the role of renewable energy,clean technology and resource recycling systems on the green economy.Jakob and Edenhofer[5] considered green growth is the economic growth model of enhancing “social welfare” and “human happiness”.McKendry and Janos[6] discussed green growth and sustainable development of industrial cities in developed countries.Tong etc.[7] researched modeling China's green economy 2050.Zhang etc.[8] explored greenization of venture capital and green innovation of Chinese entity industry.Liu etc.[9] studied the evolution characteristics of greenization in China.Ding etc.[10] give a general introduction on progress of coordinated

development of industrialization,urbanization,agricultural modernization,informatization,and greenization in China,and other literatures,etc.

2.2 Limitations of existing research

(1)The research on the informatization needs to be further deepened at home and abroad.

(2) The research on the greenization is at the initial stage, and the research is not deep enough, and the research has not formed theoretical system.

(3)The interaction research of informatization and greenization is less, and it is difficult to guide the practice.

This study made up for these shortcomings.

3 Interaction evaluation model of informatization and greenization

3.1 Interaction evaluation indicators system of informatization and greenization

This paper contructed an interaction evaluation indicator of informatization and greenization，Table 1 is the evaluation indicators system. In this paper, we use AHP (Analytic Hierarchy Process) Method to synthesize 5 indicators(Index of post and telecommunications service,Computer ownership rate,Telephone penetration rate,Internet penetration rate,Electronic information industry specific gravity) into informatization comprehensive index. Similarly, we use AHP Method to synthesize 5 indicators (Renewable energy power generation ratio, Per capita sulfur dioxide emissions, Investment proportion of environmental pollution government, GDP energy intensity, Forest coverage) into greenization comprehensive index.

Table 1 Interaction evaluation indicators system of informatization and greenization

	Informatization and Greenization	evaluation indicator	Concrete representation
Interaction degree of informatization and greenization	Informatization comprehensive index	Index of post and telecommunications service	Number of Posts and telecommunications business volume/post and telecommunications industry practitioners(yuan/person)
		Computer ownership rate	Computer ownership rate per hundred persons (tai/hundred persons)
		Telephone penetration rate	Telephone penetration rate per hundred persons(bu/hundred persons)
		Internet penetration rate	Internet penetration rate per hundred persons(Percentage)
		Electronic information industry specific gravity	Electronic information industry accounted for GDP(percentage)
	greenization comprehensive index	Renewable energy power generation ratio	Renewable energy power generation accounts for the proportion of total energy power generation(percentage)
		Per capita sulfur dioxide emissions	Annual average sulfur dioxide emissions per capita(ton/person)
		Investment proportion of environmental pollution government	Environmental pollution government investment accounted for GDP(percentage)
		GDP energy intensity	Ten thousand yuan GDP energy consumption(tons of standard coal)
		Forest coverage	Regional annual average forest coverage (percentage)

3.2 Coupling degree model and coupling coordination degree model

In this paper, the coupling theory of physics subject is introduced, which is used to explore the interactive development level evaluation of informatization and greenization.The model of coupling theory used in this paper is as follows.

1. Coupling degree model

Coupling degree model of physics subject is as follows:

$$C_n = \left\{ \frac{(U_1 \times U_2 \times \ldots \times U_n)}{\prod (U_i + U_j)} \right\}^{1/n} \quad (1);$$

In the above formula, $U_1, U_2, \ldots, U_n$ represent n systems, C_n represent Coupling degrees of the n systems。

There are two systems(informatization and greenization) in this paper,So,the coupling degree of the two systems is as follows：

$$C = C_2 = \left\{ \frac{(U_1 \times U_2)}{(U_1 + U_2)^2} \right\}^{1/2} \quad (2);$$

In the above formula, U represent informatization comprehensive index, and U_2 represent greenization comprehensive index, C_2 represent coupling degree index C of the two systems，$0 \le C < 1$.

2. Coupling coordination degree model

coupling degree index C express two system coupling degree, but it can't reflect the actual interaction and coordination degree of the two systems, such as: the informatization and greenization level of a region is low, but we can draw high coupling degree evaluation results,and this is not meaningful. Therefore, we need to introduce coupling coordination index D to measure the degree of interaction between the two systems.

$$D = \sqrt{C \times T} \quad (3) \quad ; \quad T = \alpha u_1 + \beta u_2 \quad (4);$$

Among them, D represents coupling coordination index,expresses the degree of interaction of the systems.T represents comprehensive evaluation index of two systems,reflect the overall efficiency of the two systems. α and β represent undetermined coefficients.Generally speaking,we think that informatization and greenization are equally important. So, α and β values are the same,both are 0.5.

3.3 Interactive degree evaluation standard of informatization and greenization

Coupling coordination index D is the indicator which measures the degree of interaction and coordination between informatization and greenization,the measuring standard is in Table 2.

Table 2 Interactive degree evaluation standard of informatization and greenization

Interactive development phase	Coupling coordination degree of D value	Interaction type	Interactive development phase	Coupling coordination degree of D value	Interaction type
Low level interaction: Very little contact	0.0000-0.9999	Extreme lack of interaction	Strengthen interaction: Running in contact	0.5000-0.5999	Reluctant interaction
	0.1000-0.1999	Serious lack of interaction		0.6000-0.6999	Primary interaction
	0.2000-0.2999	Moderate lack of interaction		0.7000-0.7999	Intermediate interaction
Start interaction: Contend with each other	0.3000-0.3999	Slight lack of interaction	High level interaction: Fusion and symbiosis	0.8000-0.8999	Good interaction
	0.4000-0.4999	On the verge of lack of interaction		0.9000-1.0000	High quality interaction

4 Evaluation and analysis of the interactive degree of China's informatization and greenization

Specific relevant data of China's informatization and greenization in 2014 whose each indicator is showed in table 1, is derived from ***China Statistical Yearbook(2015)***,Statistical Yearbook of Chinese various provincial regions in the year 2015,***China economic information network statistics database***, CNKI"***Statistical database of China's economic and social development***",People's Republic of China"***national statistical database***"and other relevant statistical data. According to the interaction evaluation model of informatization and greenization presented above, we got interactive degree evaluation results of China's informatization and greenization in 2014,the results are shown in table 3.

Table 3 Interactive degree evaluation results of informatization and greenization of Chinese provincial regions in 2014

Geographical district	Provincial region	Coupling degree index C	Comprehensive evaluation index T	Coupling coordination index D	Interactive degree evaluation
North China	Beijing	0.4992	0.8295	0.6435	Primary interaction
	Tianjin	0.4937	0.7928	0.6256	Primary interaction
	Hebei	0.3895	0.5942	0.4811	On the verge of lack of interaction
	Shanxi	0.3648	0.3986	0.3813	Slight lack of interaction
	Inner Mongolia	0.3621	0.4137	0.3870	Slight lack of interaction
Northeast China	Heilongjiang	0.4382	0.5793	0.5038	Reluctant interaction
	Jilin	0.4359	0.6328	0.5252	Reluctant interaction
	Liaoning	0.4430	0.6591	0.5404	Reluctant interaction
East China	Shanghai	0.4986	0.8206	0.6396	Primary interaction
	Jiangsu	0.4864	0.7265	0.5944	Reluctant interaction
	Zhejiang	0.4793	0.7153	0.5855	Reluctant interaction
	Anhui	0.4239	0.4529	0.4382	On the verge of lack of interaction
	Fujian	0.4632	0.6817	0.5619	Reluctant interaction
	Shandong	0.4583	0.6754	0.5564	Reluctant interaction
	Jiangxi	0.4326	0.4620	0.4471	On the verge of lack of interaction
Central China	Henan	0.4478	0.5158	0.4806	On the verge of lack of interaction
	Hubei	0.4257	0.6034	0.5068	Reluctant interaction
	Hunan	0.4192	0.5651	0.4867	On the verge of lack of interaction
South China	Guangdong	0.4725	0.7482	0.5946	Reluctant interaction
	Guangxi	0.4068	0.4360	0.4211	On the verge of lack of interaction
	Hainan	0.4391	0.5398	0.4869	On the verge of lack of interaction
Southwest China	Chongqing	0.4502	0.6473	0.5398	Reluctant interaction
	Sichuan	0.4187	0.4802	0.4484	On the verge of lack of interaction
	Guizhou	0.3514	0.3579	0.3546	Slight lack of interaction
	Yunnan	0.3950	0.3857	0.3903	Slight lack of interaction
	Tibet	0.3483	0.3265	0.3372	Slight lack of interaction
Northwest China	Shaanxi	0.4365	0.6153	0.5182	Reluctant interaction
	Gansu	0.3816	0.3127	0.3454	Slight lack of interaction
	Qinghai	0.3528	0.3376	0.3451	Slight lack of interaction
	Ningxia	0.3275	0.3214	0.3244	Slight lack of interaction
	Xinjiang	0.3749	0.3682	0.3715	Slight lack of interaction

The data in table 3 are analysed as follows. In the interactive degree of China's provincial regional informatization and greenization in 2014, Beijing, Shanghai, Tianjin belong to the primary interaction. Guangdong, Jiangsu, Zhejiang, Fujian, Shandong, Liaoning, Chongqing, Jilin, Shaanxi,

Hubei, Heilongjiang belong to reluctant interaction.Hainan, Hunan, Hebei, Henan, Sichuan, Jiangxi,

Anhui, Guangxi are on the verge of lack of interaction. Yunnan, Inner Mongolia, Shanxi, Xinjiang,

Guizhou, Gansu, Qinghai, Tibet, Ningxia belong to the Slight lack of interaction.Overall, there are interactions in China's provincial regional informatization and greenization in 2014, but the degree and level of interaction is not high. At present, the informatization and greenization strategy which is implemented in China's national level, is an opportunity for the China's provincial region.Every province should hold this opportunity,vigorously promote the local area of informatization and greenization,and promote the interaction between informatization and greenization;to make informatization and greenization become the transformative power which promote the development level of the local economy,society,science and technology,and other aspects. This is a necessary way which is used to narrow the regional gap, to make China as a whole realize modernization.

5 Conclusions

This paper contructed an interaction evaluation model of informatization and greenization based on the coupling theory in physics;and gave an empirical test and analysis on the support of Chinese provincial regional data for the year 2014.Study results confirms:the interaction evaluation model of informatization and greenization of this paper contructed is a scientific and comprehensive evaluation model of coincidencing the idea of sustainable development.The model has considerable

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