ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

Research on the Impact of Digital Economy on Economic Growth in Late-developing Regions

Xiaoxuan Yuan

Department of Economics and Management, Guangxi Normal of University, Guilin, China
misangxx@163.com

Abstract: *This paper measures the development level of digital economy in 18 provinces in the central and western China from 2011 to 2020, and describes the regional economic development level with the data of per capital GDP development level, and makes metrological analysis on this basis. The results show that the digital economy significantly promotes the economic growth of the central and western regions, and this conclusion is still true after replacing the robustness test of the explained variables and the heterogeneous test of the divided regions. Finally, this paper puts forward research and prospects for the implementation of digital economy development policies in the latecomer areas, which provides an empirical basis for local governments to improve relevant policies and measures.*

Keywords: *Digital economy, Economic growth in late-developing regions, High-quality development*

1. Introduction

In the face of the impact of the normalization of the global economic downturn on economic growth, thinking about new factors and ideas of economic growth is a necessary means to alleviate growth bottlenecks. Especially for the late-developing regions in the central and western regions that are less resilient than the eastern region, exploring new development ideas and innovative models is conducive to leading the economic growth of the late-developing regions, and using the advantages of latecomers to catch up and overtake to increase the economic growth rate and shorten the gap between the rich and the poor with the eastern region. The digital economy is becoming the main direction of national innovation-driven development and the key driving force of supply-side structural reform. The data, platform and networking derived from the digital economy will become a new road platform for economic development. The advent of the digital economy era provides new ideas for the economic growth of late-developing regions, and breaks through the bottleneck of economic growth in late-developing regions on the basis of giving full play to the advantages of digital economy resource integration and innovative development.

In the existing research, the economic growth promotion mode of late-developing areas is mainly based on absorbing the progress and upgrading of advanced technology elements, and dividing technological progress into two paths to promote economic growth, so as to realize the growth driven by the number of basic factors, transferred to technological imitation driven growth, and finally improved to innovation R&D driven growth.[1]The emergence of digital technology elements provides new ideas for late-developing areas to achieve economic and growth fatigue, and the sharing of information resources further facilitates information acquisition in late-developing regions and lays a realistic foundation for effective economic growth.[2]

At present, the research on the impact of digital economy on the economic growth and development path is mainly analyzed from the national and provincial levels, and the relationship between the digital economy and industrial development is further analyzed from the industrial level. At the national level, the digital economy mainly plays a role in promoting China's high-quality economic development,[3] especially emphasizing the key position of production factor quality in the digital economy, and exploring the role of digital economy in promoting high-quality development from the two dimensions of "external performance" and "endogenous power".[4]At the provincial level, the path mechanism of the digital economic development level of developed provinces affecting the economic growth of the province is concentrated, [5-6] and the development heterogeneity between different regions is further analyzed.[7] In addition, the impact of the digital economy on industrial structure upgrading and industrial structure transformation is also positively affected.[8]Therefore, the economic growth analysis of the impact of digital economy on the advantages of late-developing regions needs to be improved, and this paper

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

empirically analyzes the impact of digital economy on the economic growth of late-developing regions from the perspective of the development level of digital economy in 18 provinces in central and western China.

Specifically, this paper combines the development characteristics of data information in the digital economy, constructs an analysis framework from the perspective of the economic growth of the central and western regions as the late-developing region,[9] and measures the comprehensive development level of the digital economy in 18 provinces in the central and western regions from 2011 to 2020. The impact and role of digital economy on the economic growth of late-developing regions are empirically tested by using measurement methods.

2. Literature review

At present, there is still no unified standard for the definition of the concept of digital economy, but combined with the definition of digital economy by organizations and scholars, it can be basically determined that data and digital technology are the foundation and key elements of the digital economy, and will become effective influencing factors for the development of the future digital economy era. [10] As a kind of integrated innovation economy, the essence of industrial digitalization and digital industrialization is the combination of information technology and digital labor,[11] breaking through the established resource allocation decisions under the dual constraints of geography and information, and then promoting the interaction between traditional enterprises, technologies and organizations, thereby evolving into a new economic form. Therefore, this paper mainly studies the transformation and upgrading of manufacturing industry from the perspective of digital industrialization and industrial digitalization from the perspective of data and digital technology.

The research on the economic development mechanism of digital economy focuses on three aspects: market resource allocation, technological innovation and industrial structure transformation. First, the digital economy provides impetus for China's economic development in the post-epidemic era by playing a significant role in the growth of total factor productivity, and uses the advantages of the digital economy platform to achieve effective allocation of factor markets. Secondly, some scholars use the threshold effect to analyze the role of digital technology innovation in promoting high-quality economic development, and put forward ideas for technological collaborative innovation, propose to accelerate the breakthrough of blockchain core technology, improve the innovation mechanism of enterprise innovation subject, and effectively use innovation ability, external connection and digital interconnection technology to promote the development of digital innovation. [12] Finally, the digital economy will extend to industrial structure transformation on the basis of technological innovation, and the research field is mainly aimed at the transformation and upgrading of the manufacturing industry, indicating the development path by promoting the value-added upgrading of the global value chain of the knowledge-intensive manufacturing sector. There are still studies that show that when the economic efficiency is low and the economic structure is unreasonable, the digital economy has a more significant role in promoting high-quality economic development. [13, 14]

In summary, the role of digital economy in empowering economic growth has been widely verified,[15-17]but most of them focus on the overall economic development situation and the economic effects of developed regions, and there are few quantitative studies on the relationship between digital economy and economic development in provinces in post-developed regions. Based on this, based on the panel data of 18 provinces in the late-developing areas of the central and western regions from 2011 to 2020, this paper explores the mechanism of the impact of the digital economy on the economic development of the late-developing areas, and implements the digital economy development policy for local governments Provide empirical and theoretical basis.

3. Materials and methods

3.1. Constructing an evaluation index system

This paper constructs the digital economy comprehensive development index as a primary index, the Internet penetration, Internet related employees, Internet output, mobile Internet users, digital financial HP development as a secondary index to measure the development of digital economy, and on the basis of Internet users per hundred, computer services and software practitioners, teleservice per capital, per one hundred mobile phone users, China digital HP financial index as a tertiary index to measure, finally

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

draw lessons from Zhao tao [3], processing method to measure the comprehensive development level of digital economy. The construction of the index system is shown in Table 1. The full text of the article must be typeset in single column.

Table 1: Digital economy evaluation index system.

Level 1 Indicators	Secondary Indicators	Tertiary Indicators	Metric Properties
Digital Economy Comprehensive Development Index	Internet penetration	Number of Internet users per 100 people	Positive indicators
	Number of Internet-related employees	Proportion of computer services and software practitioners	Positive indicators
	Internet-related outputs	Total telecommunications services per capital	Positive indicators
	Number of mobile Internet users	Number of mobile phone subscribers per 100 people	Positive indicators
	Digital Finance HP Evolves	China Digital HP Financial Index	Positive indicators

3.2. Data sources

This study included 18 provinces in central and western China from 2011 to 2020 to ensure the completeness and availability of the data. The data comes from China City Statistical Yearbook, Peking University Digital Financial Inclusion Index, National Bureau of Statistics, etc. For missing data in some provinces, the mean method and exponential growth rate are used for filling.

3.2.1. The variable being explained.

This paper uses GDP per capital to express the level of economic growth, and takes logarithmic treatment, which is recorded as $\ln PGDP_{it}$, where the regional GDP data is from the China Statistical Yearbook.

3.2.2. Core explanatory variables.

The core explanatory variable in this paper is the development level of digital economy in the T period of region i, which is denoted as DIGITAL. Considering the scientificity, availability and completeness of data, this paper draws on the treatment methods of Shen yunhong, Huang jian [18] and Yang wenbo[19] , and selects relevant indicators such as the development level of Internet information and digital finance in the central and western regions as the main components to measure the development level of digital economy.

Table 2: Variable definitions and their measures

Type	Variable	Variable measures
The variable being explained	Level of economic growth (PGDP).	GDP level per capital
Explanatory variables	Level of development of the digital economy (DIGITAL).	The level of informatization of the digital economy
Control variables	Industrial Structure (STR).	The added value of the secondary industry accounts for the proportion of GDP
	Investment intensity (INV).	Number of local fixed asset investments
	Degree of government intervention (GI).	The level of local financial expenditure on science and technology

3.2.3. Control variables.

Specifically, it includes: industrial structure (STR), expressed as the proportion of added value of the secondary industry to GDP; Local asset base (INV), expressed as local fixed asset investment figures; The degree of government intervention (GI), expressed as the level of local fiscal expenditure on science and technology; The relevant data comes from the China Statistical Yearbook, the China Science and Technology Statistical Yearbook and the relevant statistical yearbooks of local governments. Table 2

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

shows the definitions of each variable and their measurements.

3.3. Data processing

3.3.1. Missing data completion

The Hermite interpolation method constructs an interpolation polynomial through the function value and derivative value on the unknown function f(x) node, which can bring the interpolating function and interpolated function closer together. However, the direct use of the Hermite interpolation method may cause a ‘‘Runge phenomenon’’ [20]. To improve the accuracy of interpolation, this study uses the piecewise cubic Hermite interpolation method to complete missing data.

3.3.2. Calculate the index score

Considering the different dimensions of the original indexes, this study performs a dimensionless processing of the indexes in the data element and digital economy systems using the extreme difference standardization method:

Step 1.Index standardization: $X_{ij}=X_{ij}$ - min{X_j}/{max{X_j}- min{X_j}}

Step 2.Calculate the index information entropy: $e_j= -k\sum_{i=1}^{m}[y_{ij}\ lny_{ij}]$

Step 3.Calculate fixed weights：where K=1/lnm, $y_{ij}=x'ij/\sum_{i=1}^{m}[x'_{ij}]$

Step 4.Calculate the index weight：The jth metric is weighted $j\omega=1- e_j / \sum_j [1-e_j]$

After obtaining the weight of each indicator at the level of the index, the score of a single institutional indicator in year i can be obtained by multiplying its weight j with the regularization value ωof indicator j, and the score of the j indicator in year i can be calculated as $S_{ij}=\omega_j x_{ij}$.This paper uses the score as an indicator to measure the development level of digital economy in central and western China. In this paper, the proportional data values are kept unchanged in the process of quantitative regression, and the other variable data is logized.

3.4. Research model

In order to study the impact of digital economy on the economic growth of late-developing regions and whether there are differences in the impact of digital economy on different industries, this paper uses panel data models for empirical research. Among them, the panel data model is set as follows:

$$PGDP_{it} = \beta_0 + \beta_1 DIGITAL_{it} + \theta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Among them, $PGDP_{it}$ represents the per capital GDP of the region in the i period; $DIGITAL_{it}$ represents the comprehensive level of development of the digital economy in the period of Region i. X_{it} is other control variable, indicating other factors affecting regional economic growth, including industrial structure, local asset base, degree of government intervention, etc.; μ_i is the individual fixed effect, λ_t is the time fixed effect, and ε_{it} is the residual term.

4. Results and analysis

4.1. Descriptive Statistics

As shown in Table 3, the panel composed of 18 provinces in the central and western regions, during the period 2011-2020, has a total of 180 samples. The mean value of the core explanatory variable (DIGITAL) is 0.528, indicating that the current level of digital economy development in the central and western regions is relatively medium. On the one hand, the threshold of digital economy and technology is high, and regions that can make full use of technology need to have certain capital, technology and talent capabilities. On the other hand, whether the new opportunities of the digital economy can provide latecomer advantages to latecomer regions such as the central and western regions remains to be examined, and this article will attempt to provide empirical support for this. The indicators related to the level of economic development fluctuated to different degrees, among which the local fixed asset base and the degree of government intervention fluctuated greatly, with the difference reaching about 4.7, but on the whole, the standard deviation of the two converged with the change of core explanatory variables.

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

Table 3: Descriptive statistics of variables

Variable	Sample Size	Average Value	Standard Deviation	Minimum	Maximum
lnPGDP	180	10.60	0.314	9.706	11.27
DIGITAL	180	0.528	0.936	-1.027	2.785
STR	180	0.466	0.131	0.267	0.922
lnGI	180	3.822	0.979	1.218	5.935
lnINV	180	13.95	0.933	10.85	15.51

4.2. Benchmark regression analysis

In this paper, the ordinary least squares method (OLS) benchmark model is first used to perform regression to test the impact of digital economy on economic growth, and the regression results are shown in Table 4.

Table 4: Benchmark return of digital economy to economic growth in late-developing regions

	Model 1	Model 2	Model 3	Model 4
VARIABLES	lnPGDP	lnPGDP	lnPGDP	lnPGDP
DIGITAL	0.240***	0.136**	0.134***	0.129***
	(0.0122)	(2.33)	(0.0178)	(4.89)
lnINV			0.238***	0.155***
			(0.0712)	(3.97)
lnGI			0.0968**	0.072**
			(0.0452)	(2.51)
STR			-0.121	-0.590***
			(0.153)	(-4.00)
Constant	10.47***	10.481***	6.904***	8.415***
	(0.00645)	(420.95)	(0.880)	(16.67)
PROVINCE FE	NO	YES	NO	YES
YEAR FE	NO	YES	NO	YES
R-squared	0.831	0.835	0.934	0.927

Note: ****, **, * represent 1%, 5%, 1, respectively 0% significant level; T values in parentheses.

In Table 4, Model 1, Model 2 and Model 3 represent that the wind does not contain the control variable and the time individual solid effect, does not contain the control variable, contains the control variable does not contain the time individual fixed effect, and the Model 4 is the formula (1) estimates, i.e. including control variables and individual, temporal fixed effects. Comparing Model 2 with Model 4, the variable digital was significantly positive at the statistical level of 1%, with or without control variables. It shows that the development of digital economy has a strong positive effect on the economic growth of the central and western regions, and promotes the economic growth of the late-developing areas in the central and western regions, so that local economic growth benefits from the positive effect brought by digital development.

Compared with Model 3 and Model 4, the regression coefficients of the digital economy impact level of the two are 0.134 and 0.129, respectively, and the hypothesis that the digital economy promotes economic growth in the late-developing regions in the central and western regions is still stable under the condition of introducing the fixed effect of time. The model difference is only reflected in the significant level of influence on the control variables, and the digital economy also has a positive impact on the overall regional economic development, and it is still stable on the basis of controlling basic assets, technology investment, and industrial level.

4.3. Endogenous analysis and robustness test

4.3.1. Endogenous analysis.

It is known from benchmark regression that the digital economy significantly promotes the economic growth of the late-developing regions in the central and western regions, but OLS regression tends to ignore the endogenous problems that may exist in the model, resulting in biased results. Based on this, the endogenous problem in this paper may be caused by the endogenous bias caused by missing variables, based on this paper, the first and second periods of the lag of the digital economy development level are

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

used as instrumental variables, and the results are re-performed in Table 5, the first 4 column, showing that after replacing the tool variable, the impact of the digital economy on economic growth in the central and western regions is still significantly positive, indicating that the results obtained above are reliable.

Table 5: Endogenous analysis and robustness test

	(1)2SLS	(2)2SLS	(3)2SLS	(4)2SLS	(5)	(6)
VARIABLES	first	two	first	two	PGDPyuan	PGDPyuan
L.DIGITAL	0.150***	0.291***				
	(16.01)	(16.80)				
L2.DIGITAL			0.190***	0.341***		
			(15.40)	(17.27)		
DIGITAL					11,330***	9,362***
					(1,186)	(2,067)
lnINV	0.175***	0.130***	0.129***	0.144***		8,418**
	(7.36)	(4.54)	(4.91)	(4.94)		(3,140)
lnGI	0.102***	-0.024	0.108***	-0.042*		1,936
	(4.64)	(-1.05)	(4.54)	(-1.81)		(4,222)
STR	-0.407***	-0.087	-0.573***	-0.185*	44,823***	-20,008
	(-5.13)	(-0.83)	(-6.28)	(-1.76)	(1,096)	(13,108)
Constant	8.072***	8.954***	8.809***	8.936***		-69,104*
	(26.69)	(25.31)	(25.69)	(24.84)		(40,313)
R-squared		0.637		0.657	0.690	0.746

Note: ****, **, * represent 1%, 5%, 1, respectively 0% significant level; T values in parentheses.

4.3.2. Robustness test.

In order to ensure the reliability of the model results, this paper uses the method of replacing the explanatory variables and adding the control variables sequentially to test the robustness of the influence effect of digital economy on economic growth in central and western China. The robustness test was performed using the per capital GDP of each province as a proxy variable to measure economic growth, and the regression results are shown in column (5)(6) of Table 5, core explanatory variable DIGITAL passed the 1% significance level test, and the other control variables remained significant, so the results remained stable. The results show that under the model of substituting the explanatory variables, the impact of digital economy on economic growth in late-developing regions still has a significant positive effect.

4.4. Heterogeneity testing

Table 6: Heterogeneity Testing

	(1)	(2)	(3)	(4)
VARIABLES	westward	westward	Central	Central
DIGITAL	0.254*	0.104*	0.162***	0.162***
	(1.92)	(1.92)	(5.75)	(5.75)
lnINV		0.227**		0.138***
		(3.01)		(6.84)
lnGI		0.083		0.115*
		(1.61)		(2.48)
STR		-0.156		-0.118
		(-1.04)		(-0.51)
Constant	10.308***	7.108***	8.738***	8.738***
	(144.82)	(7.36)	(6.57)	(6.57)
Observations	120	120	60	60
R-squared	0.904	0.947	0.954	0.954
Number of PROVINCE	12	12	6	6
PROVINCE FE	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES

Note: ****, **, * represent 1%, 5%, 1, respectively 0% significant level; T values in parentheses.

In this paper, the latter region is further divided into two parts, the central region and the western region, and heterogeneity is tested. As shown in Table 6, the regression results show that the digital

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

economy in the central and western regions promotes economic growth by 1% and 10%, respectively, and the results in the central region are relatively stable, regardless of whether control variables are added, the development level of digital economy tends to be stable. Compared with the western region, the role of control variables has a certain impact on the model regression coefficient, indicating that the western region needs to pay attention to the influence of relevant control variables in the process of developing the digital economy, give full play to the role of the government in the development of the digital economy, expand the foundation of the development of the digital economy, strengthen the government's investment in science and technology in the digital economy, and explore the road of industrial structure optimization and upgrading, so as to realize the development of the digital economy in the western region and narrow the digital economy gap with the central region.

5. Conclusion and policy recommendations

5.1. Key findings

Based on the fact that the digital economy has brought new opportunities for China's economic development, this paper uses the panel fixed effect model based on the provincial-level data of 1 8 cities in the late-developing areas of central and western China from 2011 to 2020 2SLS model, etc., empirically test and analyze the influence effect of digital economy on the economic growth level of late-developing regions. The main conclusions are as follows: (1) the digital economy obviously promotes the economic growth level of late-developing regions and becomes a new driving force for late-developing regions to promote economic development in the new era. In terms of the heterogeneity between the central and western regions, the central region has become the main region driving the development of the digital economy in the overall late-developing region, and the western region still needs to strengthen investment in the development of the digital economy. (2) the platform-based development of the digital economy is conducive to strengthening the economic growth advantages of the late-developing regions in the central and western regions, making up for spatial information differences by using the advantages of data, and reducing trade costs caused by information deviations.

5.2. Policy recommendations

This paper provides empirical evidence for analyzing the impact of the digital economy on economic growth in late-developing regions, and the conclusion of the text also has the following policy implications: (1) under the premise that the digital economy can be used as a new driving force to effectively promote the economic growth of late-developing regions, the central and western regions should increase investment in the Internet, promote the construction of digital and intelligent system infrastructure, and realize the construction of digital China. (2) the development foundation of digitalization in the western region is relatively weak, and we should maintain a positive attitude towards investment in the development of the digital economy and have the courage to break through the bottleneck of technological innovation.

References

[1] Sun Wei, Xu Shaojun (2021). Transformation of technological progress, heterogeneous labor mobility and the evolution of regional economic gaps. Economic Review, (05), 21.
[2] Li Zhen (2022). New development pattern empowered by digital economy: theoretical foundation, challenges and responses. Social Sciences, (03), 11.
[3] Zhao Tao, Zhang Zhi, Liang Shangkun(2020). Digital economy, entrepreneurial activity and high-quality development: Empirical evidence from Chinese cities. Management World, (36), 12.
[4] Song Yang(2019). Digital economy and high-quality development from the perspective of economic development quality theory. Guizhou Social Sciences, (11), 7.
[5] Liu Yue, Peng Yan, Zhou Liang(2014). Research on the relationship between the development of regional information industry and the quality of economic growth in Chin. Sankei Review, (5), 10.
[6] Jiang Song, Sun Yuxin (2020). An empirical study on the impact of digital economy on the real economy. Research Management, (41), 8.
[7] Chao Xiaojing, Ren Baoping(2011). Temporal changes and regional differences in China's economic growth quality. Economic Research Journal, (46), 15.
[8] Li Yingjie, Han Ping(2021). The impact of digital economy development on the optimization and upgrading of china's industrial structure: An empirical analysis based on provincial panel data.

ISSN 2616-5902 Vol. 5, Issue 6: 114-121, DOI: 10.25236/AJBM.2023.050617

Journal of Business Economics, (06), 6.
[9] Jing Wenjun, Sun Baowen (2019). Digital economy promotes high-quality economic development: A theoretical analysis framework. The Economist, (02), 8.
[10] Yi Xianrong, Chen Yingying, Yi Yushuang (2019). Research on several major theoretical issues in digital economy—based on general analysis of modern economics. The Economist, (07), 9.
[11] Han Haiting(2020). How data empowers the growth of the digital economy. New Finance, (08), 3.
[12] Wang Dehui, Wu Zang(2020). Research on the mechanism and countermeasures of digital economy to promote the transformation and upgrading of China's manufacturing industry. Changbai Journal, (06), 92-99.
[13] Han jing, Sun Yawen, Chen Xi(2020). Path analysis of China's digital economy development in the post-epidemic era. Comparison of Economic and Social Systems, (05), 9.
[14] Wang Juan(2019). Digital economy drives high-quality economic development: factor allocation and strategic choice. Ningxia Social Sciences, (05), 7.
[15] Jia Hui, Guo Yanan, Chu Hao(2020). An empirical analysis of digital economy driving economic development in the post-epidemic era. Industrial Technological Economics, (39), 7.
[16] Chen Xiaohong, Li Yangyang, Song Lijie(2022). Theoretical system and research prospect of digital economy. Management World, (38), 21.
[17] Liu Jun, Yang Yuanjiang, Zhang Sanfeng(2020). Research on the measurement and driving factors of china's digital economy. Shanghai Economic Research Journal, (06), 16.
[18] Shen Yunhong, Huang Jian(2020). Research on the impact of digital economy level on the optimization and upgrading of manufacturing industrial structure——based on panel data from zhejiang province from 2008 to 2017. Science and Technology Management Research, (40), 8.
[19] Yang Wenbo(2021). Digital economy and regional economic growth: Latecomer advantage or latecomer disadvantage? Journal of Shanghai University of Finance and Economics, (23), 14.
[20] Elhorst J.P.(2014). Matlab software for spatial panels, International Regional Science Review, (68), 401-420.