

Spatio-Temporal Evolution and Driving Mechanisms of the Digital Creative Industry in China's Coastal Regions

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Abstract: Against the backdrop of the rapid development of the digital economy, the digital creative industry has gradually emerged as a key driver of regional economic restructuring and urban spatial reconfiguration. However, there remains a lack of systematic empirical research into its spatial evolution patterns and driving mechanisms. This study focuses on China's coastal regions, utilising microdata from 25,162 digital creative enterprises. By combining spatial statistical analysis with the Geographically Weighted Time-Space Regression (GTWR) model, it systematically analyses the spatiotemporal evolution characteristics and driving mechanisms of the digital creative industry. The study reveals that the digital creative industry in China's coastal regions exhibits significant spatial agglomeration, gradually forming a multi-centred network structure centred on the Yangtze River Delta and the Pearl River Delta. Analysis of the driving mechanisms indicates that economic development levels, innovation capacity and digital infrastructure are key factors influencing the industry's spatial pattern, with innovation capacity and internet infrastructure playing an increasingly significant role in the later stages of industrial development. Different urban agglomerations exhibit distinct trajectories in industrial development: the Pearl River Delta region relies more heavily on digital platforms and market environments, whilst the Yangtze River Delta region is primarily driven by the aggregation of innovation resources. Overall, the development of the digital creative industry follows an evolutionary path shifting from being driven by economic foundations to being driven by innovation and the digital environment. This paper reveals the evolutionary process of the driving mechanisms of the digital creative industry from a spatiotemporal perspective, providing new empirical evidence for understanding the spatial organisation of the creative industry within the context of the digital economy.

Key words: Digital creative industries; Spatial evolution; Driving mechanisms; Spatiotemporal heterogeneity; Coastal China

Amid the global digital transformation, the digital economy has emerged as the core driver of economic structural transformation and spatial restructuring(Huang & Wang, 2025). The World Bank's Development Report notes(Kar, 2023) that the share of digital factors in the global economic system is growing at an accelerating rate, making them a vital strategic asset. China's 14th Five-Year Plan for the Development of the Digital Economy emphasizes the pivotal role of the digital economy(Wu et al., 2024); its core industries account for 10% of GDP, while the adoption rate of digital tools among enterprises has reached 84.1%, highlighting the rapid convergence and transformation of the digital sector(R. Li & Zheng, 2025). This has spurred the continuous concentration of innovation resources, high-value-added industries, and highly skilled talent in specific regions, while new forms of spatial organization—based on knowledge spillovers and network synergies—are constantly emerging, forming a crucial practical backdrop to contemporary regional economic disparities and the competitive landscape of cities.

Within the digital economy, the creative industries centered on digital content production, creative design, and cultural integration have emerged as the most knowledge-intensive and creativity-dependent core sectors(F. Li, 2020), playing a vital supporting role in economic expansion, employment growth, and social transformation. A UNESCO report notes that global creative industry jobs are highly concentrated in large cities and core metropolitan areas, exacerbating structural disparities among regions in terms of industrial development, talent attraction, and innovation, and widening the gap between digital creative hubs and the broader regions. Therefore, analyzing the evolution of the digital creative industry from a spatial perspective helps reveal the mechanisms of internal structural differentiation within the digital economy and understand the spatial organization patterns of the digital creative industry.

In the Chinese context, the spatial distribution of the digital creative industry exhibits marked regional

disparities. Leveraging their high level of openness, digital infrastructure, and innovation resources, coastal regions continue to attract the clustering of digital creative industries and talent, forming industrial hubs of national influence. However, amidst this rapid clustering, significant divergence has emerged within these regions regarding expansion rates, output capacity, and structural quality. The uneven diffusion of the digital creative industry poses severe challenges, including a situation where the sector is large but not strong and structural weaknesses (H. Zhang et al., 2024). At the same time, certain cities have remained at a low level of development or experienced stagnation due to the interplay of multiple factors. The evolving landscape of complex contradictions in coastal regions provides a representative research context for identifying industrial driving mechanisms, which is crucial for promoting the coordinated development of the digital creative economy across regions, as well as for guiding policy planning and sustainable development strategies.

This paper takes China's coastal regions as its subject of study, constructs a multi-source spatial dataset, and systematically characterizes the spatio-temporal evolution of the digital creative industry. Adopting a multi-dimensional perspective on driving factors, it explores the industry's formation mechanisms and spatial heterogeneity. The paper aims to address three core questions: What spatial evolution pathways does the digital creative industry exhibit in coastal regions? To what extent do different driving factors explain its spatial distribution? Are there significant differences in their driving mechanisms across different regions and time periods? The paper seeks to deepen the theoretical understanding of the mechanisms underlying industrial spatial restructuring in the digital economy era, systematically revealing the spatio-temporal evolution and driving mechanisms of the digital creative industry. In practical terms, it aims to provide more targeted empirical evidence for the optimization of regional digital industrial layouts and the development of creative cities.

The structure of this paper is as follows: the 'Literature Review' section introduces existing research literature and identifies research gaps; the 'Theoretical Framework and Research Methods' section outlines the logical framework of the study and details the research methods and tools employed; the 'Results' section analyzes the findings and summarizes the driving mechanisms; the 'Discussion' section discusses the significance of the findings and engages in a broader discussion; and the 'Conclusion' section systematically summarizes the research conclusions and proposes policy recommendations.

1. Literature Review

1.1 The Concept and Characteristics of the Digital Creative Industry

Research into the digital creative industries can be traced back to the development of theories on the creative economy and cultural industries (Florida, 2003). Early research largely drew upon cultural economics (Throsby, 1994) and the creative economy perspective (Greenhalgh, 1998), viewing cultural sectors such as the arts, design, and media as the core vehicles for creative activity and emphasizing the significant role of creative elements in economic growth, job creation, and urban regeneration. With the rapid development of information technology, relevant research has gradually incorporated digital technology (Abbasi et al., 2017; Grierson, 2016; Wibowo et al., 2024) into its analytical framework, driving the transformation of creative activities towards digital, platform-based, and networked forms and leading to the gradual emergence of new industrial categories that integrate digital technology with creative content.

Compared with traditional cultural industries, the digital creative industries rely more heavily on digital infrastructure and innovation resources, and their spatial distribution often exhibits significant characteristics of urban agglomeration. As the industry type with the greatest potential (Lee & Rodríguez-Pose, 2014), its expansion trends, talent concentration, and cultural atmosphere can rapidly drive the formation of spatially dependent agglomeration patterns. However, much of the relevant research focuses on constructing evaluation indicator systems based on the development level of the digital creative industries (Boix-Domenech & Soler-Marco, 2017; Evans, 2012), using indicators such as the number of enterprises, the workforce, or industrial output to measure and

compare their development status. At the same time, due to significant differences in statistical methodologies, industrial classification standards, and data sources across studies, the comparability of research findings between regions is limited, making it difficult to establish a unified measurement framework. Most studies remain confined to describing the level of industrial development(Gong & Hassink, 2017), lacking a dynamic perspective on the differentiation of industrial spatial structures and mechanistic explanations thereof.

Existing research has yet to reach a consensus on the boundaries of the digital creative industries. One strand of research, drawing on industrial classification systems(Amankwah-Amoah et al., 2024; Lerro et al., 2022), views the sector as an intersection of cultural and digital industries, primarily encompassing industrial sectors where digital content is the core product, such as digital publishing, digital film and television, and games and animation. Another strand of research emphasizes its technological foundation (O'Connor, 2009), incorporating all industrial activities that rely on digital technology for creative production into the scope of analysis(Flew & Cunningham, 2010). Consequently, it is necessary to conduct a systematic analysis of the development patterns of the digital creative industries from a spatial evolution perspective, based on micro-level enterprise data.

1.2 Theories of Creative Industry Clustering and Spatial Evolution

Research into the spatial distribution of the digital creative industries stems from the theoretical tradition of industrial agglomeration and spatial organization within regional economics. Traditional theories of industrial location emphasize the role of factors such as transport costs ('Micro-Foundations of Urban Agglomeration Economies', 2004), market size, and resource endowments in the spatial distribution of industries(Hall, 2008). As research perspectives have evolved dynamically, emphasis has shifted to the notion that regional industrial structures are subject to continuous constraints from industrial foundations and knowledge structures, leading to differentiated evolutionary trajectories. Existing research has gradually shifted its focus to the impact of factors such as knowledge spillovers, innovation networks, and industrial synergies on industrial agglomeration(Balland et al., 2020), with technological linkages and complementarities between firms serving as key mechanisms for enhancing regional innovation capacity and industrial resilience.

In the field of creative industries research, studies indicate that these sectors often exhibit distinct urban agglomeration characteristics. Relevant theories have established a multidimensional explanatory framework spanning from agglomeration mechanisms to evolutionary processes and from spatial structures to network relationships; however, significant limitations remain. On the one hand, most studies focus on explaining the general patterns of cluster formation, with insufficient attention paid to the dynamic processes of internal cluster structures. On the other hand, different studies analyze the subject from economic, innovative, or institutional dimensions, respectively, lacking a systematic portrayal of the synergistic effects of multiple driving factors. Theoretical shortcomings are particularly pronounced in the fields of knowledge-intensive and innovation-driven industries; it is necessary to further introduce a spatio-temporal perspective on the basis of existing theories and conduct more refined empirical research on the evolutionary mechanisms of industrial clusters.

1.3 Driving Mechanisms of the Digital Creative Industries

Relevant research suggests that the spatial distribution of the digital creative industries is influenced by a complex interplay of economic, social, and institutional factors. These specific influencing factors can broadly be categorized into four groups. The first category comprises economic fundamentals, including regional economic development levels, industrial structure, and the scale of the consumer market, which are regarded as the material foundation for the development of the digital creative industries(Pratt, 2004; Scott, 2014). The second category comprises innovation capacity factors, primarily involving the intensity of R&D investment, the development of innovation platforms, and the level of knowledge output. Research reveals that the concentration of innovation resources can significantly enhance the growth potential and technological upgrading capacity of the digital creative industry (Asheim & Coenen, 2005; Kogler et al., 2017). The third category comprises talent and human capital

factors, focusing on higher education resources, labor force structure, and patterns of talent mobility. It posits that high-quality human capital is the most fundamental factor of production in the digital creative industries and serves as the key driver underpinning the sustained expansion of creative activities (von Einem, 2013). The fourth category comprises urban environment and institutional factors, including the level of digital infrastructure, cultural atmosphere, degree of openness to the outside world, and extent of policy support. These play a vital role in shaping the environment for creative activities, reducing transaction costs, and enhancing regional attractiveness (Storper & Scott, 2009).

Existing research employs quantitative analyses such as ordinary regression models, panel data models, and spatial econometric models to examine the marginal effects of various factors on the development level of the digital creative industry (Comunian et al., 2010). However, most studies are based on the assumption of spatial homogeneity, making it difficult to reflect the divergence in driving pathways resulting from differences in regional development conditions; there is a lack of in-depth discussion on how influencing factors exhibit spatial heterogeneity ('The Empirics of Agglomeration Economies', 2015). At the same time, research lacks a unified logic in variable selection and model specification; influencing factors are often discussed in a fragmented manner, making it difficult to form a systematic explanatory framework. It is necessary to further incorporate a spatio-temporal perspective and spatial heterogeneity analysis methods to conduct more refined empirical research on the driving mechanisms of the digital creative industries.

In the Chinese context, a unified explanatory framework has yet to be established for the spatial characteristics of the digital creative industries, which are characterized by both high agglomeration and regional differentiation. This study constructs a comprehensive analytical framework to systematically characterize the spatial patterns and spatio-temporal evolution of the digital creative industries, revealing their multidimensional driving mechanisms, thereby addressing the shortcomings of existing research in terms of spatial explanatory power and the integration of mechanisms.

2. Research Methods and Data Description

2.1 Study Area and Data Sources

China's coastal regions span multiple national-level urban agglomerations, including the Bohai Rim, the Yangtze River Delta, the West Coast of the Taiwan Strait, the Pearl River Delta, and the Beibu Gulf. They constitute one of the regions with the highest concentration of economic activity, the most comprehensive industrial systems, and the greatest degree of openness to the outside world. The *China Marine Statistical Yearbook* clearly defines the coastal areas of mainland China as comprising 11 provincial-level administrative units: Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi, and Hainan. The region's gross regional product has long accounted for over 50% of the national total. It is home to a large concentration of high-tech enterprises, research institutions, and higher education establishments, boasting a high density of innovation resources, which provides a favorable market environment and industrial foundation for the development of the digital creative industry. At the same time, the coastal regions exhibit marked spatial disparities and structural imbalances. Taking China's coastal regions as the subject of study provides a representative empirical sample for understanding the internal structural adjustments and regional development disparities within China's digital economy.

The study systematically analyzes the policy definitions of the digital creative industry as outlined in the 'Classification of Strategic Emerging Industries (2018)' and the 'Statistical Classification of the Digital Economy and Its Core Industries (2021),' using these classifications to identify relevant enterprises. Taking China's reform and opening-up as a starting point, relevant data has been collected from 1978 to 2026. Data was accessed via the reliable third-party platform Tianyancha (<https://www.tianyancha.com/>) to construct a digital creative industry dataset. This platform integrates government information with corporate data to ensure comprehensive coverage

across all sectors(H. Zhang et al., 2024). The study collected detailed data, including company names, registration status, date of establishment, province/city of origin, national standard industry classification, and industry scope, screening a total of 25,162 enterprises, excluding data from Hong Kong, Macao, and Taiwan. These were categorized into the service sector, manufacturing sector, and entertainment sector according to the national standard industry classification to facilitate subsequent research (Fig. 1).

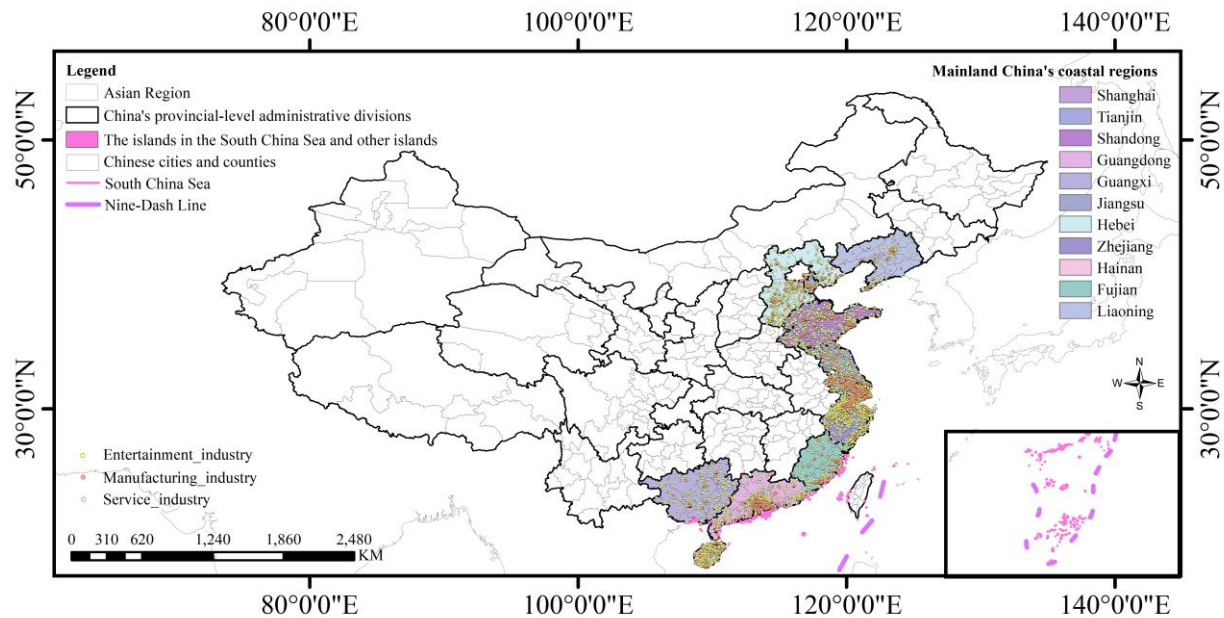


Fig. 1 Map showing the spatial distribution of the digital creative industry in coastal regions of mainland China

2.2 Development of an Indicator Framework

To systematically characterize the underlying mechanisms of the spatial evolution of the digital creative industries, this study examines the construction of indicators for influencing factors, grounded in the logic of industrial production. Drawing on existing literature reviews, the digital creative industries are influenced by multiple factors, including the regional economy, innovation resources, human capital, and the cultural and institutional environment (Balland et al., 2015; Kogler, 2017) and develop as knowledge-intensive creative industries supported by digital technology. Consequently, this paper constructs a system of 20 indicators across four dimensions: economic foundation, innovation capacity, talent structure, and urban environment (Table 1). Subsequent research employs standardization methods to perform dimensionless processing and utilizes correlation analysis and variance inflation factor tests to eliminate the impact of severe multicollinearity, thereby providing a stable data foundation for spatio-temporal heterogeneity analysis.

Table 1 Indicator System for the Driving Mechanisms of the Digital Creative Industry in China's Coastal Regions

Primary dimension	Secondary indicator	Definition of indicator	Data source
Economic basis	GDP per capita	Per capita development level	China Statistical Yearbook
	Share of the tertiary sector	Degree of service orientation	China Statistical Yearbook
	Total expenditure	Intensity of market demand	China Statistical Yearbook
Innovative capacity	R&D expenditure intensity	Level of investment in innovation	Yearbook of High-Tech Industries
	Number of invention patents	Innovation intensity	National Bureau of Statistics
	Number of creative enterprises	Innovation actors	Annual Statistical Yearbook of Science and Technology
Workforce composition	Proportion of the population with higher education	Human capital structure	Census
	Number of researchers	Innovative talent	Annual Statistical Yearbook of Science and Technology
	Number of people employed in the information services sector	Creative workforce	Statistical Yearbook
Urban environment	Internet penetration rate	Digital infrastructure	Ministry of Industry and Information Technology
	Foreign investment	Level of openness to the outside world	Ministry of Commerce
	Urban built-up area	Spatial carrying capacity	City Statistical Yearbook

2.3 Methods for analysing the evolution of spatio-temporal geographical patterns

To systematically characterize the spatial evolution of digital creative enterprises in coastal regions of mainland China, this study constructs a multi-level spatial analysis framework comprising global pattern identification, local clustering diagnosis, directional evolution analysis, and measurement of regional disparity structures. Specifically, the Nearest Neighbor Index (NNI) is employed to identify overall spatial agglomeration characteristics and assess the agglomeration status of enterprise distribution. Subsequently, kernel density analysis is utilized to reveal spatial agglomeration patterns, while standard deviation ellipses and centroid migration trajectories are analyzed to examine the directional evolution of enterprise distribution and changes in axial structure, thereby establishing a spatially progressive and logically rigorous analytical framework for spatial evolution.

The Nearest Neighbor Index (NNI) (Tang et al., 2020) is used to assess the spatial distribution patterns of point features. Treating enterprises as spatial point features, the actual observed average nearest neighbor distance ($\bar{D}_O$) is obtained by calculating the Euclidean distance between each enterprise and its nearest neighbor. Building on this, the theoretical average distance ($\bar{D}_E$) is introduced. Assuming that enterprises follow a completely random distribution pattern, the expected distance is derived based on the study area's area (A) and the number of enterprises (n), as expressed in Equation(1):

$$NNI = \frac{\bar{D}_O}{\bar{D}_E} = \frac{\sum_{i=1}^n d_i / n}{\frac{1}{2} \sqrt{\frac{A}{n}}} \quad (1)$$

d_i denotes the spatial distance between firm i and its nearest neighbour; n is the total number of firms in the digital creative industry within the study area; and A is the area of the study region. If $NNI < 1$, this indicates that the actual nearest-neighbour distance between firms is less than the expected distance under a random distribution, suggesting that firms exhibit a clustered distribution pattern. If $NNI > 1$, this indicates that the distribution of firms is relatively uniform or tends towards dispersion. If $NNI = 1$, this indicates that firms exhibit a completely random spatial distribution pattern.

The nuclear density index is a research method used to detect local variations in the density of geographical features and to assess the characteristics of spatial clustering (Ding et al., 2024). The specific formula (2) is:

$$D(x_i, y_i) = \frac{1}{ur} \sum_{i=1}^u k\left(\frac{d}{r}\right) \quad (2)$$

In the formula: $D(x_i, y_i)$ represents the kernel density value of the digital creative industry at the spatial location (x_i, y_i) . r is the search radius. u is the number of digital creative enterprises located within a distance of at most r from the position (x_i, y_i) . k represents the spatial weighting function. d is the distance between the current enterprise and the position (x_i, y_i) .

The standard deviation ellipse is a spatial statistical tool that quantifies the spatial attributes of geographical entities, revealing the directionality, centre of mass and spread of their distribution (Xiao et al., 2024). The specific formula (3) is:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^n (w_i x \cos \alpha - w_i y \sin \alpha)^2}{\sum_{i=1}^n w_i^2}} \quad \sigma_y = \sqrt{\frac{\sum_{i=1}^n (w_i x_i \sin \alpha - w_i y_i \cos \alpha)^2}{\sum_{i=1}^n w_i^2}} \quad (3)$$

In the formula, the coordinates of the centre of mass of the ellipse are denoted by $(\bar{x}, \bar{y})$. The azimuth is denoted

by $\tan \alpha$. The spatial location of the digital creative industry is (x_i, y_i) . ω_i represents the weight. (x_i, y_i) enotes the deviation of the location of the digital creative industry from the coordinates of the centre of mass $((\bar{x}, \bar{y}))$. σ_x is the standard deviation along the X-axis, and σ_y is the standard deviation along the Y-axis.

2.4 Methods for analysing spatiotemporal driving mechanisms

Geographical detectors are used to identify the causes of spatial variations in the distribution of a particular indicator and to quantify the extent to which a specific geographical factor influences these variations, as well as to determine the weighting of that factor (Y. Zhang et al., 2023). The specific formula (4) is as follows:

$$Q = 1 - \frac{1}{N\sigma^2} \sum_{h=1}^H N_h \sigma_h^2 \quad (4)$$

In the equation: $h = 1, 2, \dots$ where $h = 1, 2, \dots, L$ denotes the stratification of the dependent variable Y (number of traditional villages) and the influencing factor X; N_h and N represent the number of digital creative industries in stratum h and the study area, respectively; σ_h^2 and σ^2 represent the variances of stratum h and the Y values, respectively; the final result of the analysis is the q-value, which can range from 0 to 1; the larger the value, the greater the influence of the digital creative industry. If $q(x_1 \cap x_2) > q(x_1) + q(x_2)$, this indicates that these two factors are interacting.

The spatio-temporal geographically weighted regression (GTWR) model introduces a temporal dimension to the traditional geographically weighted regression (GWR) model, using both spatial and temporal weighting functions to measure the proximity between observations (Ye et al., 2025). The specific formula (5) is as follows:

$$y_i = \beta_0(u_i, v_i, t_i) + \sum_{k=1}^p \beta_k(u_i, v_i, t_i) x_{ik} + \varepsilon_i \quad (6)$$

In the formula, y_i represents the dependent variable for the i -th sample point, x_{ik} denotes the k -th independent variable for the i -th sample point, $\beta_k(u_i, v_i, t_i)$ refers to the local regression coefficient at the spatial location (u_i, v_i) and time t_i , reflecting the spatio-temporal non-stationarity of the relationship between variables, and ε_i represents the random error term.

The weights of each observation point in the model are determined by spatio-temporal distance, and the weight matrix is defined as:

$$W_i = \text{diag} \left\{ \exp \left[-\frac{(D_{ij}^S)^2}{h_s^2} - \frac{(D_{ij}^T)^2}{h_t^2} \right] \right\} \quad (7)$$

The formula D_{ij}^S represents the spatial distance between sample points i and j , whilst D_{ij}^T denotes the temporal distance; h_s and h_t are the spatial and temporal bandwidth parameters, respectively, determined using the AICc or CV criteria. When $D_{ij}^T = 0$, GTWR reduces to the traditional GWR model; when spatial positions are fixed, it becomes time-weighted regression (TWR).

3 Results

3.1 Spatial Distribution Characteristics of the Digital Creative Industry in Mainland China's Coastal Regions

Based on the context of policy changes and market transformation over the years, this study divides the timeline into four distinct periods. The period from 1978 to 1991 marked the launch of reform and opening-up and the initial development of the coastal economy, during which the gradual establishment of market mechanisms drove the growth of coastal cities. The period from 1992 to 2001 represented the formation of coastal clusters, characterised

by the acceleration of market-oriented reforms in 1992, which spurred the aggregation of industrial chains. The period from 2002 to 2012 represents the development of the creative industries, during which China's accession to the WTO strengthened external market linkages and stimulated the spatial consolidation of knowledge and service factors. From 2013 to the present, the period has been characterised by a restructuring driven by the digital economy, with digital infrastructure and platform-based organisational models reshaping the location and diffusion patterns of enterprises.

3.1.1 Spatial Aggregation Properties and Significance Tests

Based on the phased developmental characteristics of China's coastal digital creative industries, the nature of their spatial distribution was assessed using the nearest neighbour index (Table 2). The results indicate that the NNI was consistently significantly less than 1 across all periods and continued to decline over time, suggesting that the industry's spatial structure gradually evolved from a relatively weak agglomeration to a highly concentrated pattern. Concurrently, the absolute value of the Z-score expanded rapidly, indicating a significant increase in the deviation of the spatial distribution of enterprises from a completely random state, with spatial organisation shifting from early-stage statistically significant agglomeration to a highly structured, core-based pattern. The continuous compression of the average observation distance further corroborates the systematic contraction of spatial distances between enterprise locations, reflecting a phased intensification of agglomeration strength.

At the sectoral level, different types of industries exhibited significant divergence in the early stages. In the 1990s, the service and entertainment sectors displayed a dispersed distribution, whilst the manufacturing sector already exhibited characteristics of relative agglomeration, reflecting the influence of functional differences on location choice. However, since 2001, NNI values across all sectors have declined significantly, with spatial structures gradually converging towards an agglomerated pattern, and entering a phase of high-intensity centralisation after 2013. This evolutionary trajectory from divergence to convergence across industries reveals the process of spatial restructuring within the functional division of labour in the digital creative industries.

Table 2 Proximity Index for the Digital Creative Industries in China's Coastal Regions

Type	Year	Nearest ratio	Z-score	Average observation distance	Expected average distance	Study area
The digital creative industry in mainland China's coastal regions	1991	0.6958	-2.0981	137732.7289	197943.8692	2.03745E+12
	2001	0.4084	-13.1994	34116.595	83544.5789	3.79695E+12
	2012	0.2970	-42.0816	9554.6371	32173.0448	4.05347E+12
	2026	0.1746	-244.8132	1202.6375	6889.9409	4.5637E+12
Service industry	1991	3.5527	8.4584	447307.2902	125906.6513	1.9023E+11
	2001	0.5201	-8.2624	51830.5306	99651.6362	3.21747E+12
	2012	0.2922	-35.3896	11210.1936	38369.8791	4.02218E+12
	2026	0.1833	-208.2021	1469.1786	8015.7173	4.56367E+12
Manufacturing industry	1991	0.6228	-2.2821	140555.2899	225690.7352	2.03745E+12
	2001	0.6502	-4.6366	75129.9876	115553.3212	2.56369E+12
	2012	0.4105	-16.2638	26971.3248	65698.0476	3.59111E+12
	2026	0.2809	-53.9885	7320.4020	26063.7545	4.18461E+12
Entertainment industry	2001	2.2854	6.5059	367638.591	160865.5712	7.24576E+11
	2012	0.3940	-10.8761	35588.7949	90335.6908	2.87251E+12
	2026	0.2247	-102.0866	3396.4627	15117.4966	4.33035E+12

3.1.2 The overall spatial hotspot structure and its phased evolution

The nearest-neighbor index confirms the overall pattern of agglomeration and intensification within the digital creative industry; combined with core-density analysis, it further reveals the specific form of its spatial structure and its phased evolutionary trajectory (Fig. 2). To ensure the comparability of core-density results across different phases in terms of numerical scale, this study standardized the core-density grids for each period and employed a unified classification scheme for visualization. Overall, during the study period, the distribution of the industry underwent a structural transformation from sporadic emergence and axial expansion to multi-core consolidation, with spatial organization gradually shifting from localized concentration towards systematic agglomeration.

From 1978 to 1991, the spatial pattern of industrial distribution remained in its nascent stage, with high-density zones scattered sporadically, primarily centered on a few coastal gateway cities and regions at the forefront of reform

and opening up, and had not yet formed a stable, continuous structure. Agglomeration during this phase manifested more as nodal clustering, with relatively loose spatial connections and no significant collaborative networks established between regions. From 1992 to 2001, the distribution range expanded markedly, with the coastal main axis gradually exhibiting a continuous distribution pattern. No high-density agglomeration emerged within the unified hierarchical zones; instead, growth hotspots shifted from single-point intensification to strip-like extension. The deepening of regional openness and the strengthening of outward-oriented industrial linkages brought about structural integration effects. From 2002 to 2012, the spatial pattern entered a phase of accelerated agglomeration. The Yangtze River Delta, Pearl River Delta, and Bohai Rim regions formed a structure characterized by the coexistence of multiple cores, with a significant increase in the intensity of economic hotspots and a gradual clarification of hierarchical differentiation within the coastal economic belt. During this phase, density within core areas intensified, functional division of labor and synergy between regions strengthened, and spatial organization transitioned from a single-core model to a networked pattern. From 2013 to 2026, the industrial spatial pattern exhibited characteristics of high centralization and node reinforcement. High-density zones contracted further and concentrated in the core cities of several metropolitan areas, with spatial distribution tending towards compactness and polarization. Several high-intensity agglomeration poles formed within the coastal main axis, with Hainan Province experiencing explosive agglomeration during this period. At the same time, secondary hotspots emerged in some provincial capitals and regional central cities, revealing structural characteristics of both core spillover and gradient diffusion. The overall pattern shifted from the early phase of axial expansion to a stage characterized by the coexistence of core reinforcement and network restructuring.

Taken together, the evolution of core density across the four periods indicates that the spatial structure of the digital creative industry did not simply expand but underwent a progressive process from the emergence of nodes through axial extension and the formation of multiple cores to a state of high polarization. Its spatial organization gradually moved away from a state of random diffusion, forming a networked pattern dominated by the coastal main axis and supported by multiple metropolitan areas. This phased evolution laid the structural foundation for subsequent analyses of spatial differentiation within different industries and their directional migration patterns.

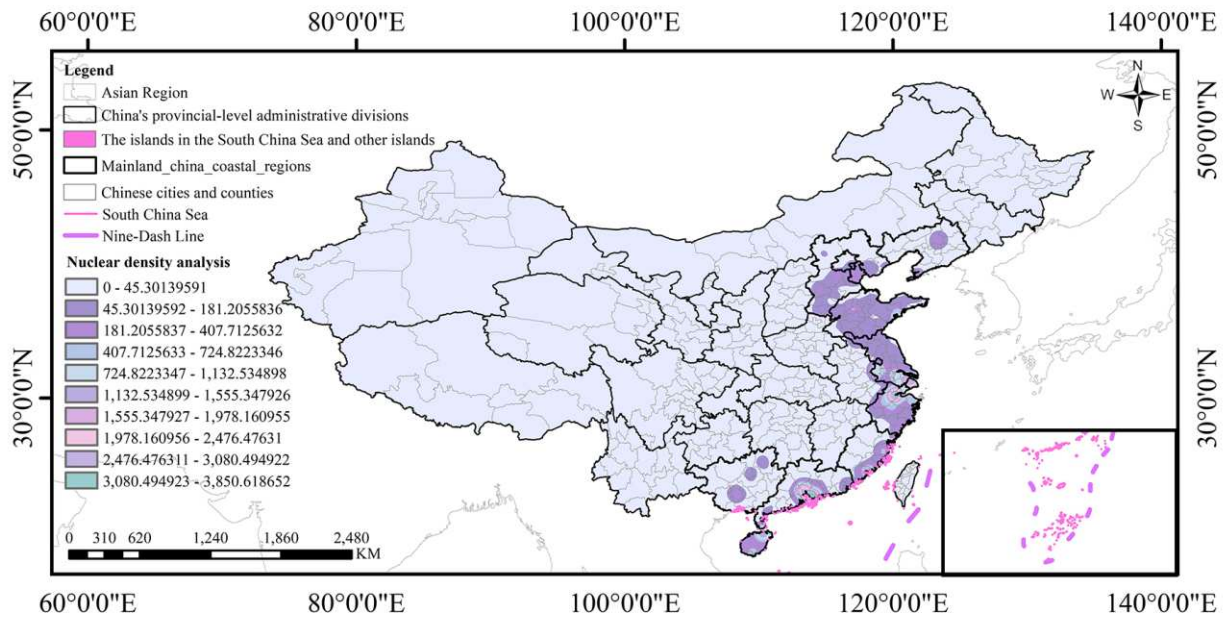
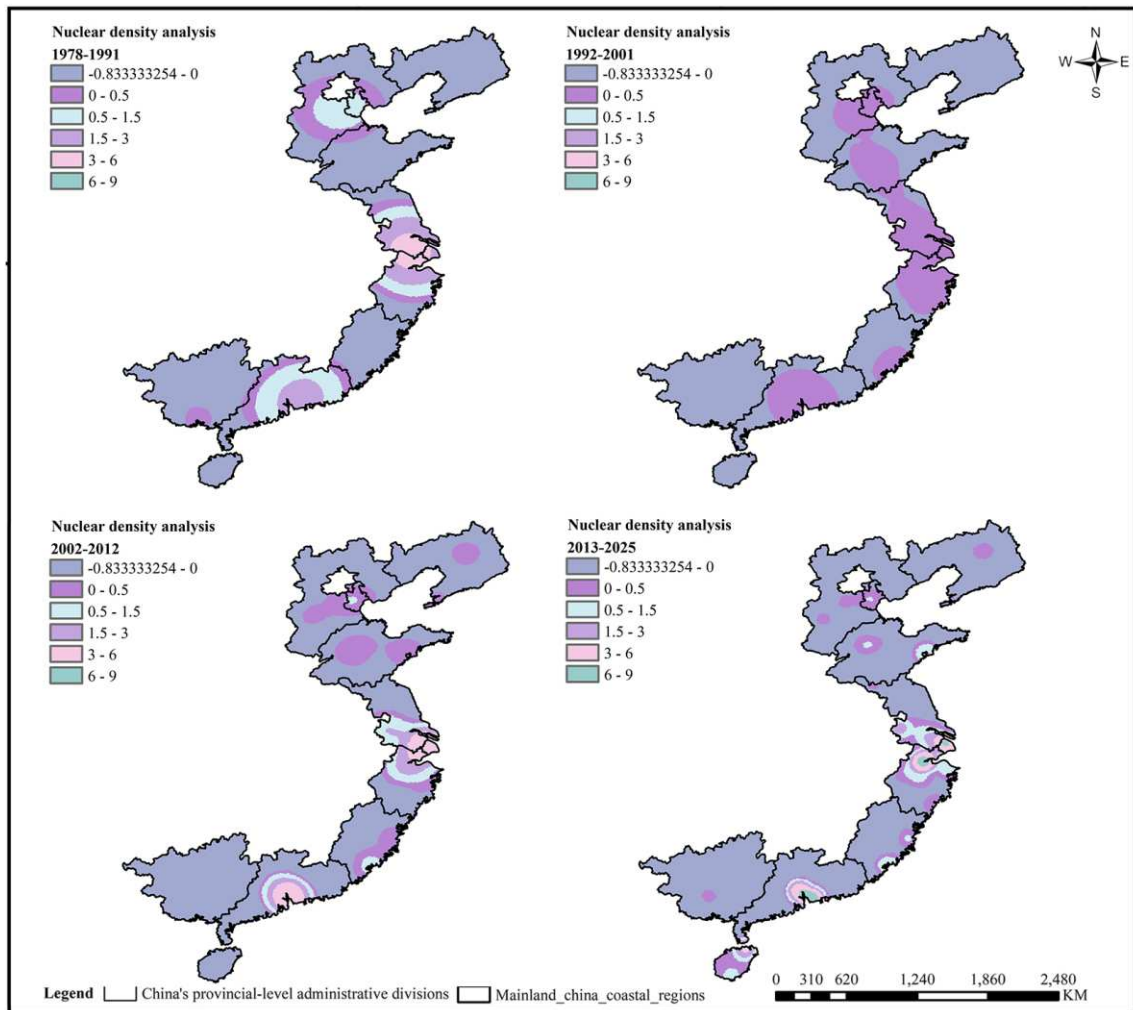


Fig 2 Analysis of the cluster density of the digital creative industry in coastal regions of mainland China

3.1.3 Sectoral Heterogeneity and Spatial Differentiation Patterns

From an industry perspective, the digital creative industries along the coast exhibit significant functional

differentiation and spatial selection patterns (Fig. 3). In the early stages, manufacturing had already formed relatively continuous coastal high-value clusters in the Pearl River Delta and Yangtze River Delta, with Shanghai, Suzhou, and Ningbo, as well as Guangzhou, Shenzhen, and Dongguan, serving as the backbone, exhibiting distinct axial organizational characteristics. The service sector, however, was concentrated primarily in core cities such as Shanghai, Guangzhou, and Shenzhen, with a spatial pattern dominated by node-based agglomeration, and had not yet formed a stable corridor structure. The entertainment industry, meanwhile, was scattered, with only weak agglomeration occurring in a few central cities, and overall density levels remained low. With the deepening development of the coastal economic belt, high-value manufacturing zones became increasingly contiguous in the late 1990s, forming stable industrial corridors along the Yangtze and Pearl River deltas while gradually establishing node-based responses in the Bohai Rim region. The service sector expanded from core cities to regional centers such as Hangzhou, Nanjing, and Xiamen, constructing a hierarchical structure underpinned by metropolitan areas. The entertainment sector, meanwhile, saw marked reinforcement in Beijing, Shanghai, and the core areas of the Pearl River Delta, demonstrating a tendency to converge towards cities with larger populations and stronger cultural consumption capacity. Since the turn of the 21st century, the intensity of agglomeration across all sectors has increased significantly, yet spatial structural disparities have become more pronounced. Manufacturing has maintained the continuity of the coastal axis while strengthening cluster-based node connections in Suzhou, Wuxi, Changzhou, Shenzhen, and Foshan, presenting a multi-node pattern driven by industrial chain synergy. High-value zones in the service sector have stabilized in the core areas of the Yangtze River Delta and the Pearl River Delta, while forming secondary clusters in the Bohai Rim, demonstrating a high degree of dependence on the functions and information resources of high-tier cities. The scope of entertainment industry hotspots has contracted relatively while their intensity has increased, concentrating in the core cities of Beijing, Shanghai, and the Pearl River Delta, revealing a strong lock-in effect of cultural production and the platform economy on core metropolitan areas. Since 2013, the sector's spatial structure has further concentrated towards core metropolitan areas. High-value zones in the service and entertainment sectors have shown a trend towards compactness, with peripheral expansion weakening, while manufacturing, while maintaining the continuity of coastal corridors, has seen its high-density zones become more concentrated in key node cities with robust industrial foundations and well-developed supply chains.

Overall, the spatial organization of the coastal digital creative industries can be summarized as a pattern characterized by 'core metropolitan area dominance, multi-node coordination, and axial linkage.' The Yangtze River Delta and the Pearl River Delta constitute the dual core clusters of industrial agglomeration, while the Beijing-Tianjin-Hebei region, centered on Beijing, forms a key supporting pole; together, these three elements constitute the dominant structure of the coastal digital creative industries. Cities such as Shanghai, Shenzhen, and Hangzhou exhibit a pronounced 'core-pole effect' in the service and entertainment sectors, while cities including Suzhou, Ningbo, and Dongguan serve as key nodes in the manufacturing sector. This gives rise to a multi-tiered spatial system centered on high-tier cities and supported by industrial chain node cities. The functional differentiation within the industry is consolidated through the urban hierarchy, resulting in a spatial organization model for the digital creative industry in coastal regions characterized by the coexistence of 'reinforced core poles and network extension.'

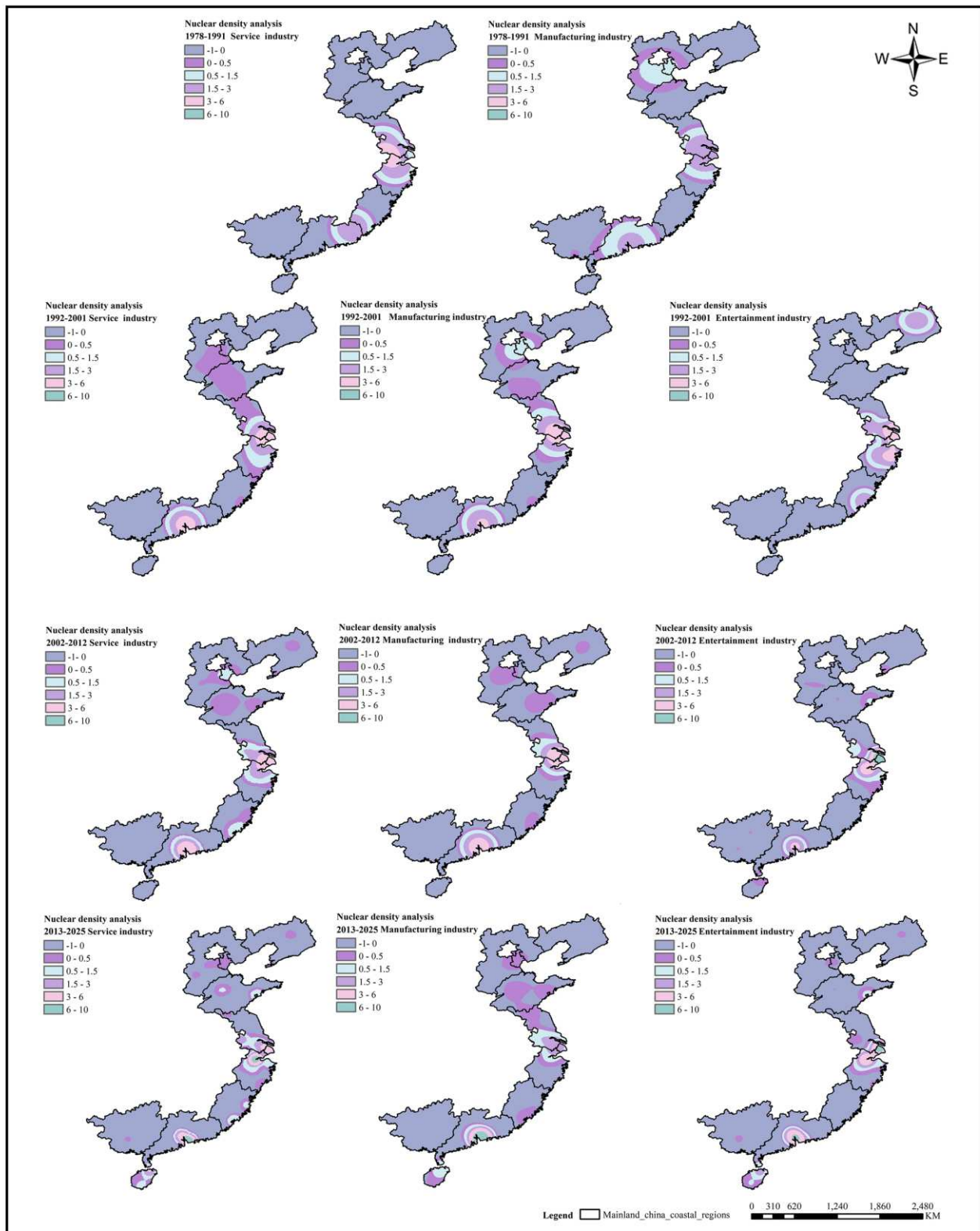


Fig 3 Map of the Distribution of the Digital Creative Industry in Coastal Areas of Mainland China

3.1.4 The Shift in Spatial Focus and the Evolution of Directional Structures

The results of the standard deviation ellipse analysis further reveal the dynamic evolutionary characteristics of the coastal digital creative industry in terms of directionality and center of gravity(Fig. 4). Overall, the major axes of the ellipses in each period exhibit a distinct northeast to southwest orientation, closely aligning with the spatial

axis of China's coastal economic belt. This indicates that industrial expansion has unfolded along existing urban belts and transport corridors, demonstrating significant path dependence and axial lock-in characteristics. In the early stage, the ellipses were relatively large with high dispersion, and the spatial center of gravity was situated between the Pearl River Delta and the Yangtze River Delta, reflecting a multi-point layout and dispersed functional distribution of the industry. In the middle stage, the ellipse contracted in area, and its center of gravity shifted towards the Yangtze River Delta, indicating that resource allocation and innovation factors were concentrating within higher-tier urban systems. In the later stage, the ellipse became even more compact, its orientation stabilized, and its spatial center of gravity was locked within the core metropolitan area, demonstrating a shift from expansive agglomeration to structural concentration. This process aligns with the evolutionary trend in areas of high nuclear density, where expansion from contiguous areas has shifted towards the reinforcement of the core.

At the sectoral level, the elliptical patterns of the service sector exhibit a shift from dispersion to concentration, with the center of gravity continuously shifting towards the Shanghai–Hangzhou axis, reflecting the high dependence of knowledge-intensive activities on the innovation environment and high-end factor markets. The manufacturing sector's ellipse consistently maintains a significant degree of axial extension, unfolding along coastal corridors. Its spatial form is markedly constrained by industrial chain synergies and logistics networks, exhibiting a corridor-like character. The center of gravity of the entertainment sector's ellipse has shifted from the southern coast towards the Yangtze River Delta and the Beijing-Tianjin-Hebei region, while its area has gradually contracted, indicating that content production and digital platform activities are concentrating in high-tier consumer markets.

The results of the standard deviation ellipse analysis indicate that the spatial structure of the coastal digital creative industry is highly stable in terms of orientation, continues to shift northwards in terms of center of gravity, and tends towards convergence in terms of form. Industrial organization has evolved from an early dispersed layout to a structural form characterized by a focus on the coastal axis, dominance by core metropolitan areas, and multi-node coordination, further corroborating its evolutionary path of core metropolitan area dominance and networked coordination.

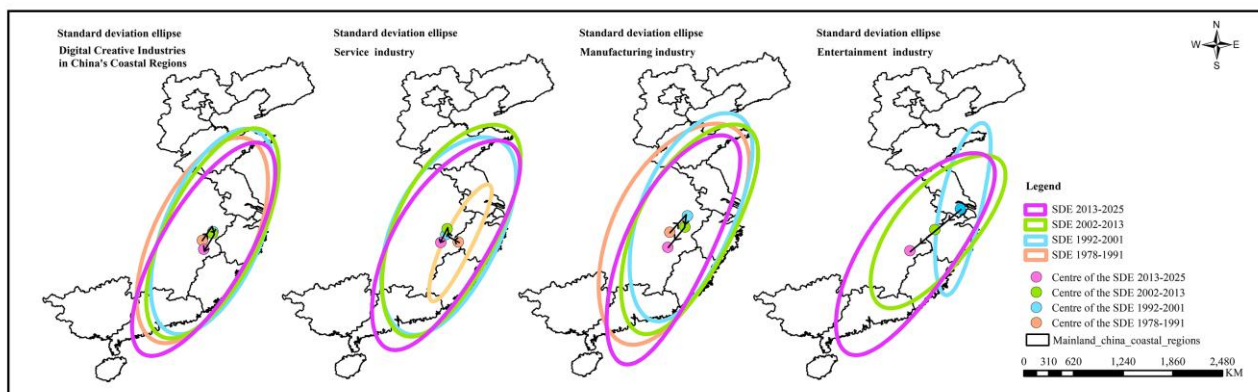


Fig 4 Standard deviation ellipse analysis map of the digital creative industry in coastal regions of mainland China

3.2 The Spatial Distribution Drivers of the Digital Creative Industry in Mainland China's Coastal Regions

3.2.1 Interaction Analysis of Single and Dual Factors in Geodetical Detectors

According to the results of the geographical indicator analysis (Table 3), all driving factors were found to have a statistically significant impact on the spatial distribution of the digital industry in coastal areas of mainland China. From an overall perspective, the explanatory power of these factors on the spatial distribution of the industry exhibits a certain gradient, with internet penetration, foreign direct investment, and the number of invention patents showing relatively high q-values, making them the primary driving factors influencing the spatial pattern of the coastal digital

industry. This reveals a composite driving structure formed by the combined effects of multiple factors.

The driving structures of different industrial types exhibit certain differences. In the service-oriented digital industry, internet penetration, foreign direct investment, and the number of invention patents demonstrate relatively prominent explanatory power, forming a spatial agglomeration pattern underpinned by these core variables. By comparison, the driving structure of the digital manufacturing industry exhibits distinct selective characteristics: while the explanatory power of variables such as the proportion of the population with higher education, the number of invention patents, and internet penetration has significantly increased, some variables failed to pass the significance test. This indicates that the spatial formation of the manufacturing digital industry is more susceptible to constraints imposed by key factors. The overall explanatory power for the entertainment sector has increased markedly, with the number of invention patents demonstrating the most prominent explanatory capacity. Meanwhile, foreign investment and total consumption also remain at a high level, indicating that the digital entertainment sector exhibits greater sensitivity to external development conditions during its spatial distribution process.

Table 3 Results of the Geographical Survey of the Digital Creative Industry in China's Coastal Regions

Type	Test parameters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
the coastal regions of mainland China	q statistic	0.0019	0.0037	0.0050	0.0041	0.0077	0.0038	0.0049	0.0046	0.0014	0.0084	0.0079	0.0026
	p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Services industry	q statistic	0.0026	0.0038	0.0044	0.0033	0.0056	0.0028	0.0036	0.0035	0.0010	0.0101	0.0076	0.0018
	p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Manufacturing industry	q statistic	0.0098	0.0040	0.0057	0.0064	0.0137	0.0094	0.0144	0.0057	0.0015	0.0127	0.0103	0.0084
	p value	0.0060	0.2019	0.0790	0.0517	0.0000	0.0085	0.0000	0.0778	0.6828	0.0000	0.0000	0.0148
Entertainment industry	q statistic	0.0081	0.0038	0.0125	0.0081	0.0181	0.0088	0.0098	0.0109	0.0051	0.0067	0.0133	0.0077
	p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

X1 represents GDP per capita; X2 represents the share of the tertiary sector; X3 represents total consumption; X4 represents R&D expenditure; X5 represents the number of invention patents; X6 represents the number of creative enterprises; X7 represents the proportion of the population in higher education; X8 represents the number of research personnel; X9 represents employment in the information services sector; X10 represents internet penetration; X11 represents foreign direct investment; X12 represents the area of the built-up urban area

There is a clear synergistic effect between different driving factors, with the Q-values of the interaction terms generally higher than those obtained from single-factor analyses (Fig 5). This indicates the unique nature of the spatial pattern of China's digital creative industry, which is shaped by the coupled effects of multiple factors. Looking at the overall sample, the most prominent interaction combinations are primarily concentrated in the areas of per capita GDP and the number of invention patents ($X1 \cap X5$), the share of the tertiary sector and internet penetration ($X2 \cap X10$), and total consumption and internet penetration ($X3 \cap X10$). This indicates that the synergistic effects between economic development levels, industrial structure upgrading, and digital infrastructure constitute important foundational conditions for driving the spatial agglomeration of the digital creative industry.

When examined by industry type, the driving structures exhibit certain differences. Within the service-oriented digital creative industries, combinations such as per capita GDP and R&D expenditure ($X1 \cap X4$), as well as the share of the tertiary sector and employment in the information services sector ($X2 \cap X9$), are relatively prominent. Service-oriented digital creative industries rely more heavily on the synergistic support of the service-oriented economic structure, innovation investment, and the employment environment in the information services sector.

The digital creative industry in the manufacturing sector, however, exhibits stronger structural characteristics. Combinations such as per capita GDP and the number of invention patents ($X1 \cap X5$), per capita GDP and the number of creative enterprises ($X1 \cap X6$), and the share of the tertiary sector and internet penetration rate ($X2 \cap X10$) demonstrate higher explanatory power, indicating that the digital creative industry in manufacturing relies more on the synergistic accumulation of economic foundations, technological innovation, and enterprise entities. In contrast, within the digital creative industries of the entertainment sector, combinations such as total consumption and R&D expenditure ($X3 \cap X4$) and total consumption and internet penetration rate ($X3 \cap X10$) are more prominent. This suggests that the synergistic effect of consumer market scale and the digital dissemination environment exerts a more significant influence on its spatial distribution.

Overall, the driving factors generally exhibit a synergistic relationship. The service sector relies more heavily on the support of the service economy and the information employment environment, while the manufacturing sector places greater emphasis on the synergy between the economic foundation and innovation capacity. The entertainment sector, however, is more influenced by the consumer market and digital communication conditions, demonstrating that different sub-sectors exhibit distinct characteristics in their location formation mechanisms.

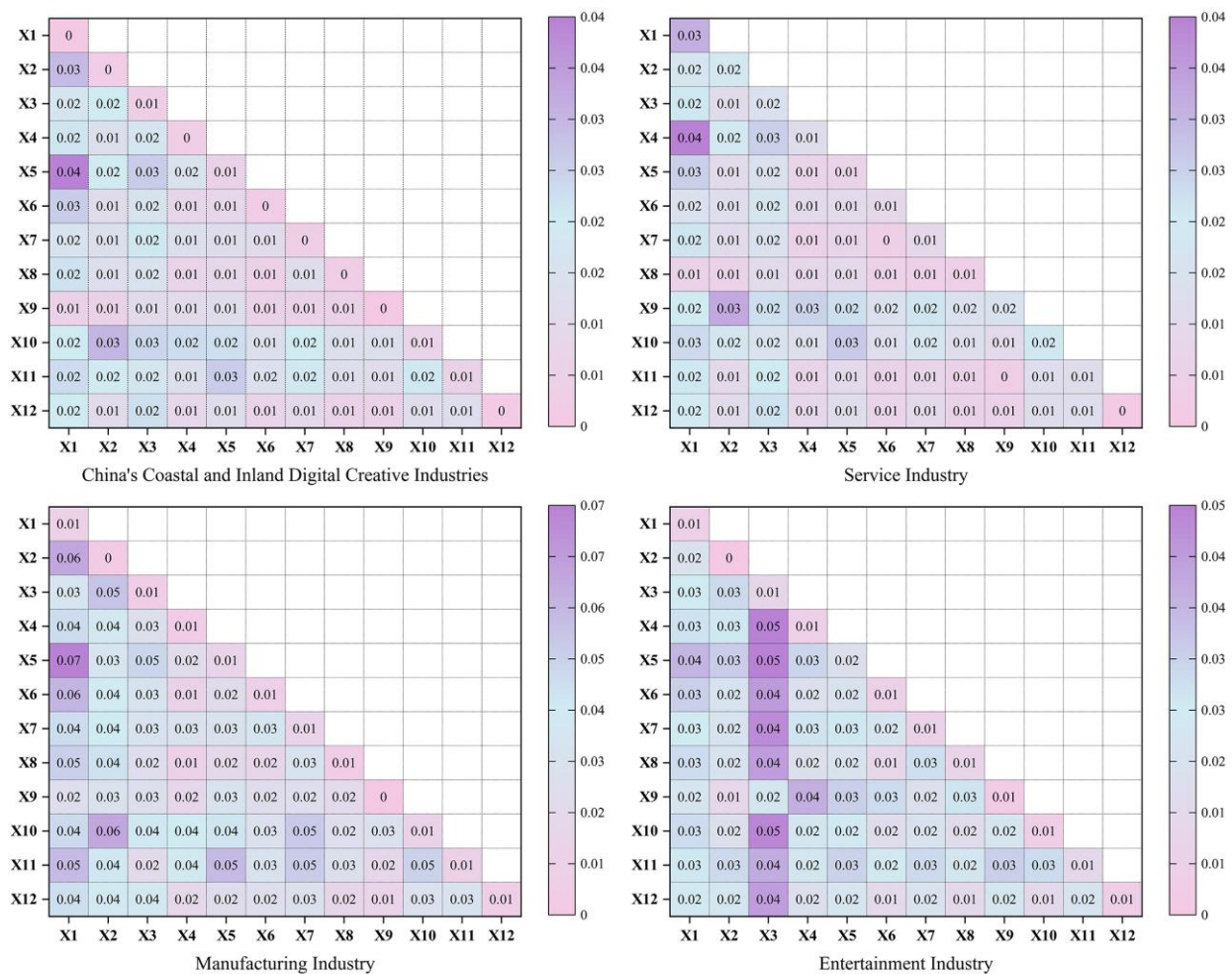


Fig 5 An Interaction Analysis of Factors Influencing the Digital Creative Industry in Coastal Regions of Mainland China

3.2.2 Analysis of the spatio-temporal heterogeneity of influencing factors

The spatial distribution of the digital creative industry is influenced by a combination of factors. To avoid issues of multicollinearity, this study conducted Pearson correlation analyses and Variance Inflation Factor (VIF) tests on each variable. The results indicate that the correlation coefficients passed the significance level test; consequently, six indicators—per capita GDP, the share of the tertiary sector, R&D expenditure, the number of

invention patents, internet penetration rate, and the area of the urban built-up area—were selected for subsequent analysis (Table 4).

Ordinary Least Squares (OLS), Time-Weighted Regression (TWR), Geographically Weighted Regression (GWR) and Spatio-Temporally Weighted Regression (GTWR) reflect temporal effects, spatial effects and spatiotemporal interactions respectively, and exhibit significant differences in their fitting performance. The findings (Table 5) indicate that the GTWR model exhibited the highest values for both R^2 and adjusted R^2 , whilst its AICc was the lowest, suggesting that it significantly outperformed the other models in terms of explanatory power, residual control and model stability. Furthermore, the GTWR model had the smallest bandwidth parameter, indicating that it was most sensitive to local spatiotemporal variations and was thus better able to capture the spatiotemporal non-stationarity of the study subjects. In summary, the GTWR model demonstrated the best overall performance and is the optimal model for characterising the spatio-temporal mechanisms in this study.

Table 4 Results of tests for correlation between indicators and multicollinearity

Factors influencing	Unstandardised coefficient		Standardised beta coefficient	t	Significance	Statistical tolerance f or collinearity	VIF
	B	Standard error					
(constant)	-3807.7829	1193.9468		-3.1892	0.0015		
GDP per capita	0.0716	0.0090	0.2464	7.9311	1.4113E-14	0.3273	3.0557
Share of the tertiary sector	46.6248	32.3059	0.0336	1.4432	0.1496	0.5817	1.7192
R&D expenditure	3.1806	2.3977	0.0400	1.3265	0.1853	0.3484	2.8704
Number of invention patents	0.7455	0.0435	0.4993	17.1280	3.636E-52	0.3718	2.6898
Internet penetration rate	-1.5157	11.4278	-0.0039	-0.1326	0.8945	0.3566	2.8042
Area of the built-up area	15.1051	1.3780	0.2774	10.9619	3.1771E-25	0.4933	2.0272
R^2				0.8408			
Adjusted R^2				0.8389			
F				443.5943			

Table 5 Comparison of Regression Attributes for the Globe-OLS, TWR, GWR and GTWR Models

Model	R^2	Adjusted R^2	AICc	RSS	Bandwidth
OLS	0.8410	—	5676.8000	1.066×10^{10}	—
TWR	0.8940	0.8920	5595.3700	7.133×10^9	0.1785
GWR	0.9810	0.9810	5116.7200	1.285×10^9	0.2159
GTWR	0.9930	0.9930	4952.6900	8.623×10^7	0.1122

Globe-OLS refers to the global ordinary least squares regression model; TWR refers to time-weighted regression; GWR refers to geographically weighted regression; and GTWR refers to spatio-temporally weighted regression. AICc refers to the adjusted Akaike information criterion; RSS refers to the model's residual sum of squares; and Bandwidth refers to the model's estimated bandwidth.

Building upon a comparison of geographical detector models, the GTWR model was further employed to analyze the spatio-temporal heterogeneity of the driving factors (Fig 6). The regression coefficients of each driving factor illustrate the evolutionary trends across different spatio-temporal phases, reflecting the spatio-temporally non-stationary characteristics of the driving mechanisms behind China's coastal digital creative industries. In the early stages of the study, economic fundamentals exerted a significant influence; the strong explanatory power of per capita GDP demonstrated the dependence of initial agglomeration development on the scale of the regional economy and the foundation of market demand. As the study period progressed, the influence of innovation capacity factors on the industry's spatial pattern gradually increased. From the 2000s onwards, the regression coefficients for indicators such as the number of invention patents and R&D expenditure rose markedly in the Yangtze River Delta and Pearl River Delta regions, with knowledge-based innovation capacity gradually playing a leading role in driving the development of the digital creative industry. The agglomeration of innovation resources strengthened the industrial appeal of core cities by enhancing regional technological levels and facilitating exchange and cooperation among creative enterprises. Following the rapid development phase of the digital economy, internet penetration rates exhibited a strong positive influence in the southeastern coastal regions and the Pearl River Delta, indicating that the improvement of the digital network environment can effectively reduce information transmission costs and promote the production of creative content and the development of digital platforms. At the same time, the built-up area of cities exhibited higher regression coefficients in some core cities, suggesting that urban spatial scale and functional agglomeration capacity provide an important spatial platform for the digital creative industry.

Synthesizing the regression results across different stages reveals an evolutionary trend in the driving mechanisms of China's coastal digital creative industries, shifting from being driven by economic foundations to being driven by innovation capacity and digital infrastructure. From a spatial perspective, the Pearl River Delta region exhibits a high level of influence across indicators such as per capita GDP, internet penetration rate, and urban built-up area, demonstrating its significant advantages in terms of economic foundations and digital infrastructure. The Yangtze River Delta region, meanwhile, stands out in terms of R&D investment and the number of invention patents, reflecting an industrial development model centered on the aggregation of innovation resources. In contrast, the regression coefficients for most indicators in the Bohai Rim region are generally low, indicating that the development of its digital creative industries remains constrained to some extent by innovation resources and digital environmental conditions.

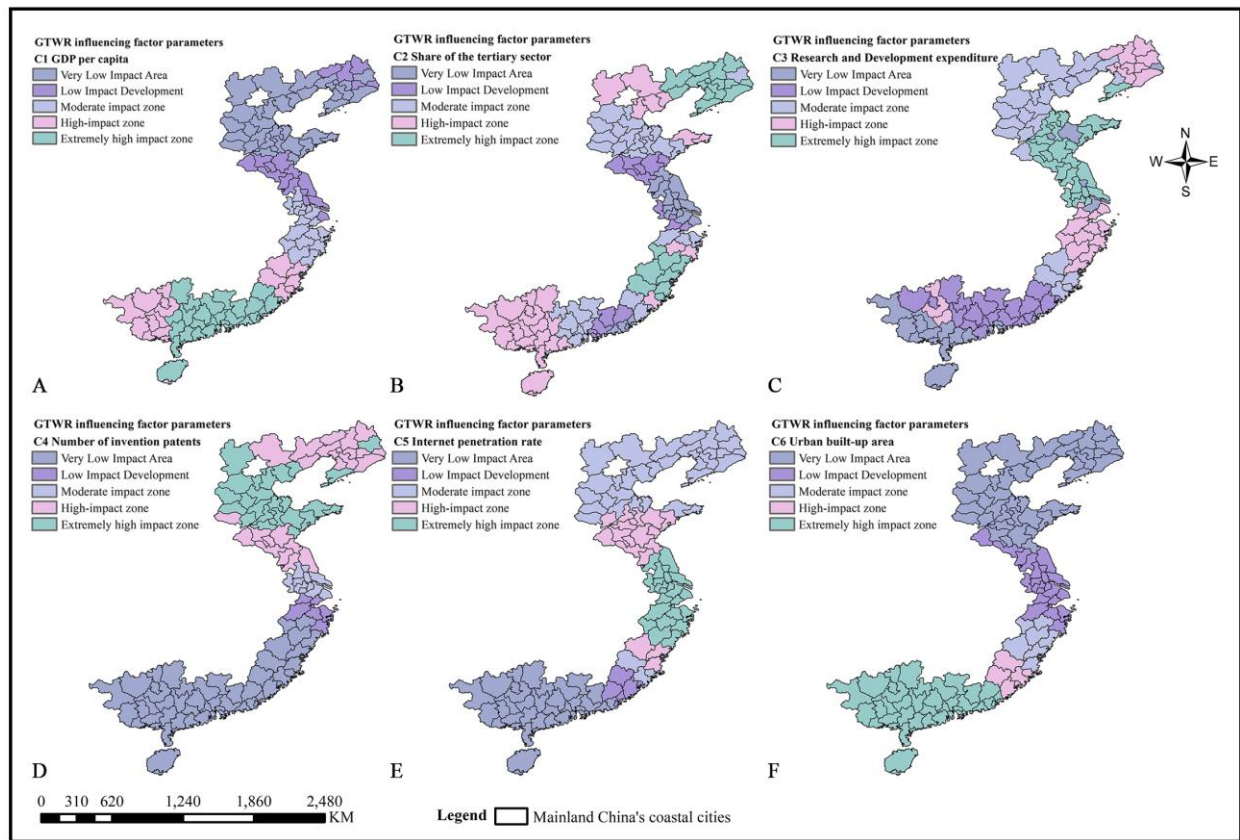


Fig 6 Spatio-temporal regression analysis map of the digital creative industry in coastal regions of mainland China

4 Discussion and Conclusions

This study systematically analyzes the evolution of the digital creative industry and its influencing factors, highlighting its pronounced tendency to cluster within core metropolitan areas and the mechanisms of influence arising from the interplay of multiple factors, including knowledge networks, creative talent, and the information dissemination environment. The paper integrates discussion and conclusions to provide a coherent reflection from both theoretical and practical perspectives.

In terms of spatial structure, China's coastal digital creative industries have gradually formed a dual-center structure centered on the Yangtze River Delta and the Pearl River Delta, with an important secondary growth pole emerging in the Bohai Rim region. This reflects both the creative industries' reliance on high-tier urban environments and the characteristics of industrial network diffusion under the digital economy. Regarding driving

mechanisms, distinct differences are evident across different regions and even at different developmental stages. In spatial terms, the Pearl River Delta region possesses significant advantages in market scale and digital infrastructure, while the Yangtze River Delta region excels in research resources and technological innovation. The Bohai Rim region, however, still lags behind in terms of innovation resources and the foundations of the digital economy, resulting in relatively slower industrial development. In temporal terms, during the early stages of development, regional economic levels and market scale are crucial conditions for industrial formation. In the intermediate stage, knowledge production capacity becomes the key driver of industrial development. In the rapid development phase, the catalytic role of digital infrastructure and the information dissemination environment in industrial development is further enhanced. The aforementioned evolutionary process reflects the multi-layered, overlapping influence structure of the driving mechanisms under the spatio-temporal evolution of the digital creative industries.

At the policy level, promoting the high-quality development of the digital creative industries requires the establishment of a multi-dimensional, collaborative development environment. Firstly, the digital infrastructure system must be improved to enhance the capacity of the internet and information technology environment to support the development of the creative industries. Secondly, the aggregation of innovation resources must be strengthened to promote collaborative innovation among research institutions, universities, and creative enterprises. Finally, different regions should formulate differentiated development strategies based on their own industrial foundations and resource endowments.

This study still has certain limitations. Enterprise data is primarily sourced from commercial databases, and the statistical scope may be affected by variations in the updating of enterprise registration information and differences in industry classification standards. At the same time, the indicator system constructed in this paper is mainly based on macro-level statistical data, and its characterization of soft factors such as the mobility of creative talent, cultural atmosphere, and industrial network structures remains limited. Future research could integrate multi-source data to reveal the underlying mechanisms of the spatial evolution of the digital creative industry from a more micro-level perspective.

Overall, this study has revealed the spatial evolution patterns and driving mechanisms of China's coastal digital creative industry from a spatiotemporal perspective, providing new empirical evidence for understanding the spatial organization patterns of the creative industry in the context of the digital economy. Furthermore, the findings offer important references for optimizing the regional layout of the digital creative industry and formulating policies for innovative development.

Declarations

Ethical Approval

This study did not involve human participants or identifiable personal data, and therefore did not require formal ethical approval.

Informed Consent

Not applicable. This study did not involve human participants, surveys, interviews, or any identifiable personal data.

Competing Interests

The authors declare no competing interests.

Data Availability

The datasets generated and analysed during the current study are derived from publicly available sources, including the Tianyancha enterprise information platform and official statistical yearbooks such as the *China Statistical Yearbook*, *China High-Tech Industry Statistical Yearbook*, and *China City Statistical Yearbook*. Processed data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Legends

Fig. 1 Spatial distribution of the digital creative industry in coastal regions of mainland China.

This figure illustrates the geographic distribution of digital creative enterprises across China's coastal regions based on enterprise registration data. The spatial pattern reflects the overall clustering characteristics of the digital creative industry, highlighting the concentration of enterprises in major metropolitan regions such as the Yangtze River Delta and the Pearl River Delta.

Fig. 2 Kernel density analysis of the digital creative industry in coastal regions of mainland China across different periods.

Kernel density estimation is used to visualize the spatial clustering intensity of digital creative enterprises during four development stages. Higher density values represent stronger industrial agglomeration, revealing the gradual transition from dispersed distribution to multi-core spatial clustering along the coastal economic belt.

Fig. 3 Sectoral spatial distribution of the digital creative industry in coastal regions of mainland China.

This figure presents the spatial distribution patterns of different sectors within the digital creative industry, including service, manufacturing, and entertainment industries. The results highlight significant spatial heterogeneity among sectors and demonstrate differentiated agglomeration patterns across major coastal urban regions.

Fig. 4 Standard deviation ellipse analysis of the digital creative industry in coastal regions of mainland China.

The standard deviation ellipse is used to analyze the directional evolution and spatial center of gravity of the digital creative industry. The ellipse indicates the dominant spatial orientation and dispersion of enterprise distribution, while the centroid migration trajectory reflects the shifting spatial focus of industrial development over time.

Fig. 5 Interaction analysis of factors influencing the digital creative industry in coastal regions of mainland China.

This figure illustrates the interaction effects between different driving factors identified by the geographical detector model. The interaction q-values indicate the combined explanatory power of factor pairs, demonstrating the synergistic influence of economic development, innovation capacity, and digital infrastructure on the spatial

distribution of the industry.

Fig. 6 Spatio-temporal regression analysis of driving factors affecting the digital creative industry.

The figure presents the spatial distribution of regression coefficients derived from the GTWR model, illustrating the spatial heterogeneity of key driving factors. The results reveal regional differences in the influence of economic development, innovation resources, and digital infrastructure on the development of the digital creative industry.

Tables

Table 1

Indicator system for analyzing the driving mechanisms of the digital creative industry in China’s coastal regions.

The table presents the multi-dimensional indicator framework constructed to evaluate the driving mechanisms of the digital creative industry, including economic foundation, innovation capacity, workforce composition, and urban environment.

Table 2 Nearest neighbor index results for the digital creative industry in China’s coastal regions.

This table reports the nearest neighbor index (NNI) results used to assess spatial agglomeration characteristics of digital creative enterprises across different periods and sectors. NNI values below 1 indicate spatial clustering.

Table 3 Geographical detector results for the driving factors of the digital creative industry.

The table presents q-statistics and significance levels for each explanatory variable, indicating the degree to which different factors explain spatial variations in the digital creative industry.

Table 4 Results of correlation and multicollinearity tests of influencing factors.

Pearson correlation analysis and variance inflation factor (VIF) tests are used to evaluate the relationships among explanatory variables and identify potential multicollinearity.

Table 5 Comparison of regression models for analyzing driving mechanisms of the digital creative industry.

This table compares the performance of the OLS, TWR, GWR, and GTWR models based on R^2 , adjusted R^2 , AICc, residual sum of squares (RSS), and bandwidth parameters.

Supplementary Files

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