

The Impact of the Digital Economy on Regional Economic Development

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Abstract

The rapid development of the digital economy has reshaped the way economic activities are organized and has increasingly influenced regional development patterns. In the process of China's transition toward high-quality development, differences in regional development capacity remain a practical concern. This study constructs an indicator system to measure digital economy development and regional economic development, and examines their relationship using panel data from selected Chinese provinces and cities during 2016–2022. Fixed effects models, robustness tests, and heterogeneity analysis are applied to explore whether and how digital economy development affects regional economic performance. The empirical results show that digital economy development does have a positive and significant relationship with regional economic development. That said, the effects are not the same across all regions. The eastern region sees the strongest impact, the western region comes next, and the central region shows a relatively weaker effect. These differences, as it turns out, may have a lot to do with variations in economic foundations, digital infrastructure conditions, and regional digitalization capabilities. What the findings really suggest is this: if we want to achieve more coordinated regional development, it would be important to improve digital infrastructure, strengthen regional digital integration, and also take local development conditions into proper account.

Keywords

Digital Economy; Regional Economic Development; Panel Data; Heterogeneity Analysis; Regional Disparities.

1. Introduction

Research Background and Contributions of This Study

Over the past several decades, China's economic development has undergone profound changes driven by institutional reform, globalization, manufacturing expansion, and market-oriented transformation. All these changes have, over the years, supported sustained economic growth and, in doing so, have enabled China to become a more deeply integrated participant in global production networks. At the same time, though, the benefits brought by economic transformation have not been spread evenly across different regions, and the gaps in development capacity between the eastern, central, and western areas have remained a persistent issue.

The eastern region, for a long time now, has enjoyed the advantages of relatively stronger infrastructure, more favorable geographic conditions, better-developed transportation networks, and a higher degree of market integration. In contrast, many of the central and western regions are still up against various limitations when it comes to infrastructure quality, factor endowments, and their overall economic foundations. On top of that, regional protectionism and market segmentation tend to get in the way of factor mobility, which only

makes it harder to close the development gaps between regions and achieve the kind of coordinated growth that we are aiming for^[1].

It is against this very backdrop that promoting more balanced regional development has come to be seen as an important part of China's broader push toward high-quality development. In the meantime, the rapid expansion of the digital economy has, to a certain extent, opened up new possibilities for reshaping the way regional development patterns unfold. Through better and faster information transmission, a noticeable reduction in the constraints imposed by geography, and changes in how economic agents interact with one another, digitalization stands to influence both the allocation of resources and the ways in which different regions take part in economic activities. Having said that, there are still two questions that need to be examined more carefully: one is whether digital economy development can really make a meaningful contribution to regional economic development, and the other is whether its effects, if any, would vary from one region to another.

This study is an attempt to address these very questions, and it does so from a number of angles. The first is that it builds a framework that connects digital economy development with regional economic development, with the aim of taking a closer look at the economic implications of digitalization. The second is that it puts together an indicator system for measuring how the digital economy is doing, and then uses that system to analyze its relationship with regional development, while at the same time bringing in human capital, foreign direct investment, and financial development as control variables. And the third is that it compares how these effects play out across the eastern, central, and western regions, which, in turn, provides some useful evidence for understanding why regional differences exist in the digital economy space and for coming up with more targeted development strategies going forward.

2. Conceptual Definitions and Literature Review

2.1. Conceptual Definitions

2.1.1. The Concept of the Digital Economy

The meaning of the digital economy has changed with the development of technology and the transformation of economic activities. In the early stage, discussions of the digital economy were mainly related to the application of information and communication technologies (ICT) and their role in improving information processing and supporting economic exchanges. As technologies such as big data, cloud computing, artificial intelligence, and digital platforms have continued to develop, the digital economy has gradually extended beyond the traditional ICT sector.

At present, the digital economy is commonly regarded as an economic form in which data functions as an important production factor and digital technologies support value creation, resource allocation, and productivity improvement. If we are to compare digitalization with traditional economic activities, one thing becomes quite clear: it has changed, in a number of ways, how information gets generated, transmitted, and put to use, and on top of that, it has also left its mark on production processes, business models, and the way organizations are structured. Because of all this, the integration of digital technologies with traditional industries has, quite naturally, become an important feature of contemporary economic development.

In China's case, the expansion of the digital economy has, in recent years, been closely tied to technological progress, the country's own innovation capacity, and the particular characteristics of its large-scale domestic market. When these factors are combined together, they have not only accelerated the adoption of digital technologies across various sectors of the economy, but have also created a practical setting in which one can observe and study the development process of digitalization and the economic effects that come along with it.

The G20 Digital Economy Development and Cooperation Initiative, which was released at the Hangzhou Summit back in 2016, offers a definition of the digital economy. According to this document, it refers to a series of economic activities that use digital knowledge and information as key factors of production, rely on modern information networks as important carriers, and apply information and communication technologies in order to improve efficiency and optimize economic structures^[2]. Interestingly enough, this definition brings out three important elements of the digital economy: one is that digital information serves as a production factor, another is that digital infrastructure acts as a supporting foundation, and the third is that ICT applications function as a means of enhancing economic efficiency.

2.1.2. The Concept of Regional Economic Development

Regional economic development has, for quite some time now, been a topic of considerable importance in both regional economics and development economics. Different studies may, of course, choose to emphasize different aspects of it, but when you look across the literature, the concept tends to be discussed around two central issues: one is what development is actually supposed to achieve, and the other is how we should go about understanding coordination between regions.

When it comes to development objectives, regional economic development is certainly not just about increasing economic output. It also involves narrowing the gaps that exist between regions, making public services more accessible, and creating opportunities that are more equal for different areas. For those regions that have relatively weaker foundations to begin with, enhancing their endogenous development capacity becomes especially important, and that, in turn, calls for improvements in infrastructure, productivity, and income levels. At the same time, the whole idea of coordinated development is really about achieving a more efficient allocation of public resources, and about encouraging regions to make full use of their comparative advantages through industrial specialization and interregional cooperation.

The scope of regional economic development can also be understood at a couple of different levels. In a narrower sense, it is mainly about reducing economic disparities between regions and promoting relatively balanced growth through better resource allocation and regional cooperation. A broader understanding, on the other hand, would go well beyond economic indicators to include things like social welfare, environmental sustainability, resource efficiency, technological innovation, and the integration of urban and rural areas.

If we look at it from this perspective, regional economic development should really be viewed as a process of improving regional development capacity, rather than simply trying to get all areas to achieve similar levels of economic output. It involves the continuous adjustment of resource allocation, economic structures, and development conditions, and the whole point of it is to support growth that is more sustainable and more inclusive. This way of understanding things also provides us with a useful basis for examining how digital economy development might, one way or another, influence regional economic outcomes.

2.2. Literature Review

2.2.1. Literature Review on the Digital Economy

Research on the digital economy has, over time, developed right alongside advances in information technologies and the ongoing changes in how economic activities are organized. Since the 1990s, scholars have gradually moved away from a purely technology-oriented understanding of digital activities and have, instead, begun to pay more attention to the broader economic changes that information, data, and digital technologies have brought with them.

Early discussions, for the most part, were concerned with how Internet technologies ended up influencing economic transformation. Tapscott (1996), for instance, introduced the concept of the "digital economy" and made the argument that Internet-based economic activities could, in

various ways, affect business operations, industrial transformation, and the overall patterns of economic growth. Around that same period, Turban and Volonino (1996) described the digital economy as a form of economic activity that is supported by technology and associated with globalization and Internet platforms, and they placed particular emphasis on the importance of information flows and technological integration.

If we trace the theoretical origins of the digital economy a bit further back, they can actually be linked to earlier studies of knowledge-based and information-based economic activities. Machlup (1962) was the one who proposed the concept of the "knowledge industry," and then Porat (1977), a bit later, examined the role of information activities in economic development through the idea of the "information economy." Subsequent research went on to explore, in greater depth, the influence of information and communication technologies on production, distribution, exchange, and consumption. The OECD (2012), for its part, also highlighted the role that digital technologies and data resources play in supporting online transactions and the various economic activities that go along with them.

Now, the digital economy does share certain connections with the information economy, the network economy, and the knowledge economy, but it is probably more accurate to say that it represents a further development of these concepts rather than a simple replacement of any of them^[3]. To be more specific, the information economy tends to emphasize the value of information resources, the network economy focuses more on connectivity and interaction, and the knowledge economy highlights knowledge creation and accumulation. What the digital economy does, in effect, is to combine these various elements through digital technologies, data applications, and network infrastructures, and in doing so, it reflects the changing characteristics of contemporary economic transformation.

2.2.2. Literature Review on Regional Economic Development

Regional economic development has, over the years, been widely discussed in regional economics and development studies, and much of the attention has gone to two questions in particular: one is why development differences tend to emerge between regions, and the other is how coordinated growth might actually be achieved. If we look at the context of China, the issue of regional disparity became especially visible after the reform and opening-up period got underway. Coastal areas, particularly the southeastern region, managed to achieve relatively rapid economic growth, whereas many of the central and western regions developed at a considerably slower pace. As a consequence of that, differences in economic levels, urban-rural development, and income distribution have persisted right up to the present day.

When it comes to studies on the causes of regional disparities, they have tended to highlight the influence of various internal conditions, including resource endowments, capital accumulation, human capital, and technological capabilities. Zhang (2004), for example, pointed out that differences in resource conditions and in the capacity to enhance productivity are, in fact, important reasons behind regional economic divergence. On the basis of this understanding, quite a few scholars have emphasized that regional development strategies really ought to take local conditions into account and make good use of comparative advantages, rather than simply adopting identical development paths across the board.

As for approaches to coordinated development, Chen and Chen (2007) put forward the argument that promoting specialized industries according to regional characteristics, and at the same time improving infrastructure conditions, can go a long way toward strengthening economic connections between regions. In addition to these internal factors, external factors have also become increasingly relevant when it comes to explaining regional development differences. Wang (2004) found that eastern coastal regions attracted more foreign direct investment (FDI) largely because of their geographic advantages and stronger economic

foundations, and this, in turn, further reinforced their development advantages relative to the central and western regions.

Taken together, what the existing literature shows is that regional economic development is not determined by any single factor, but rather results from the combined influence of internal foundations and external conditions. Differences in resources, infrastructure, technology, and capital accumulation all help to explain why regional disparities exist, while improving regional cooperation and strengthening development capacity remain important directions to pursue if we are to achieve more coordinated regional development.

2.2.3. Literature Review on the Relationship between the Digital Economy and Regional Economic Development

The interaction between digital economy development and regional economic development has, in recent years, received increasing attention from researchers. Existing studies have explored this relationship from a number of different analytical levels, looking into how digital technologies might influence individual economic activities, industrial transformation, and the broader processes of regional development.

At the micro level, scholars have, for the most part, focused on the effects of digital technologies on information exchange and market activities. Digital applications, as it turns out, can reduce information asymmetry, bring transaction costs down, and improve the efficiency with which market participants are matched to one another. These changes, in turn, may create new opportunities for employment and entrepreneurship by lowering the barriers to economic participation. Acemoglu (1998) analyzed the impact of technological change on economic activities, and his work has, since then, provided some useful theoretical support for understanding the connection between technological progress and economic performance.

When we move up to the meso level, research has paid more attention to the relationship between digitalization and industrial transformation. The application of digital technologies in traditional industries can, in a number of ways, improve production efficiency, promote changes in industrial structures, and support the development of emerging economic activities. Jing and Sun (2019), for instance, emphasized the role that digital technologies play in promoting industrial upgrading and structural adjustment.

At a broader regional level, studies have examined how digital economy development affects economic connections and resource allocation among regions. Digital technologies may, to some extent, weaken geographical constraints by making information more accessible, facilitating communication, and supporting the movement of production factors across regional boundaries. Si (2023) discussed the wider economic implications of digital development and its potential role in promoting regional economic coordination.

If we put all of this together, what emerges is that existing research generally recognizes the positive economic effects associated with digital economy development. Having said that, though, the actual outcomes of digital transformation are likely to vary, depending on differences in regional foundations, infrastructure conditions, and digitalization capabilities. This, in itself, suggests that the relationship between digital economy development and regional economic development still calls for further examination, and particularly so from the perspective of regional heterogeneity.

3. Theoretical Foundations and Impact Mechanisms

3.1. Theoretical Foundations

3.1.1. Digital Economy Theory

The theoretical understanding of the digital economy has, in large part, been developed out of earlier discussions on the information economy, the network economy, and the knowledge

economy. All of these perspectives, one way or another, emphasize the growing role that information, knowledge, and technological innovation have come to play in economic activities. With digital technologies becoming ever more deeply integrated into economic processes, the digital economy extends these earlier ideas by bringing data resources, digital technologies, and information networks directly into production and resource allocation activities, and in doing so, it reflects some fairly fundamental changes in how economic organization works in the digital era[4].

If we were to compare it with traditional economic models, which tend to rely more heavily on physical capital and tangible resources, the digital economy places a much greater emphasis on the role of data as a production factor and on digital technologies as tools for driving efficiency gains. The widespread application of digital technologies has, in fact, already changed quite a bit about how information gets generated, transmitted, and put to use, and on top of that, it has also left its mark on production organization, business models, and the overall patterns of economic interaction[5].

What the development of digital economy theory seems to suggest, then, is that digital technologies may very well create new channels for productivity improvement, innovation activities, and resource optimization. By reducing information constraints and weakening the influence of geographical distance, digital development has the potential to reshape economic connections among different participants in the economy. And it is precisely this that provides us with a theoretical perspective for examining how digital economy development might, in one way or another, affect regional economic outcomes[6].

3.1.2. Regional Economic Development Theory

Regional economic development theory, at its core, is mainly concerned with two things: one is why development levels tend to differ so much from one region to another, and the other is what factors actually influence regional growth and the degree of coordination that can be achieved. Traditional perspectives on this have tended to emphasize that regional development outcomes are, in large measure, shaped by differences in resource endowments, capital accumulation, technological capabilities, and institutional environments. All of these factors, in one way or another, affect the ability of regions to attract resources, improve productivity, and maintain the kind of long-term development momentum that really matters.

The concept of regional coordination, as it turns out, extends well beyond the simple expansion of economic output within individual areas. It also involves improving the efficiency of resource allocation, strengthening the connections that exist between regions, and creating the kinds of conditions that would allow for more balanced development to take place. In this particular process, infrastructure improvement, regional cooperation, and the movement of production factors across areas are all regarded as important foundations for enhancing regional development capacity.

As economic structures and technological conditions have continued to change over time, regional development theory has, quite gradually, incorporated new factors into its framework—things like innovation capacity, information flows, and various emerging production elements. The competitiveness of a region, these days, is no longer determined solely by its existing economic foundation; its ability to absorb new technologies and to make better use of available resources has also become increasingly relevant to the whole picture.

This theoretical perspective, if we think about it, can help to explain why emerging factors—including digital technologies and data resources—may, in fact, end up influencing regional development patterns in meaningful ways. At the same time, it also provides us with a basis for understanding why digital economy development might produce different effects across regions that have, after all, quite different economic foundations, infrastructure conditions, and development capabilities.

3.2. Impact Mechanisms

The digital economy, as it turns out, may very well affect regional economic development through a number of different channels. If we take into consideration both the characteristics of digital technologies and the general process of regional economic development, this study chooses to focus on three possible mechanisms in particular.

One such channel has to do with information efficiency. One important way in which digital technologies end up influencing economic activities is by improving the efficiency with which information is generated, transmitted, and put to use. Traditional economic interactions, more often than not, are affected by geographical distance and by the problem of incomplete information, and these two things together can limit the effective matching that needs to happen between different actors in the economy. The application of digital platforms and information networks works to reduce these constraints, mainly by enabling faster communication and by improving the connection between supply and demand. As information circulation becomes more efficient, resources stand a good chance of being allocated more effectively across regions, and that, in turn, creates more favorable conditions for regional economic development to take place.

Another way digitalization can make a difference is through transaction cost reduction. Digital technologies can also, in their own way, influence regional development by bringing transaction costs down. Through digital platforms and online information systems, economic participants are able to reduce the costs that are normally associated with information searching, negotiation, and coordination. When transaction processes get simplified in this manner, it tends to improve the efficiency of economic exchanges and, at the same time, makes it easier for production factors to move across regional boundaries. In this particular way, digitalization can strengthen the economic connections that exist between regions and contribute to a more efficient use of available resources.

A third channel worth considering is market expansion. The development of digital technologies has, quite clearly, changed the traditional patterns of consumption and the way businesses go about their operations. By improving firms' access to market information and by enhancing their ability to respond to consumer demand, digitalization may, in various ways, support product innovation and service improvement. At the same time, digital platforms provide broader channels for market participation and economic interaction, and this, in turn, opens up new possibilities for regional economic activities. Existing studies, for that matter, have suggested that digital development can promote market integration and expand the overall scope of economic exchanges by reducing the constraints imposed by geography [7].

Taken together, digital economy development may influence regional economic development through improvements in information efficiency, reductions in transaction costs, and the expansion of market opportunities. These mechanisms, taken as a whole, offer a useful theoretical explanation for examining the relationship between digital economy development and regional economic performance.

4. Construction of Indicators for Regional Economic Development and the Digital Economy

4.1. Construction of the Regional Economic Development Indicator System

To measure regional economic development, this study constructs an indicator system based on three dimensions: economic development, industrial structure, and economic vitality. The system includes 10 tertiary-level indicators, with the specific indicators and measurement framework presented in Table 1.

Table 1. Evaluation index system of regional coordinated development level

Primary Indicator	Secondary Indicator	Tertiary Indicator	Unit
Regional Economic Development Level	Economic Development	GDP per capita	RMB/person
		Retail sales of consumer goods per capita	RMB/person
		Per capita disposable income	RMB/person
	Industrial Structure	Share of primary industry in GDP	%
		Share of secondary industry in GDP	%
		Share of tertiary industry in GDP	%
	Economic Vitality	Local fiscal revenue	10,000 RMB
		Fixed asset investment	10,000 RMB
		Total retail sales of consumer goods	10,000 RMB
		Total import and export trade volume	10,000 USD

4.2. Construction of the Digital Economy Development Indicator System

Following the framework proposed by Cheng et al., this study constructs an indicator system to measure digital economy development. The evaluation system consists of three dimensions: digital infrastructure, information technology application, and digitalization development. It includes 12 tertiary-level indicators, with the specific indicators and measurement framework presented in Table 2.

Table 2. Evaluation index system of the comprehensive development level of the digital economy

Primary Indicator	Secondary Indicator	Tertiary Indicator	Unit
Digital Economy Development Level	Digital Infrastructure Development	Long-distance optical cable lines	KM
		Broadband access ports	Number
		Number of Internet websites	Number
		Number of domain names	Number
	Information Technology Application	Mobile communication penetration rate	%
		Internet penetration rate	%
		Number of Internet users	Person
		Number of broadband subscribers	Person
	Digitalization Development Level	Number of e-commerce enterprises	Number
		Digital Inclusive Finance Index	
		E-commerce procurement volume	10,000 RMB
		E-commerce sales volume	10,000 RMB

5. Empirical Analysis of the Impact of Digital Economy on Regional Economic Development

5.1. Variable Description and Model Specification

5.1.1. Variable Description

The empirical analysis examines the effect of digital economy development on regional economic development. The core explanatory variable is the digital economy development level (Dig), measured by the digital economy development index constructed from three dimensions: digital infrastructure, information technology application, and digitalization development.

The dependent variable is the regional economic development level (Eco), which is evaluated through three dimensions: economic development, industrial structure, and economic vitality. To reduce the potential influence of other factors on regional economic development, three control variables are included in the model: human capital (Hc), foreign direct investment (Fdi), and financial development (Fin). Human capital reflects the role of labor quality in regional development, foreign direct investment captures the influence of external capital and technology inflows, and financial development represents the role of financial resources in supporting economic activities.

The definitions, measurement methods, and data sources of all variables are presented in Table 3.

5.1.2. Data Sources

The study uses provincial panel data from selected Chinese provinces and cities during the period of 2016–2022. The data used for measuring regional economic development, digital economy development, and control variables are collected from official statistical publications, including the China Statistical Yearbook, China City Statistical Yearbook, and relevant provincial statistical yearbooks.

After data collection, the indicators are organized and processed to construct the variables required for empirical analysis. The final dataset provides the basis for examining the relationship between digital economy development and regional economic development.

5.1.3. Descriptive analysis

Table 3. Descriptive analysis

VarName	Obs	Mean	Median	SD	Min	Max
A	240	0.23	0.191	0.13	0.081	0.701
Dig	240	0.17	0.114	0.14	0.026	0.758
Hc	240	0.02	0.020	0.01	0.009	0.041
Fdi	240	0.02	0.017	0.01	0.000	0.080
Fin	240	3.35	3.169	1.15	1.664	8.131

Table 3 presents the descriptive statistics of the variables. The regional economic development index (A) has a mean value of 0.23, ranging from 0.081 to 0.701, with a standard deviation of 0.13. The digital economy development index (Dig) has a mean value of 0.17, with a range of 0.026 to 0.758 and a standard deviation of 0.14. The differences between the minimum and maximum values indicate substantial variation in both regional economic development and digital economy development among the sampled regions.

5.1.4. Collinearity Diagnostic

Table 4. Collinearity Diagnostic

Varia	VIF	1/VIF
Dig	1.340	0.746
Hc	1.230	0.811
Fdi	1.270	0.788
Fin	1.300	0.767
Mean VIF	1.290	

Table 4 reports the results of the multicollinearity test. The variance inflation factor (VIF) values of all variables are below 10, while the tolerance values are above 0.1. These results indicate that there is no severe multicollinearity among the explanatory and control variables.

5.1.5. Hausman+F test

Table 5. Hausman+F test

Test Type	Test Statistic	P	Conclusion
F test	10.32	0.0000	FEM Model
Hausman	85.93	0.0000	FEM Model

The model selection results are presented as follows. The F-test reports a p-value of 0.000, which is below the 5% significance level, indicating that the fixed effects model (FEM) is preferred to the pooled ordinary least squares (OLS) model. The Hausman test also yields a p-value of 0.000, supporting the selection of the fixed effects model over the random effects model. Therefore, the fixed effects model is employed in the subsequent empirical analysis.

5.1.6. Model Specification

To examine the impact of digital economy development on regional economic development, this study specifies the following fixed effects model:

$$A_{ij} = \partial_0 + \partial_1 Dig_{ij} + \partial_2 ctrl_{ij} + \mu_i + \lambda_j + \varepsilon_{ij} \quad (1)$$

In Equation (1), A_{ij} represents the level of regional economic development in region i during period j . ∂ denotes the estimated coefficient of the digital economy development variable. Dig_{ij} represents the level of digital economy development in region i during period j . $ctrl_{ij}$ represents a set of control variables. μ captures regional fixed effects. λ_j captures time fixed effects. ε denotes the random error term.

5.2. Regression Results Analysis

5.2.1. Baseline Regression

Table 6 presents the results from our baseline regressions. In Column (1), the coefficient for the digital economy development index comes out at 0.837, and in Column (2), after we add in the control variables, it moves up a bit to 0.916. Both of these estimates are positive and are statistically significant at the 1% level. What this tells us, essentially, is that regions with a higher level of digital economy development tend to perform better when it comes to regional economic development, and this pattern holds up even after we account for other influencing factors.

Once we bring the control variables into the picture in Column (2), the coefficients for human capital and financial development both turn out to be negative, though neither of them is statistically significant. As for why financial development shows a negative sign, it might have something to do with the way financial resources are distributed across regions-it is not exactly even. In places where financial development is already relatively strong, capital tends to flow in even more, and that only reinforces the advantages they already have. For the surrounding regions, though, access to financial resources is often more limited, and as a result, the support they get for development ends up being weaker in comparison.

The coefficient for foreign direct investment (FDI), however, tells a different story. It is positive and it is statistically significant. This particular finding suggests that FDI can, in a number of ways, contribute to regional economic development-through capital accumulation, through the diffusion of technology, and through improvements in management practices, to name just a few.

Table 6. The impact of the digital economy on regional economic development

	(1)	(2)
VARIABLES	A	A
Dig	0.837***	0.916***
	(22.85)	(16.94)
Hc		-0.047
		(-0.26)
Fdi		0.452
		(2.06)
Fin		-0.026
		(-5.02)
Constant	0.094	0.161
	(15.51)	(10.72)
Observations	240	240
R-squared	0.792	0.838
Number of regions	8	8

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2.2. Heterogeneity Analysis

What we are seeing here, in terms of the heterogeneous effects across regions, is actually quite consistent with what previous studies have already found. Those studies, for the most part, suggest that the economic outcomes of digital economy development tend to depend, to a considerable extent, on differences in regional conditions-things like infrastructure foundations, the efficiency of resource allocation, and the overall level of digitalization capabilities[8]. As for the relatively weaker effect that we observed in the central region, that may well come down to certain limitations in its existing development conditions. What this means, in effect, is that the potential benefits that digital transformation could have brought to the region have not yet been fully tapped into or realized.

These regional differences, if we think about it, point to something fairly important: improving digital infrastructure, strengthening the integration of digital technologies with traditional industries, and promoting the digital transformation of industrial sectors all remain crucial if we want to enhance regional development capacity[9]. With these kinds of efforts in place, regions would stand a better chance of making good use of the opportunities that digitalization has to offer, and at the same time, they would be better positioned to participate in digital economic activities down the road.

On top of that, digital economy development might also, in one way or another, influence regional coordination by improving the mobility of production factors and by narrowing the gaps that exist in development conditions between regions. Insofar as digitalization works to weaken the barriers that stand in the way of economic interaction, and insofar as it helps to facilitate the flow of resources, it could very well contribute to regional economic convergence and, in doing so, provide some useful support for more balanced, long-term development[10].

Table 7. Heterogeneity analysis of the impact of the digital economy on regional economic development

	(1)	(2)	(3)
VARIABLES	A	A	A
Dig	0.915***	0.659**	0.705***
	(16.03)	(3.01)	(4.55)
Hc	-0.414	-2.150	0.086
	(-1.23)	(-1.47)	(0.22)
Fdi	0.365	-2.958*	2.548***
	(1.55)	(-2.23)	(7.07)
Fin	-0.033***	0.048	-0.009**
	(-6.28)	(1.65)	(-2.85)
Constant	0.210***	0.142*	0.107***
	(10.58)	(2.05)	(5.51)
Observations	96	40	80
R-squared	0.793	0.676	0.836
Number of regions	8	8	8

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2.3. Robustness Tests**Table 8.** Robustness tests

	(1)	(2)	(3)	(4)
VARIABLES	A	A	A	A
Dig	0.891***	0.971***		
	(17.53)	(28.46)		
Hc		-0.222	0.929	-0.084
		(-0.26)	(1.02)	(-0.11)
Fdi		0.449	0.300	0.427
		(1.35)	(1.00)	(1.46)
Fin		-0.026***	-0.013***	-0.026***
		(-7.04)	(-2.71)	(-7.97)
dig			1.009***	0.928***
			(36.66)	(30.87)
Constant	0.096***	0.168***	0.089***	0.162***
	(12.07)	(8.78)	(3.39)	(9.65)
Observations	210	210	208	240
R-squared	0.788	0.832	0.885	0.836
Number of regions	7	7	8	8

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 presents the results of a series of robustness checks that we carried out using different model settings and various treatments of the sample. In Column (1), what we did was to introduce a one-period lag of the core explanatory variable, and we ran that specification without including any control variables. Then, in Column (2), we took that same lag structure but added the full set of control variables into the model. For Column (3), we decided to exclude observations from the year 2020, mainly to reduce the possible influence that any abnormal events from that period might have had on the estimates. And for the fourth one, Column (4), we applied winsorization to the data-that is, we replaced values that fell below the 1st percentile and above the 99th percentile with the corresponding threshold values, so as to limit the impact of extreme outliers.

Now, if we look across all of these different specifications, what we find is that the coefficient for digital economy development remains positive and statistically significant at the 1% level in every single case. The control variables, for their part, also show coefficient directions and significance levels that are broadly similar to what we saw in the baseline regression results. Taken together, this gives us some confidence that the positive relationship we have observed between digital economy development and regional economic development is not substantially affected by changes in how we treat the variables, how we select the sample, or how we specify the model.

6. Conclusion and Policy Recommendations

6.1. Research Conclusion

This study sets out to examine the relationship between digital economy development and regional economic performance, using panel data drawn from selected Chinese provinces and cities over the period 2016–2022. To do this, we constructed separate evaluation systems for measuring both digital economy development and regional economic development, and then applied fixed effects models, along with robustness tests and heterogeneity analysis, to get a clearer picture of the economic effects that digitalization might be bringing about.

What we find from the empirical work is that digital economy development does have a significant positive association with regional economic development. This result holds up after we introduce control variables, and the robustness checks we ran confirm that the relationship stays stable across different variable treatments, sample adjustments, and model specifications-so the finding seems reasonably solid.

That said, the impact is far from uniform across regions. Our heterogeneity analysis shows that the eastern region enjoys the strongest positive effect, whereas the central region shows a considerably weaker one. These differences are likely tied to variations in regional economic foundations, infrastructure conditions, and digitalization capabilities, which suggests that how much a region benefits from digital transformation depends, to a non-trivial degree, on its own starting conditions.

When we look at the mechanisms at work, it appears that digital economy development may influence regional economic performance through several pathways-improving the efficiency of information flows, lowering transaction costs, and opening up new market opportunities. By facilitating information exchange and strengthening economic interaction, digitalization can support more efficient resource allocation and, in turn, bolster regional development capacity. On balance, the evidence points to digital economy development playing an important role in shaping regional economic outcomes. But the effects are not the same everywhere, and any effort to promote more coordinated regional development needs to take local conditions into account.

6.2. Policy Recommendations

6.2.1. Develop Digital Markets According to Regional Comparative Advantages

Because regions differ quite a bit in their economic foundations, industrial structures, and digitalization capabilities, the impact of digital economy development varies from place to place. That being the case, building digital markets should not be a one-size-fits-all exercise. Instead, regional characteristics and comparative advantages need to be given due consideration.

For regions with stronger economic fundamentals and more advanced digital development, the focus can be on raising the efficiency of digital applications and deepening the integration of digital technologies into advanced industries. For those with relatively weaker digital infrastructure, on the other hand, a more appropriate approach might be to improve digital accessibility first, and then explore digital economic activities that fit their local circumstances. A differentiated strategy along these lines would help regions make the most of their existing strengths, strengthen their capacity for digital transformation, and ultimately contribute to more coordinated regional development.

6.2.2. Step Up Digital Talent Development in Emerging Areas

The digital economy, after all, runs on people. Adequate human capital is essential, particularly in fields that involve digital technologies and information applications. The availability of digital talent, quite simply, can make or break a region's ability to adopt new technologies and turn digital development opportunities into tangible economic gains.

That is why strengthening digital talent development and expanding the supply of professionals with relevant skills matters so much for boosting regional digitalization capacity. A better-trained workforce would facilitate the uptake of digital technologies in economic activities, improve regions' ability to navigate digital transformation, and sustain the long-term growth of the digital economy. For regions that are lagging behind in digital development, this becomes even more urgent. Having more skilled people on the ground would help lower the barriers to digital transformation and unlock greater development potential.

6.2.3. Strengthen Institutional Frameworks and Digital Economy Governance

Digital economy development does not happen in a vacuum—it depends not just on technological advances and market expansion, but also on a supportive institutional environment. Given the wide disparities in regional development conditions, sound governance mechanisms are critical if we want to improve both the efficiency and the long-term stability of digital economic development.

Strengthening the institutional frameworks that surround the digital economy can create better conditions for technology adoption, resource allocation, and market development. At the same time, stronger governance capacity would help strike a better balance between technological innovation, economic activity, and regional development priorities. When the institutional environment is more favorable, regions are better positioned to seize the opportunities that digitalization brings, overcome constraints in the transformation process, and enhance their ability to achieve more balanced and coordinated development.

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