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Measurement and Evaluation of Rural Industrial Integration Development in China

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Abstract

Firstly, the connotation of rural industrial integration development is explained theoretically. Then, based on the provincial panel data from 2005 to 2019,the level evaluation index system is constructed from the four integration dimensions of rural industrial integration development,and the level of rural industrial integration development is comprehensively evaluated by using the coupling coordination degree model and the entropy method. The results show that the overall level of rural industrial integration in China has increased from 0.162 to 0.326,by 0.164.The development of rural industrial integration in various regions has shown a steady growth trend, but the level of rural industrial integration in the western region is far lower than that in other regions. The level of integrated development in four different dimensions shows obvious regional heterogeneity.

Keywords

Rural Industrial Integration; Entropy Method; Coupling Coordination Model; Measure.

1. Introduction

At this stage,the increase of farmers'income in China shows a slowing trend.The per capita annual disposable income of urban residents increased from 343 yuan in 1978 to 43834 yuan in 2019,while the per capita annual net income of rural residents increased from 134 yuan to 17131 yuan in 2019.The absolute income gap between the two is widening.In addition to the intuitive visible income gap,urban residents enjoy social security,health care,public services, educational opportunities and employment opportunities and other benefits are also in a dominant position compared with rural residents.It can be said that the income gap between urban and rural development has become an obstacle to China's high-quality development.

The implementation of the rural revitalization strategy is a major decision-making deployment made by General Secretary Xi in the report of the 19th National Congress of the Communist Party of China for the three rural issues.Based on this strategic goal,he also clearly pointed out the general requirements of the rural revitalization strategy,namely,“industrial prosperity, ecological livable,rural civilization,effective governance and rich life”.Agriculture is the basic industry in rural areas,and agricultural revitalization has become the core of rural industrial revitalization.From the perspective of traditional agricultural solidification and industrial segmentation,the strictly defined industrial boundary hinders the flow of resource factors,and from the perspective,it is limited to the single economic function of agriculture and ignores its original multi-functionality.For example,agriculture is only regarded as an industry producing agricultural products,while agriculture is ignored as the carrier of cultural politics,the protection of the ecological environment,and the social value function.Moreover,due to the short industrial chain of agriculture,farmers often only play the role of agricultural producers and rarely participate in the processing and circulation of agricultural products in the value chain,resulting in agricultural management has always made farmers'production does not increase income.The development path of industrial segregation has forced agriculture into a

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dead end of development.To break through its development bottleneck,agricultural operators are required to seek the emancipation of ideas and a new way of combining agricultural input factors with agricultural production conditions.In the guidance issued by the State Council in 2015 on promoting the integration of primary,secondary and tertiary industries in rural areas,the State Council stressed the need to“focus on building a modern industrial system of cross-integration of agriculture and secondary and tertiary industries,forming a new pattern of rural development with urban-rural integration,promoting agricultural efficiency,increasing farmers’income and rural prosperity,and providing important support for the sustained and healthy development of the national economy and the building of a moderately prosperous society in all respects”.Obviously, the integration of primary, secondary and tertiary industries in rural areas(hereinafter referred to as the integration of rural industries)plays an important role in promoting agricultural efficiency, increasing farmers'income and rural development. However,before the work of promoting the integration of rural industries begins,it is necessary to adopt a scientific and reasonable method to measure the level of integration and development of various regions. Only by finding out the stage of the integration and development of rural industries in various regions can more targeted measures be taken in the practice of the subsequent integration and development of rural industries.

2. Literature Review on Rural Industrial Integration

The idea of rural industrial integration originated from six industrializations in Japan.In the mid-1990s,Nishimura,a famous industrial economist in Japan, found that there was a huge difference in the value between the agricultural products produced by farmers and the agricultural products consumed by the people.This part of the value difference flowed out of rural areas to cities through the circulation of agricultural products, the processing of agricultural products and the catering industry,and agricultural producers could not increase their income. In order to change the dilemma of agricultural development in Japan,he first put forward the concept of"sixth industry," that is,to encourage farmers to engage in diversified business,by extending the agricultural industry chain, expanding the multi-functionality of agriculture, farmers,agriculture and rural areas to obtain more value added.

Chinese scholars have long been keen to observe the phenomenon of integration of agriculture and other industries, but there are few relevant literature, and the research perspective mainly focuses on the integration of agriculture and the tertiary industry.In the earliest study on the standardization of the integration of domestic three industries,Rengang Yu(1997)believed that due to the further development and improvement of the market economy, the three relatively isolated industries began to show mutual penetration under the natural economy and the planned economy, especially the trend of the tertiary industry to the primary industry[1]. Binbin Ran(2008)believes that the integration of agriculture and tourism can promote the upgrading of traditional agricultural industrial structure, expand the development space of tourism, improve the added value of agricultural products and value creation ability,and bring the market integration between the two[2].Xiaoli Xi(2008)believes that modern agriculture not only has economic function, but also plays an important role in social security,cultural heritage, environmental protection and other aspects of a country.The integration of agriculture and other industries makes the multi-function of modern agriculture more obvious[3].

Since the General Office of the State Council issued the“guidance on promoting the integrated development of primary,secondary and tertiary industries in rural areas”in 2015,the research on the theme of integrated development of rural industries has gradually begun.For the measurement of the level of rural industrial integration development,it is mainly measured by constructing scientific and reasonable evaluation criteria and index system.Summarize the methods of scholars,mainly divided into the following two categories.One is to construct an

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index system to measure the depth and breadth of industrial integration and the benefits generated by industrial integration.Li(2017)took the integration behavior of agriculture and secondary and tertiary industries and the economic and social effects of integrated development as the first-level indicators of the index system,constructed a comprehensive evaluation index system containing three levels,and used the analytic hierarchy process to evaluate the level of agricultural industrial integration in Beijing[4].Ling Wang(2017) constructed a comprehensive evaluation system of rural industrial integration development level from five dimensions of industrial chain extension,multi-functional development, agricultural service industry integration,farmers'income increase and employment and urban-rural integration,and used entropy method to calculate the rural industrial integration development level of 13 provincial cities in Jiangsu Province.The second is to construct an index system only based on the breadth and depth of industrial integration to measure the level of integration[5].Li Cheng(2020)constructed an index system with the internal reorganization and integration of agriculture,the extension and integration of agricultural industrial chain,the expansion and integration of agricultural multi-functions,and the infiltration and integration of advanced factors into agriculture as the first-level indicators,and used the entropy method and the coupling coordination model to measure the level of rural industrial integration in the upper reaches of the Yangtze River[6].Lin Zhang(2020)constructed a comprehensive index evaluation system with the extension of agricultural industry chain,the exertion of agricultural multi-functionality and the integration of agricultural service industry as the first-level indicators, used the weighting method combining analytic hierarchy process and entropy weight method,and then used the Euclidean distance function method to calculate the comprehensive index of rural industrial integration development[7].

To sum up,the idea of rural industrial integration originated in Japan.In the early stage,the research perspectives of Chinese scholars mainly focused on the theoretical analysis of the integration of agriculture and the tertiary industry,especially the tourism industry,lacking comprehensive and systematic discussion.With the introduction of a series of documents from the central government,the research perspectives of rural integration are diverse,the research fields are expanded,and the research contents are gradually deepened.Existing research can provide useful reference for this article,but there are still shortcomings.First,in the process of measuring the development level of rural industrial integration,many scholars who choose the depth and breadth of integration and the benefit of integration to construct indicators tend to simply make the change of farmers'income directly as the benefit of rural industrial integration.In fact,the sources of farmers'income are diverse,and the benefit of directly incorporating them into the implementation of rural industrial integration will often exaggerate its practical role.Second,most scholars tend to focus only on the tourism function of agriculture while ignoring the social,ecological and cultural functions of agriculture in the construction of agricultural multi-functional expansion and integration index system.It is of great significance to solve these problems,construct a reasonable index evaluation system,and scientifically measure the stage of rural industrial integration and development in various regions for rural revitalization.

3. Basic Connotation and Interpretation of Rural Industrial Integration Development

3.1. Basic Connotation of Rural Industrial Integration Development

Rural areas refer to the areas where agricultural workers are mainly concentrated,mainly including agricultural areas,towns and villages,which not only have specific natural features but also have social and economic conditions different from those of cities.In the industrial structure of rural areas,agriculture occupies a fundamental position.Compared with cities,

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agriculture also occupies a larger proportion.Therefore,it is necessary to highlight the important position of agriculture in the research on rural industries.The so-called industrial integration refers to the process of continuously seeking industrial innovation due to the profit-driven nature of the industry itself.When technological shocks and economic deregulation occur,the boundary between industries or the boundary between different industries in the same industry will become blurred,so that the competition and cooperation between the internal and external industries will be strengthened,resulting in changes in the structure of the industry,and ultimately leading to industrial upgrading or the birth of new industries.For agriculture,it is often difficult to obtain excess profits or even average profits compared with other industries in the process of production and operation.Therefore,under the internal requirement of improving industrial competitiveness,it will seek competition and cooperation within and outside agriculture.Therefore,the integrated development of rural industry is based on agriculture,through the cross-border intensive allocation of technology,capital and various resource elements,under the guidance of the new agricultural management subject and the promotion of the government's support for agriculture policy,to innovate the mode of agricultural development,realize the internal restructuring of agriculture industry,the vertical extension of agricultural industry chain,the exertion of agricultural multi-function and the infiltration of technology,so as to promote farmers'income,agricultural development and rural prosperity.

3.2. Interpretation of the Basic Connotation of Integrated Development of Rural Industry

3.2.1. Integration Subject of Integrated Development of Rural Industries: Different from Integration among Industries within Rural Areas

The integration of various industries in rural areas includes the integration of sub-industries within agriculture, the integration between agriculture and non-agricultural industries,and the integration between non-agricultural industries. Compared with the integration of rural industries, the starting point of its policy is to put the development of agriculture and non-agricultural industries at the same level, without focusing on the development of agriculture. Agriculture is the lifeline of a country and the guarantee of farmers'income. In particular,to curb the widening gap between agricultural development and non-agricultural industrial development, it requires us to accelerate agricultural development and transform traditional development thinking.The development of rural industrial integration emphasizes agriculture as the basic support of integration and plays a leading role in the trend of integration. Of course, the basic basis of agricultural integration is not to ignore the characteristics of different rural resource endowments and take one-size-fits-all development model, to give full play to the comparative advantages of different rural areas,for example,in some rural areas of China, fertile land,adequate light suitable for the development of planting industry as the main industry integration; some rural natural scenery, rich ecological resources suitable for the development of rural tourism as the main industry integration;it is suitable for the development of digital agriculture in rural areas with complete infrastructure construction such as power supply, mobile network coverage and Internet connection,and rich digital resources.The theory of rural industrial integration is rooted in rural areas.Under the framework of agriculture as the main industry of integration, the characteristics of different rural resource endowments are fully considered, because heterogeneity is the source of agricultural development competitiveness in various regions.

3.2.2. Integration Goal of Rural Industrial Integration Development: Upgrading and Expansion of Agricultural Industrialization

Agricultural industrialization is a market-oriented,leading enterprises and other business entities as the carrier,with technology as the support organization to guide small farmers into

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the large market of agricultural integration.The integrated development of rural industry emphasizes not only the extension of the industrial chain,but also the centralization,enterprise and scale of the production and processing of agricultural products,the implementation of standardized operation in the whole process,and the creation of higher comprehensive productivity.At the same time,compared with the agricultural industrialization,it pays more attention to the reverse extension of the agricultural industrial chain and the integration and interaction with the agricultural,forestry,animal husbandry and fishery services.That is,guiding the breeding of new varieties of crops,providing support for agricultural technology,quality and safety services of agricultural products,making the ability of agricultural production more prominent,that is,the integration and development of rural industries is the'upgrading'of agricultural industrialization.In addition to increasing new supply through'addition'between industries,it also cultivates new formats through'multiplication'between industries.With the improvement of living standards, people's consumption demand is becoming more personalized, diversified and high-end.The integration of rural industries blurs the boundaries between agriculture and other industries,drives the organic restructuring of resources,factors and technologies,and enables the integration of agriculture and other industries to cultivate new formats, which meets people’s multi-functional needs for agricultural culture, education, leisure tourism,ecological environment and social security.The development of rural industry integration is the expansion of agricultural industrialization.

3.2.3. Integrated Interests of Integrated Development of Rural Industries: Balancing the Interests of All Parties under the Principle of Farmers as Beneficiaries.

The integrated development of rural industries has formed a community of interests with farmers as the main beneficiaries,diversified sharing of development achievements and close connection. Its fundamental purpose is to promote the development of agricultural and rural areas and continuously improve the welfare of farmers, which is in line with the deep concern about the three rural issues in the report of the 19th National Congress of the Communist Party of China and the people’s yearning for the growing needs of a better life. At present, due to the weak industrial foundation in rural areas,the development of rural industrial integration is difficult to rely solely on its own strength, so it needs to rely on the support from external resources in rural areas. When the natural capital with the nature of profit-seeking is combined with the peasant class,due to the inherent contradiction between the two,if the distribution of interests is improper, with the influx of capital constantly dividing the big cake of the integration of the three industries,rural industrial integration has become a means of capital exploitation in different spaces.Farmers cannot enjoy the integration results,and rural areas cannot be developed, which is obviously contrary to the original intention of promoting the development of rural industrial integration. At the same time,if non-agricultural capital is excessively restricted in the distribution of integration benefits, its motivation to participate in integration is bound to be greatly reduced and it is likely to result in isolated rural development. Therefore,in order to fully mobilize the enthusiasm of all parties,it is necessary to balance the interests of different subjects, so as to take care of the interests of all parties under the principle that the balance of interests is moderately inclined to farmers.

4. Measurement of the Level of Rural Industrial Integration

4.1. Construction of Index System

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Table 1. Comprehensive Evaluation Index System of Rural Industrial Integration Development Level

First Grade Indexes	Secondary Indicators	Specific Indicators	
Agricultural Internal Restructuring and Integration	Integration Level of Farming and animal husbandry Integration Level of Farming and Fishery Integration Level of Farming and Forestry Integration Level of Animal Husbandry and Fishery Integration Level of Animal Husbandry and Forestry Integration Level of Fishery and Forestry	GDP of farming (billion yuan), GDP of animal husbandry (billion yuan) . GDP of farming (billion yuan), GDP of fishery (billion yuan) . GDP of farming(billion yuan), GDP of forestry (billion yuan). GDP of animal husbandry(billion yuan), GDP of fishery (billion yuan). GDP of animal husbandry(billion yuan), GDP of forestry(billion yuan) . GDP of fishery (billion yuan), GDP of forestry (billion yuan).	
Extension and Integration of Agricultural Industry chain	Development Level of Agricultural Products Processing Industry Level of agricultural services	Agricultural products processing industry main business income / primary industry output value (%) . Gross output value of agriculture, forestry, animal husbandry and fishery specialty and auxiliary activities / gross output value of primary industry (%).	
Multifunctional Extension and Integration of Agriculture	Agricultural Ecological Function Agricultural Social Function Agricultural and Cultural integration	Pesticide use per square hectare (kg / ha) ; fertilizer use per square hectare (kg / ha) . Output of main agricultural products per capita (kg / person).	
		agriculture	agricultural productivity : GDP of primary industry / population engaged in primary industry (yuan / person) ; land productivity : gross output value of planting industry / land acreage (Yuan / ha) ; average effective irrigation area (ha / person) ; rural per capita electricity consumption (kWh / person) ; rural per capita investment in fixed assets of agriculture, forestry, animal husbandry and fishery (yuan / person) ; forest cover rate (%).
		culture	per capita cultural expenses (yuan / person) ; number of books in public libraries per capita (book / person) ; number of books per capita (book / person) ; per capita number of journals (book / person) ; number of newspapers per capita (volume / person) ; the ratio of circulation number of public libraries to the total population (%) ; number of major cultural institutions per 10,000 persons (per 10,000 persons) ; the comprehensive population coverage rate of radio programs (%) ; TV program comprehensive population coverage rate (%).
	Integration of agriculture and tourism	agriculture tourism	agricultural indicators set as above. The number of domestic tourists (10000) ; receiving inbound overnight tourists (millions) ; international tourism revenue (billion yuan) ; domestic tourism revenue (billion yuan) ; total number of star hotels (one) ; total number of travel agencies (one) ; restaurant business income above quota (billion yuan).
Integration of Advanced Elements	Agricultural mechanization level	abour average agricultural machinery power (kW / person) ; per capita machine-cultivated area (ha / person) ; per capita air sowing area (ha / person) ; harvest area per capita (ha / person).	

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into Agriculture	Integration of Agriculture and Logistics	agriculture logistics industry	agricultural indicators set as above. Railway mileage per million (km / million) ; road mileage per million (km / million) ; river operation mileage per 10,000 people (km / 10,000 people) ; highway mileage per million (km / million) ; average delivery per person (piece / person) ; passenger turnover (billion kilometres) ; cargo turnover (billion tons of kilometers).

According to the relevant research of industrial integration theory,combined with the current characteristics of China's rural industrial integration development,the comprehensive evaluation index system of China's rural industrial integration development level is constructed.The first level index represents the development level of rural industrial integration in different dimensions,which is divided into four dimensions,namely,the internal restructuring and integration of agriculture,the extension and integration of agricultural industrial chain,the expansion and integration of agricultural multifunctionality,and the infiltration and integration of advanced elements to agriculture.Based on the principles of accessibility,operability,systematicness and scientificity of index data,a comprehensive evaluation system of rural industrial integration development level is constructed,such as Table 1.

4.2. Research Method

4.2.1. Entropy Method

This paper selects entropy method to weight the index,and determines the weight of the index by analyzing the correlation and information between the indexes,which can avoid the deviation caused by subjective influence to a certain extent.The specific steps are as follows:

(1)Index selection

Set a total of h years, m provinces, n evaluation indexes, Xθij refers to the j evaluation index of the i province in the θ year.

(2)Dimensionless treatment of indicators

Before the calculation of indicators, the incommensurability caused by different dimensions of indicators should be eliminated to make the data comparable, so the evaluation indicators should be dimensionless. In this paper, the range standard method is selected for dimensionless processing of data. In order to make the data meaningful and meet the subsequent operation requirements, the dimensionless index value is shifted by 0.0001 units to the right.

Dimensionless treatment of positive indicators: X'θij=(Xθij-Xmin)/(Xmax-Xmin).

Dimensionless treatment of reverse indicators : X'θij=(Xmax-Xθij)/(Xmax-Xmin).

where Xθij and X'θij are the jth index values of the ith province in the θth year before and after the dimensionlessization, respectively ;Xmin is the minimum value of item j in all evaluation objects, and Xmax is the maximum value of item j in all evaluation objects.

(3)Normalization of indexes

Calculate the proportion of Xθij to the sum of all year index j for all evaluation objects.

$$P\theta ij=X'\theta ij/\sum_{\theta}^{h}\sum_{i}^{m}X'_{\theta ij}$$

(4)Calculation of entropy for item j

$$Ej=-k\sum_{\theta}^{h}\sum_{i}^{m}(P_{\theta i}\ lnP\theta ij),\ where\ k=1/ln(h*m)$$

(5)Calculate the information utility value of indicator j

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$$Dj=1-Ej$$

(6)Calculate the weight of indicator j

$$Wj=Dj/\sum_j^n Dj$$

(7)Calculation of rural industrial integration development level scores in provinces

$$U\theta i=\sum_j^n (X'_{\theta ij} * W_j)$$

4.2.2. Coupling Coordination Degree Model

Coupling refers to the phenomenon that two or more systems or modes of motion affect each other through various interactions.The degree of coupling is used to describe the degree of interaction between systems or elements,but the degree of coupling only measures the intensity of interaction between systems,and it cannot be distinguished as benign interaction or inferior interaction.Coordination is a benign correlation between two or more systems or system elements,a relationship of proper coordination,harmony and virtuous circle between systems or system elements,and a guarantee for the healthy development of multiple systems or elements(Yang Shihong,2003)[8].Coupling coordination not only analyzes the strength of the interaction between systems,but also analyzes the state of mutual cooperation and harmonious development between systems,which is to measure the degree of harmony and consistency between systems or internal elements in the development process,reflecting the trend of the system from disorder to order.Industrial integration is not a simple addition of the two subsystems,but a mutually reinforcing and mutually supporting coupled open system formed by the structural effects of the internal subsystems.In this paper,the coupling coordination model is established according to the coupling concept of physics.Taking the planting industry,animal husbandry,forestry,fishery and agriculture,culture industry,tourism and circulation industry as the coupling system,the level of internal reorganization and integration of agriculture,agriculture and culture industry,agriculture and tourism,agriculture and circulation industry are calculated.The calculation method of coupling coordination degree is as follows:

(1)A binary system composed of M and N industries is established,then the coupling evaluation model formula of the binary system is:

$$C=(U1*U2)1/2/(U1+U2)$$

C represents the coupling degree of the binary system,and U1 and U2 are the comprehensive industrial evaluation values obtained by linear weighted summation of all indicators of industries M and N,respectively.The steps of specific algorithm and entropy method(7).

(2)The coupling coordination degree of the binary system is calculated and the formula is:

$$H=(C*T)1/2;\ T=aU1+bU2$$

H is the coupling coordination degree of the binary system,T is the comprehensive evaluation value of the two subsystems,a is the weight of U1 industry,and b is the weight of U2 industry.We believe that the importance of these two industries is equivalent,so the values of a and b are 0.5. The value range of coupling coordination degree is[0,1].The closer the coupling coordination

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degree is to 1,the better the mutual coordination between binary systems is.The tighter the coupling coordination degree is,the worse the mutual coordination between the binary systems is.

4.3. Measurement of Rural Industrial Integration Development Level

4.3.1. Data Source and Processing

In the construction of the comprehensive evaluation index system of rural industrial integration development,the data of 30 provincial administrative regions except Hong Kong, Macao and Taiwan and Tibet from 2005 to 2019 are used,and all nominal data are reduced in 1978.The main business income data of agricultural products processing industry comes from'China Industrial Statistics Yearbook'and provincial economic census yearbook, provincial statistical yearbook;the data of cultural industry comes from'Statistical Yearbook of Chinese Cultural Relics and Tourism'and'Statistical Yearbook of Chinese Cultural Relics';fixed assets investment data and rural electricity consumption data of rural agriculture, forestry, animal husbandry and fishery come from China Rural Statistical Yearbook.Tourism data from the' China Cultural Heritage and Tourism Statistical Yearbook','China Tourism Yearbook',the provincial tourism statistics annual bulletin;agricultural mechanization level data from the' China Agricultural Machinery Industry Yearbook'.The data are from the official website of the National Bureau of Statistics and the statistical yearbooks of provinces.

4.3.2. Calculation Process and Result Analysis

According to the above research methods,the index evaluation values of agricultural internal restructuring and integration level,agricultural industrial chain extension level,agricultural multi-functional expansion and integration level,and advanced factors on agricultural penetration and integration level in each province from 2005 to 2019 are calculated,and the comprehensive evaluation value of agricultural industrial integration level in each province is calculated again through the entropy method for the index evaluation values of these four sub-integration levels.Taking the calculation of the industrial integration level of agriculture and culture industry as an example,the comprehensive development level of the two is calculated by entropy method,and then the coupling coordination degree of the binary system is calculated by coupling coordination model as the industrial integration level of agriculture and culture industry.The calculation methods of the industrial integration level of agriculture, agriculture and tourism industry,agriculture and circulation industry are the same.

Limited to the length of the article,this paper only lists the final evaluation values of the level of rural industrial integration development across the country and the eastern,central,western and northeastern regions from 2005 to 2019,as shown in Table 2,and the evaluation values of sub-indicators are shown in Table 3.

It can be seen from table 2 that the overall level of China's rural industrial integration development is increasing year by year.The annual average value increased from 0.161 in 2005 to 0.3263 in 2019,with an average growth rate of 118.2%and an average annual growth rate of 8.44%.From the regional differences in the growth rate of rural industrial integration level,the average growth rate in the eastern region is the lowest,72%,116%in the northeast region,132%in the central region and 147%in the western region.The western region has the lowest level of integration and the highest average growth rate.This may be because the western region is more backward in the development of China’s regional economy than other regions,and the proportion of agriculture in the regional economy is significantly greater than that in the central and eastern regions.Therefore,its role in stimulating regional economic growth is also higher than that in the other two regions.In order to improve the pulling effect of agriculture on economic growth,the integration of rural industry is undoubtedly the best choice for the government and the public to promote agriculture and western economic development.The lowest average growth rate of rural industrial integration in the eastern

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region may be due to the fact that as the most developed region of China's economy,the pulling effect of agriculture on economic growth is lower than that of the secondary and tertiary industries,so the enthusiasm of rural industrial integration is lower than that of other regions.In order to avoid the phenomenon of heavy head and light foot in economic structure and make rural and agricultural development go hand in hand with other industries in the tide of social development,the eastern region must also thoroughly implement the development concept of rural industrial integration.

Table 2. Comprehensive Evaluation of China 's Rural Industrial Integration Development Level

region / year	Nation	Eastern	Central	western	northeast
2005	0.162	0.214	0.146	0.113	0.197
2006	0.177	0.224	0.168	0.128	0.218
2007	0.191	0.242	0.181	0.137	0.234
2008	0.207	0.256	0.196	0.155	0.261
2009	0.222	0.269	0.214	0.167	0.283
2010	0.237	0.285	0.229	0.177	0.309
2011	0.255	0.304	0.263	0.185	0.333
2012	0.263	0.309	0.261	0.196	0.359
2013	0.275	0.322	0.275	0.206	0.376
2014	0.287	0.332	0.291	0.218	0.386
2015	0.298	0.342	0.305	0.228	0.391
2016	0.309	0.351	0.338	0.232	0.394
2017	0.307	0.347	0.323	0.238	0.395
2018	0.313	0.356	0.329	0.245	0.391
2019	0.326	0.367	0.338	0.256	0.425

Table 3. the integration level of each sub-integration mode of rural industrial integration

region	Nation				Eastern				Central			
year	A1	A2	A3	A4	A1	A2	A3	A4	A1	A2	A3	A4
2005	0.267	0.101	0.385	0.085	0.31	0.175	0.416	0.09	0.333	0.066	0.358	0.061
2006	0.27	0.13	0.384	0.093	0.311	0.199	0.404	0.097	0.333	0.109	0.361	0.07
2007	0.298	0.134	0.394	0.102	0.339	0.216	0.411	0.105	0.371	0.103	0.376	0.078
2008	0.327	0.136	0.411	0.116	0.368	0.218	0.423	0.116	0.411	0.096	0.389	0.094
2009	0.335	0.149	0.425	0.128	0.376	0.228	0.435	0.126	0.421	0.116	0.403	0.105
2010	0.357	0.154	0.436	0.141	0.397	0.24	0.44	0.141	0.449	0.121	0.416	0.116
2011	0.391	0.171	0.439	0.148	0.433	0.259	0.439	0.148	0.486	0.173	0.417	0.123
2012	0.413	0.165	0.452	0.157	0.453	0.257	0.443	0.15	0.511	0.137	0.433	0.135
2013	0.433	0.172	0.46	0.163	0.47	0.266	0.453	0.156	0.533	0.149	0.442	0.139
2014	0.447	0.18	0.469	0.174	0.481	0.275	0.46	0.163	0.551	0.162	0.453	0.148
2015	0.458	0.186	0.478	0.182	0.491	0.287	0.465	0.167	0.561	0.174	0.466	0.158
2016	0.47	0.201	0.487	0.181	0.502	0.298	0.475	0.166	0.576	0.241	0.468	0.158
2017	0.477	0.18	0.497	0.189	0.506	0.276	0.483	0.171	0.584	0.189	0.481	0.166
2018	0.487	0.173	0.51	0.199	0.514	0.278	0.497	0.179	0.593	0.179	0.494	0.178
2019	0.507	0.169	0.527	0.216	0.533	0.278	0.512	0.188	0.623	0.172	0.508	0.185

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A1 represents the integration of agricultural restructuring, A2 represents the integration of industrial chain extension, A3 represents the integration of agricultural multifunctional expansion, A4 represents the penetration of advanced elements into agriculture.

Continued Table 3 the integration level of each sub-integration mode of rural industrial integration.

region	western				northeast			
year	A1	A2	A3	A4	A1	A2	A3	A4
2005	0.185	0.071	0.349	0.065	0.296	0.037	0.465	0.185
2006	0.19	0.098	0.352	0.072	0.301	0.06	0.479	0.203
2007	0.214	0.097	0.364	0.078	0.326	0.063	0.487	0.223
2008	0.237	0.102	0.383	0.092	0.357	0.071	0.522	0.244
2009	0.242	0.109	0.403	0.103	0.367	0.098	0.513	0.271
2010	0.262	0.105	0.417	0.113	0.389	0.114	0.536	0.295
2011	0.292	0.104	0.42	0.115	0.425	0.117	0.555	0.321
2012	0.312	0.106	0.435	0.122	0.457	0.126	0.578	0.348
2013	0.332	0.11	0.441	0.128	0.476	0.132	0.59	0.367
2014	0.347	0.115	0.454	0.14	0.488	0.133	0.587	0.389
2015	0.361	0.117	0.464	0.147	0.494	0.124	0.595	0.405
2016	0.379	0.113	0.477	0.144	0.487	0.12	0.603	0.416
2017	0.388	0.109	0.489	0.152	0.495	0.105	0.606	0.431
2018	0.4	0.1	0.505	0.161	0.505	0.077	0.602	0.45
2019	0.418	0.096	0.526	0.172	0.516	0.072	0.622	0.53

From the A column of the overall level of rural industrial integration development in Table 3,it can be seen that the level of internal restructuring and integration of agriculture in China has continued to improve, from 0.267 to 0.507,which has increased by 0.24.The level of agricultural internal integration in the western region is lower than that in other regions over the years, and only this region is lower than the national average. This may be due to the unique geographical environment and climate characteristics in the western region, which makes its agricultural management mainly based on nomadic and oasis agriculture. The development level of fishery and forestry does not match it.It is difficult to present the scene of'raising chickens under the forest','raising fish in paddy field'and'symbiosis between shrimp and rice', and the cooperation between sub-industries in agriculture does not play a good role.

From the B column of the overall level of rural industrial integration development in Table 3,the level of extension and integration of China's agricultural industrial chain has increased from 0.101 to 0.169,which is 0.068.The level of agricultural industrial chain extension and integration in the eastern region is much higher than that in the other three regions, and only the region has been higher than the national average over the years. As a region with strong industrial foundation and solid industrial development in China, the eastern region has continuously promoted the development of deep processing of agricultural products, the construction of investment projects and the development of markets in recent years, and played the guiding role of agricultural service industry in agriculture.Various measures have fully extended the value chain of agricultural products and created more value of agricultural products.

From the C column of the overall level of rural industrial integration development in Table 3,it can be seen that the level of agricultural multi-functional expansion integration in China has increased from 0.349 to 0.526,and the average growth rate in the central and western regions

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is the fastest. The western region has rich multi-functional agricultural resources, but because most of these resources are distributed in poor villages,the overall level of economic development is relatively backward, so the development of agricultural function expansion integration is restricted. In recent years,under the impetus of the government,through the integration of rural tourism resources,the scenic spots,modern agriculture,folk culture,catering and accommodation and other related industries are organically integrated and pushed to the market, so that these resources can truly face the public and obtain the benefits of agricultural multifunctional integration.

From the D column of the overall level of rural industrial integration development in Table 3,it can be seen that the level of agricultural integration of advanced elements in China has increased from 0.085 to 0.216,and increased by 0.131.Advanced technology has the most obvious growth trend for agricultural penetration integration compared with other integration modes. The penetration and integration of advanced elements to agriculture in Northeast China is higher than that in other regions. In recent years,agriculture in Northeast China has accelerated the development of rural e-commerce around agricultural mechanization and large-scale development, showing a good trend of vigorous development.

In summary, the level of rural industrial integration in China has steadily increased year by year, and the average development level has increased from 0.162 to 0.362.The level of rural industrial integration in each region is steadily improving, and the average increase in the western region is the largest,but the level of integration is still far behind that in other regions. In terms of the integration level of each sub-index,the eastern region has a solid industrial foundation,which can fully promote the continuous and deep processing of agricultural products,and the extension integration level of agricultural industry chain is much higher than that of other regions; the sub-industries in agriculture in the central region are mutually integrated and promoted,and the development level of this indicator is higher than that of other regions; the western region is rich in multi-functional agricultural resources,but due to the limitation of economic development, it cannot give full play to the advantages of multi-functional agriculture,and this indicator ranks second.The northeast region continues to promote the development of modern agriculture, and the level of agricultural infiltration and integration of advanced elements ranks first.

5. Conclusions and Implications

This paper theoretically analyzes the connotation of rural industrial integration development,and uses the panel data of 30 provincial administrative regions in China except Hong Kong,Macao and Taiwan from 2005 to 2019 to measure the level of rural industrial integration development in various regions.The study finds that:

The overall level of rural industrial integration in China has increased from 0.162 to 0.326,by 0.164.For the four specific integration modes,the integration level of agricultural internal restructuring,agricultural industrial chain extension,agricultural multi-functional expansion and integration,and the penetration of advanced elements on agriculture are from 0.267 to 0.507,from 0.101 to 0.169,from 0.385 to 0.527,and from 0.085 to 0.216,respectively.

There are obvious regional differences in the level of rural industrial integration development in China.The level of rural industrial integration development in the eastern and northeastern regions is higher,while the level of rural industrial integration development in the central and western regions is lower.

The development level of four specific integration modes of rural industrial integration in China has the characteristics of regional differentiation.The central region has the highest level of agricultural restructuring and integration,the eastern region has the highest level of

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agricultural industrial chain extension and integration,and the northeast region has the highest level of agricultural multi-functional expansion and integration and advanced elements.

Based on the above research conclusions,in order to better promote the development of rural industrial integration in China,this paper puts forward the following suggestions:

We should follow the path of integrated development of agricultural ecology, optimize the planting and breeding structure according to local conditions, promote the circular development of agriculture, forestry,animal husbandry and fishery,and improve the utilization rate of agricultural resources;actively promote the transformation of agricultural products from planting,initial processing to deep processing and finishing, through the leading role of leading enterprises, the establishment of'company+farmer cooperatives+family farms', 'company+family farms'and other agricultural industrialization organizations,promote the extension and integration of agricultural industry chain development; fully tap the various functions of agriculture, relying on tourism resources with local characteristics,carry forward rural folk customs and farming culture,take the road of green and sustainable development of agriculture, and promote the integrated development of agricultural function expansion; innovating the mode of agricultural production,improving the conditions of agricultural production and operation,continuously improving the level of agricultural production technology, promoting the development of advanced machinery manufacturing industry in agricultural machinery and equipment,accelerating the development of digital agriculture, making full use of the logistics industry to realize the marketing and promotion of agricultural products, and realizing the deep penetration of advanced elements to agriculture.

Each region should rely on the local natural resources endowment, historical and cultural heritage,characteristic industries and advantageous industries to choose the suitable agricultural internal restructuring and integration mode, agricultural industry chain extension mode, agricultural multi-functional expansion and integration mode and advanced elements of agricultural infiltration and integration mode.The eastern region should continue to make full use of the pulling effect of the secondary industry and the tertiary industry on agriculture, and continue to promote the in-depth innovation and development of agricultural products processing industry, so as to produce both large quantities of agricultural products and high-quality agricultural products. Although the stock of agricultural tourism resources in the eastern region as a whole is not abundant in other regions,it can rely on the developed tertiary industry to optimize and integrate agricultural resources and build a sound commercialization system of agricultural tourism. The extension index of agricultural industry chain in the central region is still lagging behind the eastern region, which shows that the development maturity of agricultural products processing industry is not enough, and the proportion of agriculture, forestry, animal husbandry and fishery service industry in the agricultural industry chain is not high.To continue the steady development of agriculture in the central region, it is necessary to complement the corresponding shortcomings and encourage farmers to actively participate in the processing and circulation of agricultural products. The economic foundation of the western region is weak,and the integration and development of rural industries should first achieve key breakthroughs. The resource advantages should be concentrated on the expansion and integration of multi-functional agriculture.Relying on local natural ecology,ethnic villages, characteristic agriculture and other rural tourism resources,we should carry forward the farming culture, dig deep into the ecological conservation,leisure sightseeing,cultural experience,pension services and other functions and multiple values of agriculture and rural areas, and promote the development and upgrading of leisure agriculture and rural tourism. The level of rural industrial integration in Northeast China is higher than that in other regions, so more attention should be paid to the construction between farmers and capital

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References

[1] Rengang Yu.Three industrial classifications and industrial integration trends.[J]Economic research reference,1997,(25):46–47.

[2] Binbin Ran.Integration of agriculture and tourism in urban and rural development[D]. Chengdu: Southwest Jiaotong University,2008.

[3] Xiaoli Xi.Research on the development of modern agriculture from the perspective of industrial integration[D].Fuzhou:Fujian Normal University,2008.

[4] Yun Li,Junhong Chen,Ci Chen.Research on the evaluation index system of agricultural industry integration and its application in Beijing[J].Science and technology management research,2017,37 (04):55-63.

[5] Ling Wang.Measurement and Regional Difference Analysis of Rural Industrial Integration in Jiangsu Province[J].Agricultural Economy,2017,(06):21-22.

[6] Li Cheng,Fangxia Kong.Measurement and influencing factors of rural industrial integration development level in the upper reaches of the Yangtze River[J].Statistics and Information Forum, 2020,35(01):101–111.

[7] Lin Zhang,Tao Wen,Yuanbo Liu.Rural industrial integration development and farmers'income growth:theoretical mechanism and empirical judgment[J].Journal of Southwest University(Social Science Edition),2020,46(05):42-56+191-192.

[8] Shihong Yang,Chongbin Liao,Zongqing Zheng.Urban Ecological Environment Science[M]. Beijing: Science Press,2003.