

# Research on the Heterogeneity of Digital Economy Driving Regional Integration Development

-- Comparative Analysis Based on Three Major Urban Agglomerations

Qingyang Ye\*, Xinyu Cao

School of Economics, Anhui University of Finance and Economics, Bengbu, Anhui, China

\*Corresponding author: dct12138@126.com

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**Abstract:** Based on the panel data of 63 cities in China's Yangtze River Delta, Beijing Tianjin Hebei and Pearl River Delta urban agglomerations from 2011 to 2019, this paper measures the level of digital economy development and regional integration based on relevant theories and practical basis, and tests the impact of digital economy development on regional integration development and its heterogeneity in the three urban agglomerations. Finally, the following conclusions are drawn: ① The development level of digital economy has a significant positive impact on the development level of regional integration of urban agglomeration, that is, promoting the development of digital economy of urban agglomeration is conducive to the integrated development of urban agglomeration. ② There are significant differences in the impact of the digital economy development level of the three urban agglomerations on the regional integration development level of urban agglomerations, showing the phenomenon of Yangtze River Delta > Beijing Tianjin Hebei > Pearl River Delta. Finally, on this basis, the paper puts forward some suggestions on how to use digital economy to drive the development of regional integration.

**Keywords:** Digital economy, Regional integration, Urban agglomeration, Coefficient of variation.

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## 1. 1. Introduction

Under the general trend of current economic globalization, regional development links and interdependence are deepening, the scope and field of regional cooperation are expanding, and the scale of cooperation is growing. Regional integration has become an important and effective way to promote high-quality economic development. China's regional integration development, represented by the Yangtze River Delta, Beijing Tianjin Hebei, Pearl River Delta and other regions, has made more striking achievements. China attaches great importance to the development of regional integration and provides an important engine for future economic growth and efficiency improvement. At the same time, the digital economy is booming, impacting all aspects of the economy and society. The report of the 19th National Congress of the Communist Party of China clearly pointed out that "China's economy has shifted from a stage of rapid growth to a stage of high-quality development". In recent years, with the vigorous development of information technology, a large number of new technologies, new industries, new products and new models have emerged. All kinds of innovation activities are in full bloom, and a hundred schools of thought contend with each other, which has promoted profound changes in the global economy and blurred the boundary between the real world and the digital world. It can be called the "fourth industrial revolution". In terms of connotation, digital economy mainly includes "digital industrialization" and "industry digitalization", which shows that digital economy has shown strong inclusiveness and integration. It can not only form information industry, digital industry and other industries, but also combine with various industries and achieve mutual promotion. In this context, how the digital economy affects the development of regional integration is a subject worth studying.

## 2. Literature Review and Theoretical Analysis

The term "digital economy" first came into public view in a newspaper named The San Diego Union Tribune in 1994, and was formally proposed in Don Tapscott's work on digital economy in 1996. With the increasing social concern of digital economy, academic research on digital economy has become increasingly rich. The existing research on digital economy mainly focuses on the definition of the connotation of digital economy, the quantification of digital economy and the impact of digital economy on the economy. First of all, scholars try to define digital economy from different angles and clarify its connotation. First, define the digital economy from the perspective of its contents. Mesenbourg (2001) believed that e-commerce could well reflect the digital economy [1]. The Chinese Academy of Information and Communications (2017) divided the digital economy into two parts: the digital economy foundation and the digital economy integration [2]. Second, represented by the G20 Summit in 2016, scholars believe that the digital economy is an economic activity [3]. Third, some scholars define digital economy from the perspective of industry and output, represented by scholars such as Knickrehm (2016). The academic community mainly adopts two methods to quantify the digital economy. Kang Tiexiang (2008), Liu Fang (2019) and other scholars use the added value of the digital industry to quantify the digital economy [4, 5], while Chen Fang (2018), Shen Yunhong (2020), Liu Jun (2020) and other scholars build an indicator system to measure the size of the digital economy [6, 7]. The impact of the digital economy on the economic society is a matter of great concern in academia and the real economic society. Scholars have explored the impact of the digital economy on all aspects of the economic society from different perspectives. How Fan (2019) believed

that the digital economy would have an impact on the economic benefits of enterprises, and confirmed the positive role of the digital economy in promoting them [8]. Xu Ming (2021) proposed that the combination of digital economy and finance forms digital inclusive finance, which has played a significant role in promoting high-quality economic development [9]. With the further development of the digital economy, many scholars have begun to pay attention to the control and governance of the digital economy, such as Xiong Hongru (2019), Du Qinghao (2019) and other scholars [10, 11].

With regard to regional integration development, Yin Xiuying and others built an evaluation system based on the three levels of economy, society and ecosystem, and used the system coupling degree model to evaluate the level of regional coordinated development [12]. Zhang Chao (2020) analyzed the Spatio-temporal differentiation of China's regional coordinated development and its influencing factors by using entropy method and local coordinated development measurement method [13]. Chen Panpan (2020) measured the level of regional coordinated development in Central Plains using Moran index, average weighting method and other methods and proposed improvement strategies [14].

At present, there is relatively little research on the impact of digital economy on the development of regional integration. Wang Qingxi, Wu Jin and others (2020) used the spatial panel econometric model to investigate the factors and effects of digital economy on the development ability of regional integration in the Yangtze River Delta [15]. Wang Yu and Zhang Zhanbin (2021) analyzed the relationship between digital economy and regional integration by constructing digital economy development level and regional integration indicators, and discuss the intermediary effect of production factor allocation [16].

According to relevant literature, the combination of intelligent manufacturing, Internet of Things and other technologies in the digital economy with traditional manufacturing can help promote the industrial transformation and economic development of marginal cities and narrow the economic development gap between central cities and surrounding cities on the basis of improving enterprise production efficiency. In addition, digital economy and technology can make use of the integration of traditional industries, traditional products and digital technologies to create new models, new products and new formats, radiate the scientific and technological content and industrial upgrading of surrounding cities, and improve the overall scientific and technological innovation level of urban agglomeration. Therefore, this paper hopes to use the urban panel data of the

Yangtze River Delta, Beijing Tianjin Hebei and Pearl River Delta urban agglomerations in China to test the impact of digital economy development on regional integration development and its heterogeneity in the three urban agglomerations. For this, this paper proposes the following assumptions.

**Hypothesis 1:** The development of digital economy has a positive impact on the regional integration level of the three urban agglomerations.

**Hypothesis 2:** The impact of digital economy on the regional integration level of the three urban agglomerations is heterogeneous.

### 3. Variables, Data and Models

#### 3.1. Variables and Data Description

The core variables involved in this paper are mainly the level of digital economy and regional integration. The level of digital economy is represented by the "Peking University Digital Inclusive Finance Index" [17], which is recorded as dig. The regional integration level is expressed by the coefficient of variation of urban GDP growth rate in the region. The coefficient of variation is the standard deviation of each city index in the region divided by the average value of the index. The larger the value is, the higher the dispersion degree of the index in the region is, and the more obvious the non integration is. It is selected as ri. In addition, the following control variables are selected: (1) population size of urban agglomeration. (2) The degree of government intervention (gov) is calculated by the coefficient of variation of the ratio of financial expenditure to GDP in urban agglomeration. (3) Urban living environment is expressed by the variation coefficient of green coverage rate of built-up areas. (4) The degree of opening to the outside world (ope) is expressed by the coefficient of variation of the ratio of foreign investment to GDP in urban agglomeration.

In order to study the impact of digital economy on the development of regional integration, this paper takes the Yangtze River Delta, the Pearl River Delta, and the Beijing Tianjin Hebei urban agglomeration as the research object, and collects and collates the relevant data of 41 cities in the Yangtze River Delta, 9 cities in the Pearl River Delta, and 13 cities in Beijing Tianjin Hebei from 2011 to 2019. Except that the digital economy level comes from the "Peking University Digital Inclusive Finance Index", the data are all from the China Urban Statistical Yearbook, and some missing values are supplemented by interpolation. Descriptive statistical results of each variable are shown in Table 1.

**Table 1.** Descriptive Statistical Results of Variable Data

Variable	Obs	Mean	Std. Dev.	Min	Max
ri	567	0.014	0.005	0.005	0.027
dig	567	0.189	0.073	0.018	0.324
size	567	0.544	0.302	0.074	1.469
gov	567	0.349	0.049	0.232	0.404
living	567	0.082	0.034	0.025	0.248
ope	567	0.721	0.240	0.407	1.442

#### 3.2. Model Design

Build the following panel model of digital economy

affecting regional integration level:

$$ri_{it} = \beta_0 + \beta_1 Dig_{it} + \beta_2 X_{it} + u_i + \varepsilon_{it} \quad (1)$$

Where,  $ri_{it}$  represents the regional integration level of the  $i$ th urban agglomeration in period  $t$ ,  $Dig_{it}$  represents the digital economy development level of the  $i$ th urban agglomeration in the  $t$  period,  $X_{it}$  represents the control variable group,  $i$  and  $t$  represent the region and time respectively, and  $u_i$  represents the individual fixed effect of the  $i$ th urban agglomeration that does not change over time,  $\varepsilon_{it}$  is a random perturbation term.

#### 4. Empirical Analysis

Table 2 shows the impact of the digital economy development level of the Yangtze River Delta, Beijing Tianjin Hebei and the Pearl River Delta on the regional integration development. The variable coefficients of each digital economy level are significantly negative at the 1% confidence level, indicating that the digital economy has a significant negative impact on the coefficient of variation of regional GDP. Therefore, the current digital economy development has a significant positive impact on the regional integration development, the higher the development level of digital economy in the urban agglomeration, the smaller the economic growth rate gap among the cities within the urban agglomeration, and the higher the level of regional integration development. According to the hypothesis of this paper, the further development of digital economy in urban agglomeration can promote the regional integration development of urban agglomeration. In horizontal comparison, the relationship between the absolute value of the digital economic coefficient is: Yangtze River Delta > Beijing Tianjin Hebei > Pearl River Delta, while the relationship between the average value of the digital economic level and the average value of regional GDP is Pearl River Delta > Beijing Tianjin Hebei > Yangtze River Delta, which is just the opposite, indicating that the digital economy in the internal cities with low levels of digital economic development and urban agglomeration with low levels of

economic development can better promote the regional integration development of urban agglomeration.

From the perspective of control variables, except that the population size of urban agglomeration has no significant impact, government intervention (gov), urban living environment (living), and the degree of opening to the outside world (ope) all have a significant impact on the development of regional integration. First of all, the coefficients of government intervention degree (gov) and urban living environment (living) in the Yangtze River Delta and Pearl River Delta are significantly negative at the 1% confidence level, indicating that government intervention degree and urban living environment have a significant negative impact on the coefficient of variation of regional GDP. Therefore, government intervention degree and urban living environment have a significant positive impact on the development of regional integration. The higher the degree of government intervention in urban agglomeration is, the better the urban living environment is, the smaller the economic growth rate gap between cities within the urban agglomeration is, and the higher the level of regional integration development is. It can be seen from this that in the Yangtze River Delta and the Pearl River Delta, we should continue to improve the degree of government intervention, expand financial expenditure, expand the green area of built-up areas, optimize the urban living environment, and then improve the level of regional integration development. The coefficient of government intervention degree (gov) and urban living environment (living) in the Beijing Tianjin Hebei region is significantly positive at the 1% confidence level, which is contrary to the Yangtze River Delta and the Pearl River Delta, indicating that there may be excessive government intervention and excessive green area in the Beijing Tianjin Hebei region. It is necessary to reduce financial expenditure, reduce government intervention, appropriately reduce green area in built-up areas, and increase the remaining land area, to promote the development of regional integration. Secondly, the coefficient of the degree of

**Table 2.** Regression Results of the Impact of Digital Economy on the Regional Integration Development of the Three Urban Agglomerations

	(1) Full sample	(2) Yangtze River Delta	(3) Beijing Tianjin Hebei	(4) Pearl River Delta
dig	-0.0206*** (0.00179)	-0.0413*** (0.00112)	-0.0336*** (0.00322)	-0.0255*** (0.00362)
gov	-0.0700*** (0.00791)	-0.0596*** (0.000702)	0.117*** (0.0131)	-0.117*** (0.00186)
living	-0.0437*** (0.00423)	-0.130*** (0.00540)	0.0128 (0.0439)	-0.0313*** (0.000975)
size	-0.0109 (0.00656)	-0.00103 (0.00795)	-0.0200 (0.0197)	-0.00752* (0.00332)
ope	-0.000938 (0.000479)	-0.0278*** (0.000960)	-0.00370*** (0.000992)	0.000656 (0.000874)
_cons	0.0522*** (0.00440)	0.0654*** (0.00401)	0.000391 (0.0201)	0.0576*** (0.00116)
Individual fixation	Yes	Yes	Yes	Yes
Time fixation	Yes	Yes	Yes	Yes
R2	0.2686	0.4190	0.2410	0.6032
N	567	369	117	81

Note: What is reported in brackets in the table is the robust standard error. \*\*\*, \*\* and \* respectively indicate that the

regression results pass the significance test at 1%, 5% and 10% confidence levels.

opening to the outside world (ope) of the Yangtze River Delta and Beijing Tianjin Hebei is significantly negative at the 1% confidence level, indicating that the degree of opening to the outside world has a significant negative impact on the coefficient of variation of regional GDP, so the degree of opening to the outside world has a significant positive impact on the development of regional integration. The higher the degree of opening to the outside world in the urban agglomeration is, the smaller the gap in the economic growth rate of cities within the urban agglomeration, and the higher the level of regional integration development. From this, we can see that in the Yangtze River Delta and Beijing Tianjin Hebei, we should continue to improve the degree of opening up, attract foreign investment, and develop in coordination with the digital economy, thus improving the level of regional integration. The coefficient of the degree of opening to the outside world (ope) of the Pearl River Delta region is positive and not significant, which means that the Pearl River Delta region can properly develop local enterprises, reduce dependence on foreign investment, and promote regional integration.

## 5. Conclusions and Suggestions

Based on the panel data of 63 cities in the Yangtze River Delta, Beijing Tianjin Hebei, and Pearl River Delta urban agglomeration regions from 2011 to 2019, this paper measures the regional integration level and digital economy development level of each city based on certain theoretical and practical basis and conducts empirical tests. According to the above theoretical and empirical analysis, the following conclusions are drawn: (1) Economic development level, digital economy development level It is obviously different from the level of regional integration. (2) The development level of digital economy has a significant positive impact on the development level of regional integration of urban agglomeration, that is, to increase the development of digital economy of urban agglomeration to form economic scale effect, optimize resource allocation, and enhance regional competitiveness, which is conducive to the integrated development of urban agglomeration. (3) The impact of the development level of digital economy of the three urban agglomerations on the development level of regional integration of urban agglomerations is significantly different, showing the phenomenon of Yangtze River Delta > Beijing Tianjin Hebei > Pearl River Delta, which indicates that the development status of urban agglomerations should be considered when using digital economy to promote the development level of regional integration. The level of digital economy is low Urban agglomerations with relatively backward economy and insufficient regional integration development should make greater use of digital economic development to promote regional integration development. (4) The degree of government intervention and urban living environment in the Yangtze River Delta and the Pearl River Delta have a significant positive impact on the development of regional integration. The higher the degree of government intervention and the better the urban living environment in the urban agglomeration, the smaller the gap between the economic growth rates of cities within the urban agglomeration, and the higher the level of regional integration development. However, Beijing Tianjin Hebei region may have excessive government intervention and too large green area. We should reduce financial expenditure, reduce government intervention, and appropriately reduce green area

in built-up areas to promote regional integration. (5) The degree of opening up of the Yangtze River Delta and Beijing Tianjin Hebei has a significant positive impact on the development of regional integration. However, the degree of opening up in the Pearl River Delta has no significant positive impact on regional integration. It is said that the Pearl River Delta can properly develop local enterprises and reduce dependence on foreign investment to promote regional integration.

Based on the above research conclusions, the following suggestions are put forward: First, urban agglomeration needs to further accelerate the development of digital economy, and let the digital economy development dividend of central cities and cities with better digital economy development radiate to the surrounding areas. Central cities and cities with better digital economy development have already had a good foundation in digital economy technology, facilities, talents and various resources. We should continue to seek breakthroughs in new generation information technology, big data, artificial intelligence and other emerging technologies, so that these cities have the ability to continuously radiate technology to marginal cities, and drive backward cities to develop digital economy. Second, urban agglomerations with relatively backward economic development and digital economy should seize the opportunity of digital economy development and use the development of digital economy to accelerate the development of backward cities in urban agglomerations, thus promoting regional integration. Digital economy can promote the high integration of traditional industries and digital technologies through industrial digitalization and digital industrialization, and realize the transformation and upgrading of traditional industries. Therefore, marginal backward cities should actively and actively embrace cutting-edge digital economic technologies, such as intelligence, platform, etc., to bring the development of traditional economy alive, promote the return of various production factors, and promote regional integration. Third, urban agglomerations should pay attention to the degree of government intervention, so that government intervention can be positive and effective. At the same time, attention should be paid to avoiding the adverse impact of excessive intervention on regional integration development. Fourth, reasonably plan the area of urban internal land, expand the green area of built-up areas, optimize the urban living environment, improve the overall quality of life and attractiveness of the urban agglomeration, and then promote regional integration development. Fifth, cities with well developed local enterprises should further increase the introduction of foreign investment and expand the degree of opening up to the outside world. At the same time, they should pay attention not to rely too much on foreign capital, so as to realize the reasonable introduction and effective utilization of foreign capital.

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