SPATIO-TEMPORAL EVOLUTION AND INFLUENCING FACTORS OF THE E-SPORTS INDUSTRY IN CHINA

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Summary: The emergence and development of new industry play a key role in regional development and economic growth. This study explores the e-sports industry evolution, a typical cross-sector new industry, through a theoretical lens of the evolutionary economic geography (EEG) based on Chinese e-sports industry enterprise data between 1998-2018 and examines the influencing factor by multivariate regression. Results show e-sports industry development is a typical evolutionary process that combines spin-off, path creation, spatial evolution, and firms' network. Furthermore, the e-sports industry is characterized by the integration of the sports and creative industries. However, technology correlated-based knowledge spillover from culture and sports does not significantly impact the e-sports industry, whereas the knowledge spillover from the information software industry promotes e-sports industry development. The regression result also confirms that the institution and culture significantly impact the industrial development. This study enriches the knowledge body of evolutionary economic geography from case studies of the e-sports industry, and also expands the existing study system of emerging industries.

Keywords: Evolutionary economic geography, e-sports industry, spatial evolution, influencing factor

1 Introduction

The emergence and development of new industry play a key role in regional development and economic growth. There is common recognition of the need to highlight the complex and dynamic interactions between industry and regional development in studies and practices (KLEPPER 2010). Especially crucial is creating an innovative path of new industry to promote regional economic growth in the transformation stage under the constraints of local resource conditions (ZHANG 2009). Regional and urban development is a process where new industries emerge and old industries die out (SADLER 2004). In particular, geographers and regional economists have always focused on regional industrial agglomeration and industrial cluster development. The evolutionary turns in economic geography and formation of the evolutionary economic geography provide a powerful analytical perspective for regional and urban industry development.

The e-sports industry is an emerging industry that combines the competitive sports industry, cultural creative industry, and information technology service industry and has the characteristics of strong innovation, low pollution, driving regional economy, and sustainable development (HEERE 2018). E-sports developed from early arcade games. At first, competitive e-sport competitions were established only inside specific countries. Many countries started to dig the potential of the e-sports industry from the "eyeball economy" consideration with the development of television broadcasting and the Internet after the 1990s (HALLMANN & GIEL 2018). As one of the fastest growing industries in recent years, the e-sports industry has formed relatively mature business models in China, the United States, and South Korea. Only in the field of organized professional and semi-professional e-sports games, the e-sport industry's market revenue in 2019 reached 951 million U.S. dollars, according to Newzoo's data (see Fig. 1).

An increasing number of studies focus on esports from different perspectives including discipline definition, industry characteristics, consumer motivation, and specific business model (GIACHINO et al. 2023, JORDAN-VALLVERDU et al. 2024, TANG et al. 2023, ZHAO et al. 2023). These studies, however, remain rather fragmented due to the lack of study on location selection, development process, spatial transfer, and driving factors. As an emerging country with dazzling economic growth, China's e-sports industry has developed rapidly in recent years, occupying the world's largest e-sports market and providing a typical case for studying the formation and evolution of a new industry. Therefore, the analysis of the emergence, spatial evolution, and influencing



Fig. 1: Global e-sports market revenue in 2020

factors of the e-sports industry from the perspective of evolutionary economic geography strengthens the understanding of the e-sports industry's development and enriches the theoretical system of evolutionary economic geography.

Evolutionary economic geography, based on the theories of Generalised Darwinism, path dependence, and complexity (JAMES et al. 2023), advocates the heterogeneity of firms, emphasises the specificity of spatio-temporal scenarios, the importance of history, and the creative role of contingent events, and is an important theory for explaining the formation of new industries (HASSINK et al. 2014). Evolutionary economic geography explains the spatial-temporal evolution of firms, industries, networks, urbans, and regions from the process of location selection, entry, growth, decline, and exit of firms (FRENKEN & BOSCHMA 2007, MARTIN & SUNLEY 2007, BOSCHMA & MARTIN 2007). However, restricted by the fuzziness of industry division and data availability in the early stage of new industries' emergence, existing studies pay more attention to the mature new industries, and focus on the stage where the new industries' development has already begun to take shape (HASSINK et al. 2019). For example, some spatial institutional studies include European regional economic policy, the German software industry, and the American venture capital industry (MACKINNON et al. 2009, STRAMBACH 2010, MENZEL et al. 2017). Furthermore, the institutional and cultural have become the key factors in evolutionary economic geography study, more and more empirical research about the impact of institutions and culture from the spatial perspective is emerging (BOSCHMA & GIANLUCA 2015, ZHU et al. 2021).

In addition, the existing study on evolutionary economic geography mainly focuses on the experience of western countries (ZHU & HE 2019). Developing countries are not often paid sufficient attention, especially China, which creates economic miracles. China's industrial development has many similarities and differences with Western countries and has distinctive characteristics of transformation and post-socialism. China's industrial development can provide some lesson learned for other developing countries.

This article analyzes the industrial spatial evolution mechanism in developing countries from the perspective of evolutionary economic geography. This perspective allows us to deepen our understanding of the complexity and dynamics of the spatial-temporal evolution process of emerging industries in transformation countries. In addition, this article makes a methodological contribution to the literature of industries' spatial evolution by providing a quantitative analysis of the influencing factors of the e-sports industry's spatial evolution based on the mining of e-sports firms' data. Some results of this article confirm the results of existing studies, while others are contrary.

The contribution of this study is twofolds. At the theoretical level, it extends the theoretical foundations of EEG. Currently, the growing threat of global recession, the increase in geopolitical risks, and the rise of various populisms have made the issues of institutional risk and cultural conflict at the regional level more and more important for the formation of new pathways of regional evolution and change (KOGLER et al. 2023, YEUNG 2024). However, the theoretical definition of EEG focuses on cumulative historical change and concentrates on explaining how the spatial organisation of economic activity itself emerges over time (KOGLER et al. 2023), without consideration of context, institutions and culture, and without reference to the human geography literature (CHU & HASSINK 2023). By introducing institutional and cultural elements, this paper helps to understand how regional path development is rooted in different political and cultural contexts. At the level of industrial development, it extends the empirical scope of fostering emerging industries. Emerging industries are industries and firms that emerge in response to the latest technological advances and potential market demand (LI et al. 2022), and growing industries face a high degree of uncertainty and lack useful metrics and external legitimacy. Using the e-sports industry as an example, this paper explores possible mechanisms affecting emerging industries in the Chinese context, which can help policymakers develop effective strategies regarding the promotion of emerging industries based on the characteristics of local resource endowments.

The rest of paper is organized as follows. Section 2 discusses the industrial spatial evolution's theoretical background, focusing on the mechanism and influencing factors. Section 3 introduces the methods and data sources used in this article. Section 4 reviews the e-sports industry's evolutionary process. Sections 5 analyzes the e-sports industry's influencing factors based on the multiple regression. Section 6 raises our conclusion and policy implications.

2 Theoretical background: Industrial spatial evolution

By implementing deeper learning and absorbing evolutionary economics, evolutionary economic geography was introduced to the economic geography in the middle 1990s focusing on the historical perspective to explore the evolutionary mechanism of the spatial distribution of economic activities (BOSCHMA & LAMBOOY 1999). Evolutionary economic geography theory comes from a generalized Darwin theory, path dependence theory, and complexity theory (FRENKEN & BOSCHMA 2007). Evolutionary economic geography emphasizes the study of firms' spatial behavior and understands industry location selection from a dynamic perspective (BOSCHMA & MARTIN 2007). On one hand, the goal of evolutionary economic geography is to explain the economic landscape's evolution. On the other hand, evolutionary economic geography focuses on how geographical factors affect the economic landscape's evolution. A new trend has emerged in recent years of economic geography to explore the motivation and mechanism of industrial evolution. The emergence and development of a new industry is not achieved overnight. How does the spatial layout of industry come into being? What is the driving mechanism? What factors affect it? These questions offer the focus of this study regarding evolutionary economic geography.

2.1 Industrial spatial evolution mechanism

Evolutionary economic geography suggests economic landscape evolution is a dynamic historical process, and introduces the concepts of contingency, routine, path dependency, and novelty into economic geography based on the generalized Darwin theory (HODGSON 2009). The spatial change of industry has a certain historical contingency, which is not a completely rational resource allocation process (BOSCHMA & FRENKEN 2003). In the early stage of new industry emergence, local resources do not meet industry development needs, and opportunity events play a greater role (ZHANG 2009). The act of routine is a firm's DNA, which forms in the historical process of enterprise development and affects the firm's organization and decision-making (BOSCHMA & WENTING 2007). Spin-off is the main mechanism of routine inheritance and diffusion. Based on the diversity of firm routines and environmental resources, the entry and exit of different firms form in the selection mechanism of market competition (BOSCHMA & FRENKEN 2011). This novelty is a key driving force of industrial evolution. Novel innovation includes endogenous and exogenous innovation. It emphasizes the reshaping of industrial structure by technological innovation under a certain historical or geographical background. On one hand, technological innovation changes the industry's organization. On the other hand, technological innovation promotes industrial upgrading (METCALFE et al. 2006).

Path dependence is initially applied in the process of technological, economic, and institutional changes, which mainly involves technological lockin, dynamic increasing returns, and institutional slowness (MARTIN 2010). The path dependence in evolutionary economic geography emphasizes the technological relatedness among industries (MARTIN & SUNLEY 2006). Due to the similar technical requirements of adjacent industries, the production of enterprises is more likely to leap to the new industries with close cognition distance and technological relatedness (STRAMBACH 2010). Therefore, the landing of new industries often chooses the regions with comparative advantages in the related industries (HIDALGO et al. 2007).

Firm spin-off is an important approach of expanding the scale of emerging industries (HU & HASSINK 2017). The successful routines are copied from the parent firm to the subsidiary firm in the firm spin-off process, which promotes the formation and diversified development of industrial clusters (FRENKEN et al. 2007). In the spin-off model constructed by Brian (BRIAN 1994), the existing firms created new firms, and the new firms spread out new firms. The probability of firm spin-off rests on the number of existing firms in the region, and the region where new firms are generated is similar to the parent firm. However, the firms in this model are considered homogeneous and will not grow or exit. Therefore, KLEPPER proposed a new spin-off model. Successful firms in the market will achieve spin-off, and firms with poor development will exit (KLEPPER 2007). In addition, due to the interaction between the spin-off firms and agglomeration economy, the firm spin-off promotes the emergence of the industrial cluster at the early stage, and strengthens the agglomeration economy, which enhances the spinoff effect of successful firms (KLEPPER 2010). In the empirical research, the automobile industry in the UK (BOSCHMA & WENTING 2007), the tire industry in Ohio (BUENSTORF & KLEPPER 2009), and the motorcycle industry in Italy (MORRISON & BOSCHMA 2019) all confirmed the important role of firm spin-off in the formation of industrial clusters.

2.2 Influencing factors for the industrial spatial evolution mechanism

Existing studies revealed that emerging new industries associate with many factors. For example, the theory of factor endowment argues the comparative advantage mainly comes from the difference of factor endowment of human resource, capital, and technology (COLE & ELLIOTT 2003). In addition, technological relatedness, institution, and culture have important influence on the industry's geographical distribution and evolution.

According to the evolutionary economic geography, the emergence of new industries originates from the evolution of regional comparative advantages, and knowledge spillover occurs in industries with strong technology relatedness in the process of path dependence, thus promoting the development of industries to the related industries with existing industrial structure (HIDALGO & HAUSMANN 2009). The region can provide the necessary labor force, knowledge, and potential entrepreneurs for the new industry's development, and the new industry has a greater probability of obtaining comparative advantage and development opportunity in the region if the new and local industries have a high degree of technical relatedness (KLEPPER 2007). Empirical studies in the United States, the Netherlands, and China confirmed the importance of technological relatedness at the regional, industrial, and technical levels (Essletzbichler 2015, Frenken et al. 2007, HU & HASSINK 2017).

Since the mid-1990s, on the basis of absorbing the thoughts of institutional economic geography and cultural geography, scholars began to pay attention to the collaborative evolution of institution, culture and enterprise, which promoted the "institutional turn" and "cultural turn" of evolutionary economic geography (MENZEL et al. 2017). The opportunities for new industry development rest on the institutional environment in the process of industrial evolution. The institutional environment includes not only explicit laws and policies, but also informal rules and standards (WEI et al. 2007). Institutions co-evolve with the development of enterprise routines in the evolution of industry, which may have positive or negative effects on the industry (STRAMBACH 2010). Some scholars considering institutional variables through studies have also confirmed this influence in recent years. For example, Germany's software industry's policy arrangement and technological innovation reflect the effect of co-evolution, and the design professional regulation in Paris restricts the development of the advertising design industry (STRAMBACH 2010, WENTING & FRENKEN 2011). At the same time, based on the tradition of China's socialist economic system, the government's policy guidance is more important to industrial development.

Cultural turn emphasizes the integration of culture into the framework of economic landscape interpretation, and that culture plays a constructive and productive role in social and economic development (ZHANG 2009). The definition of culture in evolutionary economic geography is no longer limited to livelihood and cultural elements such as service and food, spiritual and cultural elements such as language and religion, and institutional and cultural elements such as law and politics, but covers the meaning, emotion, identification, value, and ideology of all social behaviors (HASSINK et al. 2019). A large number of consumption behaviors are linked to culture in the economic field, and regional economic behaviors are based on common values and cultural identity. For example, a series of "material cultures" such as Starbucks, Haagen-Dazs, and the iPhone shape consumption tendency, or historical districts attract investment. In evolutionary economic geography, culture is a concrete "thing" in the economic system's dimension.

This paper examines the e-sports industry to further explore industry evolution, especially the new industry with a high density of knowledge technology and low energy and resource consumption. This paper makes a detailed analysis based on the aforementioned theoretical lens of evolutionary economic geography.

3 Data and methods

As an emerging industry, the e-sports industry does not have enough open data at the urban level. In order to better identify and elaborate the spatial evolutionary process and influencing factors of the e-sports industry in China, this study conducts its research on the data mining of e-sports enterprise combined with economic geography theory. The enterprise data come from the national enterprise credit information publicity system and is obtained through Tianyancha (www.tianyancha.com). The label information of targeted enterprises includes "e-sports," "e-sports game," "e-sports events," "e-sports club," "e-sports media," "e-sports information," "e-sports content production," "e-sports broadcast," "e-sports community," "e-sports live," "e-sports training," "esports broker," "e-sports internet cafe," "e-sports industry chain," "game," "game development," "game events," "game media," "game platform," "game information," "game peripherals," "game equipment," "game hardware," "game players," and "game live." We screened the obtained enterprise data according to the classification of e-sports industry. The enterprises not belonging to the e-sports industry were excluded from this study. The database of new e-sports enterprises in China in 1998, 2003, 2008, 2013 and 2015-2018 was constructed according to the time of enterprise registration. The remaining data accrued from the National Bureau of Statistics, the Baidu Index, local government websites, thee Newzoo Global Games Market Report 2020 (www.newzoo. com), the Qianzhan Industry Research Institute (www.qianzhan.com), and the China Industry Information Network (www.cnii.com.cn).

Considering the e-sports industry's characteristics, this study chooses technical relatedness, institution, and culture as explanatory variables, and the number of newly established firms in the provinces is taken as explanatory variables to analyze the influencing factors and driving mechanism of spatial evolution in the e-sports industry. The equation is as follows:

$$NewFirm_{i,t} = \alpha_0 + \alpha_1 LocalFiscalExpenditure_{i,t} + \alpha_2 LocalPolicy_{i,t} + \alpha_3 CSEI_{i,t} + \alpha_4 ISI_{i,t} + \alpha_5 Race_{i,t} + (1) \\ \alpha_6 X_{i,t} + \eta_i + \varepsilon$$

i and *t* represent province and year, respectively. $X_{i,t}$ represents the control variables at the provincial level, including GDP per capita, industrialization level, and international level. *LocalFiscalExpenditure*_{*i*,*t*} represents the influence of local fiscal expenditure. *LocalPolicy*_{*i*,*t*} represents the influence of local poli-

cies. CSEI_{it} represents the total investment in fixed assets in the cultural, sports, and entertainment industries. ISI_{i,t} represents the total investment in fixed assets in the information software industry. Race_{it} represents the degree of attention paid to various provinces with e-sports events. η_i represents individual heterogeneity. α_0 is the constant term and ε is the error term. The model uses lagged variables to eliminate the impact of endogeneity. Except for the data between 2016-2018 selected as the dependent variable, all other variables are selected from the 2015-2017 data. The above indicators originate from the National Bureau of Statistics database, Baidu Index, and various local people's government websites. Table 1 reports the variable description.

Institution

The e-sports industry has both entertainment and media attributes, and the institution greatly affects its scale and development. This study adapts a number of local policies related to the e-sports industry (*LocalPolicy*) and local fiscal expenditures on culture, sports, and media (*LocalFiscalExpenditure*) to measure the institutional environment for the development of the e-sports industry in different provinces. If the local government issues a policy to support the e-sports industry's development, it is recorded as "+1" and a policy to restrict the e-sport industry's development is recorded as "-1".

Technological relatedness

Technology relatedness refers to the fact that adjacent industries have similar technical bases and can efficiently obtain spillover knowledge from related industries, so that enterprises are more likely to enter the region with a technology-related industrial structure. This study uses the cultural, sports, and entertainment industry and information software industry total fixed assets investment related to the e-sports industry to measure the industrial basis of the e-sports industry's development in each province.

Culture

Culture plays an important role in the geographic process of industry formation. The psychological research of e-sports industry consumers found that, as a sport, the competitive sports culture of e-sports significantly improves user satisfaction. (HEERE 2018). The league of Legends Global Final and Dota2 International Invitational, which have been announced by ESCHARTS as having the most spec-

Variable		Definitions	Year
Dependent variable	NewFirm	The number of newly established E-sports companies in the province i in year t	2016-2018
Institution	LocalFiscalExpenditure	Local fiscal expenditures on culture, sports and media in Province <i>i</i> in year <i>t</i>	2015-2017
	LocalPolicy	The number of E-sports related policies issued by province i in year t	2015-2017
Technological relatedness	CSEI	Investment in fixed assets of the whole society in the cultural, sports, and entertainment industries of the province i in year t	2015-2017
	ISI	Investment in fixed assets of the whole society in the information software Industry of the province i in year t	2015-2017
Culture	Race	Baidu Index of the degree of attention to major E-sports events in province <i>i</i> in year <i>t</i>	2015-2017
Control variables	GDPPC	GDP per capita of province <i>i</i> in year <i>t</i>	2015-2017
	Industrialization	The proportion of the secondary industry in the province <i>i</i> in year <i>t</i> in GDP	2015-2017
	ForeignInvestment	Number of foreign-invested enterprises in province i in year t	2015-2017

Tab. 1: Definition of variables

tators in 2019, were selected to measure the attention of different regions to e-sports events through statistics from the Baidu search index of the two events in each province during the event.

Control variables

In addition to the above variables, this study selects the degree of economic development, industrialization level, and international level that affect the geographic distribution of the e-sports industry to control the heterogeneity between provinces. The economic development selects per-capita GDP, the industrialization level selects the proportion of the secondary industry in GDP, and the international level selects the number of foreign-invested enterprises. As a global sports competition, e-sports are mainly developed by the United States and South Korea, so the international market has a great impact on the industry's spatial pattern.

4 Evolution process of E-sports industry in China

The e-sports industry started early in China, and its development was not smooth. However, it has developed rapidly in recent years. Figure 2 shows that the proportion of China's global e-sports users increased year by year, and by 2019, the proportion reached 64.44%. In addition, according to Tencent's survey data in eight countries including China, the United States, South Korea, France, Brazil, Russia, Japan, and Vietnam, 68% of Chinese users recognize that e-sports is an emerging industry, ranking first among the surveyed countries. China's e-sports industry output value ranks first in the world with its public recognition improvement and industrial influence and is still in the trend of rapid development.

Based on the number of newly established esports firms each year, the evolution of China's e-sports industry can be divided into 4 stages (see Fig. 3): the initial stage, 1998–2003; the fluctuating development stage, 2003–2008; the stable development stage, 2008–2013; and the rapid development stage, 2013–2018. Using EEG as a guide, the evolution process and mechanism of China's e-sports industry in each stage is shown in Table 2.

4.1 The initial stage (1998-2003)

In 1983 Nintendo launched a cassette video game like the Red and White Machine, and the game market took off. Game studios induced the develop-



Fig. 3: The number of new firms in the e-sports industry

Stage	Evolution process	Evolution mechanism	Culture and institutions
The initial stage	Relying on the local industrial base to achieve industrial start-up	Spin-off of new firms based on the software industry	The industry regime is not yet clear
The fluctuating development stage	Conflicting social values lead to limited industrial development	Cognitive and institutional lock-in impede external entry	Legitimising and Contesting Exclusion
The stable development stage	Promoting industrial upgrading through path creation	Cross-industry production between proximate industries relying on technological relatedness	Gradual relaxation of the institutional environment
The rapid development stage	Increasing returns to scale through agglomeration economy	Industrial agglomeration promotes factor sharing and improves resource allocation efficiency and output effectiveness	Cultural influence expanded, and local government support

Tab. 2: The evolution process of China's e-sports industry

ment of a large number of computer games as they gradually transitioned Nintendo games to Windows systems. The first competitive real-time strategy game, "Dune 2," was released in 1992 in this context.

Video games that supported LAN battles became popular in China during the time when the Internet was not yet popular. The release of the game "StarCraft" in 1998 marked the e-sports industry's official start. Subsequently, a series of video games such as "Warcraft 3" and "Counter Strike" gradually attracted players to establish team organizations with excellent entertainment, and some informal competitions were soon established. With the rapid increase in the number of participants and competitions, the World Cyber Games (WCG), organized by the Korea International Electronic Marketing Corporation, was held worldwide, and Chinese players achieved good results. Then in 2002, the China Game Center hosted the domestic e-sports event, China Internet Gaming. In September 2002, a game company named Haofang used the Internet to develop an online multiplayer e-sports platform, which accelerated the promotion of e-sports in China.

During this period, China's e-sports industry was realized from scratch. A new industry formed on the basis of the game industry, resulting from the cross-integration of technology and industry. In the 1980s, the game industry was originally based on video games, and a new routine emerged due to the contingency of transplanting video games to personal computers. Under the diffusion of the computer game firms' routine, they adapted to the environment and repositioned the game industry to accommodate the e-sports industry. Judging from the establishment of new firms, Chinese e-sports firms are mostly concentrated in the field of software and hardware equipment. Location has also had a greater impact on the industrial layout. Early e-sports industry firms were mainly located in regions with a better competitive foundation and a more developed software industry such as Beijing, Guangdong, and Jiangsu, as well as regions with greater market demand, such as Anhui and Sichuan. From the theory of evolutionary economic geography, contingency, choice, novelty, and path dependence are the main driving forces for the e-sports industry's emergence, which can be seen as the path from the game industry to the e-sports industry.

4.2 The fluctuating development stage (2003-2008)

In 2003, the Chinese team won three gold medals in the WCG, indicating the growing influence of China in the world of e-sports. In the same year, the General Administration of Sport of China recognized e-sports as the 99th sport in China, officially recognizing e-sports as a competitive sport. The esports industry's development has gradually expanded to content production and communication fields such as competition news and video production.

As the e-sports industry is still in its infancy, its regulations have not synchronized with its development. The e-sports industry, as an extension of the game industry, may bring negative impacts on juveniles. In 2004, The State Administration of Press, Publication, Radio, Film and Television (SARFT) issued the *Notice on the Prohibition of the Broadcasting of Computer Online game programs*. As a result, all TV programs related to e-sports were ordered to stop broadcasting, media were suspended, advertising was withdrawn, and competition prizes were reduced. As a result, the e-sports industry declined. The number of new firms in the e-sports industry at this stage declined from 2003. For example, Guangdong Province, which grew the most in 2008, only added 497 new firms.

China's e-sports industry was developing slowly during this period, and the industrial chain gradually extended to game operation, competition execution, and derivative content production. The market scale was the main driving force for the development of industries and firms at this stage. China's huge market demand lowered the entry barrier for new firms and promoted firm diversity. E-sports is a competitive sport under the same competitive rules. However, as the carrier of the industry, electronic games cannot bypass the game's characteristics, and the negative impact of the game itself caused a lockin effect on the industry cognition. The industry's cognition is a problem due to the negative characteristics of the game itself. The institutional environment is the main factor affecting the development of the e-sports industry during this period, and the development of the industry is greatly restricted by the influence of laws, policies, and informal habits.

4.3 The stable development stage (2008–2013)

The e-sports market in China began to decline due to the 2008 financial crisis; the club disbanded and small competition was suspended. At the same time, online games began to rise (see Fig. 4); compared with the past LAN game, online games' competition, playability, and picture quality greatly improved. In 2009, Tencent's online games "Crossing the Line of Fire" and "Dungeon and Warriors" were formally shortlisted for WCG, and China's self-developed "QQ Speed" and "Anti-Terrorism Action" also gradually entered e-sports competition. Driven by online games, well-known game giants such as Tencent, SNDA, and NetEase entered the e-sports industry.

The e-sports industry's profit model also began to diversify and be market-oriented. Revenue is not limited to traditional game development, operation, and competitions. Content producers of e-sports videos began to add e-commerce advertisements in video content and won the audience's understanding and support. The improvement of cashability attracted investors' attention. Major international competitions such as WCG and Battle.net World Cup were held in China, and media platforms such as ImbaTV and SiTV became the main partners of advertisers. The number of new firms in the e-sports industry grew rapidly, and the number of new firms in this stage increased by 119.6% compared with that in 2008. E-sports firms focusing on game software and application research achieved preliminary industrial agglomeration in Shenzhen.

The institutional environment of China's esports industry was liberalized at this stage, and the development of online games became the key driving force for the e-sports industry. The e-sports industry began to obtain stable and sustained economic returns in the market through advertising and e-commerce. Market demand and supply achieved a preliminary match, and the industrial division of labor further expanded and deepened. Evolutionary economic geography believes that new industries will continue to shape an environment conducive to the development of their own industries in practice.



Fig. 4: China's online game market 2008-2013

Shenzhen has the knowledge base and technologyrelated industries required by the e-sports industry. The knowledge spillover and labor pool of related industries accelerated knowledge transfer and sharing between the local industry and e-sports industry.

4.4 The rapid development stage (2013-2018)

With the development of the e-sports industry, the popularity of smart devices and mobile internet birthed a new industry - game live. Marked by the establishment of Douyu in 2014, a series of live broadcast platforms such as Zhanqi, Huya, and Dragon Ball attracted a large number of users (see Fig. 5), which not only brought huge exposure to e-sports, but also lowered the entry barrier for the e-sports industry, and created a new profit model for e-sports. Meanwhile, a series of new games such as League of Legends, DOTA2, and CS: GO extended the e-sports industry's business model by taking advantage of the vast number of new users. According to data from iResearch Consulting, the scale of China's mobile esports market in 2018 reached 45.6 billion yuan.

As a competitive sport, the level of e-sports is the key to the industry's development. On the basis of the increasing market scale and audience scale, the major electronic competitions settled in China. E-sports was selected into the performance projects of the Asian Games in 2018. At the same time, the management of e-sports clubs also improved. Wanda, Jingdong, Suning, and Tobo sports clubs invested a lot of funds and jointly established the Chinese E-sports Club Alliance to guide e-sports club management. Chinese players successively won world championships in several mainstream e-sports events such as "DOTA2 International Invitational," "League of Legends Global Finals," "PUBG Global Invitational," and the championship in the 2018 Asian Games League of Legends, greatly improving e-sports' influence and cultural identity. The largescale mass base of the e-sports industry also affected the change of social values. E-sports is no longer regarded as a scourge, and has evolved beyond the cognitive lock of the original game industry.

Up to now, China's e-sports industry increasingly gained more policy support with its huge economic benefits and social effects. The National Development and Reform Commission, General Administration of Sport of China, Ministry of Culture, and Ministry of Education all issued policies to promote the e-sports industry's development. The central government encourages local governments to hold national or international e-sports games and entertainment events, propose to promote the upgrading of the game industry structure and promote the development of new business formats such as mobile games, game live, and virtual reality games. The local government provided a series of support measures to promote the e-sports industry's development in terms of policies, funds, and resources by constructing e-sports industrial parks, introducing e-sports events and clubs, and establishing special mutual funds.

China's e-sports industry witnessed great development at this stage from the perspective of the scale of new e-sports industry firms. In 2018, there were 54,420 new firms, up 655.0% compared with those in 2013. The scale of the industry presents a spatial pattern of decreasing from east to west. Eastern China such as Guangdong, Jiangsu, Zhejiang, Hubei, Hunan, Shandong, Fujian, and Anhui, achieved a high level of agglomeration, especially concentrated in urban clusters of the Yangtze River Delta, the middle reaches of the Yangtze River, and the Pearl River Delta. In 2018, the software and information technology service industry in eastern China accounted for 79% of the country's total. Through



Fig. 5: Users of game live

the knowledge spillover in technology-related industries, Guangdong, Jiangsu, Zhejiang, Fujian, and Shandong provinces attracted more e-sports firms to enter and form an agglomeration economy. Central China, represented by Hubei and Hunan provinces, achieved industrial development by virtue of its good development in the field of competitive participation, content production, and broadcast. A window of development opportunities opened with the support of local government and the influence of a good e-sports cultural atmosphere. Shaanxi, Sichuan, Chongqing, and other provinces in western China achieved greater development compared with the previous stage, but the overall industrial foundation was still weak.

4.5 E-sports industry chain analysis

China's e-sports industry has achieved self-reinforcing and increasing returns from the dimensions of institution, technology, culture, and market selection through more than 20 years of development. In the process of firm spin-off and diversification, technological innovation spawned a new industry in the e-sports industry-the game live-which attracted a large number of users and capital investment in a short period, and changed the entire industry's spatial structure and organizational form. Under the influence of the agglomeration economy, the knowledge spillover effect of the original R&D firms continued to increase, and the influence of path dependence began to expand, prompting the esports industry to form a complete industrial chain (see Fig. 6). The e-sports industry chain is consisted of upstream content authorization, midstream esports events, and downstream content production and dissemination. The upstream game developers are responsible for game programming, design, production, and testing, license the product to the publisher, or put the product into the distribution channel of mobile games for self-operation, and then export the products to the downstream of the industrial chain. E-sports events in the midstream of the e-sports industry chain consist of event participation and event execution. In order to promote



Fig. 6: E-sports industry chain. Source: Adapted from IRESEARCH (2023).

the popularity of e-sports and attract more fans, the upstream game developers have invested heavily in e-sports events and promoted the creation of e-sports brands, such as Tencent's LPL (League of Legends Pro League), Valve Corporation's TI (The International DOTA2 Championships) are the core resources of the current e-sports industry. Content production and dissemination in the downstream of the industry chain is the most important channel of attracting fans and monetizing for the e-sports industry. Professional players and popular anchors effectively transmit event content to users through the live broadcast platform, which further increases esports game sales. At the same time, users' rewards for anchors have gradually become an important profit channel.

With the increasing influence of Chinese esports in the world and the expansion of the mass base, culture gave e-sports a strong sense of identity at the social level during this stage. Relying on China's advantages in the capacity of the e-sports market attracted more firms to enter the e-sports industry. At the same time, the transformation of the institutional environment under the market economy had a greater impact on the e-sports industry. The government's policy support and preferential measures promoted the technological innovation and project implementation of new firms.

5 Influencing factor of E-sports industry

According to the results of the Hausman test, an individual fixed-effects model is best for quantitative analysis, which calculates the interaction term of *ISI* with *Race* and *LocalFiscalExpenditure*. Table 3 reports the econometric results. In Model 1, the Variance Inflation Factor (VIF) is around 2.97, which is lower than the critical point of 10, which indicates that the possibility of multicollinearity is very low.

Table 2 reports the regression results of the influencing factors of China's e-sports industry. Column (1) reports the regression results including all explanatory variables and control variables; Column (2) r reports the regression results after excluding the insignificant *CSESI* to test whether

	Variable	(1)	(2)	(3)	(4)
Explanatory	LocalFiscalExpenditure	-0.3260***	-0.3275***	-0.2242**	-0.3070***
variables	1	(-2.78)	(-2.77)	(-2.44)	(-4.06)
	LocalPolicy	0.0950^{***}	0.0952***	0.0891***	0.1008***
		(3.41)	(3.44)	(3.58)	(4.15)
	CSESI	0.0119	—	—	
		(0.32)			
	ISI	0.1126**	0.1180***	0.1154***	0.1125***
		(2.45)	(2.79)	(2.98)	(3.08)
	Race	0.1905***	0.1927***	0.1230**	0.0953*
		(2.94)	(3.01)	(2.25)	(1.97)
Interaction	ISI·Race			0.0858^{**}	
term				(2.04)	
	ISI · LocalFiscalExpenditure	_	_	_	0.1465***
					(2.82)
Control	GDPPC	-0.5623***	-0.5611***	-0.4452***	-0.3019**
variables		(-3.24)	(-3.24)	(-3.36)	(-2.09)
	Industrialization	0.1066^{*}	0.1056^{*}	0.0385	0.0116
		(1.81)	(1.81)	(0.76)	(0.24)
	ForeignInvestment	3.0151***	3.0084***	2.2687***	2.3667***
		(12.88)	(13.29)	(6.08)	(6.50)
Individual fixed-effects		Yes	Yes	Yes	Yes
Ν		93	93	93	93
R-squared		0.8721	0.8720	0.8839	0.8886

Tab. 3: Empirical results

Notes: ${}^{*}p < 0.1$, ${}^{**}p < 0.05$, ${}^{***}p < 0.01$.

the results are still valid; Column (3) reports the interaction term of *ISI* and *Race*; Column (4) reports the regression results of the intersection of *ISI* and *LocalFiscalExpenditure* to see the interactive impact of the investment for the ICT, culture, and policies.

From the industry attribution of the e-sports industry, according to the "Sports Industry Statistical Classification (2019)," issued by the China Statistics Bureau, e-sports is listed as "professional sports competition performance activities." Most current scholars classify the e-sports industry and game industry as emerging subsectors of the cultural and creative industries. Therefore, we have added the impact of investment in culture, sports, and entertainment on e-sports new firms in the regression model. Interestingly, from the regression results of the technological relatedness, the social fixed asset investment coefficient of the CSEI is not significant, indicating that knowledge spillovers in the CSEI have little impact on the e-sports industry's development. From the e-sports industry chain in Figure 6, the key profit channels of the e-sports industry come from game research and development in the upstream of the industry chain, game sales by operators, and product sales on e-commerce platforms, which are affected by technology spillovers from the sports and cultural industries. The direct influence of the technology spillover of sports and cultural industry is small, which indicates that our regression results on CSESI are reasonable. The software development, telecommunications, and Internet information technology services in the information software industry have direct technical connections with the R&D, content production and output of e-sports games. Therefore, we tested the impact of the total investment in fixed assets in the information software industry (ISI), and the results were significantly positive, indicating that the development of the e-sports industry has a high correlation with the information software industry. After excluding CSEI, the regression results are consistent with Column (1), and the ISI coefficient is more significant.

From the regression results at the institution, the local policy coefficient (*LocalPolicy*) is significantly positive, indicating that the policy incentives such as supporting event hosting, subsidy, and preferential tax have a positive effect on the e-sports industry. Taking into account the direct investment of some local governments in e-sports venues, clubs, and cultural media enterprises, we have added the variable of local fiscal expenditure on culture, sports, and media (*LocalFiscalExpenditure*) to the model. The coefficient of Local Fiscal Expenditure is significantly negative, indicating that the government's direct expenditure on culture, sports and entertainment does not effectively promote the e-sports industry's development. In other words, the local government's policy support for the e-sports industry is more effective than direct investment, and the e-sports industry may be more dependent on market mechanisms. This may be due to the fact that, on the one hand, the development of the e-sports industry requires local governments to adapt their industrial structure to the trend of digitisation and networking, including by supporting the development of e-sports-related game development, event organisation, live streaming of content and other new businesses. However, this is often difficult to achieve through direct government expenditure. On the other hand, while policies at the national level have begun to recognise e-sports and include them in the statistical classification of the sports industry, direct investment by local governments often remains focused on traditional sports, crowding out investment in the e-sports industry.

From the regression results of culture, the attention of e-sports events (*Race*) is significantly positive, indicating that cultural factors promote the e-sports industry's development. This is consistent with our description in the evolution path of the e-sports industry. As a sports competition, event participation and execution are the core of the midstream e-sports industry chain, connecting the upstream with the downstream of e-sports industry. E-sports events have greatly enhanced the influence and cultural identity of e-sports in China, created a large-scale mass base and gradually affected the change of social values.

In order to observe the interactive effects of investment in the information software industry with culture and policies, we report the interaction in columns (3) and (4). The interaction, ISI*Race, has a positive effect on firm entry. This means that cultural factors can enhance the knowledge spillover effect of the ISI on the e-sports industry. The regression result of the interaction term of ISI*LocalFiscalExpenditure is significantly positive. Combined with the result that the LocalFiscalExpenditure coefficient is significantly negative, this result indicates that investment in the ISI can weaken the adverse effects of policies in the e-sports industry. As a technology-related industry of the e-sports, we believe that technology spillover of information software industry is extremely important to the development of e-sports.

6 Conclusion

As a multi-sector integrated industry, the e-sports industry has a huge market among young people, a strong driving force for related industries, and an environmental friendliness and low-carbon emission. Therefore, many local governments in China have encouraged the development of the e-sports industry through a variety of incentive policies in recent years. For now, however, it is clear that the goals of most local governments are far from being achieved. The main reason for the current predicament of local government in China is that a full understanding of development law and e-sports influencing factors has not yet developed. This paper investigates the evolutionary process and influencing factors of the e-sports industry in China based on the evolutionary economics geography theory, combined with the database of e-sports firms, to try and address this gap.

The results of this study show the composition of the e-sports industry development in China by different factors of contingency, spin-off, novelty, path dependence, and increasing returns to scale. Those factors are not isolated from each other but instead they interact and co-evolve. The e-sports industry's development has a significant spatiotemporal heterogeneity, and institution and culture have a significant impact on its development. Furthermore, our empirical findings suggest that local government incentive policies promote innovation and development in the e-sports industry.

The scale of the e-sports industry also has a significant spatial pattern of decreasing from east to west. Eastern China attracts a lot of e-sport firms and relies on the advantage of software and information technology services. Central China has achieved the diffusion of firms by virtue of competition and content production. However, western China, such as Shaanxi, Sichuan, and Chongqing, has a good development condition in that their industrial development is still relatively weak.

This study find evidence that not all influencing factors of the e-sports industry are equally important in explaining the development and spatial evolution of the e-sports industry from the perspective of evolutionary economic geography. Although the e-sports industry has the combined characteristics of the sports and creative industries, our results find that cultural and sports industry knowledge spillover has no significant impact on the e-sports industry, whereas the information software industry knowledge spillover promotes the e-sports industry's development. At the same time, the regression results of institution and culture also confirm that it has a significant influence on the e-sports industry's development, and cultural factors also enhance the knowledge spillover effect from the information software industry.

This study provides a empirical insights and theoretical references for promoting the policy optimization and development of e-sports industry. In terms of the industrial distribution of the e-sports industry in China, the scale of the industry is highly dependent on the software and information technology service industries, and the similar technological foundation between the two industries enables the e-sports industry to efficiently acquire spillover knowledge from related industries. Therefore, when local governments introduce e-sports industries or formulate industrial policies, they should consider whether the existing industrial structure and industrial advantages of the region are compatible with e-sports industries. Focusing on the introduction of industries with a high degree of relatedness to the local technological base is conducive to enhancing the survival rate of enterprises and the sustainable development of new industries. Cultivate the formation of functional areas for e-sports industry agglomeration and form scale pay-off increments. When fostering new industries, although similar industrial development pathways are worthy of reference, it is more worthwhile to think about how to embed new industries in specific institutional and cultural contexts.

This study takes the e-sports industry as an example to investigate the evolutionary process of new industry, tries to add institutional and cultural variables into quantitative research, and explores the institutional, cultural, and economic landscape's mutual influence over time from the perspective of evolution. Since there is no universally accepted standard for the definition of a quantitative cultural variable, its mechanism of affect and regional differences still require further exploration. In addition, given that the e-sports industry is a new industry, the spatial characteristics and evolutionary process of industrial development need not only continuous follow-up observation, but also comparative study of multiple countries and regions.

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