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Research on Spatial Differentiation and Influence Mechanisms of Coupled and Coordinated Development Between New Quality Productivity and Common Prosperity: A Perspective Based on the Dagum Gini Coefficient

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Abstract: Common prosperity is an essential requirement of socialism with Chinese characteristics and the fundamental objective of high-quality development. New-type productive forces represent a novel form of productive force development in the new era. Logically mapping their synergistic development with common prosperity, deconstructing their mechanisms, and exploring pathways will help us pioneer new prospects for China's high-quality development. This holds significant guiding significance for solidly advancing common prosperity in the new development stage. This paper utilizes panel data from 30 provinces spanning 2012–2022. It employs the coupling coordination degree model and the Dagum Gini coefficient to measure the development level of new-type productive forces, the level of common prosperity, and their coupling coordination degree. It comprehensively analyzes the spatiotemporal evolution and distribution characteristics of the coupling coordination degree between new-type productive forces and common prosperity using the Dagum Gini coefficient and kernel three-dimensional density estimation. The findings reveal that while the coupling coordination between new-type productive forces and common prosperity has gradually improved, the overall coordination level remains relatively low. Regional disparities are diminishing overall but persist at a significant level, primarily driven by inter-regional differences. Based on these findings, policy recommendations are proposed from three perspectives: strengthening regional cooperation and collaborative innovation, implementing differentiated policy support, and continuously enhancing the level of coupling coordination.

Keywords: New Quality Productivity; Common Prosperity; Dagum Gini Coefficient.

1. Introduction

Developing new-quality productive forces is an intrinsic requirement and key focus for advancing high-quality development. Promoting high-quality development serves as the foundation and prerequisite for fostering common prosperity, which must be advanced through high-quality development. Ni Fangfang (2024) emphasizes that new-quality productive forces not only bring greater opportunities and benefits to society but also provide crucial support and safeguards for achieving common prosperity [3]. Song Zelian and Yang Ermei (2024) contend that the “new” in “new-quality productive forces” manifests as innovations in the forms and capabilities of productive factors, while the “quality” reflects the optimization of their qualitative attributes and enhanced efficiency. These two characteristics exert positive effects on advancing common prosperity [7]. The development of new-quality productive forces aligns with the new development philosophy and serves as a vital force for driving high-quality economic and social development. By enhancing production efficiency, it creates more employment opportunities and income sources, thereby laying the material foundation for common prosperity. Promoting the development of new-quality productive forces facilitates coordinated regional development, narrows regional disparities, enables resource sharing and complementary advantages, and fosters balanced economic and social progress across all regions. The synergistic development of new-quality productive forces and common prosperity represents a critical contemporary issue. Therefore, in-depth exploration of their interdependent relationship is both a practical necessity for addressing the dual challenges of “growing the pie” and “distributing the pie fairly,” and an inevitable requirement for achieving regional coordination (Yang Chengjia, Li Zhongxiang 2024) [4].

Although research on new-type productive forces and common prosperity is gradually increasing, it is evident that systematic literature linking the two remains scarce. Moreover, much existing research remains theoretical, lacking in-depth empirical analysis. Simultaneously, deficiencies persist in measuring and evaluating new-quality productivity. These include the failure to adequately reflect the substantial boost to production efficiency generated by pervasive factors, as well as the inadequate representation of the distinctive characteristics of innovative laborers and original technologies—essential for developing new-quality productivity—in current indicator selections. Regarding synergistic development with common prosperity, the indicator systems established by existing institutions show little overall divergence from previous evaluation frameworks for new development concepts and high-quality development. Therefore, this paper examines the synergistic development of new-quality productive forces and common prosperity, analyzing their collaborative development levels and regional disparities. It introduces a new research perspective and employs methods such as the coupling coordination model and the Dagum Gini coefficient to address these shortcomings, providing reference suggestions for future research.

2. Construction and Measurement of the New Quality Productivity and Common Prosperity Indicator System

2.1. Analysis of the Coupling and Coordination Degree Between New Quality Productivity and Common Prosperity

This paper measures the level of coordinated development between new-type productive forces and common prosperity through coupling coordination.

Coupling coordination measures the degree of harmonious alignment among subsystems during development and assesses the extent of coordinated development within a system's subsystems (Tang, Ling et al., 2010) [9]. Coupling degree reflects the interdependence between systems; higher coupling indicates stronger interrelatedness. Coordination degree, meanwhile, reveals the extent to which subsystems mutually reinforce each other; higher coordination signifies stronger positive synergistic effects. Coupling coordination degree thus jointly demonstrates both the developmental and coordination levels among systems.

2.1.1. Establishment of the Indicator System

This paper, starting from the theoretical connotations of new-quality productive forces, focuses on three aspects: "new," "quality," and advanced nature. Drawing on the research of Han Wenlong et al. (2024), it constructs an evaluation index system for new-quality productive forces. The new-quality productive forces system encompasses six dimensions: new laborers, new means of labor, new objects of production, new technologies, production organization, and data elements, comprising a total of 24 basic indicators [10]. Based on the defining characteristics of common prosperity, this study draws upon the research of Tan Yanzhi et al. (2022) to construct an evaluation indicator system for common prosperity [11]. The common prosperity system encompasses three dimensions: developmental, shared, and sustainable, comprising 20 foundational indicators. The specific indicator compositions of both systems are detailed in Tables 1 and 2 on the following page.

Table 1. Evaluation Indicator System for New Quality Productivity

	Constituent elements	Sub-indicators	Basic indicators	Direction
New Quality Productivity	New Workers	Number of new workers	Number of Employees in New Industries	Positive
		New Workforce Structure	New Industry Employee Education Structure	Positive
			Skill Structure of Employees in New Industries	Positive
	New Means of Production	New production tools	Industrial Robot Penetration Rate	Positive
			Integrated Circuit Production Volume	Positive
		New Infrastructure	Number of 5G mobile subscribers	Positive
			Number of National Major Scientific and Technological Infrastructure Projects	Positive
	New labor object	New Energy	Share of New Energy Power Generation	Positive
			Number of Ultra-High Voltage Transmission Lines	Positive
			New Energy Utilization Efficiency	Positive
		New Materials	Output Value of the New Materials Industry	Positive
			Number of Listed Companies in the New Materials Sector	Positive
	New Technology	Technology Research and Development	High-Tech Research and Development Personnel	Positive
			High-tech Research and Development expenditure	Positive
			Number of high-tech Research and Development institutions	Positive
		Innovation Output	Number of High-Tech Invention Patent Applications	Positive
			Sales Revenue from High-Tech New Products	Positive
	Production Organization	Intelligent	Number of e-commerce enterprises	Positive
			Number of artificial intelligence companies	Positive
		Greening	Industrial pollution control investment completed	Positive
		Integration	Level of Integration of Informatization and Industrialization	Positive
	Data Element	Big Data Generation	Mobile Internet Access Data Traffic	Positive
		Big Data Processing	Data Processing and Intelligent Logistics Services Revenue	Positive
		Big Data Trading	Number of data exchanges	Positive

Table 2. Evaluation Indicator System for Common Prosperity

Common Prosperity	Developmental	Wealth	Per capita disposable income of urban residents	Positive
			Per capita disposable income of rural residents	Positive
			Per capita consumption expenditure of urban residents	Positive
			Per capita consumption expenditure of rural residents	Positive
		Shared Experience	Permanent Resident Urbanization Rate	Positive
			Urban-rural income gap	Negative
	Shared nature	Level of social security	Urban Employee Pension Insurance Coverage Rate	Positive
			Employee Basic Medical Insurance Coverage Rate	Positive
			Unemployment Insurance Coverage Rate	Positive
		Wage levels	Average Wage of Urban Employees (On the Job)	Positive
		Level of education	Per capita education expenditure	Positive
		Medical standards	Number of health technicians per 10,000 people	Positive
		Public Infrastructure	Number of road transport vehicles per 10,000 people	Positive
	Sustainability	Degree of Openness	Import and Export Trade Volume/GDP	Positive
		Ecological Environment	Per capita green space area	Positive
		Fiscal investment	Government Expenditures/GDP	Positive
		investment in science and education	Expenditure on Science and Education/GDP	Positive
		Quality of Development	Urban Registered Unemployment Rate	Negative
			Total Factor Productivity	Positive
			Value Added of the Tertiary Sector	Positive
			GDP per capita	Positive

2.1.2. Coupling Coordination Degree Measurement

Standardization of indicator data. Due to the varying units of measurement in the original indicator data, the range normalization method is employed to render the indicators dimensionless, thereby enhancing their comparability and yielding normalized evaluation values. The coupling coordination degree model comprises multiple subsystems. Let X_{ki} = (k=1,2,…,m; i=1,2,…,n), where element x_{ki} represents the i-th indicator (sequential parameter) of the k-th subsystem, satisfying $\alpha_{ki} \le x_{ki} \le \beta_{ki}$. α_{ki} and β_{ki} denote the lower and upper bounds of the i-th sequential parameter in the k-th system. Order parameters are categorized into benefit-type and cost-type parameters. For benefit-type parameters (where the original indicator is positive), the larger the value of x_{ki} = (x_{k1}, x_{k2}, …, x_{kn}), the higher the system order; conversely, the lower the value, the lower the order. Cost-type order parameters are negative indicators where larger values of x_{ki} = (x_{k1}, x_{k2}, …, x_{kn}) indicate lower system order, and vice versa. Let the normalized results be denoted as x_{ki} as follows:

Positive indicator:

$$x_{ki}^{'} = \frac{x_{ki} - \alpha_{ki}}{\beta_{ki} - \alpha_{ki}} \tag{1}$$

negative indicator:

$$x_{ki}^{'} = \frac{\beta_{ki} - x_{ki}}{\beta_{ki} - \alpha_{ki}} \tag{2}$$

When k takes the value a, it represents new-type productive forces; when k takes the value b, it represents common prosperity. x_{ai} and x_{bi} denote the original values of the i-th indicator for new-type productive forces and common prosperity, respectively, where i takes values from i = 1, 2, ..., n.

Calculate the comprehensive development level. The coupling coordination degree model involves several subsystems, and the comprehensive development level of these subsystems is central to evaluating coupled coordination development. To avoid human interference, this paper adopts the entropy weight method from objective weighting techniques, as referenced in Zhang Hu and Han Aihua (2019) [13], to assign weights. This yields the comprehensive development levels for new-type productive forces and common prosperity:

The weight of the i-th sequential parameter in constructing the k-th sample is:

$$y_{ki} = x_{ki}^{'} \Big/ \sum_{k=1}^{m} x_{ki} \tag{3}$$

Calculate the information entropy of the i-th sequential parameter as follows::

$$e_i = -K \sum_{k=1}^{m} y_{ki} \ln y_{ki} \quad K = 1/\ln m \tag{4}$$

The information utility value of an indicator depends on the difference between its information entropy e_k and 1. The greater the information utility value, the greater its importance to the evaluation, and the larger its weight. That is,

$$d_i = 1 - e_i \tag{5}$$

The weight of the i-th sequential parameter can thus be calculated.:

$$\theta_i = d_i \Big/ \sum_i d_i \tag{6}$$

thereby achieving a comprehensive level of development in new-quality productive forces and common prosperity:

$$U_k = \sum_{i=1}^{n} \theta_{ki} x_{ki}^{'} \tag{7}$$

Calculate the coupling degree and coupling coordination degree. Constructing a coupling degree model between new-type productive forces and common prosperity can reflect the magnitude of their mutual interaction:

$$C_{ab} = 2\sqrt{U_a U_b} \Big/ (U_a + U_b) \quad (8)$$

Among these, C_{ab} represents the coupling degree between new-type productive forces and common prosperity, while U_a and U_b denote the comprehensive development levels of new-type productive forces and common prosperity, respectively. Since coupling degree only reflects the magnitude of interaction between new-type productive forces and common prosperity without specifying whether it exerts a promoting effect at high levels or a constraining effect at low levels, the coupling coordination degree model is introduced to accurately assess:

$$D_{ab} = \sqrt{C_{ab} T_{ab}} \qquad T_{ab} = \alpha U_a + \beta U_b \quad (9)$$

Here, D_{ab} denotes the coupling coordination degree between new-type productive forces and common prosperity, with a value range of [0,1]. Tab represents the comprehensive evaluation index for new-type productive forces and common prosperity. α and β denote the undetermined coefficients, whose weights are obtained using the entropy method (α+β=1).

2.1.3. Analysis of Test Results

General Characteristics. The coupling coordination degree between new-type productive forces and common prosperity is shown in Table 3.

The national average coupling coordination index rose from 0.2876 in 2012 to 0.43219 in 2022, with an annual growth rate of 4.36%, indicating steady improvement in the synergistic development between new-quality productive forces and common prosperity. However, the overall average in 2022 remained within the moderate coordination range, suggesting substantial room for enhancing coordination between the two systems nationwide.

Table 3. Values for the Coordination Degree of Synergy Between New Quality Productivity and Common Prosperity

Region	Province	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Eastern	Beijing	0.546	0.563	0.599	0.566	0.592	0.625	0.633	0.647	0.666	0.684	0.712
	Tianjin	0.348	0.359	0.346	0.343	0.398	0.409	0.451	0.385	0.395	0.408	0.413
	Hebei	0.257	0.277	0.307	0.297	0.327	0.357	0.382	0.388	0.423	0.432	0.441
	Shanghai	0.529	0.513	0.538	0.543	0.580	0.574	0.589	0.589	0.600	0.624	0.644
	Jiangsu	0.405	0.431	0.451	0.465	0.500	0.520	0.549	0.572	0.599	0.643	0.665
	Zhejiang	0.417	0.432	0.456	0.469	0.500	0.505	0.527	0.546	0.557	0.586	0.562
	Fujian	0.282	0.300	0.333	0.334	0.355	0.357	0.379	0.394	0.407	0.433	0.458
	Shandong	0.336	0.363	0.379	0.380	0.426	0.454	0.461	0.476	0.497	0.525	0.542
	Guangdong	0.484	0.509	0.515	0.531	0.574	0.593	0.627	0.660	0.675	0.713	0.733
	Hainan	0.219	0.228	0.224	0.223	0.243	0.245	0.248	0.267	0.277	0.321	0.341
	Mean	0.382	0.398	0.415	0.415	0.449	0.464	0.485	0.492	0.510	0.537	0.551
Central	Shanxi	0.249	0.266	0.257	0.252	0.287	0.322	0.331	0.332	0.371	0.377	0.383
	Anhui	0.324	0.347	0.351	0.351	0.392	0.409	0.428	0.442	0.458	0.483	0.495
	Jiangxi	0.208	0.226	0.232	0.236	0.259	0.264	0.289	0.307	0.319	0.339	0.357
	Henan	0.263	0.295	0.306	0.305	0.336	0.361	0.376	0.384	0.414	0.428	0.451
	Hubei	0.283	0.304	0.310	0.348	0.377	0.374	0.393	0.406	0.410	0.432	0.448
	Hunan	0.242	0.264	0.269	0.277	0.301	0.304	0.311	0.339	0.355	0.390	0.416
	Mean	0.262	0.284	0.288	0.295	0.326	0.339	0.355	0.368	0.388	0.408	0.425
Western	Inner Mongolia	0.210	0.243	0.255	0.245	0.312	0.341	0.350	0.346	0.372	0.381	0.385
	Sichuan	0.266	0.293	0.297	0.298	0.319	0.329	0.346	0.369	0.388	0.416	0.425
	Chongqing	0.245	0.261	0.267	0.279	0.293	0.302	0.308	0.329	0.340	0.361	0.470
	Guangxi	0.215	0.230	0.235	0.251	0.265	0.270	0.277	0.293	0.320	0.340	0.351
	Guizhou	0.194	0.218	0.223	0.249	0.266	0.267	0.274	0.295	0.305	0.311	0.325
	Yunnan	0.220	0.244	0.242	0.248	0.267	0.270	0.276	0.297	0.304	0.316	0.319
	Shaanxi	0.260	0.282	0.248	0.303	0.320	0.338	0.340	0.353	0.358	0.376	0.391
	Gansu	0.259	0.279	0.272	0.281	0.319	0.322	0.324	0.344	0.343	0.359	0.367
	Qinghai	0.217	0.233	0.275	0.259	0.267	0.261	0.267	0.290	0.281	0.290	0.298
	Ningxia	0.233	0.253	0.211	0.246	0.263	0.256	0.261	0.237	0.241	0.251	0.261
	Xinjiang	0.205	0.230	0.227	0.224	0.243	0.243	0.243	0.265	0.264	0.282	0.310
	Mean	0.229	0.251	0.250	0.262	0.285	0.291	0.297	0.311	0.320	0.335	0.355
Northeast	Liaoning	0.278	0.296	0.305	0.288	0.299	0.307	0.327	0.335	0.358	0.381	0.389
	Jilin	0.218	0.233	0.241	0.240	0.253	0.259	0.269	0.271	0.283	0.295	0.300
	Heilongjiang	0.216	0.234	0.234	0.234	0.270	0.275	0.284	0.288	0.299	0.312	0.314
	Mean	0.237	0.254	0.260	0.254	0.274	0.280	0.293	0.298	0.313	0.329	0.334

Overall, within regions, internal imbalances are most pronounced in the East, followed by the West, while the Central and Northeast regions exhibit relative equilibrium. Inter-regional disparities show a significant and widening gap between the East and other regions, with the Northeast lagging in development. The Central and West regions require strengthened policy support to bridge the gap. Further analysis is needed to identify the specific sources of these differences.

3. Dagum Gini Coefficient Analysis

This paper is based on the Dagum Gini coefficient method and uses MATLAB software to measure the overall, interregional, and intraregional differences in the coordinated development level of new quality productivity and common prosperity in China from 2012 to 2022, as well as their sources.

Table 4. Regional Disparities in the Synergistic Development of New Quality Productivity and Common Prosperity, 2012–2022

Year		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
G—T		0.1657	0.1528	0.1637	0.1568	0.1542	0.1590	0.1623	0.1569	0.1577	0.1558	0.1537
G—W	Eastern	0.1611	0.1509	0.1520	0.1507	0.1420	0.1411	0.1360	0.1417	0.1382	0.1329	0.1327
	Central	0.0761	0.0736	0.0766	0.0839	0.0827	0.0799	0.0771	0.0709	0.0650	0.0629	0.0605
	Western	0.0577	0.0555	0.0604	0.0496	0.0517	0.0665	0.0681	0.0699	0.0784	0.0802	0.0915
	Northeast	0.0574	0.0526	0.0564	0.0472	0.0376	0.0379	0.0444	0.0483	0.0531	0.0579	0.0592
G—nb	Eastern—Central	0.2086	0.1919	0.2028	0.1972	0.1890	0.1848	0.1847	0.1756	0.1676	0.1623	0.1554
	Eastern—Western	0.2424	0.2300	0.2404	0.2377	0.2352	0.2416	0.2528	0.2374	0.2406	0.2383	0.2259
	Eastern—Western	0.2551	0.2333	0.2560	0.2497	0.2511	0.2564	0.2573	0.2536	0.2474	0.2439	0.2485
	Central—Western	0.0856	0.0849	0.0845	0.0866	0.0908	0.1001	0.1065	0.1001	0.1085	0.1098	0.1094
	Central—Northeast	0.0871	0.0829	0.0897	0.0948	0.0976	0.1053	0.1040	0.1108	0.1130	0.1138	0.1250
	Western—Northeast	0.0635	0.0588	0.0654	0.0549	0.0511	0.0590	0.0603	0.0661	0.0714	0.0740	0.0830
G—t (%)	within the region	20.026	20.084	19.362	19.619	19.170	19.488	18.726	19.815	19.807	19.667	20.648
	interregional	72.759	70.946	72.917	71.184	72.219	71.702	72.430	71.793	71.472	72.953	71.321
	Hyper-Density	7.2152	8.9709	7.7207	9.1975	8.6113	8.8102	8.8450	8.3929	8.7214	7.3801	8.0310

Note: G—T, G—nb, G—t denote the overall Gini coefficient, intra-regional Gini coefficient, inter-regional Gini coefficient, and contribution rate, respectively.

4. Conclusion

Based on data from 30 provinces in China covering the period from 2012 to 2022, this study constructs an evaluation index system for new-type productive forces and common prosperity. It employs a coupling coordination degree model to measure the level of synergistic development between new-type productive forces and common prosperity. Through the decomposition of the Dagum Gini coefficient, the spatial variations in the level of synergistic development between new-type productive forces and common prosperity are systematically analyzed. The following conclusions are drawn:

First, the coupling coordination degree between new-type productive forces and common prosperity follows the order: Eastern > Central > Western > Northeastern regions, with an overall steady upward trend, indicating a gradual improvement in their synergistic development. Specifically, the national average has risen from low coupling coordination in 2012 to moderate coupling coordination in 2022, demonstrating a considerable annual growth rate and signifying a progressive enhancement in the coordination level between the two systems. However, the overall level remains within the moderately coupled coordination range, and regional development imbalances remain prominent.

Second, Dagum Gini coefficient analysis shows that the overall Gini coefficient has been steadily declining during the observation period, indicating a gradual narrowing of the gap in coordinated development between and within regions. Nevertheless, inter-regional disparities remain the primary source of overall variation, reflecting that regional development imbalances are still significant. Regionally, internal disparities have decreased across all areas, with the most significant reduction observed in the eastern region, where coordination is gradually improving. Nevertheless, internal inequality in the east remains higher than in other regions. The central, western, and northeastern regions have seen gradual improvements in internal coordination through policy adjustments and resource optimization.

In summary, China has made positive progress in the coordinated development of new productive forces and common prosperity, yet regional imbalances remain a primary challenge. Future efforts should focus on addressing the siphon effect, enhancing the precision of regional policies, and promoting innovation in cross-regional cooperation mechanisms to achieve higher-quality, more inclusive coordinated development.

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