

# Coupling Research on the Integration and Development of Cultural Industry and High-tech Industry

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**Abstract:** *Promoting industrial transformation and upgrading through industrial integration development is an inevitable trend of industrial development. Based on the coupling mechanism and the coupling evaluation model, this paper empirically analyzes the comprehensive evaluation index, integration degree and coupling coordination degree of the two industries based on the related data of the cultural industry and the high-tech industry from 2008 to 2016. The empirical results show that there is a significant integration phenomenon between China's cultural industry and high-tech industry, and the degree of integration is in a highly coupled stage. At the same time, the integration and development between the two industries is fluctuating.*

**Keywords:** cultural industry; high-tech industry; integrated development; coupling mechanism

## 1. Introduction

As an important driving force for the growth of the world economy, the cultural industry has become an important foundation for national cultural competitiveness. As a company with strong permeability and relevance, it has a natural coupling relationship with other industries, and has a good foundation and broad prospects for integration and development with various industries. As a new knowledge- and technology-intensive industry, the high-tech industry relies on its own unique advantages to break through industrial boundaries and restructure industrial factors with cultural industries, and to carry out a wider range, deeper level and higher level of integration and innovation in a timely manner. The spillover effect of the two promotes fission of the business, solves various problems faced in the process of cultural industry transformation, realizes industrial upgrading, and enhances the vitality of industrial development. Therefore, the integration of cultural industries and high-tech industries is an inevitable trend of industrial development.

With the development of industrial integration practice, the theory of industrial integration has attracted extensive attention from scholars at home and abroad. In terms of the connotation of industrial integration, Greenstein & Khanna (1997) believes that industrial integration is a phenomenon in which industrial boundaries shrink or disappear in order to adapt to industrial growth<sup>[1]</sup>. Zhi Caoyi (2001) points out that industrial integration is a process of lowering barriers between industries due to technological innovation and relaxation of restrictions<sup>[2]</sup>. Ma Jian believes that industrial integration is the integration of technology at the industrial boundary due to technological progress and deregulation, which promotes the blurring of industrial boundaries<sup>[3]</sup>. In the measurement method of industrial integration, Xu Yingzhi and Sun Jian (2009) use the input-output method to measure The degree of integration of China's information industry and manufacturing industry<sup>[4]</sup>. Weng Gangmin et

al. (2016) use the coupling coordination degree model and spatial correlation analysis method to study the current status and level of integration of tourism industry and cultural industry<sup>[5]</sup>. Fu Weizhong and Jin Min (2017) based on the AHP-information entropy coupling evaluation model evaluating the integration development and effect of high-tech service industry and equipment manufacturing industry in the context of Industry 4.0<sup>[6]</sup>.

From the existing literature research, the domestic and foreign scholars' research on the theory and practice of industrial integration development mainly focuses on the information industry and manufacturing industry. The coupling mechanism of the cultural industry and high-tech industry integration development is less in the existing research. Based on the coupling mechanism and coupling evaluation model, this paper analyzes and evaluates the integration and development of cultural industry and high-tech industry by using time series data, and then proposes corresponding suggestions for further integration and development of the two industries.

## 2. The Mechanism Analysis of the Integration and Development of Cultural Industry and High-tech Industry

Cultural industries and high-tech industries are ecological and sunrise-oriented industries, and their internal attributes determine the possibility of their integration. With the improvement of material living standards and the development of technological innovation, it is an inevitable trend to promote industrial restructuring and transformation and upgrading with high-tech industries. The combination of external driving force and internal driving force has promoted the integration and development of the two industries in a multi-coupling and synergistic trend, which is mainly achieved through the combination of soft power integration and hard power integration.

The integration of soft power mainly includes industrial market and talent resources. In the industrial market, the cultural industry and high-tech industries are characterized by high radiation. The integration of the two industries promotes the improvement of their service capabilities and service radius, creating greater market space. At the same time, the integration of high-tech industries has created conditions for the improvement of the efficiency of cultural industry operations, and the development of cultural industries is also the promotion for high-tech. The organic combination of the two industries promotes the rapid growth of industries in the integration, and expands the scale of the industry; In terms of talent resources, the integration of cultural industries and high-tech industries requires the guidance of highly skilled talents. The large number of new jobs created by their integration attracts service-oriented employees to the cultural industry at a relatively high speed, which is conducive to the continuous optimization of the overall employment structure of society.

The integration of hard power mainly includes industrial resource integration and product innovation design. In terms of industrial resource integration, with the integration of cultural industries and high-tech industries, the characteristics of informationization, intelligence, and knowledge of high-tech accelerated the flow of capital, technology, information and other factors in the market. A variety of resources are more effectively deployed in a larger time and space, breaking through the boundaries of the original industry ,which promotes the common development of the two industries. In terms of product innovation and design, the integration and development of the cultural industry and the high-tech industry has spawned a large number of innovative new products with the characteristics of the two industries, which can simultaneously satisfy people's dual needs for culture and technology, and promote the profound changes in people's consumption concepts and consumption behaviors to some extent. It is an important combination point for promoting the integration and development of the two industries.

### 3. Coupling and Coordination Research on the Integration and Development of Cultural Industry and High-tech Industry

#### 3.1 Coupling Model

##### 1) Coupling degree model

In order to determine the strength of the correlation between the cultural industry and the high-tech industrial system, the

coupling model and the coupling coefficient model are used to establish the coupling model between the cultural industry system and the high-tech industrial system as follows:

$$C = 2 \sqrt{\frac{f(x)g(y)}{(f(x) + g(y))^2}} \quad (1)$$

Among them,  $f(x)$  is a comprehensive evaluation function of cultural industry, and  $g(y)$  is a comprehensive evaluation function of high-tech industry.  $C$  represents the degree of coupling of the system and has a value range of  $[0, 1]$ . A larger  $C$  indicates a higher degree of coupling between the two subsystems, and vice versa.

##### 2) Coupling coordination model

Because the coupling degree model may have pseudo-coordination when the two subsystems interact, in order to more accurately judge the degree of coordination between the cultural industry and the high-tech industry, and fully fed back the degree of contribution of the two subsystems to the whole coupled system, the model of coupling coordination between cultural industry and high-tech industry is as follows:

$$D(f(x), g(y)) = \sqrt{CgT} \quad (2)$$

$$T = \alpha f(x) + \beta g(y) \quad (3)$$

$D$  is the degree of coupling coordination, and the value range is  $[0, 1]$ . The degree of coupling coordination of the system increases as the value of  $D$  increases.

$T$  is the comprehensive coordination coefficient, reflecting the overall synergy between the cultural industry and the high-tech industry. The larger the  $T$  value, the higher the synergy effect between them, and the lower the opposite. The  $\alpha$  and  $\beta$  are the weights that reflect the importance of the cultural industry and the high-tech industry, and the values are determined according to the specific situation. In view of the actual situation,  $\alpha = 0.5, \beta = 0.5$

Refer to the research results of previous scholars to evaluate the coupling level of the industrial system. The evaluation criteria are shown in Table 1.

**Table 1:** Division of evaluation criteria of coupling degree and coupling coordination degree between cultural industry and high-tech industry

Coupling degree C	Coupling level	Coordination degree D	Coordination level	Coordination degree D	Coordination level
(0, 0.3]	Low coupling	(0, 0.1]	Extreme misalignment	(0.5, 0.6]	Barely coordinated
(0.3, 0.7]	Antagonistic phase	(0.1, 0.2]	Serious disorder	(0.6, 0.7]	Primary coordination
(0.7,0.9]	Run-in phase	(0.2, 0.3]	Moderate imbalance	(0.7, 0.8]	Intermediate coordination
(0.9,1)	Highly coupled	(0.3, 0.4]	Mild imbalance	(0.8, 0.9]	Good coordination
1	Fully coupled	(0.4, 0.5]	Endangered	(0.9, 1]	Quality coordination

### 3.2 Empirical Analysis of Industrial Coupling

#### 1) Data source

According to the classification criteria of the national economic industry classification and code (GB/T 4754-2017), and the consideration of data accessibility, the high-tech industry of this paper is mainly represented by information transmission, software and information technology service industry. The data mainly comes from "China Statistical Yearbook 2008-2016", "China High-tech Industry Statistical Yearbook 2008-2016", "Chinese Culture and Related Industry Statistical Yearbook 2008-2017", "China Tertiary Industry Statistical Yearbook" and China Science and Technology Database. The missing data is

interpolated according to the years before and after.

#### 2) Construction of rating indicator system and determination of weight

According to the principle of industrial integration, on the basis of the principles of comparability, representativeness, scientificity, reliability and systemicity, the evaluation index system of the subsystem integration relationship between the cultural industry and the high-tech industry is constructed from four aspects: industrial scale, industrial efficiency, industrial potential, and openness. The indicators are weighted by the entropy method and the results are shown in Table 2 and Table 3.

**Table 2:** Evaluation index and weight of cultural industry and high-tech industry development

Cultural industry			High-tech industry		
Primary indicator	Secondary indicator	Weight	Primary indicator	Secondary indicator	Weight
Industry Scale	Number of Legal Persons X1	0.1206	Industry Scale	Number of enterprises Y1	0.1071
	Investment in fixed assets X2	0.0819		Investment in fixed assets Y2	0.1201
	Number of employed persons in urban units X3	0.0816		Number of employees Y3	0.1105
Industrial Benefits	Industry added value X4	0.0832	Industrial Benefits	Main business income Y4	0.1118
	Industry growth rate X5	0.0857		Profit amount Y5	0.1105
Industrial potential	Industry as a percentage of GDP X6	0.0829	Industrial potential	High-tech industry research and experimental expenditures Y6	0.1115
	Patent authorization X7	0.0801		Number of patent applications Y7	0.1099
Open to the outside world	Total import and export volume X8	0.083	Open to the outside world	Import and export trade volume Y8	0.1088
	Product import and export growth rate X9	0.0812		Export delivery value Y9	0.1097

**Table 3:** Coupling results of cultural industry and high-tech industry development

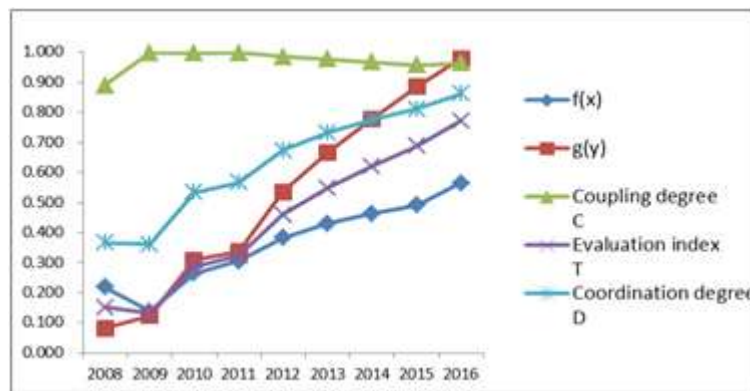
Year	f(x)	g(y)	Coupling degree C	Evaluation index T	Coordination degree D	Coordination level
2008	0.219	0.082	0.891	0.151	0.366	Mild imbalance
2009	0.138	0.124	0.998	0.131	0.362	Mild imbalance
2010	0.264	0.309	0.997	0.286	0.534	Barely coordinated
2011	0.306	0.336	0.999	0.321	0.566	Barely coordinated
2012	0.383	0.535	0.986	0.459	0.673	Primary coordination
2013	0.430	0.666	0.977	0.548	0.732	Intermediate coordination
2014	0.464	0.779	0.967	0.621	0.775	Intermediate coordination
2015	0.490	0.885	0.958	0.688	0.812	Good coordination
2016	0.566	0.978	0.964	0.772	0.862	Good coordination

### 4. Analysis of the results

According to the data of 2008-2016, the evaluation indexes f(x), g(y), and coupling degree C, the coupling coordination degree D and the comprehensive evaluation index T of the cultural industry and high-tech industry subsystems are obtained by constructing the coupling degree model, the comprehensive development level model and the coupling coordination degree model. Figure 1 shows the level of development of the two industry integrations.

#### (1) Time series analysis of comprehensive evaluation index

Judging from the time series evolution of the comprehensive evaluation index T: the comprehensive evaluation index of the cultural industry and the high-tech industry is generally on the rise, and only slightly declined in 2009, which may be caused by the macroeconomic downturn. During the period of 2008-2016, the comprehensive evaluation index of the integration between the two systems was quickly increased from 0.151 to 0.772. By taking correlation analysis on T, the coefficient was 0.879, indicating that there was a significant correlation between the two variables, that is, the two systems were mutually Coupling and affecting each other.



**Figure 1:** The development level of the integration of cultural industry and high-tech industry

From the time series evolution of the single subsystem comprehensive evaluation index: the cultural industry system  $f(x)$  and the high-tech industrial system  $g(y)$  all showed an overall upward trend, and only  $f(x)$  had a slight decline in 2009. Among them, the cultural industry system comprehensive index rose from 0.219 to 0.566, an increase of 158.45%; the high-tech industrial system  $g(y)$  rose from 0.082 to 0.978, an increase of nearly 10 times. It can be seen from the figure that the upward trend of the  $g(y)$  curve is steep, and the comprehensive rating index of the high-tech industrial system is much larger than that of the cultural industry system, indicating that the high-tech industry is developing rapidly and there is a large room for improvement.

From the time series evolution of the comprehensive evaluation index comparison of the two subsystems: the process of integration of cultural industry system and high-tech industry system can be roughly divided into three stages: In 2008,  $f(x) > g(y)$ , the development of the cultural industry is slightly ahead of the high-tech industry, but because of the low comprehensive index, the driving effect is not significant, and both of them have large development space; 2009-2011,  $f(x) \approx g(y)$ , the development level of the two industries is basically the same, among which the cultural industry comprehensive index has a slight decline, and the high-tech industry comprehensive index continues to rise. The reason may be that the macroeconomic downturn restricts the development of the cultural industry; 2012-2016,  $f(x) < g(y)$ , the high-tech industry is developing at a high speed, gradually leading the cultural industry and the gap between them is widening, and the comprehensive index is also at a relatively high level. Give full play to the characteristics of high innovation, high additivity and high multiplication of high-tech industries to promote the transformation and upgrading of cultural industries.

**(2) Time series analysis of coupling degree and coupling coordination degree**

From the perspective of the evolution of the coupling degree C: According to the data of 2008-2016, the coupling degree between China's cultural industry and high-tech industry is basically around 0.9, and the highest value even reaches 0.999, indicating the existence of industrial integration, and

the coupling effect is very obvious. There is a significant fusion phenomenon between the two industries.

From the time evolution of the coupling coordination degree D: 2008-2009, the industrial coupling coordination index between the two industries was only about 0.3, and the coordination level was in a state of slight imbalance. The main reason may be that China's cultural industry as a modern emerging industry is still in its infancy and its development is relatively slow before 2008. At the same time, the high-tech industry is also in the primary stage, and the relatively weak industrial base makes the integration of cultural industries and high-tech industries less integrated. In addition, the impact of the economic crisis on the macro economy is also a non-negligible factor; By 2016, the coupling coordination index between the two industries rose to 0.862, an increase of 135.52%, and the coordination level has reached a good coordination state. From the overall perspective of 2008-2016, both the cultural industry and the high-tech industry have developed at a high speed. The index of industrial coupling coordination between the two industries has shown a linear upward trend, and the development of inter-industry integration is remarkable.

**5. Conclusions and Recommendations**

Based on the relevant data from 2008 to 2016, the analysis of industrial coupling degree between the two industries shows that the integration and development of China's cultural industry and high-tech industry is in a highly coupled stage, and the degree of coupling coordination is generally high, and the integration situation is significant and fluctuating. At the same time, the development level of high-tech industry is ahead of the cultural industry. Making full use of the characteristics of high-tech industries to achieve its multi-integration with the cultural industry in the industrial market, human resources, industrial resources and product innovation, which is conducive to the promotion of cultural industry structure optimization and transformation and upgrading, and realize the coordinated development of cultural industries and high-tech industries.

Based on the above research results, the countermeasures and suggestions for further promoting the integration and development between China's cultural industry and



high-tech industry are as follows:

### **5.1 Relaxing government regulation and shaping qualified market players**

The cultural industry has traditionally been more inclined to public welfare undertakings and has a stronger political nature. With the continuous deepening of China's market economic system reform, it is important to emphasize the regulatory role of market mechanism on industrial integration and development, relax government regulation, follow the principle of separation of government and enterprise, construct a reasonable market competition mechanism and order, and give full play to the principle of market survival and the fittest, which is conducive to the free flow of resources and elements of the two industries in a wider scope, enhancing the innovation and competitiveness of industrial integration, and promoting the accelerated development of the integration of the two industries and the transformation and upgrading of the cultural industry.

### **5.2 Promoting technological innovation and breaking through the bottleneck of cultural industry development**

Technological innovation plays an important role in promoting the integration and development of China's cultural industry and high-tech industries. Strengthening technology investment and innovation is conducive to promoting technology integration between the two industries, breaking through common technologies, key technologies and core technologies that restrict industrial integration and development, and increasing the contribution rate of technological innovation development to the integration and development of cultural industries. Making full use of modern high-tech information technologies such as digitalization and intelligence to promote the transformation and upgrading of traditional cultural industries, extend the industrial chain, optimize the technical structure of cultural industries, enhance core competitiveness, and create new cultural industries.

### **5.3 Strengthening the construction of the talent team and forming competitive advantages for talents**

Increasing human capital investment and promoting the development of human resources to give full play to the role of human resources in promoting the integration of cultural industries and high-tech industries. First, innovating talent policy and introducing professional talents. Providing preferential conditions and opening a green channel to introduce composite high-end talents at home and abroad in the integration of cultural technology, is conducive to the breakthrough achievements of the two industries in the integration of innovation; Second, attaching importance to the cultivation of talents in colleges and universities. Colleges and universities are the main positions for cultivating industrial-integrated talents. Attaching importance to the cultivation of creative talents and design-oriented talents and building backbone cultural and

scientific talents R&D teams to give full play to the role of providing strong talents for the society. Third, enterprises cultivate talents independently. Encouraging cultural enterprises to continue education and training of talents and achieving the connection with job demand to solve the problem of insufficient talent resources, and meet market demand.

### **5.4 Strengthening industrial R&D efforts and enhancing independent research and development efficiency**

China's cultural industry faces problems such as traditionalization and low-end at present. Increasing investment in research and development, improving research and development efficiency, and strengthening independent research and development capabilities, which is conducive to the process of promoting the integration and development of cultural industries and high-tech industries. First, increasing the investment in R&D of industrial integration and development. Establishing R&D centers and research practice bases, and building strong industrial integration carrier platforms to provide necessary support for the integration and development of the two industries. Second, improving the research and development efficiency in the process of industrial integration and development. Although increasing R&D investment is an important means to promote industrial integration and development, improving the efficiency of R&D investment makes it fit with R&D capital investment plays an important role in promoting the process of industrial integration. Giving full play to the promotion of high and new technology in promoting research and development efficiency is helpful to more optimal allocation of limited resources, and increasing the added value of the integration of the two industries, which is conducive to realize the organic unity of economic, ecological and social benefits.

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