Research on the Coupling of "Population-Consumption-Industry-Economy" System from the Perspective of High-quality Development

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Abstract: This article calculates the coupling coordination index of the quaternary system of the population-consumption-industry-economy in China and its 31 provinces from 2006 to 2019 from the perspective of high-quality development. The results indicate that the coupling coordination degree of the system shows a slow increasing trend year by year with significant regional differences. In addition, panel data was established to study the impact of coupling coordination between various subsystems on the overall coupling of the system. The study found that the coupling coordination degree between any two subsystems has a significant negative impact on the overall coupling of the system. While the degree of any three subsystems has a significant positive impact on the overall coupling of the system. The analysis suggests that in the development process of the country and various provinces, a high-quality development positive cycle should be established around the above factors, including population structure transformation, consumption structure upgrading, industrial optimization, and sustainable economic development.

1. Introduction

After more than 40 years of development since the reform and opening up, the Chinese economy has achieved significant achievements, with a significant increase in the total national economy and per capita GDP. In order to meet the requirements of sustainable development in the new era, the rapid growth economic development model needs to be adjusted. The Chinese government has proposed that "China's economy has shifted from a stage of high-speed growth to a stage of high-quality development" in multiple meetings, indicating a significant shift in the focus of China's economic development at this stage. As a comprehensive system involving various factors such as development models, development dynamics, environmental ecology, innovation and competition, and people's lives, whether there are problems with the coupling and coordination between various subsystems within the large system during the development process, and what policy measures should be taken to ensure coordinated development between subsystems to promote high-quality economic development are research topics worth exploring in depth.

In the process of development, population has a crucial impact on economic development. Changes in population age, space, gender, and quality will first affect the consumption structure through changes in consumer demand. Then, through the demand side, it has an impact on the employment, output value, and rationalization of the three industries, ultimately affecting the high-quality development of the Chinese economy. At the same time, the results of high-quality development will have an impact on the structure of population, consumption, and industry. Therefore, in the process of high-quality development, how to measure the coupling degree and coupling coordination degree of each subsystem in time and space, how the coupling characteristics between each system will affect the high-quality development of the economy, what measures should be taken to promote high-quality development are the main research purpose of this article.

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2. Literature Review

Among the numerous studies on population, consumption, industry, and economic growth, most scholars first focus on the study of pairwise relationships. In the study of the relationship between population structure and economic growth, scholars mainly focused on the relationship between population dividend and economic growth. Zhai Zhenwu and Chen Wei (2007)[1], based on estimation of the fertility rate of the late 1990s, believed that the age and gender structure have a positive impact on economic growth. Subsequently, scholars have successively studied the relationship between population expected dividends and population quality dividends, and found that the dual capital deepening effect caused by these two dividends has a significant impact on industrial structure change and industrial agglomeration (Lu Fei and Liu Minghui, 2018; Wang Shu, 2021)[2,3]. In the study of the relationship between consumption structure and economic growth, scholars have either directly conducted research on the mutual influence mechanism between them, and found that investment structure is the main transmission channel for the impact of consumption structure on economic growth(Yu Jian and Fang Fuqian, 2015)[4], Alternatively, mainly analyze the consumption differences among urban residents and the impact of changes in residents' consumption expenditures in the three industries on the Chinese economy (Ni Hongfu and Ji Cheng, 2020)[5]. More scholars believe that the driving force of consumption structure on economic growth is transmitted through industrial structure. (Zhang Guangzhu (2019), Wang Qing et al. (2017)[6,7] mainly studied the impact of consumption upgrading on industrial structure, believing that consumption upgrading plays a dominant role in industrial structure transformation compared to other factors. At the same time, there are significant differences in geographical effects between the two in terms of mutual influence and interaction (Xiao Biyan, 2020)[8].

Regarding the research on industrial structure and economic growth, domestic and foreign scholars believe that the adjustment and evolution of industrial structure have an important driving effect on economic growth and have obvious phased characteristics. Through empirical research found that the rationalization and upgrading of industrial structure after adjustment have a significant impact on economic growth (Cimoli, 2009; Gan Chunhui, 2011)[9,10]. Some scholars have used empirical research on inter provincial panel data, using statistical methods to verify the contribution of industrial structure to regional economic growth (Cui Hongkai and Wei Xiao, 2018; Wang Feng et al., 2018)[11,12].

In summary, firstly, most of the existing research focuses on the pairwise relationship between population, consumption, industry, and economy. secondly, when considering the interrelationships between them, there is no or less consideration of establishing an indicator system from the five dimensions of high-quality development; thirdly, in the indicator system established for population structure, it is also necessary to distinguish the human capital structure from dimensions such as age, education level, spatial distribution, etc. in order to further examine the relationship between population structure, consumption structure, industrial structure, and high-quality economic development. this article first examines the dynamic evolution of the coupling status between the four subsystems in terms of time series and spatial distribution. On this basis, it explores the impact of the coupling coordination degree between subsystems on the overall coupling of the system, in order to identify important determinants of high-quality economic development.

3. Research Logic and Indicator System Construction

3.1. The Mechanism of the System of "Population-Consumption-Industry-Economy"

From the perspective of high-quality development, population, consumption, industry, and economy interact with each other in the coupled development. Starting from the structural system of population, the changement of age, education level, spatial geographical distribution, gender, will all lead to changes in the proportion of different consumption demands in the composition of residents' consumption, such as clothing, food, housing, transportation, medical care, culture, education, and entertainment, resulting in changes in the overall consumption structure. which will further force supply from the demand side and affect the adjustment and optimization of industrial

structure, achieve high-quality development. At the same time, changes in indicators such as the proportion of aging population and education structure will have an impact on the scale of employment personnel and employment structure among the three industries. These factors will in turn force the upgrading of industrial structure and technology and promote economic development from an innovative perspective.

From the perspective of consumption system analysis, the differences in the dual consumption structure between urban and rural residents, as well as the changes in the proportion of survival, consumption, and development consumption structures, will promote the adjustment and optimization of various industries.From the perspective of the industrial system, the demand side and supply side reforms over the years have promoted the gradual rationalization and evolution of the industrial structure, while also affecting changes in population structure and consumption structure. From the perspective of economic development changes, regional differences in economic development level and income will have an impact on regional population structure and consumption structure, thereby affecting the development of industrial structure and economic development.thereby the four subsystems form a larger range of high-quality development closed-loop systems that constrain or promote each other's development through mutual coordination. If there are problems between any subsystems, it will lead to the weakening or stagnation of the conduction influence mechanism, thereby affecting the overall development of the large systems. Therefore, when considering the coupling development of the quaternary system of the high-quality development, it is necessary to analyze the coupling situation of the quaternary system and the two or three subsystems, then the main influencing factors can be analyzed and research conclusions can be obtained more accurately.

Based on the above analysis, this article proposes the following two hypotheses:

Hypothesis 1: In the coupled development of the population-consumption-industry-economy quaternary system, the coupling coordinated development degree between any two subsystems will have a positive and significant impact on the overall system.

Hypothesis 2: In the coupled development of the population-consumption-industry-economy quaternary system, the coupling coordinated development degree between any three subsystems will have a positive and significant impact on the overall system.

3.2. Construction of Indicator System, Data Sources, and Indicator Weights

Following the principles of comprehensiveness, scientificity, and representativeness, based on the indicator settings of relevant scholars (Wang Lianghu et al., 2020; Lu Jin et al., 2018)[13,14], combined with the main research content of this article. Finally, 26 indicator systems were set up under the three systems of population, consumption, and industry. Data collection and analysis were conducted across the China and 31 provinces from 2006 to 2019 through the "China Population and Employment Statistical Yearbook" and the national and provincial statistical yearbooks.

For the panel data from China and 31 provinces from 2006 to 2019, including time and spatial dimensions, it is more suitable to apply the global entropy method, which evaluates the weight of n indicator variables in M regions within T years, to determine the weight of the indicator system and calculate the development index of the global entropy evaluation matrix constructed in this article. The calculation steps are as follows:

① Standardized processing of data. To avoid inconsistent dimensions of indicator data, standardize the data using the following formula:

Formula for processing positive indicators:

$$x_{ij}^{'}(t)=\frac{x_{ij}^{'}-x_{j\min}}{x_{j\max}-x_{j\min}}\times 99+1 \tag{1}$$

Formula for handling negative indicators:

$$x_{ij}^{'}(t)=\frac{x_{j\max}-x_{ij}^{'}}{x_{j\max}-x_{j\min}}\times 99+1 \tag{2}$$

Among them, $1\le i\le M, 1\le j\le n, 1\le t\le T$.

② Calculate the information entropy of the j indicator:

$$e_j = -K\sum_{i=1}^{T}\sum_{i=1}^{n} y_{ij}^{t} \ln y_{ij}^{t}, K = \frac{1}{\ln MT} \tag{3}$$

③ Calculate the information redundancy of the jth indicator:

$$g_j = 1 - e_j \tag{4}$$

④ Calculate the objective weights of each evaluation indicator:

$$0 \le w_j \le 1, \sum_{j=1}^{n} w_j = 1 \tag{5}$$

The calculated indicator w_j weights meet the requirements $w_j = \frac{g_i}{n - \sum_{j=1}^{n} e_j}$.

⑤ Calculate the comprehensive evaluation value:

$$s_i = \sum_{j=1}^{n} w_j (x_{ij}^{t})' \tag{6}$$

The results of determining the weights of each indicator in the population, consumption, and industry indicator system according to the above steps are shown in Table 1:

Table 1 Evaluation system and weights of population, consumption, and industry indicators.

First level indicator	Second level indicator	Third level indicator	Unit	Indicator attribute	Weight
Population structure	Age structure	Proportion of population aged 0-14	%	Negative	0.030994
		The proportion of young and middle-aged in the employed	%	Positive	0.153949
		The proportion of middle-aged in the employed	%	Positive	0.1166
		Proportion of elderly in the employed	%	Negative	0.117255
		Proportion of population aged 65 and above	%	Negative	0.082708
		Total social dependency ratio	%	Negative	0.026136
	Quality structure	Average length of education	yr	Positive	0.074835
		The proportion of higher education employed	%	Positive	0.102449
	Distribution structure	Urbanization rate of the total population	%	Positive	0.087269
		Proportion of employed in urban and rural areas	%	Positive	0.078016
	Gender structure	Gender ratio of the total population	%	Negative	0.009274
	Population size	Total Population	w	Positive	0.120516
Consumption structure	Survival consumption of urban	Proportion of clothing, food, housing, and transportation consumption	%	Negative	0.121214
	Enjoyable consumption of urban	Proportion of consumption of household equipment and services, other goods and services	%	Positive	0.188937
	Development consumption of urban	Proportion of medical, trans and communication, cultural and educational consumption	%	Positive	0.155687
	Survival consumption of rural	Proportion of clothing, food, housing, and transportation consumption	%	Negative	0.153287
	Enjoyable consumption of rural	Proportion of consumption of household equipment and services, other goods and services	%	Positive	0.237855
	Development consumption of rural	Proportion of medical, trans and communication, cultural and educational consumption	%	Positive	0.14302
Industrial structure	Output structure	Proportion of the primary industry output value	%	Negative	0.022980
		Proportion of the secondary industry output value	%	Positive	0.203447
		Proportion of the tertiary industry output value	%	Positive	0.219156
	Employment structure	Proportion of the primary industry employed	%	Negative	0.077038
		Proportion of the secondary industry employed	%	Positive	0.069319
		Proportion of the tertiary industry employed	%	Positive	0.145013
	Industrial rationalization	Theil index	--	Negative	0.105705
	Industrial upgrading	The ratio of the output value between the tertiary and the secondary industry	%	Positive	0.157338

Regarding the establishment of an indicator system for high-quality economic development, the academic community has closely measured and studied from innovation, coordination, green,

openness, and sharing dimensions. Based on the research experience of scholars and considering the three principles of evaluating high-quality economic growth in the "Blue Book of China's High Quality Economic Development (2019)", this article sets the indicator system for high-quality economic development as an indicator system consisting of 40 variables under five evaluation dimensions of innovation, coordination, green, openness, and shared benefits for analysis.

4. Analysis of the Coupling of Population-Consumption-Industry-Economy System

4.1. Calculation of Coupling Coordination Degree

The coupling situation of the population consumption industry economic system can be analyzed through the calculation of coupling degree and coupling coordination degree, which reflect the intensity of interaction within the system and the degree of coordinated development between subsystems. It should be noted that compared to coupling degree, coupling coordination degree can more comprehensively reflect the overall coordination level of the system.

Steps for calculating coupling coordination degree:

① Calculate the coupling degree C of the quaternion system, and the calculation formula is as follows:

$$C_4 = \left\{ \frac{(u_1, u_2, u_3, u_4)}{\prod (u_i + u_j)} \right\}^{\frac{1}{4}} \tag{7}$$

Among them, $u_i (i = 1,...,4)$ is the evaluation value of the population, consumption, industry, and economic systems obtained in the previous part . $i \neq j$, The C is between 0 and 1, and its size is positively correlated with the degree of correlation between each system. The larger the C, the greater the degree of correlation between each system.

② Calculate the degree of development of a quaternion system T:

$$T = \alpha u_1 + \beta u_2 + \chi u_3 + \lambda u_4 \tag{8}$$

α、β、χ、γ is the undetermined coefficient. According to the research logic of this article, this article sets the undetermined coefficients α、β、χ、γ to be equal, all of which are 1/4.

③ Calculate the coupling coordination degree D of the quaternary system using the following formula:

$$D(u_1, u_2, u_3, u_4) = \sqrt{C(u_1, u_2, u_3, u_4) \times T(u_1, u_2, u_3, u_4)} \tag{9}$$

The calculated coupling coordination degree D meets $0 \le D(u_1, u_2, u_3, u_4) \le 1$, and based on the results of the calculation, the level of coupling coordination degree is divided into intervals. The level division and corresponding explanations are shown in Table 2:

Table 2 Coupling coordination level classification and characteristics.

Coupling coordination degree D	Coordination level	Feature
0--0.19	Severe imbalance	The development of subsystems are mutually constrained, and the development is extremely uncoordinated, seriously constraining high-quality development
0.2--0.39	Moderate imbalance	The constraint effect between subsystems still dominates in the development. The system structure has a degree of rationality, while there are many problems need to be adjusted and improved
0.4--0.59	Basic coordination	The development of subsystems has a good overall positive trend. It is necessary to identify problems and improve overall coordination
0.6--0.79	Moderate coordination	The coordination between systems is relatively high, and high-quality development has achieved certain results.
0.8--1	Highly coordinated	The development between systems is in an ideal state, requiring dynamic monitoring and management to maintain a highly coordinated development state

4.2. Analysis of the Calculation Results of the Coupling Coordination Degree of Quad System

The data shows that since 2006 to 2019, the coupling coordination degree at the national level has been slowly increasing year by year (see Table 3), from 0.4886 in 2006 to 0.5140 in 2019, and the coupling coordination degree is within the basic coordination range. It shows that the policies such as population, increasing consumption, transforming consumption structure, optimizing industrial upgrading, and transforming economic development models have gradually achieved good results nationwide. The basic coordinated development of the system has a good positive promoting effect on high-quality development. The focus of the future needs to be on studying the internal structure of each system, locally improving the unreasonable parts, and promoting the coupling coordination degree of the quaternary system.

Table 3 National population-consumption-industry-economy system coupling coordination degree from 2006 to 2019.

Year	2006	2007	2008	2009	2010	2011	2012
Coupled Coordination degree	0.4886	0.4889	0.4899	0.4951	0.4998	0.5029	0.5045
Year	2013	2014	2015	2016	2017	2018	2019
Coupled Coordination degree	0.5075	0.5038	0.5071	0.5077	0.5092	0.5116	0.5140

Figure 1 shows that the coupling coordination degree of the four regions in China has been on a slow upward trend from 2006 to 2019, all of which are between 0.4 and 0.5, indicating that the development in each region is basically coordinated. Meanwhile, Figure 1 clearly shows that the average coupling coordination degree in the eastern regions of the four major regions is the highest, followed by the northeast and the west region, indicating that there are still regional differences. However, comparing the data from 2006 and 2019, it can be seen that with the implementation of regional development strategies such as the country's western development, the rise of the central region, and the revitalization of the northeast, the coupling and coordination between different regions have been increasing, while the regional differences are slowly narrowing year by year.

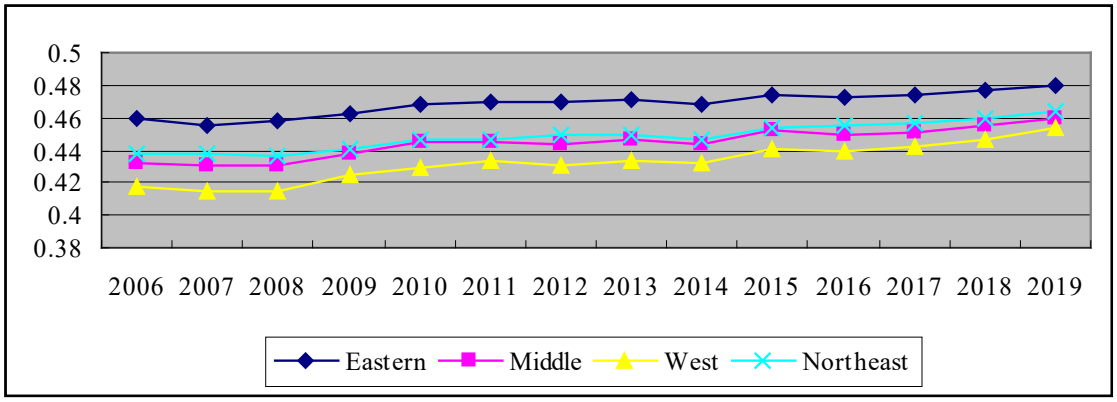

Figure 1 Population-consumption-industry-economy coupling coordination degree by region from 2006 to 2019.

Table 4 Mean and ranking of coupling coordination degree among provinces from 2006 to 2019.

Region	BJ	SH	TJ	ZJ	JS	GD	SD	LN	FJ	CQ	HE
avg	0.5022	0.4986	0.4753	0.4709	0.4708	0.4655	0.4584	0.4558	0.4539	0.4522	0.4485
Ranking	1	2	3	4	5	6	7	8	9	10	11
Region	HB	HL	SC	SX	HA	JL	AH	HN	SN	JX	HI
avg	0.4478	0.4457	0.4454	0.4452	0.4450	0.4446	0.4445	0.4440	0.4416	0.4407	0.4405
Ranking	12	13	14	15	16	17	18	19	20	21	22
Region	NX	NM	QH	XJ	GX	GS	XZ	YN	GZ		
avg	0.4396	0.4387	0.4356	0.4294	0.4264	0.4242	0.4196	0.4193	0.4169		
Ranking	23	24	25	26	27	28	29	30	31		

From the perspective of provinces, the ranking of the average coupling coordination degree

between 2006 and 2019 (see Table 4) shows that all provinces are within the basic coordination range of 0.4 to 0.59. Among them, Beijing has the highest score and ranks first, and is also the only region with an average greater than 0.5. Guizhou Province ranks 31st with a score of 0.416 9.

5. Analysis of Factors Influencing the Coupling Coordination Degree of Quad System

From the system theory, the overall coupling coordination degree of a system is closely related to the coupling coordination degree between its subsystems.In order to identify the main influencing factors and formulate policies, it is necessary to calculate the coupling coordination degree between two or three subsystems within the system, and analyze the impact of each variable on the large system. The steps are the same as above. calculate the coupling coordination degree of binary and ternary systems such as population-consumption(X12),population-industry (X13), population-economy(X14), consumption-industry(X23), consumption-economy(X24), industry-economy(X34), population-consumption-industry(X123), population-consumption-economy(X134), population-industry-economy (X134), and consumption-industry-economy(X234) across the country and each province from 2006 to 2019, Using them as explanatory variables and the coupled coordination degree (Y) as dependent variable, establish panel data to examine the impact of each explanatory variable on the dependent variable.

5.1. Stability Testing of Panel Data

Before conducting analysis, it is necessary to first conduct a stationarity test on the panel data to avoid pseudo regression where there is no true correlation between the data. This article mainly uses LLC for the same root unit test and ADF-Fisher for the different root unit tests for testing.

According to Eviews7.0, the results (see Table 5) show that except for the variables X12 and X13, which are 0-order single integers, all other data sequences are 1-order single integers..

Table 5 Unit root test results for each variable.

Variable		LLC test (P-value)	ADF-Fisher test (P-value)
Y	Y	0.97755 (0.8359)	15.3855 (1.0000)
	DY	-19.4086 (0.0000)***	297.622 (0.0000)***
X12		-5.87184 (0.0000)***	138.205 (0.0000)***
X13		-4.89444 (0.0000)***	115.745 (0.0000)***
X14	X14	1.51558 (0.9352)	13.3157 (1.0000)
	DX14	-15.6338 (0.0000)***	313.274 (0.0000)***
X23	X23	-0.61049 (0.2708)	38.5419 (0.9951)
	DX23	-18.5317 (0.0000)***	282.630 (0.0000)***
X24	X24	-2.86590 (0.0021)***	36.2710 (0.9980)
	DX24	-18.9439 (0.0000)***	283.178 (0.0000)***
X34	X34	1.80524 (0.9645)	16.8503 (1.0000)
	DX34	-16.3496 (0.0000)***	265.527 (0.0000)***
X123	X123	-1.82635 (0.0339)**	63.5375 (0.4928)
	DX123	-17.5504 (0.0000)***	268.215 (0.0000)***
X124	X124	-0.35594 (0.3609)	33.4208 (0.9994)
	DX124	-18.5393 (0.0000)***	297.552 (0.0000)***
X134	X134	3.96403 (1.0000)	5.09105 (1.0000)
	DX134	-16.5260 (0.0000)***	292.240 (0.0000)***
X234	X234	-1.00098 (0.1584)	21.1450 (1.0000)
	DX234	-21.3015 (0.0000)***	314.013 (0.0000)***

Note: * * *, * *, * respectively indicate significant at the 1%, 5%, and 10% levels.

5.2. Cointegration Testing of Panel Data

The results of the unit root test in Table 5 show that except for the variables X12 and X13, which are order 0 single integers, all other data sequences are order 1 single integers, and all of the variables can be used for cointegration testing. Use Eviews7.0 to perform Kao cointegration tests on variables X12, X13, and differential data sequences Dy, Dx14, Dx23, Dx24, Dx34, Dx123, Dx124, D134, and Dx234. The results (see Table 6) show that the P-value is less than 0.05, rejecting the original hypothesis. It is believed that there is a long-term stable equilibrium relationship between the coupling coordination degree Y and the 10 explanatory variables. thereby regression analysis can be conducted on the original panel data of the quaternary system.

Table 6 Cointegration test results of various variables.

Test Method	Statistics	Statistical Value (P-value)
Kao Test	ADF	-16.35110 (0.0000)***

Note: Same as Table 5.

5.3. Analysis of Panel Data Regression Model Results

Comparative analysis and selection of three commonly used regression estimation models for panel data were conducted. Based on the research logic of this article, combined with the output results of the Hausman test, the statistic was 400.477 181, with a P-value of 0.0000. The original hypothesis was rejected, the fixed effects model was determined for estimation analysis.

In the fixed effects regression analysis, based on the research logic, it is believed that the coupling coordination degree of the quaternion system changes over time (2006-2019) and space (across the country and 31 provinces) during the development process. For the dependent variable Y, which is the coupling coordination degree of the quaternary system, and the 10 explanatory variables, cross-sectional data at different time points and time series of different individuals will have a significant impact on the dependent variable. Therefore, using the time point individual double fixed effects model to estimate is more in line with research logic and economic interpretation.

5.4. Robustness Test for Regression Results

This step will conduct robustness tests on the data in the article by changing the number of samples. The original panel data is divided into small sample panel data from 2006 to 2012 and 2013 to 2019 for double fixed effect regression comparison. The statistical results are shown in Table 7:

Table 7 Regression results and robustness test.

Estimation Method	FE (2006-2019)	FE (2006-2012)	FE (2013-2019)
Variable	Y	Y	Y
C	0.145739*** (87.29269)	0.150059*** (66.05656)	0.147496*** (71.22774)
X12	-0.021478* (-1.764626)	-0.098845*** (5.655269)	-0.060918*** (-3.629364)
X13	0.219959*** (10.39053)	0.071814** (2.021768)	0.124003*** (2.991866)
X14	-0.14692*** (-19.12051)	-0.096861*** (-6.37097)	-0.145305*** (-14.61146)
X23	-0.121962*** (-14.9109)	-0.1523*** (-12.24681)	-0.054124*** (-3.084980)
X24	-0.08609*** (-10.95259)	-0.16331*** (-11.74662)	-0.11161*** (-10.48043)
X34	-0.018516*** (-5.13615)	-0.0344*** (-3.778235)	-0.042297*** (-5.444928)
X123	-0.000162 (-0.115732)	-0.00067 (-0.140558)	-0.000101 (-0.108568)
X124	0.227075*** (8.293171)	0.197777*** (4.210960)	0.414861*** (8.562626)
X134	0.284937*** (23.03623)	0.206111*** (10.94028)	0.285148*** (23.75606)
X234	0.37545*** (25.07247)	0.580797*** (21.37702)	0.296164*** (14.83242)
R2	0.769958	0.772348	0.765983
Ad R2	0.769952	0.771343	0.763978
DW	1.928271	1.781025	1.498340

Note: As shown in Table 5, the values in parentheses are for t.

From Table 7, it can be seen that in the panel data regression results before and after the change in sample size, the impact effect symbols and significance of the main core variables have not changed, indicating that the double fixed effects model has a certain degree of robustness.

The regression results before and after the change in sample size showed that the explanatory variables X12, X13, X14, X23, X24, and X34 had a significant impact on the dependent variable Y, and except for X13, all other variables had a negative impact. So the research hypothesis 1 in this article is not valid. The possible economic explanation for this is that during the development of the quaternary system, the overall coupling coordination degree of the quaternary system is more directly influenced by the degree between any three systems compared to the degree between any two systems. The regression results show that, except for X123, explanatory variables such as X124, X134, and X234 have a significant and positive impact on the dependent variable Y, confirming hypothesis 2 of this study.

Based on the regression results and explanations, in the process of coupled development of the quaternion system, it is necessary to first pay attention not to overly focus on the coupling coordination degree between any two systems. Secondly, it is necessary to focus on the positive coordinated development of several systems such as population-consumption-economy, population-industry-economy, and consumption-industry-economy, in order to truly improve the overall coupling coordination development of the population-consumption-industry-economy quaternary system and promoting high-quality development.

6. Conclusion and Suggestions

6.1. Research Conclusion

This article mainly analyzes the population-consumption-industry-economy quaternary system across the country and 31 provinces from 2006 to 2019 from the perspective of system coupling. The coupling coordination development of the quaternary system is obtained through the global entropy method, coupling and development degree calculations. It was found that the overall coupling coordination degree of the quaternary system nationwide is on a slow upward trend, and the development is slowly improving. From the regional perspective, the average coupling coordination development in the eastern region is the highest, followed by the northeastern and central regions, and the western region is the lowest. and the development of four major regions is also gradually increasing slowly.

In order to further investigate the main influencing factors, panel data was established for regression estimation of the coupling coordination between subsystems within the system. The results show that among the various influencing factors, the coupling coordination between any two systems has a significant and negative impact on the dependent variable Y. At the same time, the coupling coordination degree between any three systems has a significant and positive impact on the explained variable Y, which basically verifies the research hypothesis 2 in this article.

6.2. Enlightenment and Suggestions

In the development process of various regions, the eastern region should continue to maintain the role of the leading goose, driving the development of other regions through the radiation effect. Other regions need to formulate specific targeted regional talent policies, change the talent structure of the region, drive the transformation of consumption and employment structure through population structure changes, and promote the optimization and upgrading of industrial structure, promoting high-quality development of the region's economy.

According to the research conclusion, the factors that affect the coupling coordination degree of the quaternary system mainly include the coupling coordination degree between any three subsystems within the system. Relevant measures should be taken at different levels and focus on enhancing the coupling coordination degree of the above-mentioned subsystems..

At the provincial level, there are still regional disparities. For the lower ranked provinces such as XJ, GS, XZ, YN, and GZ, clear talent policies should be formulated to curb talent outflow, retain

local talents, and introduce high-end talents as much as possible to enhance talent reserves, fully leveraging the advantages of latecomers in the development process and promoting high-quality development of regional economy.

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