

# The Impact of Digital Economy on Regional Economic Disparities -- Based on an Analysis of the Yangtze River Economic Belt

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**To cite this article:**

Lu Yang, Xi Meihong. The Impact of Digital Economy on Regional Economic Disparities -- Based on an Analysis of the Yangtze River Economic Belt. *Journal of Business and Economic Development*. Vol. 7, No. 3, 2022, pp. 86-99. doi: 10.11648/j.jbed.20220703.13

**Received:** August 8, 2022; **Accepted:** September 4, 2022; **Published:** September 16, 2022

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**Abstract:** Based on the city panel data of 11 provinces (cities) in the Yangtze River Economic Belt from 2011 to 2019, this paper constructs a comprehensive evaluation index system for digital economy from three levels: digital infrastructure, digital industry development and digital inclusive finance, and empirically studies the impact mechanism of digital economy on regional economic gaps from the spatial perspective using the spatial Dubin model (SDM) and mediation effect test method. The regional heterogeneity test method was used to test the effect of digital economy on a regional economic gap. The research shows that the relationship between the digital economy and the regional economic gap has a significant spatial correlation, the digital economy has a significant inhibitory effect on the expansion of the regional economic gap in the Yangtze River Economic Belt and a negative spatial spillover effect, but there are regional differences in impact, the upper reaches of the Yangtze River Economic Belt have the most significant inhibition effect, the middle reaches of the region the inhibition effect is not obvious, and the improvement of the digital economy level in the improvement of the digital economy level in the downstream areas has expanded the regional economic gap; The secondary industry agglomeration economy has a partial intermediary effect, and the proportion of the intermediary effect to the total effect is 20.18%, which expands the research of the digital economy on the regional economic integration of the Yangtze River Economic Belt, and has certain reference significance for promoting the development. The proportion of the intermediary effect to the total effect is 20.18%, which expands the research of the digital economy on the regional economic integration of the Yangtze River Economic Belt, and has certain reference significance for promoting the development of the Yangtze River Economic Belt regional coordination and narrowing the regional economic gap.

**Keywords:** Yangtze River Economic Belt, Digital Economy, Regional Economic Disparities, Mediating Effects

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## 1. Introduction

Since the implementation of reform and opening up, the Communist Party of China and the Chinese people have gone through a difficult period of time, and after the storm, China's economic mode of operation has long been unmatched by other countries. The market economy has become more and more prosperous, and the people's way of life has changed dramatically. However, along with China's economic and social development, the economic development trends of different regions have diverged and regional economic disparities have become more prominent. China has entered a new stage of building a moderately

prosperous society and accelerating socialist modernization. Maintaining stable and rapid economic development and gradually reducing regional disparities is an issue to which our party and government have always attached great importance. To this end, China's 18th Party Congress emphasized the importance of implementing the overall strategy of coordinated regional development and carrying out a series of major changes, focusing on three development strategies: Beijing-Tianjin-Hebei coordinated development, construction of "One Belt, One Road" and development of the economic belt along the river, and the development of old revolutionary areas, ethnic areas, poor areas and border areas. In order to optimize the economic

structure, narrow the gap between the rich and the poor, and promote the full construction of a modernized socialist unified economic system. In recent years, China's digitalization, informatization and networking process has been accelerated, active innovation and entrepreneurship, new models and new business models have emerged, and the digital economy has taken the world by storm for a while, becoming a new round of economic growth engine in China. Digital economy is a very broad concept. The key production factors of digital economy are data knowledge and information, the carrier is modern information network, and the driving force is the efficient use of information technology, and the three are linked to optimize the economic structure and improve production efficiency. With the advent of the digital era, traditional industries are facing transformation, traditional business models are facing reconstruction, and traditional consumption models are facing redefinition. The vigorous development of the digital economy will effectively promote the improvement of labor productivity, prompt the integration of traditional industrial chain changes, and drive industrial upgrading. The personalized and unique characteristics brought by the digital economy will drive the birth of a large number of small and medium-sized enterprises due to the long-tail effect, promote mass entrepreneurship, and also improve the absorption capacity of middle and high-end talents, creating good employment environment. On the one hand, the digital economy has been continuously injecting vitality into China's economic development and continuously bursting out economic dividends, but will it go against the concept of coordinated development? Will it produce the Matthew effect, making developed regions increasingly developed and less developed regions increasingly lagging behind, and the economic gap between regions is growing? Or will it have a diffusion effect, making the developed regions more and more closely linked to the less developed regions through the flow of factors, thus narrowing the economic gap between regions? On the other hand, economic growth and economic agglomerations are concomitant and complementary processes. Besides directly influencing economic growth, can the digital economy indirectly regulate regional economic disparity by influencing the agglomeration economy? Therefore, it is of academic and practical value to study the mechanism of the role of digital economy on the inter-regional economic gap, and whether it can promote high-quality economic development and narrow the inter-regional economic gap through the development of digital economy.

## 2. Literature Review

The digital economy and agglomeration economy have been popular topics of research at home and abroad since they were created, and regional economic disparity is even more so. The strength of the country's comprehensive power cannot be separated from the wealth and strength of each region, and balanced development is the hard truth. The

current research around the digital economy, agglomeration economy and regional economic disparity mainly involves the following aspects.

First, the study of the impact of digital economy on social development. Based on the export quality of 5850 products in 31 Chinese provinces from 2013-2019, Li Yabo (2022) studied the impact relationship between the digital economy and China's export quality and found that the digital economy played a significant role in improving export quality, and the improvement effect becomes more significant as the magnitude of product quality differences increases [28]. Chen Yihui et al. (2022) analyzed the role of digital economy on agricultural quality development based on measuring the level of agricultural quality development in 30 Chinese provinces from 2005 to 2018, and found that digital economy promoted the speed of agricultural quality development, but there was significant regional heterogeneity, with the eastern region promoting the greatest role, followed by the central region, while the western region's agricultural quality development was inhibited [26]. Based on data from 31 Chinese provinces (cities, districts) from 2003-2019, An Meng et al. (2021) analyzed the role of digital economy development on China's innovation efficiency and found that the digital economy can drive a significant increase in China's innovation efficiency [22]. Using a panel data approach, Emmanouil Tranos (2021) finds that online content creation, which approximates digital economy activity in 2000, has a significant positive impact on regional productivity levels 16 years later [30]. Song Yang (2020) collects five consecutive years of panel data for 31 Chinese provinces from 2014-2018 to empirically analyze the role of digital economy on high quality economic development [16]. Wang Dong (2020) selected data from some cities to establish an econometric model to analyze the impact of digital economy development on employment, and the results of the study show that digital economy development can promote the employment of workers and has a strong employment attraction ability. [17]. Dong Youde et al. (2019) measured the level of digital economy development in host countries that witnessed the rapid growth of Chinese outward FDI in recent years through the mean principal component method and used an expanded investment attraction model based on panel data to study the effect of digital economy development in host countries on the level of Chinese FDI in host countries from 2009 to 2016. It is found that the level of digital economy development in the host country shows a positive relationship with Chinese direct investment in it [9]. Zhan Yunqiu (2018) studied the relationship between digital finance and economic growth in quantity and quality on the basis of panel data of 30 Chinese provinces and municipalities from 2011-2015, and found that the relationship between digital inclusive finance and economic growth in quantity and quality was non-linear in a "U" and inverted "U" shape, respectively, and the digital economy was in the suppression stage for economic growth in quantity, while the quality was in the promotion stage. growth effect is in the promotion stage. [7] The digital economy is in the

suppression stage of quantitative growth and the promotion stage of qualitative growth.

The second is the study of the mechanism of the influence of various factors on regional economic disparity. Based on the carbon emission constraint perspective, Han Minchun et al. (2022) empirically examined the mechanism of industrial intelligence affecting regional economic disparity using Chinese provincial panel data from 2003 to 2019, and the results showed that industrial intelligence can significantly reduce the inter-provincial economic disparity between national, eastern, central and western regions. [23]. Gao et al. (2021) conducted an empirical study on the role of transportation infrastructure on regional economic disparity under different effects based on the whole life cycle perspective of transportation infrastructure development and using the conduction effect approach. It is found that transportation investment during the construction period has a significant direct effect on the expansion of regional economic disparity through human capital and urbanization, and transportation services and transportation mileage during the operation period have a simultaneous effect on the reduction and expansion of regional economic disparity, and overall, transportation mileage is more effective than transportation services in reducing regional economic disparity, but the effect of transportation services will become more significant with increasing time [20]. Baoshun Wang et al. (2021) used provincial panel data from 1991-2018 in China to construct an econometric model to study the impact of local government fiscal spending on economic growth and coordinated regional economic development in the short, medium, and long term. The study shows that there is a tendency for the economic gap to narrow in China's regions, fiscal capital expenditure is beneficial to economic growth only in the short term, while fiscal welfare expenditure can significantly promote economic growth and is beneficial to the coordinated economic development of China in the short and long term [18]. Based on the panel data of 29 provinces in China from 2001-2015, Luo Nensheng et al. (2019) used the SDM model to study the influence of transportation development extremely related factors on regional economic disparity and found that transportation development plays an important role in narrowing the regional economic disparity in China. Based on the analysis of factors affecting regional economic disparities, further empirical tests were conducted to find that transportation infrastructure development and passenger traffic growth can widen regional economic disparities through the effect of polarization, and freight traffic growth can significantly reduce regional economic disparities [10]. Based on the urban panel data of 31 provinces and cities in China from 2001-2016, Chur-Ming et al. (2019) empirically investigate the mechanism of action that talent mobility has the mediating effect of widening the regional economic gap in China through technological innovation, and argue that technology transfer cannot narrow the economic gap through market-oriented channels, but can inhibit the widening of the regional

economic gap through government-led approaches [11]. Sheng Laiyun et al. (2018) constructed an econometric model using panel data from 2012 to 2017 from 31 Chinese provinces (regions and cities) to empirically study the role of the relationship between various factors such as economic system, economic structure, labor force quantity and the economic gap between the north and the south, and the results show that the lagging economic system reform, unreasonable economic structure, and scarce labor force quantity all lead to the economic development of the north. These factors widen the North-South economic gap. However, human capital can significantly reduce the North-South economic gap [8]. Yi Zhang (2017) empirically investigates the relationship between the level of foreign openness and regional income disparity using panel data of 29 Chinese provinces from 1988 to 2014. The analysis shows that the expansion of the level of external openness will increase the regional income level gap [5].

Third, a study on the impact of digital economy on regional economic disparities. Based on a study of the impact of Internet development on the balanced regional economic development of 30 Chinese provinces with panel data from 2006-2019, Li Feng et al. (2022) found that Internet development can promote the coordinated regional economic development in China [27]. Ren et al. (2022) used a systematic GMM model to empirically explore the effect of digital economy development on the change of regional economic disparity based on inter-provincial panel data in China from 1996-2019, and the study showed that digital economy development promoted factor marketization and significantly suppressed the inter- and intra-regional economic disparity from becoming larger through factor marketization [25]. Li et al. (2022) used provincial panel data from 2009-2017 to empirically investigate the mechanism of the impact between the level of digital economy development and the income gap between urban and rural residents, and the results showed that there is a threshold effect between the level of digital economy and urban and rural income gap, and the impact of the former on the latter shows an "inverted U-shaped" pattern. trend [19] The results show that there is a threshold effect between the level of digital economy and the urban-rural income gap, and the former has an "inverted U-shaped" effect on the latter. Fang Jin (2021) studied the impact of Internet development on regional economic disparity from the perspective of labor factor allocation using 2011-2019 urban panel data in China, and concluded that there is an inverted "U" shape relationship between Internet development and regional economic disparity. [21] The relationship between Internet development and regional economic disparity is inverted "U".

Fourth, the study of the role of economic benefits of agglomeration on the impact of regional economic disparity. Based on the data panel model, Wu Fang (2020) studied the impact of China's service industry agglomeration on the economic development gap of different regions during the time period of 2007-2018, and found that the increase of service industry agglomeration can effectively reduce the

regional economic gap to a certain extent [12]. Based on the inter-provincial panel data of manufacturing and service industries in China from 2005-2014, Ji Yahui et al. (2017) study the relationship between MAR, Jacobs, and Porter spillover effects and regional economic disparity, and find that MAR, Jacobs, and Porter spillover effects in manufacturing industries have a facilitating effect on the reduction of regional economic disparity, while MAR in service industries and Porter in the service sector increase the regional economic gap. [6] The spillover effects of MAR, Jacobs, and Porter in manufacturing are found to contribute to the reduction of regional economic disparities, while MAR and Porter in services increase regional economic disparities. Zhao (2013) studied the evolutionary relationship between industrial agglomeration and regional economic disparity based on the new economic geography theory and empirical data of China's regional economic development and found that the diffusion of industries to the central and western regions is conducive to reducing the regional economic disparity in China. [2]. Liu Yan (2007) used a spatial economics research framework to explain the reasons for the widening regional economic gap in Guangdong from the perspective of industrial agglomeration. From the structural decomposition of the regional economic gap, the main reasons for the regional economic gap in Guangdong are the unbalanced distribution of non-agriculture and the high share of manufacturing output value between regions. [1].

In summary, the empirical research literature on the theory of digital economy and regional economic disparity is very rich, but there are still shortcomings, mainly in the following three aspects: First, the existing literature studies mostly the effect of digital economy on social development or the influence mechanism of other factors on regional economic disparity, few studies on the influence of digital economy on the relationship between regional economic disparity, and The few literatures that have studied the relationship between digital economy and regional economic disparity have mostly explored through direct paths, and few have studied through indirect paths of mediating effects. Second, most of the literature on the digital economy and regional economic gap uses provincial data as the variable indicator, the scope is too broad, mainly studying the gap between regions in the country, ignoring the economic gap within the region, and few studies on the economic gap within a single regional economy, and there is no unified conclusion on the relationship between the digital economy and regional economic gap, which is worth continuing to explore. Third, most of the existing empirical studies ignore the spatial correlation and regional heterogeneity of the digital economy, leading to the possibility of some bias in the results of the empirical model. Therefore, this paper examines the mechanism of the role of digital economy on regional economic disparities based on the panel data of 11 provinces (cities) in Yangtze River Economic Belt from 2011-2019, using SDM model, mediating effect test and regional heterogeneity test.

### 3. Mechanistic Analysis and Hypothesis

#### 3.1. Mechanistic Analysis

As an emerging economic model, the digital economy has effectively broken the "constraints" of humanities, geography, and production factors to achieve a new economic development pattern. The analysis of the mechanism between digital economy and regional economic disparity can be carried out from the perspective of technological progress and technological innovation in the digital economy. From the perspective of technological progress, although each major technological progress has promoted labor productivity and effectively driven economic growth and social development, some studies have shown that technological progress is often accompanied by unequal income distribution, which also causes regional economic disparity. The emergence of regional economic disparities. This is due to the fact that technological progress brought about by the digital economy is generally "biased technological progress", which is a very common phenomenon in human history, meaning that digital technology affects different groups of people differently, for example, in terms of age, there may be a "digital divide" between older people and younger people. "digital divide", so that young people will enjoy the convenience brought by the digital economy more than the elderly. In terms of job sectors, the digital technology upgrade in the IT industry makes workers in the IT industry enjoy better digital dividends than those in other industries. In terms of jobs, due to the artificial intelligence brought by the digital economy, more and more jobs are gradually replaced by robots, but the probability of each job being replaced is not the same, and the introduction of artificial intelligence does not always reduce production costs, some industries due to the introduction of artificial intelligence but the demand for talent becomes greater, the corresponding human capital will also become larger. Therefore, the "biased technological progress" brought by the digital economy will produce uneven economic results, which may be better for some people or have a negative impact on others. From the perspective of technological innovation, technological innovation is an important strategic action that every producer must take to gain "market power". Along with technological innovation, the digital economy has also greatly reduced the costs of search, communication, and exchange, allowing the boundaries of firms to expand until market monopoly occurs. Once a market monopoly occurs, "rents" are created. This is not only true for companies, but also for people who have a particular skill that brings them a certain amount of "market power" and thus creates a certain amount of "rent". There are many studies that show that the rewards of working in the digital economy, whether it is employment or entrepreneurship, are much more lucrative than in other traditional industries. This is an important mechanism that causes economic disparity. Through these two mechanisms, will the digital economy widen the economic gap or narrow it? Because of technological innovation, the three elements of human, capital, and

technology are constantly converging to the central area, and the digital economy promotes the formation of agglomeration economy (Duan, et al., 2020). [14] Friedman's "center-periphery theory" views economic development as a discontinuous but cumulative process of innovation that initially originates in a few hubs of change in the region and spreads outward from these hubs to the low innovation capacity areas (peripheries) from the inside. [14]. The second mechanism therefore widens the regional economic gap. If it is more beneficial to developed regions, it will cause industrial upgrading in developed regions, incremental payoffs in digital industries, and widen the "digital divide", thus widening the economic gap, while if it is more beneficial to less developed regions, it will open up the path of dissemination of educational resources and benefit lagging regions. At the same time, the dissemination of knowledge makes the gap between less developed and developed regions not so big, and the communication and transportation costs are reduced, which greatly improves the market accessibility of the backward regions, which is more beneficial than the developed regions. Thus, the economic gap can be reduced. That whether it strengthens the first-mover advantage or reduces the backward disadvantage is needed for empirical research and data analysis, and based on the above analysis hypothesis 1 is proposed.

### 3.2. Hypothesis

Hypothesis 1: The digital economy can reduce economic disparities between regions.

With the advent of the information age, digital technologies such as the Internet, big data, communication infrastructure, and cloud computing are becoming more and more popular, and the spatial spillover effects brought about by them are becoming more and more obvious, playing a non-negligible role in promoting China's regional coordinated development level. The main manifestations are as follows:

- 1) Information spillover: the development of digital economy has led to a decrease in search costs, transportation costs, and communication costs, effectively narrowing the economic gap between cities due to their geographical location, strengthening regional collaboration between cities, and closer ties between central cities and neighboring cities, to a certain extent driving the development of neighboring areas.
- 2) Factor spillover: the development of digital economy can effectively promote the development of inter-regional capital, communication infrastructure, and cloud computing. The development of digital economy can effectively promote the flow of capital, technology, labor and other factors of production between regions, accelerate the marketization process of capital, technology and labor factors, improve the matching degree between each factor, and realize the optimal resource allocation, while the digital economy relies on its powerful information technology to break the

resource barriers between different regions, which is conducive to cross-city collaboration, resource sharing, and driving the common development of all neighboring.

- 3) technology spillover: on the one hand, the digital economy drives digital industrialization, the modern digital technology, the Internet and other scientific and technological innovation achievements of the market-oriented application of the upgrade represents the acceleration of the process of digital industrialization, it is the market-oriented application of the digital economy and the continuous transformation and upgrading of the digital economy brought about by the diffusion effect of the digital economy, technology is also constantly progressing and updating, thus triggering a new model of digital economy and new-style business model, promoting industrial clustering and forming scale effects, effectively alleviating the degree of information asymmetry between sectors and enterprises from within the enterprise, improving the efficiency of enterprise cluster collaboration, and facilitating coordinated regional development. On the other hand, it promotes the digitization of industry, the deep combination of traditional industry and digital technology, and realizes the overall optimization of traditional industry. With the continuous innovation of technology level, the production capacity and production achievements of enterprises are effectively improved, the quality of products is also improved, and industries are continuously optimized and upgraded, thus promoting the high-quality development of inter-regional economy and helping to narrow the economic gap between regions.
- 4) Knowledge spillover: the development of digital economy has triggered a new round of economic and industrial revolution, and gradually realized the digitization and digital industrialization of industries, promoting However, with the development of digital economy, the cost of information flow and communication is decreasing, knowledge is spreading, and the general public's mastery of the development process, application management, and risk management of digital economy is increasing, which strongly promotes the overall workforce The comprehensive digital economy literacy and human capital are more advanced and rationalized, which promote the healthy development of the overall economy and help the balanced and coordinated development of the inter-regional economy. Based on the above analysis, hypothesis 2 is proposed.

Hypothesis 2: There is a spatial spillover effect between the digital economy and regional economic disparities.

The agglomeration economic effect is the economic phenomenon and effect that economic activities of the same or similar industries are concentrated in a geographical and spatial distribution, forming an interdependent regional economic network or a corresponding industrial cluster.

Unlike the traditional classical "smooth economy", agglomeration economy presents the characteristics of discontinuous and sudden "block economy". With the accelerated urbanization process, China has entered a new normal stage. The industry-oriented agglomeration economy has a very important role in upgrading the urban hierarchy, shaping the inner city and the rise of urban clusters. For the primary industry, agricultural agglomeration has a catalytic effect on farmers' income growth, drives rural economic growth, effectively promotes rural revitalization, and is a powerful means to improve the competitiveness of agricultural regions. Along with the integration of digital economy, the generation and promotion of agricultural information storage management and online marketing on the Internet, agricultural information can be collected and shared rapidly, the traditional agricultural production model is reconstructed, agricultural production is effectively enhanced due to technical support for agricultural productivity in all links of the agricultural industry chain, and intelligent digital management of the agricultural sector is effectively realized, while the role of information sharing realizes labor. At the same time, the cost of employment has been reduced and the efficiency of agricultural labor utilization has been improved. At the same time, the surplus labor on the land keeps flowing to the urban manufacturing sector, which to a certain extent also promotes the growth of urban economy and strengthens the formation of industrial agglomeration economy. For the secondary industry, the secondary industry is the foundation of a strong country, the foundation of a country, and the economic lifeline of a country. The secondary industry agglomeration can effectively promote the high-quality development of the economy, in addition, the manufacturing industry agglomeration is also an important driving force to promote urbanization, which can effectively narrow the regional economic gap, and the digital technology with the Internet big data as the core is developing rapidly while continuously integrating with the real economy of manufacturing industry. The manufacturing industry seizes the unique advantages of the digital economy, relying on the characteristics of data sharing, immediacy, and marginal cost tending to zero to coordinate production, taking data transmission collection and utilization as the core, and carrying out digital transformation in each link of the industrial chain, such as procurement, production, processing, assembly, sales and service, in order to achieve the effect of lower production costs, expansion of business scale and realization of economies of scale for enterprises, and at the same time Optimize the internal structure of the industry, promote the optimization and transformation of the traditional real manufacturing industry, and help improve the quality and efficiency of the manufacturing industry. Tertiary industry refers to industries other than primary industry and secondary industry, i.e. service industry. Service industry agglomeration provides more jobs for the society, can effectively improve the rationalization of social labor division and the professional refinement of enterprise technology, avoiding wasteful and unreasonable problems in

the employment of enterprises, and technical specialization can effectively reduce the operating costs of enterprises and promote the competition among enterprises. In order to prevent being eliminated, enterprises will be the first to innovate and reform, which will promote the development of the whole regional economy. The traditional service industry will be optimized and upgraded by the deep combination of digital economy and service industry, and the output value of the tertiary industry will be promoted. The traditional retail industry will be further integrated with the digital economy through the construction of big data analysis platform, which will promote the rapid development of e-commerce, the free flow of various production factors in the market, and greatly improve the utilization rate of resources. The internal structure of the industry is optimized and upgraded, which is conducive to the optimization and upgrading of the tertiary industry. It is undeniable that primary industry, secondary industry and tertiary industry agglomeration can all effectively promote high-quality economic development, but for the impact of inter-regional economic disparity, the conclusions reached in different time periods, different geographical locations and different policy conditions are certainly inconsistent, so an empirical test must be conducted. Based on the above analysis, hypothesis 3 is proposed.

Hypothesis 3: The digital economy can indirectly suppress the widening of regional economic disparity through the agglomeration economic effect of the secondary industry.

## 4. Empirical Studies

### 4.1. Indicator Selection and Data Description

This paper selects panel data from 2011-2019 from 11 provinces (cities) in the Yangtze River Economic Belt to conduct a study on the impact of digital economy on regional economic disparities. The data sources include China City Statistical Yearbook, China County Statistical Yearbook, China Statistical Yearbook Region and local city statistical yearbooks.

- (1) Explained variable: regional economic gap. There are various methods to calculate the regional economic gap, such as using the ratio of per capita gross regional product (GNP) and per capita gross regional product (GDP) of the benchmark region as an indicator of regional economic development gap (Han Minchun et al., 2022) [23], using the population-weighted coefficient of variation method to measure the regional economic gap (Zhu Lin et al., 2022) [29], and the difference in per capita gross regional product (PGDP) of each province is used to express the regional economic gap (Zhou Ling, 2020). [13]. In this paper, the Thayer index is chosen as an indicator to measure regional economic disparity, which can not only reflect the change of per capita disposable income, but also reveal the change of urban and rural population, and its calculation method is.

$$Theil_{it} = \sum_{j=1}^2 \left[ \left( \frac{Y_{ij,t}}{Y_{it}} \right) \ln \left( \frac{Y_{ij,t} / Y_{it}}{P_{ij,t} / P_{it}} \right) \right] \quad (1)$$

where  $Y$  is the total income of the area residents,  $P$  is the total population of the area, subscript  $i$  represents the area, subscript  $j$  represents urban or rural, when  $j=1$ , urban, when  $j=2$ , rural, subscript  $t$  represents the year,  $Y_{it}$  represents the total income of the area residents in year  $t$ , and  $P_{it}$  represents the total population of the area in year  $t$ .

(2) Explanatory variable: digital economy. The digital economy has played a great role in the high-quality development of China's economy since its inception, and the digital economy dividend has penetrated into all aspects of social life. A few researchers only measure the development level of the digital economy in terms of the penetration rate of Internet information technology and other aspects, and this measurement method considers a rather one-sided perspective. This

paper draws on the research method of Song Yuegang et al. (2022) [24] (2022), combined with the availability of data in various cities in the Yangtze River Economic Zone, and constructed comprehensive evaluation indicators from three dimensions, namely digital infrastructure, digital industry development and digital inclusive finance, to measure the development level of the digital economy (see Table 1 for details). The basic indicators such as total telecommunication business (million yuan), total postal business (million yuan) and the number of employees in the information transmission, computer service and software industry (10,000 people) are used to describe the development of digital industry; digital inclusive finance is expressed in terms of the breadth of coverage, depth of use and degree of digitalization. The entropy power method is applied to standardize the above indicators by reducing the dimensionality, and finally the comprehensive index of digital economy is obtained, which is recorded as  $D$ .

**Table 1.** Digital Economy Indicator System.

	Tier 1 Indicators	Secondary indicators	Tertiary indicators
Digital Economy	Digital Infrastructure	Broadband Internet Foundation	Number of international Internet users per 10,000 people (households)
		Mobile Internet Foundation	Number of cell phone subscribers per 10,000 people (households)
		Telecommunication industry output	Total telecommunication business (million yuan)
	Digital Industry Development	Postal industry output	Total postal business (million yuan)
		Information Industry Foundation	Number of employees in the information transmission, computer services and software industry (10,000)
	Digital Inclusive Finance	Breadth of coverage	Digital Financial Inclusion Coverage Breadth Index
		Depth of use	Digital Inclusive Finance Usage Depth Index
		Degree of digitization	Digital Inclusive Finance Digitization Index

(3) Mediating variable: S economy (agg). The economic benefits generated by the concentration of many similar enterprises in a specific area are called agglomeration economies, which is an important reason for urbanization. It is extremely important to narrow the regional economic gap and coordinate the balanced regional development. Therefore, this paper draws on Yu, Binbin et al. (2015), and the agglomeration economy is measured by using industrial cluster location entropy [3], which is calculated as follows.

$$\text{agg}(t) = \left[ \frac{e_{ij}(t)}{\sum_i e_{ij}(t)} \right] / \left[ \frac{\sum_j e_{ij}(t)}{\sum_i \sum_j e_{ij}(t)} \right] \quad (2)$$

where,  $\text{agg}(t)$  represents the locational entropy value in year  $t$ ,  $e_{ij}(t)$  represents the employment of industry  $j$  in region  $i$  in year  $t$ ,  $\sum_i e_{ij}(t)$  represents the employment of industry  $j$  in all regions in year  $t$ ,  $\sum_j e_{ij}(t)$  represents the employment of all

industries in region  $i$  in year  $t$ , and  $\sum_i \sum_j e_{ij}(t)$  represents the employment of all industries in all regions in year  $t$ .

(4) Control variables: The control variables in this paper are mainly selected from industrial structure (product), education development level (edu), industrial level (industry), economic development level (economy), government expenditure scale (gov), and employment level (employ). The industrial structure is expressed as the proportion of the output value of the tertiary industry in the GDP of the prefecture-level municipality; the level of education development is measured by the proportion of the number of college students in the region in the total population of the prefecture-level municipality; the level of industry is measured by the number of industrial enterprises; the level of economic development is measured by the real GDP per capita; the scale of government expenditure is expressed as the logarithm of the proportion of local fiscal expenditure in the GDP of the prefecture-level municipality. The employment level is expressed by the number of employed persons in each region. Descriptive statistics of the variables are shown in Table 2.

Table 2. Descriptive statistics of variables.

Variables	Meaning	Sample size	Average value	Standard deviation	Minimum value	Maximum value
dc1	Digital Economy	990	0.10	0.120	.0141918	.9583222
product	Industry Structure	990	40.89	9.521	20.66	77.49
edu	Education Development Level	990	1.83	2.340	.000463	12.70424
industry	Industrial level	990	1587.19	1817.347	61	11042
economic	Economic Development Level	990	59533.22	2.05e+05	8877	6421762
gov	Scale of Government Spending	990	-1.59	0.523	-2.576716	.8239193
employ	Employment level	990	1.46e+06	2.01e+06	107161	1.55e+07
tyre	Regional Economic Gap	990	0.08	0.038	.018536	.272331

#### 4.2. Spatial Autocorrelation Test

In this paper, stata15.1 software is used to test the spatial autocorrelation between digital economy and regional economic disparity in 11 provinces and cities in the Yangtze River Economic Belt from 2011-2019, where the spatial weight matrix used is the economic distance matrix and the degree of spatial autocorrelation is expressed by Moran's I index, which is calculated as

$$\text{Moran's I} = \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{S^2 \sum_{i=1}^n (Y_i - \bar{Y})^2} \quad (3)$$

Where, n is the number of sample regions,  $\bar{Y}$  denotes the sample mean,  $S^2$  is the sample variance, and  $w_{ij}$  denotes the spatial weight matrix between region i and region j. The Moran's index takes values in the range of [-1,1], and the precondition for the existence of positive spatial correlation is that Moran's I is greater than 0 and the closer to 1, the stronger the positive correlation; the precondition for the existence of negative spatial correlation is that Moran's I is less than 0 and the closer to -1, the stronger the negative correlation; the precondition for no spatial correlation is Moran's I is equal to 0 or the result is not significant. The results of the operations are shown in

Table 3. Moran index test of digital economy and regional economic gap.

	Digital Economy		Regional Economic Gap	
	Moran's I	Z-value	Moran's I	Z-value
2011	-0.003	0.936	0.080***	12.081
2012	-0.000*	1.286	0.111***	16.058
2013	0.010***	2.899	0.153***	21.670
2014	0.006**	2.185	0.163***	22.969
2015	-0.003	0.816	0.156***	22.057
2016	0.004**	1.841	0.151***	21.436
2017	0.001*	1.455	0.153***	21.649
2018	0.005**	2.015	0.152***	21.502
2019	0.009***	2.867	0.151***	21.464

From the results in Table 3, it can be seen that Moran's I of the digital economy of the Yangtze River Economic Belt is significantly positive at the 10% or 5% or 1% level in all years except 2011, 2012 and 2015, and Moran's I of the regional economic gap is positively significant at the 1% level, thus, it can be seen that the digital economy of the Yangtze River Economic Belt 11 provinces (cities) in the

Yangtze River Economic Belt have a significant spatial correlation with the regional economic gap.

#### 4.3. Selection of Spatial Econometric Model

The results of the Moran index test indicate that there is a significant spatial correlation between the digital economy and the economic gap between regions, so the spatial econometric model is selected to empirically study the regional economic gap in the digital economy, and the following three models are constructed.

Model 1:

$$\text{Theil}_{it} = \rho W_{ij} \text{Theil}_{it} + \alpha D_{it} + \sum \beta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

Model 2:

$$\text{Theil}_{it} = \alpha D_{it} + \sum \beta X_{it} + \mu_i + \lambda_t + v_{it}, v_{it} = \gamma W_{ij} v_{it} + \varepsilon_{it} \quad (5)$$

Model 3:

$$\text{Theil}_{it} = \rho W \text{Theil}_{it} + \alpha D_{it} + \sum \beta X_{it} + \theta W (D_{it} + \sum \beta X_{it}) + \mu_i + \lambda_t + \varepsilon_{it} \quad (6)$$

Models 1-3 denote the spatial lag model (SAR), spatial error model (SEM), and spatial Durbin model (SDM), respectively. The Thayer index of region i in year t is denoted by  $\text{Theil}_{it}$ , the composite digital economy index of region i in year t is denoted by  $D_{it}$ , the control variables are denoted by  $X_{it}$ , the spatial lag coefficients of the explained variables are denoted by  $\rho$ , the spatial lag coefficients of the explanatory and control variables are denoted by  $\theta$ , the spatial weight matrix is denoted by  $W$ , the region fixed effects are denoted by  $\mu_i$ , the time fixed effects are denoted by  $\lambda_t$ , the random error terms are denoted by  $\varepsilon_{it}$ , the error of the spatial regression coefficients are denoted by  $\gamma$ .

In order to be able to obtain the most accurate results, this paper did LR test as well as Wald test, and found that the spatial Durbin model (SDM) is most suitable for the empirical study of this paper, meanwhile, based on the results of Hausman test, the fixed effect model is selected among the fixed effect model and random effect model, and the fixed effect is divided into time fixed effect, individual fixed effect and time-individual double fixed effect, on this basis, this paper combined with the results of the joint significance test, and finally chose the time individual double fixed effect.

#### 4.4. Mediating Effect Model

To examine the ways in which the digital economy



indirectly affects regional economic disparities through agglomeration economies, the following model was set up

$$agg_t = \alpha_0 + \rho_M \sum_j W_{ij} agg_t + \alpha_1 D_{it} + \beta_1 \sum_j W_{ij} D_{it} + \alpha_2 X_{it} + \beta_2 \sum_j W_{ij} X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (7)$$

$$Theil_{it} = \theta_0 + \rho_1 \sum_j W_{ij} Theil_{it} + \theta_1 D_{it} + \delta_1 \sum_j W_{ij} D_{it} + \theta_2 agg_t + \delta_2 \sum_j W_{ij} agg_t + \theta_3 X_{it} + \delta_3 \sum_j W_{ij} X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (8)$$

Where,  $agg_t$  represents the agglomeration economy. The test steps of the mediating effect model are as follows: Step 1, if the regression coefficient  $\alpha$  in model (6) is significant, it indicates that the digital economy can directly affect the regional economic disparity, and if the result is not significant, the test of mediating effect is stopped. Step 2: If the regression coefficients  $\alpha_1$  in model (7) and  $\theta_2$  in the model (8) are significant, the mediating effect test is passed. If the regression coefficients  $\alpha_1$  and regression coefficients  $\theta_2$  are insignificant, then the Sobel test should be used to continue the test. Meanwhile, if the regression coefficients  $\theta_1$  and  $\theta_2$  are insignificant and significant, it means that the agglomeration economy has a full mediation effect, and if both are significant, it means that the agglomeration economy has a partial mediation effect.

## 5. Analysis of Empirical Results

### 5.1. Spatial Decomposition Effect

In order to verify hypothesis 1 and hypothesis 2 and more accurately identify the effect of digital economy on regional economic gap, this paper adopts stata15.1 software and uses SDM model to further decompose the total spillover effect of digital economy on regional economic gap into direct effect and indirect effect, the direct effect indicates the role of digital economy development in the region on the economic gap in the region, while the indirect effect indicates the the spatial spillover effect of digital economy development in other regions on the economic gap in the region, and the specific results are shown in Table 4.

Table 4. Decomposition results of spatial spillover effects.

Variables	Direct effect	Indirect effects	Total effect
<i>Indc1</i>	-0.0442* (-2.08)	-0.368* (-2.48)	-0.412** (-2.83)
<i>lnpro</i>	0.135*** (3.31)	-0.715* (-2.40)	-0.580 (-1.93)
<i>lnedu</i>	-0.00734 (-0.66)	-0.0437 (-0.34)	-0.0510 (-0.39)
<i>lnind</i>	0.0980*** (4.55)	0.0172 (0.06)	0.115 (0.39)
<i>lneco</i>	-0.0636*** (-4.24)	0.360* (2.08)	0.296 (1.71)
<i>gov</i>	-0.0151 (-0.83)	-0.155 (-0.63)	-0.170 (-0.68)
<i>lnemp</i>	0.0252 (1.91)	0.0214 (0.12)	0.0466

The results in Table 4 show that the digital economy has a negative and significant effect on the direct, indirect and total effects of regional economic disparity, indicating that the

using causal stepwise regression in mediating effects.

development of digital economy in the region and nearby regions has a significant inhibitory effect on the widening of regional economic disparity in the region. Hypothesis 1 and hypothesis 2 are verified because the development of digital economy, in addition to promoting the innovation of production models in the region and enhancing regional competitiveness, can also effectively promote the flow of production factors between regions, break the resource barriers between regions, reduce information search costs, transportation costs, etc., and effectively enhance the collaboration between regions, thus effectively weakening the geographical restrictions. The direct effect of industrial structure is positive and significant, while the indirect effect is negative and significant at the 10% level, and the total effect is not significant, indicating that industrial transformation plays a significant role in expanding the local regional economic gap, but due to the offsetting effect of industrial transformation in the neighboring areas to inhibit the expansion of the local regional economic gap, which eventually makes the industrial transformation under the whole economic system has no significant effect on the regional economic gap. The direct effect, indirect effect and total effect of education development level are not significant, indicating that the localization, peripheralization and global improvement of education level have no significant effect on regional economic disparity, which may be because the economic growth benefit brought by education cannot achieve immediate effect, and the income improvement brought by "education realization" to individuals is Education is just like a marathon race, the training method is brilliant, but it can only improve the overall average speed, but it can not keep everyone's speed exactly the same. The direct effect of industrial development level is positive and significant, while the indirect effect and total effect results are not significant, which indicates that the improvement of industrial development level promotes the widening of local regional economic gap, probably because the improvement of industrial level promotes the improvement of social productivity, the upgrading of industrial structure and the rapid growth of economy. However, at the same time, it makes talents, capital, education resources, and employment opportunities continue to gather in the central city, thus generating the Matthew effect and contributing to the expansion of economic disparity, but the impact of the increase of industrial level in the neighboring areas and the whole economic system on the local regional economic disparity is not significant. The direct effect of economic development level is negatively significant, the indirect effect is positively significant, and the total effect is not significant, indicating that the increase of economic level in the region

can significantly reduce the economic gap in the region, which may be due to the fact that when the regional economic development level in China is at a low stage, the regional economic gap will gradually widen with the increase of economic development level, while when the economic development level is at a normal development stage, the regional economic gap will gradually narrow with the increase of the economic development level. The direct effect, indirect effect and total effect of employment level and government expenditure scale are not significant, which

indicates that whether the scale of government expenditure and employment opportunities are locally or globally improved, although they can promote sustainable economic and social development at a certain level, the effect on regional economic gap is not significant, and the spatial spillover effect is not obvious.

### 5.2. Mediating Effect Test

Based on the study of the direct path of the effect of the digital economy on the regional economic gap, the intermediary effects of the primary industry, secondary industry and tertiary industry agglomeration economy were tested separately using the causal stepwise regression test, and the results were obtained as shown in Table 5.

**Table 5.** Regression results of the mediating effects of the first, second and third industry agglomeration economies.

Paths Variables	Primary Industry		Secondary Industry		Tertiary Industry	
<i>Intyre</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>
<i>Path c Lndc1</i>	-.0877131	0.002	-.0877131	0.002	-.0877131	0.002
<i>lnagg</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>
<i>Path a Lndc1</i>	-.1705097	0.142	-.110964	0.000	.1488176	0.000
<i>Intyre</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>	<i>Coef.</i>	<i>p-value</i>
<i>Path b and c' Lnagg</i>	.0053948	0.487	-.1595378	0.000	.0624067	0.178
<i>Lndc1</i>	-.0867933	0.002	-.1054161	0.000	-.0970003	0.001

As shown in Table 5: the digital economy can negatively and significantly affect the regional economic gap under the direct path. However, in the indirect path, for the primary industry, the digital economy does not significantly affect the agglomeration economy of the primary industry, and the agglomeration economy of the primary industry does not have a significant effect on the regional economic gap, and the p-value of the Sobel test is 0.5296, which is not significant, indicating that the agglomeration economy of the primary industry fails the mediating effect test. For the tertiary industry, although the digital economy can promote the formation of the agglomeration economy of the tertiary industry at the 1% significant level, the agglomeration economy of the tertiary industry does not have a significant effect on the widening of the regional economic gap, and the p-value of the Sobel test is 0.1847, which is also insignificant, indicating that the agglomeration economy of the tertiary industry also fails the mediation effect test. For the secondary industry, the digital economy can influence the formation of the agglomeration economy of the secondary industry at the 1% significant level, indicating that the digital economy can be deeply integrated with the manufacturing industry. At the same time, the agglomeration economy of secondary industry can significantly suppress the expansion of regional

economic disparity at 1% significant level. It shows that the agglomeration economy of secondary industry passes the test of intermediary effect and the proportion of intermediary effect is 20.18%. Based on this, the original hypothesis 3 is accepted: the digital economy can indirectly suppress the widening of the regional economic gap through the agglomeration economy effect of the secondary industry. And the mechanism of the effect of digital economy on regional economic gap through agglomeration economy is: digital economy affects the agglomeration economy of secondary industry, and then indirectly reduces the regional economic gap.

### 5.3. Heterogeneity Test

The magnitude of the impact of digital economy on regional economic disparity depends largely on the economic development status of local and surrounding cities and the level of digital economy development. In this paper, the selected 11 provinces (cities) of Yangtze River Economic Belt are divided into three regions: upper, middle and lower reaches, and the impact of digital economy on regional heterogeneity of economic disparity is further investigated, and the test results are shown in Table 6.

**Table 6.** Regional heterogeneity test.

Variables	Upstream			Midstream			Downstream		
	Direct effect	Indirect effects	Total effect	Direct effect	Indirect effects	Total effect	Direct effect	Indirect effects	Total effect
<i>Lndc1</i>	-0.047** (-2.23)	-0.210** (-2.43)	-0.257*** (-3.00)	-0.031 (-0.78)	0.388* (1.69)	0.357 (1.56)	0.109** (2.04)	-0.237 (-0.75)	-0.128 (-0.39)
<i>lnpro</i>	-0.041 (-0.89)	-1.031*** (-2.96)	-1.072*** (-3.03)	0.220*** (3.20)	-0.046 (-0.12)	0.173 (0.47)	0.050 (0.55)	-0.222 (-0.53)	-0.172 (-0.41)

Variables	Upstream			Midstream			Downstream		
	Direct effect	Indirect effects	Total effect	Direct effect	Indirect effects	Total effect	Direct effect	Indirect effects	Total effect
<i>lnedu</i>	0.020 (1.52)	-0.293 (-1.16)	-0.273 (-1.05)	-0.157*** (-4.29)	1.137 (1.07)	0.981 (0.91)	-0.210*** (-4.88)	-1.035** (-2.09)	-1.245** (-2.42)
<i>lnind</i>	-0.081*** (-2.85)	-0.236 (-0.62)	-0.317 (-0.82)	0.212*** (6.51)	-0.445 (-1.21)	-0.233 (-0.62)	0.040 (0.58)	-0.798 (-0.88)	-0.758 (-0.80)
<i>lneco</i>	0.020 (1.42)	0.546** (2.32)	0.566** (2.36)	-0.358*** (-9.95)	-0.179 (-0.74)	-0.537** (-2.17)	0.129* (1.80)	0.244 (0.40)	0.373 (0.58)
<i>gov</i>	0.032 (1.53)	-0.151* (-1.87)	-0.118 (-1.48)	-0.077*** (-3.00)	0.192*** (3.91)	0.115*** (2.70)	-0.070 (-1.60)	-0.051 (-0.23)	-0.121 (-0.53)
<i>lnemp</i>	0.020 (1.01)	-0.117 (-0.43)	-0.097 (-0.35)	0.020 (1.05)	-0.072 (-0.29)	-0.053 (-0.21)	-0.005 (-0.18)	-0.247 (-1.03)	-0.252 (-1.00)

Since the reform and opening up, it is well known that the provinces and cities in the Yangtze River Economic Belt have been increasing their economic development levels from upstream to downstream due to their different geographical locations, but the digital hierarchy is not exactly the same as the economic development levels between cities. From the test results in Table 6, it is easy to see that the digital economy in the upstream area of the Yangtze River Economic Belt has a significant negative effect on the direct effect, indirect effect and total effect on the regional economic gap, indicating that the development of the digital economy in both the region and the neighboring areas can reduce the regional economic gap in the region, and the proportion of the spillover effect of the digital economy in the neighboring areas is greater than the direct effect of itself, which is perhaps due to the fact that along with the rapid development of the Yangtze River Delta urban agglomeration and the middle reaches of Yangtze River urban agglomeration has driven the economic development of the Chengdu-Chongqing urban agglomeration onto the right track gradually. The less developed regions, which are in the primary stage of economic rise and have weaker foundation, can also develop digital economy to suppress the expansion of regional economic gap by improving information infrastructure and promoting industrial structure optimization and upgrading; the direct effect of digital economy on regional economic gap in the midstream region is negative but not significant, while the indirect effect is positively significant at 10% level, while the total effect is not significant, indicating that the region's The spillover effect of the development of digital economy in the surrounding areas has widened the regional economic gap, probably because some cities in the middle reaches of the Yangtze River Economic Belt are adjacent to the downstream areas and some cities are adjacent to the upstream areas, the upstream areas are the less developed areas of Yunnan, Guizhou and Sichuan, and the downstream areas are the economically developed Yangtze River Delta city cluster. The digital economy in the downstream region of the Yangtze River Economic Belt has a significant positive direct effect on the regional economic gap, but the indirect effect and the total effect are not significant, indicating that the digital economy in the downstream region of the Yangtze River Economic Belt has a significant positive effect on the regional economic gap. This is probably because the Yangtze

River Delta city cluster is the "leading" part of the Yangtze River economic belt, with a long-term positive economic development level, and the core city "Magic City". Therefore, when the economic development of some cities in a region reaches a certain level, even if the digital economy develops rapidly, it is difficult to play a significant role in inhibiting the widening of the economic gap between regions.

#### 5.4. Robustness Test

- (1) Transformation of spatial weight matrix. Since the above results were obtained by creating a geographic adjacency-type weight matrix, the results of the spatial spillover effect of the digital economy on regional economic disparities are not completely reliable, for this reason, the spatial Durbin model was estimated again by transforming the geographic adjacency-type weight matrix into an economic distance spatial weight matrix, and the results are shown in Table 7.

Table 7. Robustness tests of the economic distance weight matrix.

Variables	Direct effect	Indirect effects	Total effect
<i>Indcl</i>	-0.0430* (-2.12)	-0.0433* (-2.18)	-0.0863** (-3.08)
<i>lnpro</i>	0.149*** (3.65)	-0.0609 (-1.38)	0.0883 (1.68)
<i>lnedu</i>	-0.00576 (-0.54)	0.0293** (3.03)	0.0236 (1.63)
<i>lnind</i>	0.106*** (5.00)	-0.0326 (-1.31)	0.0735* (2.44)
<i>lneco</i>	-0.0617*** (-4.19)	-0.000226 (-0.02)	-0.0619** (-2.90)
<i>gov</i>	-0.0158 (-0.89)	-0.0180 (-1.01)	-0.0338 (-1.24)
<i>lnemp</i>	0.0229 (1.75)	0.0140 (1.01)	0.0369 (1.80)

The results in Table 6 show that the effect of digital economy on regional economic disparity after transforming the spatial weight matrix remains consistent with the direction and significance of Table 5, and has a spatial spillover effect, and although the estimated results of individual control variables do not match Table 5, the core explanatory variable digital economy remains consistent, indicating the robustness and reliability of the empirical findings of this paper.

(2) Adding omitted variables. Given that the digital economy has a systematic effect on regional economic disparities, it may also be due to the omitted variables not examined in the empirical study above. Based on this, this paper also tests the possible impact of the following 2 types of factors: first, financial development factors, regulating the economy, providing information, avoiding risks, and allocating resources are the common functions of finance, and they are the key to the operation of modern economy, and the uneven distribution of financial resources among regions in China will cause the differentiation of economic growth levels among regions, which may have some impact on regional economic disparities. Based on data from 31 provinces in China from 1990-2017, Chengchao Lu et al. (2020) empirically examined the role of financial development on regional economic disparities, and for the whole sample, regional disparities in financial scale and financial efficiency were able to narrow China's regional economic disparities, while regional disparities in financial structure widened China's regional economic disparities [15]. Based on the panel data of 31 Chinese provinces (cities) from 2003 to 2014, Wang Yijun (2017) finds that the regional financial development and regional economic development gaps show an inverted "U" shaped relationship over a long period of time. [4] The second factor is external openness. Second, the external opening factor, which plays an important role in the process of China's rapid economic growth, but China's external opening policy is accompanied by the transformation of the economic system, and the policy orientation is extremely obvious, which has different effects on the economic development of different regions, and therefore may lead to uneven regional development and have an impact on the regional economic gap. Using panel data of 29 Chinese provinces from 1988 to 2014, Yi Zhang (2017) empirically investigates the relationship between the level of foreign openness and regional income disparity. The analysis shows that the expansion of the level of external openness will aggravate the regional income level gap [5]. Due to the diversity and complexity of the impact paths of financial development and external openness on regional economic disparities and the existence of certain differences in the time stages, economic factors, institutional factors and geographical conditions of empirical studies in different literatures, completely inconsistent conclusions may be drawn. In this paper, in order to address the possible endogeneity problem brought by financial development and foreign openness, two omitted variables of financial development and foreign openness are introduced into the previous empirical model, and the test results are shown in Table 8.

**Table 8.** Robustness tests for adding omitted variables.

Variables	Direct effect	Indirect effects	Total effect
<i>Indcl</i>	-0.0442*	-0.368*	-0.412**
	(-2.08)	(-2.48)	(-2.83)

From the test results in Table 8, it can be seen that the digital economy still has a significant inhibitory effect on regional economic disparity and a negative spatial spillover effect after adding two omitted variables, namely financial development and openness to the outside world, and the previous empirical results still hold.

## 6. Conclusions and Recommendations

This paper uses urban panel data of 11 provinces (cities) in the Yangtze River Economic Belt to construct a comprehensive evaluation index system of digital economy from three levels: digital infrastructure, digital industry development and digital inclusive finance, and adopts the spatial Durbin model (SDM), mediating effect model and regional heterogeneity test model to empirically study the impact of digital economy on regional economic disparity and its spatial spillover mechanism. The following conclusions are drawn:

- 1) The digital economy has a significant impact on regional economic disparity and can effectively curb the widening of regional economic disparity.
- 2) The digital economy can produce spatial spillover effects on regional economic disparity. The development of digital economy in neighboring regions also effectively reduces the local regional economic gap to a certain extent.
- 3) Digital economy can indirectly suppress the expansion of regional economic gap through the agglomeration economic effect of secondary industry.
- 4) The suppression effect is most significant in the upstream area of Yangtze River Economic Belt, while the suppression effect is not significant in the midstream area and the development of digital economy in the downstream area widens the regional economic gap.

Based on the above mechanism analysis and empirical results, the article proposes the following suggestions for coordinated regional development and how to narrow the regional economic gap. Accelerate the process of developing the digital economy, especially in less developed regions, to avoid the "digital divide". The digital economy has an obvious curbing effect on the widening of regional economic disparities, and the huge economic gap between regions is inextricably linked to the industrial structure and technological base of each region. It is necessary to increase investment in digital infrastructure, promote the large-scale application of 5G, Internet and artificial intelligence, accelerate the development of industrial Internet, improve network coverage, focus on promoting the basic R&D of digital technology, create a collaborative innovation system, and strengthen the common construction and sharing of innovation resources to crack the core technology "neck" problem. For less developed regions, it

is necessary to rely on their geographical location and natural resource endowment to guide and promote the digital transformation of traditional infrastructure, promote the layout and construction of industrial Internet, shape the digital transportation environment, and help lagging regions achieve "overtaking" in economic development, so as to narrow the regional economic gap and to achieve regional coordinated development.

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