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The Impact of Digitalization of the Economy on High-Quality Economic Development in Chongqing

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Abstract: The rapid rate of digital innovation has helped drive economic growth. For Chinese authorities, a key policy question is whether and how economic digitalization can promote equitable resource distribution and high-quality development. Using longitudinal data from 2011 to 2020 for Chongqing's 38 administrative units, this study applies the entropy-weighted TOPSIS method to measure the regional economic quality index. Regional variation analysis reveals that digitalization significantly improves economic quality and reshapes the economic landscape. Mechanism analysis shows that advancing digitalization drives superior development by enhancing fundamental infrastructure investment and stimulating innovation capacity. We also show that differences in progress stages and income distribution between urban and rural areas mediate the way in which the level of digitalization affects the quality of economic development. The findings demonstrate that digitalization is crucial for Chong qing's pursuit of superior development outcomes. In the face of changing economic conditions, we should realize the importance of ensuring substantially greater compatibility between regional economic policy frameworks and digital transformation while also trying to shift focus from physical spatial planning to building digital ecosystems. These approaches can help sustain the ongoing benefits of digital technology while also supporting high-quality economic development.

Keywords: Digital Economy, High-Quality Development, Chongqing Municipality, Urban–Rural Difference, City-level New Areas.

1. Introduction

To date, efforts to improve the quality of economic development have primarily considered this from a technical perspective or just in terms of economic growth measures. However, some regional administrations and policymakers in China have started to understand that careful consideration of the digital economy alongside regional economic planning and development can lead to better governance and higher-quality economic development. In the case of Chongqing, the only centrally administered municipality in the western region of China with a rapidly growing population already exceeding 30 million, there is an unusual configuration of a metropolis coexisting with large rural territories in the same jurisdiction, of main urban centers located near isolated mountainous regions, and of prosperous districts containing economically important reservoirs alongside ecologically sensitive conservation areas. As such, Chongqing can provide a valuable case study for examining how digitalization of the economy can promote higher-quality economic development. Chongqing municipality is made up of 38 administrative units that differ markedly in terms of economic development, urbanization, and digital connectivity infrastructure. These characteristics make it a good site for studying the digitalization of the economy and how its effects depend on the intensity of this digital transformation.

In this study, we examine the effects of digitalization of the economy in different contexts. Taking Chongqing as an example, this paper examines the effects of digital transformation on the achievement of high-quality economic growth in general and explores the regulatory role played by regional policies in it. The results of this work are intended to provide insights to promote the equitable and environmentally friendly development of the region in the digital age.

In China, high-quality economic development has become important in national policy. From the perspective of production, such an approach requires the establishment of an advanced supply network by reinforcing the production quality transformation, improvement of operational effectiveness, and dynamic innovation. In terms of consumption, high-quality economic development involves optimizing the Overall economic cycle links among manufacturing, allocation, circulation, and purchasing. The ultimate goal of such optimization is to produce economic gains for all citizens and to construct a circular economy between production and consumption. Researchers in the field of Development Economics in China generally understand high-quality development as an entire, multifaceted developmental model; in contrast, academics elsewhere tend to use the narrower term "quality of economic growth" and generally analyze it using variables such as economic growth rate and related societal indicators (particularly of health and ecological integrity).

Upon considering the period from 2011 to 2020, we find that the municipal authorities of Chongqing have made particularly notable achievements in five aspects. One involves greater development of modern infrastructure along with remarkable improvement of information technology. A second aspect is the noteworthy development of the digital technology sector. A third aspect involves substantial advances in the digitalization of traditional industries along with the integration of emerging digital technologies, such as big data, AI, and blockchain, which have occurred in primary, secondary, and tertiary industries. A fourth aspect is the increase in the effectiveness of digital administration. A fifth aspect, through numerous policy measures, the transparency of the digital economy has also improved markedly. Substantial support of many types has been provided by local government to the tech industry, such as digitalization level - promoting the progress in digital transformation, usage depth- the intensity of application of digital technologies, coverage

breadth - the scope of services offered digitally, and openness of the digital industry - the opening up of industry to digital innovation.

An overview of this can be provided via the statistics in Chongqing's official records (see Table 1 in Chongqing Statistical Yearbook and governmental statistical data). In terms of Chongqing's economic development, this progressed from a period of rapid expansion to a phase of growth rate moderation and structural reallocation, as well as the absorption of previous economic stimuli. From 2011 to 2025, the gross domestic product (GDP) of Chongqing rose from $153.47 billion to $472.61 billion. In this context, the information-driven digital economy became increasingly prominent, growing by more than 15% annually from 2016 to 2020. In 2024, core digital industries constituted 10.0% of the total economic output of the municipality. However, the growth rate of the economy as a whole is consistently dropping. The proportion of policy modifications has also been decreasing, from 16.4% in 2011, when the economy of Chongqing was expanding rapidly, to 5.7% in 2024.

Given this background, in this study we planned to pursue the answers to several key questions: As a rapidly growing urban center in a developing economic system, has Chongqing harnessed digitalization of the economy to promote more rapid economic expansion? When facing potential adverse conditions, such as lower returns on investment and the population expected to decline, is the gradually evolving local government strategy toward digitalization of the economy sufficient to counter the trend of slowing economic growth? See Table 1.

Table 1. The GDP scale and growth rate of Chongqing Municipality (2011-2015)

year	2011	2012	2013	2014	2015	2016	2017	2018
GDP (billion yuan)	1,001.14	1,140.96	1,278.33	1,426.26	1,571.97	1,755.88	1,950.03	2,036.32
GDP Growth Rate (%)	16.40%	13.60%	12.30%	10.90%	11.00%	10.70%	9.30%	6.00%
GDP (billion dollar)	153.47	180.66	210.28	233.16	242.10	254.06	299.70	292.96
year	2019	2020	2021	2022	2023	2024	2025	-
GDP (billion yuan)	2,360.58	2500.279	2,807.73	2,912.90	3,014.58	3,219.32	3,375.79	-
GDP Growth Rate (%)	6.30%	3.90%	8.40%	2.60%	6.10%	5.70%	5.30%	-
GDP (billion dollar)	338.38	362.39	440.53	423.02	423.48	450.68	472.61	-

Digital transformation has become a particular focus of a national strategy to promote high-quality economic expansion in China. Here, such expansion refers to a sustainable increase in productivity, ongoing and improved environmental protection, and industrial transformation driven by new sectors, social fairness, social inclusion, and operational performance. However, it can be difficult to quantify this holistically. Many academic studies have attempted to define how best to measure high-quality economic expansion. For instance, an assessment model has developed includes three aspects: the catalysts for economic expansion, the structure of economic expansion, and economic performance [1]. This group also developed a comprehensive urban economic quality evaluation framework with six aspects: technological progress, economic resilience, operational performance, balanced development, environmental sustainability, and equitable distribution [2]. Meanwhile, evaluating economic quality followed five basic principles: technological innovation, balanced development, environmental consciousness, integration with the outside world, and shared prosperity [3] [4]. From this background, we assert that there are five basic pillars for establishing a framework for assessing the quality of economic development: innovation, coordination, green development, transparency, and shared benefits. Based on these pillars, we construct a system for measuring and evaluating Chongqing's regional economic features and development needs.

Indeed, the digital economy is a driver of economic growth globally, helping to promote the efficiency, creativity, and environmental friendliness of all kinds of industries. This is an extension of Romer's endogenous growth framework, which highlights how technologies facilitate long-term economic growth [5]. While the digitalization of the economy encourages us to innovate, make better use of resources, and support equitable regional development, there are important challenges to be overcome to achieve a more inclusive, commercial and logistical and sustainable economy [6-8].

Comprehensive convergence between physical industries and digital technology is the best way to stimulate superior economic growth, which in turn elevates the quality of economic development [9]. Elsewhere, we should realize industrial digitalization through metropolitan brand influence and improve technology assimilation through digital industrialization strategies. Digital tools such as blockchain, artificial intelligence (AI), cloud computing, and big data analytics increase the productivity of research and development for companies, primarily in urban areas [10]. These advanced solutions achieve this by promoting the continuous modernization and evolution of all operative parts (e.g., manufacturing processes, distribution channels, and product design methodologies) for city-based industrial firms. Recent administrative policies and technological innovations in Chongqing have substantially accelerated the growth of the digital economy in all 38 administrative units. Indeed, digital solutions are well coupled in industrial production, the service sector, and agriculture, in line with the national Digital China framework. Meanwhile, multiple industries have already transitioned from conventional operations to knowledge-based economic activities.

However, in China, the effect of developing the digital economy is more noticeable in economically advanced urban centers that have led the digital revolution. Regions with a more advanced economy have greater ability to embrace and implement digital advances because those regions have well-developed infrastructure, a well-trained workforce, and an abundance of capital. In contrast, in areas with lower levels of economic development, it is difficult to use digital tools well. When attempting to overcome these kinds of developmental inequalities, region-specific policies that exploit the strengths of different localities are commonly applied. Such policies are also a basic requirement for achieving both extensive and high-quality economic expansion.

In terms of Chongqing's economy, the growth rate of the

city's GDP has been slowing since 2011. Regional policy interventions are important mediators of the municipality's economic performance. The strategy for Chongqing to build an "Economic Zone Accessible Within 60 Minutes" was established alongside the responsibility to develop the peripheral mountainous regions of northeastern and southeastern Chongqing, forming a spatial economic pattern of a "Core Zone with Dual Peripheral Wings." This was intended to strengthen the influence of the metropolitan area, promote population movement from the northeastern and southeastern regions to the more economically developed central area, and accelerate urbanization in underdeveloped regions. The regional governance of Chongqing uses a set of policy tools integrated with fiscal measures (including adjustments to the tax system and budgetary allocation), capital investment, urban planning, sector strategy, land management regulation, and ecological protection measures, The strategy involves choosing appropriate combinations of policy tools in relation to different goals at particular phases of development [11]. The idea is to integrate the market across the municipality.

Compared with previous studies, this paper makes new marginal contributions in terms of the themes covered and the entry perspectives analyses performed. First, in contrast to previous studies that generally analyzed indirectly mechanisms of development of the digital economy, such as digital industrialization and total factor productivity enhancement, we focus on the immediate impact of the growth of the digital economy on the overall development of Chongqing and systematically evaluate its directly driving effect on high-quality economic development. Second, we introduce a novel way to measure high-quality economic development at the district and county levels in Chongqing by a comprehensive evaluation index system that features an innovative, multidimensional assessment framework. By incorporating more factors into the analysis, this system can give us a more accurate and realistic picture of economic development in Chongqing and overcome the lack of comprehensiveness of previous economic indicator systems. Third, this paper takes 38 districts and counties in the administrative area of Chongqing as an example of a developing urban agglomeration to deeply analyze the mechanism of how the intensity of digitalization of the economy has affected the process of high-quality development. Meanwhile, by using moderation effect regression models, this work also comprehensively examines the results of Chongqing's regional economic strategy, which tends to focus on reducing the gap between urban and rural areas while maintaining economic productivity. We investigate how such policies have changed economic growth in Chongqing for 2011-2025, what problems are currently facing the municipality, and how these problems can be overcome. In this way, this paper is intended to bridge the research gap regarding the synergistic effects of local policies on the development of the digital economy.

The rest of the paper is structured as follows. Section 2 presents the research hypotheses to be tested, along with the theoretical analyses used. Section 3 is devoted to data collection, characteristics of Chongqing, and variable selection. Section 4 presents benchmark estimation results and their interpretation. Section 5 is devoted to concluding remarks and policy suggestions.

2. Research Hypotheses and Theoretical Analysis

In this section, we discuss how digitalization of the economy affects the quality of development from two perspectives. First, the direct effect of the digital economy on high-quality economic development in Chongqing; Second, the moderating role of Chongqing's regional economic policies in the relationship between the digital economy and high-quality economic development. Based on the analysis in this section, we propose the research hypotheses of this study.

2.1. The Digital Economy'S Immediate Influence on Development Quality

The theory of endogenous economic expansion is concerned with how internal elements, such as technological advances and the accumulation of expertise and skills among workers, can give rise to long-term prosperity [5, 12]. Under this theory, it is possible to invest in intellectual property in a way that achieves self-sustaining economic growth. The relationship between the nature of technological progress and the economic performance of countries shows how different levels of technological advancement can influence development [13, 14]. In the context of the digital economy, this theory explains how technological innovation promotes economic performance. Specifically, digital technologies and informational resources play a catalytic role in accelerating creativity and enhancing adaptability.

If one views economic progress from the perspective of increasing economic quality, the advancement and modernization of industry are the direct driving forces of economic progress. From this perspective, there is a strong relationship between industrial transformation and economic vitality, indicating how the digital economy changes the structure of industry. Therefore, industrial modernization should be considered an important strategy in efforts to boost competitiveness and build value-added production chains.

From the perspective of high-quality economic growth, industrial development and upgrading are the direct drivers of revenue growth. The positive correlation between industrial upgrading and economic prosperity highlights the transformative impact of the Internet economy on industrial dynamics. Regions aiming to enhance competitive advantages and value chain development must take industrial upgrading as a strategic priority.

The digital economy, based on the use of advanced technological solutions and new commercial solutions, allows the simplification of manufacturing processes, improvement of distribution networks, reductions in business costs, and increasing integration of the entire sector. Digital solutions, by automating certain routine tasks and improving operational effectiveness, are a major contributor to market competitiveness and long-term economic development. The industrial application of digital innovations can speed up local economic growth, creating an environment amenable to technological breakthroughs [15].

The results of the research show that the intensity of digitalization of the economy is related to economic efficiency. Both theoretical and empirical analyses support the assertion that digitalization improves economic performance. The interaction between digitalization and regional economic growth shows the value of encouraging technological progress via digitalization to achieve long-term economic growth [16, 17].

When digital tools become widely used, producers of digital platforms and other digital manufacturers can perform best in their own urban or rural context, thereby reducing the technology gap for those in peripheral areas [18]. Meanwhile, greater digital transformation would help deliver better public services and greater access to medical care in rural areas [19]. The platform and collaborative economic mode supported by digital infrastructure can markedly reduce the information asymmetry between urban and rural areas, reduce the cost of professional training, promote the bidirectional flow of talent markets between urban and rural areas, increase earnings, and reduce social and economic gaps [20]. These studies reveal special features of the way in which digital technology can enhance conventional tools. This highlights the importance of precisely measuring the unique impact of the digital economy on high-quality economic development in isolation from other regional heterogeneous factors, as explored in this study.

In this section, we analyze the way in which the digital economy, which is an innovative factor of production, contributes to sustainable economic development and also directly promoting high-quality economic development.

Hypothesis 1: Urban economic development characterized by high quality is positively stimulated by digitalization of the economy.

2.2. The Role and Impact of Regional Economic Policies in The Process of The Digital Economy Contributing to High-Quality Economic Development

Previous studies have shown that governmental strategies for promoting the expansion and modernization of the digital sector have often included the establishment of regional technology hubs, the support of related businesses, and the application of different measures of market-driven innovation [21]. These strategies usually produce good clustering effects in industry. In contrast, policies that implement top-down policies, sector-specific approach usually do not consider the specific characteristics of small and medium-sized businesses in the region, it could be possible for adverse impact of the local digital economies [22, 23].

Some research has shown that such policies are often underlain by the belief that state interventions aimed at technology transfer and improving the technological competencies of (developing) economies can be decisive in terms of achieving structural change [24, 25]. In addition to general environmental and sector-specific regulations, digital industrial policies focus on improving the digital competencies of the workforce. The main priorities of industrial policies are developing infrastructure, fostering a national innovation framework, and cultivating digital platforms [26, 27]. Only when domestic infrastructure requirements are satisfied can the domestic government focus on increasing international trade opportunities.

These industrial strategies can be implemented from top to bottom, can also be run via two institutional arrangements: inward-looking import substitution policies and outward-looking export-promoting policies [28, 29]. With regard to import substitution, regional authorities can help adapt foreign technologies to domestic requirements and establish complete local supply chains via supportive national and regional measures, thus developing models of the replacement of the customized digital industry that fit local characteristics. With regard to export-driven approaches, decision-makers in developing nations have seen how digital industrialization processes have substantially changed international commerce via the exchange of goods and services in the process of e-commerce transactions [30]. Moreover, Such regional trade policies that fit local benefit measures, include are highly advantageous for achieving developmental objectives and reducing systemic disparities, potentially creating a favorable platform for the digital sector to reap broader benefits [31].

For example, the supporting policies and investment in the infrastructure of the Belt and Road, e.g., the soft subsidies and direct investment, Initiative can bring great advantages for Chinese enterprises to compete in global markets. Specifically, these measures should help companies quickly become important members of international supply chains via fair and sustainable competitive advantages.

Efforts to reduce the differences between cities and the countryside are also in line with general digital industry development logic. Government policy support is the first stage for isolated rural communities to achieve digital adaptation and overcome technological inequalities [18]. A serious of radical rural economic policies place major emphasis on stimulating local economic activities in rural regions [19]. However, considering the economic structure and income differences between rural and urban residents, the more rural populations are involved in collaborative digital economy models, the greater the need for more specific and precise regulatory frameworks are needed to narrow the gap between urban and rural [32, 33].

The governments of developing nations should establish protective measures and financial incentives for business and create the foundations for improving broadband networks for use by the private sector and deploy broadband infrastructure in rural regions [19].

Hypothesis 2: The impact of digitalization of the economy on high-quality urban economic development is positively moderated by regional economic policies.

3. Research Strategy

3.1. Data Sources

Starting from the beginning of 2021, COVID-19 greatly influenced the economy in many parts of China. For example, the various phases of the pandemic had different adverse effects on economic stability [34]. The pandemic particularly affected certain industrial sectors and led to many businesses closing within a short time [35]. To avoid possible distortions caused by COVID-19 that could obscure the effects of the policy changes investigated here, in the present analysis we use the longitudinal data of 38 administrative units in Chongqing municipality from 2011 to 2020. Missing points are dealt with by interpolation. For related metrics, the data are logarithmically transformed to reduce estimation bias due to the irregularity of the variance. The statistical information is derived from Chongqing's official records.

The data sources used in this paper are Chongqing Statistical Yearbook, Chongqing Health Statistics Yearbook, and the statistical reports of all 38 districts and counties comprising Chongqing municipality. A total of 380 complete datasets were available, and the panel structure is well balanced. The characteristics for each measured variable are specified explicitly, with "+" used to indicate a favorable status and "–" used to indicate an unfavorable status.

3.2. Study Area

Chongqing is located in southwest China and is a municipality administered directly by the central government. It is one of the most densely populated regions in China, by the end of 2025, the permanent resident population of Chongqing reached 31.8726 million, approximately 387 people per square kilometer, and is the largest megacity (in terms of area) in the country. Administratively, Chongqing has 38 districts and counties.

It comprises an urban metropolitan area along with huge rural territories featuring mountainous areas and reservoirs. This configuration represents the "metropolis with large rural hinterland" spatial pattern that is common in China.

Given these features and its status as the largest directly administered municipality in the country, Chongqing was considered particularly appropriate for this research. Specifically, its 38 administrative units include regions with markedly different economic statuses, from the highly developed city to relatively impoverished mountainous areas. These areas also have large differences in terms of economic quality, urbanization, and digital infrastructure.

Chongqing became the first city in central and western China with a GDP in excess of 3 trillion yuan (about US$439.359 billion). From 2011 to 2020, Economic growth in this municipality exceeded the national average every year within this period, with average annual growth of 10.7% (the highest nationally). Key digital economy sectors, e.g. Manufacturing of computer and communication components, contributed more than 10% to the municipality's GDP. These features make the case that Chongqing is an appropriate subject for studying the transition toward better economic development. Meanwhile, the forward-looking digital economy projects and spatial planning measures implemented by the municipal government, such as the 60-Minute Economic Zone of Chongqing, provide numerous policy variations among the administrative units to study how digital transformation and the regional strategy together improve high-quality economic development.

3.3. Selection of Variables

3.3.1. High-Quality Economic Development

In this study, we adopt High-Quality Economic Development (Hqdit) as a dependent variable. Economic development quality is measured using entropy weighting technique. By employing a multi-criteria framework of this type, holistic evaluation can be achieved. The quality of economic development is commonly evaluated using a comprehensive assessment technique, which generally evaluates growth momentum, structural composition, and performance results [36]. Meanwhile, based on new development concepts proposed at the 19th CPC National Congress, some researchers have established an assessment framework consisting of five key dimensions: innovation, balance, environmental, international integration, and equitable distribution.

An urban economic quality assessment model includes six components: technological advance, economic stability, output efficiency, balanced development, environmental conservation, and social inclusiveness, according to the regional policy context in particular. Building on this previous work, the current study attempts to develop a holistic method for evaluating high-quality economic development [2].

Compared with the above-mentioned studies and considering the availability and completeness of the data for this investigation, the inclusion of two more components in the analytical framework (social welfare and the advancement of digital inclusion—in evaluating high-quality development, this is called "progress"), is proposed.

Notably, these two aspects show the practical achievements of Chongqing in pursuing "better" development, marking a new contribution to the formulation of systems for indicating such development. Therefore, the assessment framework in this research includes the following seven dimensions: macroeconomic performance, balanced growth, social welfare, equitable distribution, technological progress, innovation capacity, and global integration, with 35 measuring points in total, see Table 2.

Table 2. Indicator System for High-Quality Economic Development in Chongqing

Criterion Layer	Specific Measurement Indicator	Data Source & Calculation Method	Indicator Attribute
Overall Economy	Total Population	Chongqing Statistical Yearbook	+
	Female Population	Chongqing Statistical Yearbook	+
	Urban Population	Chongqing Statistical Yearbook	+
	Rural Population	Chongqing Statistical Yearbook	+
	Population Mortality Rate (‰)	Chongqing Statistical Yearbook	-
	Gross Regional Product	Chongqing Statistical Yearbook	+
	Primary Industry Value Added	Chongqing Statistical Yearbook	+
	Secondary Industry Value Added	Chongqing Statistical Yearbook	+
	Tertiary Industry Value Added	Chongqing Statistical Yearbook	+
	Per Capita GDP (yuan/person)	Chongqing Statistical Yearbook	+
	Urbanization Rate (%)	Chongqing Statistical Yearbook	+
Coordination	Urban-Rural Disposable Income Ratio	Urban Per Capita Disposable Income / Rural Per Capita Disposable Income	-
	Urban-Rural Consumption Ratio	Urban Per Capita Consumption Expenditure / Rural Per Capita Consumption Expenditure	-
	Urban-Rural Housing Area Ratio	Urban Per Capita Housing Area / Rural Per Capita Housing Area	-
	Urban-Rural Minimum Living Allowance Recipients Ratio	Urban Minimum Living Allowance Recipients / Rural Minimum Living Allowance Recipients	-
People's Livelihood	Basic Medical Insurance	Chongqing and District/County Statistical Yearbooks	+
	Basic Unemployment Insurance	Chongqing and District/County Statistical Yearbooks	+
	Basic Pension Insurance	Chongqing and District/County Statistical Yearbooks	+
	Number of Hospital and Health Center Beds	Chongqing Health Statistics Yearbook	+
	Number of Health Technical Personnel in Hospitals and Health Centers	Chongqing Health Statistics Yearbook	+
	Number of Licensed (Assistant) Physicians in Hospitals and Health Centers	Chongqing Health Statistics Yearbook	+
Sharing	Highway Mileage (km)	Chongqing Statistical Yearbook	+
	County and Township Road Mileage (km)	Chongqing Statistical Yearbook	+
	Highway Passenger Traffic (10,000 person-times)	Chongqing and District/County Statistical Yearbooks	+
	Road Area	Chongqing and District/County Statistical Yearbooks	+
	Per Capita Green Area (sq.m)	Chongqing and District/County Statistical Yearbooks	+
Development	Number of Internet Broadband Subscriptions	Chongqing and District/County Statistical Yearbooks	+
	Number of Cable TV Subscriptions	Chongqing and District/County Statistical Yearbooks	+
	Proportion of Internet Broadband Subscribers to Total Households	Internet Broadband Subscribers / Total Households	+
	Proportion of Cable TV Subscribers to Total Households	Cable TV Subscribers / Total Households	+
Innovation	Number of Industrial R&D Centers	Chongqing and District/County Statistical Yearbooks & Official Websites	+
	Number of Patents	Chongqing and District/County Statistical Yearbooks & Official Websites	+
Openness	Total Imports	Chongqing Statistical Yearbook	+
	Total Exports	Chongqing Statistical Yearbook	+

3.3.2. Digitalization of the Economy

In this study, we adopt Digitalization of the Economy as the main independent variable. Some research has studied the effect of the digital economy on the quality of economic development using various analytical methods. For example, digitalization of the economy was an important promoter of national economic growth, and the appropriate operation of digital technologies can effectively improve the quality of economic development [37]. The regionally dependent effects of digitalization of the economy can be performed by empirical analyses, such as the different operating channels and effects on development [38]. Furthermore, digital economic development can lead to better economic performance via improvements in operating efficiency and structural optimization [39].

The explanatory variable selected in this study is the Digital Financial Inclusion Index (lnindex_aggregate),

specifically Peking University's Digital Financial Inclusion Index of China (PKU-DFIIC). The dataset for this variable was compiled at the Institute of Digital Finance of Peking University and ranges from 2011 to 2020, with data presented at the province, municipality, district, and county levels. The index is based on the transaction records of Ant Group, which is the most widely used digital financial service platform in China, enabling comparisons between different administrative units and time periods.

To measure the development of the digital economy, the PKU-DFIIC consists of three parts: the degree of Coverage Breadth, the Usage Depth of digital financial service use, and Digitization Level in financial inclusion. With these three dimensions, we can fully explore the patterns of digital economic growth in Chongqing municipality and its 38 districts and counties.

3.3.3. Control variables

In an attempt to deal with possible endogeneity issues that may bias the results of this study, some other explanatory variables were added to the simple regression analysis. The aim of this was to reduce any potential bias associated with excluded variables and to take into account all variables that may play roles in achieving high-quality economic growth. The literature mentioned below suggests that the chosen variables are good proxies for indicating the quality of urban development.

When discussing the influence of digitalization of the economy on the economic difference between urban and rural areas, researchers added the rate of enrollment at standard secondary education institutions as a control variable and analysist how public library infrastructure influences different aspects of local economic performance [20, 40]. The dynamism of employment opportunities with private enterprises and rates of compensation also play important roles in the level of the urban workforce as important indicators and effectively guide the transmission mechanism of urban economic levels [41, 42]. The sales volume of consumer goods can also be used as a measure of residents' affluence during the same period, which indicates purchasing power and consumption level. Meanwhile, the progress of digital financial services stimulates household expenditure and facilitates the optimization of consumption patterns, which in turn contributes to boosting the economy [43, 44]. In metropolitan areas with urban–rural configurations similar to that of Chongqing has shown that capital investment in fixed assets allows industrial restructuring and modernization. The commitment to this kind of investment markedly promotes improvements in workforce productivity [45].

Against the above background, this study includes the following five control variables: Secondary School Enrollment (lnstudent_secondary), which is the number of students in standard secondary schools to control the possible nonlinear influence of educational attainment; Public Library Count (library_public), which is an indicator of basic cultural facilities in the region; Urban Non-private Sector Workforce (lnemployment_urban); logarithmically transformed), which represents the level of economic activity in the region; Consumer Goods Retail Figure (retail_sales; logarithmically transformed), which represents consumption willing in the region; and Fixed Asset Investment Expansion Rate (fai_growth; logarithmically transformed), which represents the macroeconomic status regarding investment and growth of the production capacity in the region.

Table 3 shows the descriptive statistics for these variables and provides the data profile and statistics of the main dependent variable, the main explanatory variable, and all of the control variables, see Table 3.

Table 3. Descriptive Statistics

Variable	Index	Measurement	Mean	Std. dev.	Min	Max
Hqd	High-Quality Economic Development Index	High-Quality Economic Measurement Result	0.28	0.13	0.05	0.68
Dige	Digital Inclusive Finance Index	Inclusive Finance Index by District/County	2.64	2.27	0.00	4.87
lncoverage breadth	Digital Inclusive Finance Coverage Breadth	Geographic coverage scope of digital inclusive finance	50.49	45.96	0.00	110.67
lnusage depth	Digital Inclusive Finance Usage Depth	Actual usage extent of digital services	68.90	63.03	0.00	171.32
lndigitization level	Digitalization Level	Extent of digital financial service usage	56.53	51.89	0.00	127.05
lnstudent secondary	Talent Cultivation	Students in Regular Secondary Schools (ln) (persons)	10.62	0.42	9.40	11.55
library public	Cultural Resources	Number of Public Libraries (units)	1.12	0.33	1.00	2.00
employment urban	Public Cost	Urban Non-Private Sector Employment (units)	11.34	0.67	9.32	13.06
retail sales	Basic Consumption	Total Retail Sales of Consumer Goods (ln) (yuan)	23.21	0.96	20.47	25.57
fai growth	Construction Investment	Fixed Asset Investment (ln) (yuan)	24.16	0.72	22.19	25.80
geo distance	Geographic Distance	Spherical distance from district government to Chongqing city center (km)	152.58	135.15	3.60	432.40
zone 1hr	One-Hour Economic Circle Policy	One-Hour Economic Circle Policy Dummy	0.47	0.50	0.00	1.00

3.4. Model specification

This study employs a panel data set covering a decade (2011–2020) for the 38 administrative units of Chongqing municipality to investigate the relationship between the development of the digital economy and the improvement in the quality of the regional economy. The basic regression form used in this study is as follows.

$$Hqd_{it} = \alpha_0 + \alpha_1 Dige_{it} + \alpha_2 Ctrl_{it} + \mu_i + \delta_t + \varepsilon_{it}$$

In this model, indexes i and t stand for Chongqing's 38 administrative units and the time period, respectively. The dependent variable Hqd_{it} represents the level of high-quality economic development for region i in year t.

The main independent variable $Dige_{it}$ represents the status of the digitalization of the economy in area i at time t. The estimated coefficient of this variable is the focal parameter of the study, which measures the impact of digitalization of the economy on the quality of economic growth. The term $Ctrl_{it}$ represents covariates that may affect the enhancement of economic quality.

To tackle possible bias associated with excluded variables, in this empirical framework we use a dual fixed effects approach. The individual specific effect, denoted by μ_i, represents the unobserved time-invariant characters of the Chongqing 38 geographical units; and the temporal fixed effect, denoted by δ_t, represents the wide macroeconomic fluctuations and policy changes. The stochastic disturbance term is denoted by ε_{it}. If the α_1 coefficient shows statistical significance with a positive after all control variables are included, this constitutes empirical evidence that digitalization of the economy can positively influence the quality of economic growth.

4. Benchmark Estimation Results and Analysis

4.1. Benchmark Regression

Table 4. Benchmark Regression Results

variable	model
Dige	0.025***
	(15.19)
lncoverage_breadth	0.027***
	(15.24)
lnusage_depth	0.023***
	(15.01)
lndigitization_level	0.026***
	(15.25)
lnstudent_secondary	0.047***
	(4.39)
library_public	-0.003
	(-0.17)
employment_urban	-0.022***
	(-6.65)
retail_sales	-0.024***
	(-2.8)
fai_growth	-0.013*
	(-1.87)
Observations	380
R Square	0.966

Note: *, **, *** are significant at the 10%, 5%, and 1% significance level respectively

The regression analysis revealed very good model performance with R^2 = 0.966 and the achievement of statistical significance at 1%. The main independent variable, the logarithmically transformed Digital Financial Inclusion Index, was shown to be significantly positively related to high-quality economic development (b = 0.025, p < 0.01). This means that for every 1% improvement in digital financial services, there is a corresponding 0.025-unit improvement in the financial inclusion measure. The results show that digital financial inclusion is indeed an important driver of sustainable economic development. The same finding was made for the logarithmically transformed Secondary Education Enrollment Rate (lnstudent_secondary). Specifically, a significant positive association was identified, indicating that the expansion of access to secondary education also contributes to improving the quality of economic development. Interestingly, the urban employment rate and the level of retail sales were inversely related, which can reflect deep structural imbalances in the economy. The inverse relationship with retail sales could have arisen from changes in consumer spending patterns with the increase in online shopping. Meanwhile, the marginally negative tendency for investment expansion may have arisen from the problem of the effectiveness and profitability of the way of allocating capital, see Table 4.

4.2. Addressing Endogeneity Through Instrumental Variables

Note that the main regression model has both administrative units and temporal fixed effects. However, concerns about omitted variable remain for the Digital Financial Inclusion Index ($Dige_{it}$), may be some unobserved factors, such as cultural characteristics of the region or the effectiveness of administrative authorities, that caused the endogeneity issues related to the quality of economic development.

Therefore, the authors of this study used spherical geographical distances (geo_dist) between the urban core of Chongqing and the administrative headquarters of Chongqing's 38 districts and counties as the instrumental variable for performing a two-stage least squares regression analysis.

There are two reasons for choosing this instrumental variable. First, physical distance is an important factor determining the cost of building digital infrastructure and influences the way digital innovations spread to different locations. Second, as a natural geographical feature, distance is independent of contemporary social and economic influences, meaning that it fulfills the exogeneity criterion. Hence, the instrumental variable null hypothesis can be written as follows: H0 = geographical distance (geo_dist): The development level of the digital economy is an exogenous variable. Should H0 = geographical distance (geo_dist) be relevant, then H0 should be rejected; if not, then H0 should fail to be rejected.

The empirical findings show that (1) the selected instrumental variable has strong correlations (Kleibergen–Paap rk Wald F-statistic is 221.84, which higher than the threshold value of 16.38 at the 10% significance level, indicating that the instrumental variables pass the weak instrument test and have strong explanatory power.); and (2) The under-identification test significantly rejects the null hypothesis at the 1% level. (p-value of the Kleibergen-Paap rk LM statistic < 0.01), The estimates show that digital transformation has a statistically significant positive effect on economic quality (parameter estimate = 0.039, significant at the 1% level), which means that conventional regression analysis would systematically underestimate the real economic impact of digitalization. The instrumental variable (geo_dist) satisfies two very important conditions: (1) explanatory relevance (because of the very high first-stage F-statistic of 221.84, showing that the instrument is strongly associated with the endogenous variable lnindex_aggregate)

and (2) exogeneity (that the instrument affects the outcome variable only through its correlation with the endogenous explanatory variable, reducing the bias due to omitted variables), see Table 5.

Table 5. Endogeneity Test Results

variable	model
lnindex_aggregate	0.0389***
	(25.71)
lnstudent_secondary	-0.0258***
	(-4.68)
library_public	0.0002
	(0.02)
employment_urban	-0.0058
	(-1.07)
retail_sales	0.0702***
	(10.92)
fai_growth	0.0112*
	(1.7)
constant	-1.388***
	(-15.27)
(Kleibergen - Paap rk Wald F statistic):	221.841

Note: *, **, *** are significant at the 10%, 5%, and 1% significance level respectively

4.3. Moderating Variable Regression

In this study, we test how local policies could affect the output effect of the economic impacts of digital transformation by adding to the model a dummy variable for the Economic Zone Accessible Within 60 Minutes and its interaction term with the term of digitalization intensity for a moderating effect test. The reason for choosing this kind of regulatory factor is that Chongqing implemented the Economic Zone Accessible Within 60 Minutes strategy, which is a territorial planning policy based on the advantages of geographical location and more developed transportation infrastructure.

This policy is concerned with decreasing the temporal and spatial barriers between peripheral areas and the commercial center and facilitating the movement of production factors and knowledge as embodied in the workforce. Theoretically, the administrative units within 60 min of travel from the urban center of Chongqing should have a better capacity to assimilate and exploit the growth opportunities produced by the advance of digital technologies.

This work evaluates the effect of Economic Zone Accessible Within 60 Minutes policy on the high-quality economic development (composite_score) of Chongqing. Specifically, the statistical results show that the coefficient of this regional policy is 0.033, which is significantly positive. This result shows that establishing the Economic Zone Accessible Within 60 Minutes policy helps economic performance in Chongqing. In particular, this spatial development strategy appears to strengthen the positive relationship and the promoting effect between core explanatory variable (some of which are indicators of the digital economy) and regional high-quality economic development by improving accessibility among the regions and the efficiency of resource allocation.

However, the p-value moves closer to statistical significance at the 10% level (p = 0.072), so we can say that this policy has a certain positive regulatory effect on the high-quality economic development of Chongqing, but the statistical significance is relatively weak. This means that the policy of the Economic Zone Accessible Within 60 Minutes is not strong or stable enough, This failure to reach significance might be explained by factors such as the small sample size, the short time during which this policy has been applied, or regional differences. When we compare the effect of this policy with the main explanatory variables (e.g., indicators of the digital economy), the moderation coefficient is much smaller, indicating that its moderating effect is relatively limited and far lower than that of the core explanatory variable, see Table 6.

Table 6. Moderating Variable Regression Results

variable	model
lnindex_aggregate	0.0251***
	(14.53)
zone_1hr	0.0333*
	(1.8)
mod_interaction	0.0007
	(0.61)
lnstudent_secondary	0.0527***
	(4.74)
library_public	-0.0021
	(-0.14)
employment_urban	-0.2197***
	(-6.68)
retail_sales	-0.2441***
	(-2.89)
fai_growth	-0.0183**
	(-2.29)
Observations	380

Note: *, **, *** are significant at the 10%, 5%, and 1% significance level respectively

4.4. Heterogeneity Analysis

The statistical data and research results above show that there are significant differences in economic performance, urbanization process, and income distribution between the urban and rural residents of the 38 administrative units of Chongqing.

The heterogeneity of such fundamental conditions may lead to an unbalanced characteristic of the benefits of the digital economy on regional high-quality development of the being distributed differently across the localities. However, the exact way in which such geographical diversity influences the enabling effects of digital economic activities has yet to be determined. To clarify this issue, we use three indicators, GDP per capita, degree of urbanization, and income ratio between urban and rural residents, as classification criteria to carefully discuss the heterogeneity impact of the digital economy on high-quality economic development.

4.4.1. Per Capita GDP

As mentioned above, the median GDP per capita is used as a threshold to divide the data into two sub-samples: regions with high per capita GDP and regions with low per capita GDP on each of which a fixed effects regression analysis is performed. For the regions with high per capita GDP, the regression coefficient is 0.331, which is significant at the 5% level (p = 0.023). This shows that in regions with high GDP, the main independent variable has a positive impact on the high-quality economic development of Chongqing. For

regions with low per capita GDP, the coefficient is 0.0288276, which is significant at the 1% level ($p < 0.001$). These results show that the main explanatory factor remains positively correlated with economic progress in both more and less affluent parts of Chongqing.

The results show that the impact of the digital economy level affects high-quality economic development (lnindex_aggregate) has significant heterogeneity among regions with different economic traits. For example, the effects appear more significant and more stable in regions with lower GDP per capita, while there are weaker effects with greater statistical variation in regions with higher GDP per capita. Therefore, regions with lower per capita GDP can gain the most from investment in the integration of digital technologies into industrial digitalization as the main way to increase overall development. In contrast, regions with higher GDP per capita need more complex policy measures that seek the coordinated cooperation of multiple policy tools to address their complex developmental contexts. However, there is a need for caution when planning digital economic policy in regions with higher GDP per capita because of the substantial uncertainties inherently involved.

4.4.2. Urbanization Rate

The statistical analysis shows that there is a strong relationship between the level of urbanization and the quality of economic development in Chongqing. For the areas with high levels of urbanization, the digitalization of the economy has a huge positive effect on economic development, with a coefficient of 0.3629 and statistical significance at the 99% confidence interval ($p = 0.007$).

Meanwhile, for less urbanized districts, the relationship is also positive but less intense, with a coefficient of 0.0298 and even stronger statistical significance ($p < 0.001$). These results indicate that increased digitalization always contributes to economic progress throughout Chongqing, irrespective of the level of urbanization, but the effect varies markedly between regions with high and low urbanization.

In relatively rural areas, the main independent variable (i.e., digital economic activity) is an important production factor, and the marginal returns they yield are stable and predictable. In more urban areas, where the elevation in the quality of economic growth is driven by various forces, the same inputs are more exposed to perturbations from more general economic variables (business cycles, changes in regulations, etc.). For example, the data after 2016 show the possible presence of general adverse effects on the economies of all highly urbanized areas, leading to unstable effects.

4.4.3. Urban–rural Income Ratio

The statistical analysis gives a coefficient of 0.0299 for the regions with a relatively equal urban–rural income distribution (classified as "balanced income"), which is statistically significant at the 99% confidence level ($p < 0.001$), increased digital economic activities were associated with higher-quality economic development.

Meanwhile, for the regions with a large income difference (classified as "unequal income"), the coefficient is 0.0199, which is similarly statistically significant to the above result ($p < 0.001$), Increased digital economic activities were not necessarily associated with higher-quality economic development.

Heterogeneity analysis of this study gives an important dimension that is not considered by the common economic scalars: the society in balance is a fundamental environmental determinant of how the effective and the stable implementation of the main growth mechanisms. The regions where the income ratio between urban and rural populations is close to parity show intensive and predictable patterns, while those with large income differences show extensive and uncertain ones. These empirical results have important implications for policymaking and that to make progress toward social justice and reduce the urban–rural income disparity is intrinsically productive. By fostering a "low-friction environment" for a region's various development inputs, these policy measures establish an optimal context for development investments—ensuring policy effectiveness along with the stable and complete realization of policy dividends.

In places where the income disparity between urban and rural populations is substantial, alongside the implementation of any core development strategy, reducing income inequality and promoting social equity must be pursued as a parallel and fundamental undertaking. Otherwise, development efforts may yield diminishing returns despite large investments.

The overall analysis of these three aspects shows that differences in regional economic development and urban–rural income disparity have a substantial impact on how the digital economy works as an enabler of high-quality economic growth. Namely, in regions with lower GDP per capita and lower urbanization, there is less variability and more reliability in terms of the effects of digital economic activities on the quality of economic growth (with statistically significant coefficients of 0.029 and 0.030, respectively; both $p < 0.01$).

Meanwhile, in regions with narrower differences in income between urban and rural populations, the effects of digitalization of the economy on the quality of economic growth are more targeted and predictable (coefficient = 0.030, $p < 0.01$). For regions with pronounced income inequality between rural and urban areas, such effects are smaller and exhibit greater variability. These results show that the existence of an equitable society is very important for unleashing the full power of catalysts for high-quality economic growth. In other words, making society more equal is an effective economic development strategy in itself, see Table 7.

Table 7. Heterogeneity Analysis Results

variable	GDP per capita		Urbanization Rate		Income Ratio	
	GDP pc ≤ γ1	GDP pc > γ1	UR r ≤ γ2	UR r > γ2	In R ≤ γ3	In R > γ3
coefficient	0.029***	0.331**	0.03***	0.363***	0.0199***	0.0299***
	(38.71)	(2.31)	(37.53)	(2.73)	(4.08)	(31.81)
Control Variable	Yes	Yes	Yes	Yes	Yes	Yes
fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	222	158	219	161	199	181
R-squared	0.9927	0.9466	0.9941	0.9525	0.9941	0.9929

4.5. Robustness Tests

4.5.1. Adding Additional Control Variables

To check the stability of the baseline regression results, we added the additional control variables of GDP per capita and level of urbanization. The empirical results show that when we take into account these important indicators of socioeconomic development, the estimated coefficient of the Digital Financial Inclusion Index (lnindex_aggregate) retains the same direction, magnitude, and statistical significance. This shows the basic robustness of the conclusion of our main model. In particular, the value of the coefficient itself varied little, while it still retained strong statistical significance at the 99% level. These results strongly support the validity of the relationship between our main independent variable and the Digital Financial Inclusion Index and indicate that the development level of the digital economy is not due to possible confounding factors, such as imbalanced development of the region's economy.

The results of the robustness analysis show that by also taking GDP per capita and the level of urbanization into consideration, the main independent variable (lnindex_aggregate) remains statistically significant, with coefficients nearly equal to those in the baseline analysis. This assuages concerns possible estimation errors due to the exclusion of these important macroeconomic variables and supports the main thesis of this study about the constant and positive effect of digitalization of the economy on the quality of economic development.

Table 8. Robustness Test Results: Adding Control Variables

Variable	Benchmark Model Coefficient	Robustness Model Coefficient	Assessment of Change
Digital Economy Level	0.02546	0.02571	Highly Stable
Statistical Significance	Significant at 1% level (p=0.000)	Significant at 1% level (p=0.000)	Highly Stable

4.5.2. Winsorization Test

To reduce the possible effect of outliers on the analytical results, a 1% winsorization procedure was applied to all continuous variables before re-estimation of the model. The results showed very close agreement between the estimated regression coefficient for the development level of the digital economy (lnindex_aggregate) and the corresponding results of the baseline model. This clearly indicates that outliers have not impacted the results of this study and that the findings are highly reliable.

Table 9. Robustness Test: 1% Winsorization Test Results

Variable	Benchmark Model Coefficient	Winsorized Model Coefficient	Assessment of Change
Digital Economy Level	0.02571	0.02537	Highly Stable
Statistical Significance	Significant at 1% level (p=0.000)	Significant at 1% level (p=0.000)	Highly Stable

If we use the winsorized dataset to check the robustness of the analysis, we see that both the magnitude of the coefficient and the statistical significance of the main explanatory variable correspond closely to those in the original model. These results provide strong evidence that the empirical results are insensitive to the influence of outliers, thereby reinforcing the validity and the generalizability of the main conclusions of this study.

5. Conclusions and Policy Recommendations

5.1. Conclusions

Our findings strongly support the assertion that the digital economy is very important for improving the economic quality of Chongqing in Western China. In the initial regression analysis, the main independent variable, the development level of the digital economy (lnindex_aggregate), showed a statistically significant positive correlation (coefficient = 0.025, $p < 0.01$) with the improvement of economic quality. This finding highlights the role of the digital economy in driving high-quality economic growth in Chongqing. This study also confirmed that there was a strong relationship between spatial distance and digital economic indicators.

The instrumental variable (IV) regression results confirmed that the digital economy retained a statistically significant positive influence after dealing with the endogeneity problem. These results show that the digital transformation of the economy can resolve the structural imbalance in production factor allocation well by promoting infrastructure development and building an innovative business ecosystem. When we consider the specific dimensions analyzed here, all the measured dimensions of digital inclusive finance (i.e., service coverage(lncoverage_breadth), application intensity (lnusage_depth), and digital transformation level (lndigitization_level) make statistically meaningful contributions to the quality of economic development, which means that increases in the size and quality of the economy can be achieved at the same time via digitalization. This paper shows how the digital economy is a key player and basic catalyst of local economic development.

Policymaking of Chongqing has verified the development in Chongqing changed over the 10 years of this study, but there was little coordination between the regional economic development strategy and the plans for developing the digital economy.

Taking into account the evolution of municipal policies across the 12th and 13th Five-Year Plan periods (2011–2020), we discern the following characteristics of phased development. In the first phase (the 12th Five-Year Plan), the policy focused on laying institutional foundations and removing obstacles, such as via the Economic Zone Accessible Within 60 Minutes policy and reform of requirement to register in citizens' place of residence, which formed the basis for the mobilization of resources, including human resources, between urban and rural areas.

In the second phase (the 13th Five-Year Plan), the direction focus shifted toward deeper integration and quality enhancement because of the strategic map "13th Five-Year Plan for Establishing Chongqing as a Leading Hub in Internet Economy." This had the goal of achieving deep convergence between digital innovation and traditional industry. Within this period, great progress was made in positioning Chongqing as a well-known domestic center for the digital technology sector.

By 2020, significant progress had been made toward the goal of establishing Chongqing as a leading domestic internet economy hub. Over the ten-year period, the city's digital enablement index reached 87.6%, ranking first in western China. The economic contribution of important digital sectors exceeded 10% of the total GDP of the region annually, highlighting the successful implementation of the shift from traditional spatial planning approaches to the development of strategies for the digital ecosystem of the whole region. This emphasizes the forward-thinking nature of decision-making in this city.

However, regional economic strategies have not shown any relevant beneficial regulatory effects on the way in which digitalization can promote better economic growth. We added to our model a dummy variable for the "Economic Zone Accessible Within 60 Minutes" and its interaction term alongside digital economic factors to study how regional policies affect the impact of digitalization of the economy.

These results indicate that although this policy makes a moderate contribution to regional progress in terms of improving regional connectivity and facilitating factor mobility, the regulatory influence of the policy remains relatively limited, and its effects are very weak compared with those of the main explanatory factor of digitalization of the economy. Apparently, the implementation of "Economic Zone Accessible Within 60 Minutes" policy seems to be constrained by factors such as the duration that this policy has been in place, and regional variations within Chongqing, could limit the effectiveness of the policy. In these cases, the policy must be formulated more precisely, and its effects must be monitored over a longer period to evaluate it comprehensively.

The results highlight an important structural issue. The Economic Zone Accessible Within 60 Minutes policy shows only marginally positive effects on regional development but does not involve any meaningful coordination with the digital transformation strategies. Specifically, this policy does not generate further advantages for or from digital development. This could indicate a basic mismatch between the common policymaking approach of spatial planning and the mobility of production factors in the digital world. Geographical proximity provides only the basic precondition for the spread of technology. To realize the full potential of digital advances, there is a need for additional intangible infrastructure, such as the smooth flow of data, the availability of a digitally skilled workforce, and adequate institutional support. Thus, to transition from physical spatial planning to development of the digital ecosystem, there is a need not only for the evolution of strategic conceptualization but also ways of substantially upgrading policy instruments, not only via solutions that promote physical connectivity.

5.2. Policy Recommendations

Considering the change in regional development strategies in Chongqing in particular and the increasing emphasis placed by officials on important zones in Chongqing, such as Liangjiang New District, and referring to the empirical results of this study, the following policy suggestions are made. We hope that they can be used as a guide for Chongqing and similar regions to coordinate the growth of the digital economy with regional policies for sustainable and high-quality development.

These results highlight the need to promote the link between digital development and policymaking. The integration of digital technologies can help regions become more competitive and economically resilient. Thus, we should make strategic investments in digital infrastructure, talent development, and innovation ecosystems to benefit from this. In addition, we would like to highlight to policymakers that mechanisms for monitoring and evaluating digital initiatives should be established. This would help ensure that the policies are flexible to changes in technology and regional requirements. In addition, public–private partnerships should be encouraged to boost the effects of the digital transformation and to promote growing and durable inclusivity.

When the strategies for digitalization of the economy are combined with regional development plans, conditions for high-quality growth will be well established. With the implementation of these recommendations, Chongqing and other regions can become models for the digital age and achieve economic development along with sustainability.

First, it is necessary to further promote digital transformation strategies that fit the characteristics of a particular region and to choose a particularly suitable development path. From the results of our heterogeneity analysis, we can see that there are numerous differences in the benefits achievable via the digitalization of the economy of such regions with different development backgrounds. Therefore, if we adopt a one-size-fits-all approach to digitalization, this would not be the most favorable option.

For example, for more economically advanced and urbanized regions, including core urban districts (e.g., Yuzhong, Jiangbei, and Yubei), greater attention should be paid to their strong industrial foundation, concentration of talent, and active innovation ecosystems. These areas should take the lead in efforts to achieve the convergence of digital technology with traditional industries and focus more attention on new industries, such as the industrial internet, AI, and connected vehicle technology. They should attempt to establish a digital industry platform that can compete nationally and let these regions become innovation leaders. The digital transformation of entire industrial chains can be accelerated to facilitate the diffusion of technology and to foster innovative business models by adopting different approaches, also in the catalytic role of the leader industry and of the digital platforms that can empower small and medium-sized enterprises.

In less developed areas and rural communities, we believe that more attention should be devoted to the development of equitable digital infrastructure. For example, digital literacy programs, increased coverage of digital services, and the creation of specific digital solutions in agriculture should be given priority to strengthen the digital abilities of people and enterprises. This can help to reduce the risk that differences in digital access between urban and rural areas and between different geographical regions will grow. In the case of regions where there are substantial differences in income between urban and rural areas, reform of the income distribution system and improvements of redistributive mechanisms should be given priority. Efforts to reduce income inequality and boost the purchasing power of rural residents can contribute to establishing an institutional framework that is more conducive to and convenient for running the digital economy.

The convergence of digital technology with the physical economy is key to ensuring the achievement of the benefits of qualitative transformation, efficiency enhancement, and

dynamic evolution. In fact, studies have shown that the digital economy has become an important force for high-quality development. More attention should be focused on the ability of digital economy tools to increase total factor productivity. Acceleration of the establishment of high-quality data warehouses and high-integrity data environments is recommended, following the complete Digital Chongqing plan, to realize the continuous, universal, ecosystem-wide digital reform of related fields, such as the automotive, industrial machinery, high-end materials, and electronics industries. Following the achievements of Chongqing in the era of the "13th Five Year Plan," in which the region consistently ranked first in the country for industrial–digital integration, the implementation of a targeted intelligent manufacturing plan is to be a priority. By 2027, the goal is to achieve a substantial increase in the digital technology adoption rate among manufacturing enterprises above a designated scale, while enabling a greater number of small and medium-sized enterprises (SMEs) to cross the "threshold" of digital transformation. This will foster a new digital ecosystem characterized by the integrated and mutually reinforcing development of enterprises of all sizes—large, medium, and small.

Second, it is important to promote complete alignment between the regional development strategy and digital transformation initiatives to improve policy coordination. At present, conventional regional approaches, such as the Economic Zone Accessible Within 60 Minutes policy, have not achieved real integration with advanced digital initiatives. This means that we have to ask decision-makers to reconsider the fundamental link between spatial planning and the movement of digital resources. In the past, the strategies of regions that focused on physical proximity solved problems relating mainly to transport connectivity and the movement of the physical movement of factors of production. In contrast, the drivers of development in the digital economy era are more fundamentally rooted in the exchange of information, the diffusion of knowledge, and network externalities.

Therefore, future policy improvements should concentrate on establishing cross-regional circulation mechanisms for digital factors, refining the mechanisms of development, retaining digital professionals, and introducing innovative regulations that meet the new needs of the digital economy. The strategic development of important sites, such as Liangjiang New District and Chongqing's High-Tech Zone, also requires planning the simultaneous deployment of the next generation of digital infrastructure. The installation of technology, such as fifth-generation wireless networks, information storage facilities, and computational nodes, must be planned as standard components of regional development. In this way, we can achieve growth in two dimensions: one driven by real geographical places and the other by virtual digital places. Furthermore, local government strategies have to develop from innovation regarding a single policy to system-wide coordinated innovation, which can achieve synergies that increase the effectiveness of implemented policies.

Improving the accuracy and coordination of the strategy for regional development and furthering the transformation of the Economic Zone Accessible Within 60 Minutes to the Chongqing Metropolitan Area is also an inevitable requirement for adapting to the implement development.

In light of the empirical finding that the moderating effect is limited, the further optimizing the mix of regional policy instruments should be refined as follows: (1) Accelerate the growth in coordination between satellite towns and the central urban district. Based on the interconnected infrastructure, jointly construct an Economic Zone Accessible Within 60 Minutes high-quality industrial network and a convenient residential zone to improve the density and functional performance of the metropolitan area. (2) Strengthen the collaborative framework of the "One District, Two Groups" policy. Help the outlying urban regions that are adjacent to the primary metropolitan zone (including Northeast Chongqing Three Gorges Reservoir Area Urban Cluster and Southeast Chongqing Wuling Mountain Area Urban). The industrial functions of the members of such clusters should be made complementary, and they should share public resources and strengthen efforts to achieve joint ecological governance. (3) In addition, lessons should be drawn from past pilot reforms on factor market allocation. Small-scale pilot systems should be implemented in areas such as land resources, labor, capital, technological innovation, and data management. Through institutional innovations in these pilot zones, regional market barriers can be eliminated, thereby enhancing the overall comprehensiveness and effectiveness of policy implementation.

Third, to improve anticipatory capabilities and responsiveness, a flexible policy adaptation framework must be implemented to enhance the forward-looking nature and adaptability of policies. Certain elements of economic development are generally not predictable, and the accelerated evolution of digital innovation adds complexity of policies concerning opening-up, industrial upgrading, and trade. Therefore, it is thus necessary to institute a routine mechanism for policy assessment and dynamic adjustment to promptly capture new developments and emerging trends in areas such as the digital economy, regional development, and international trade. Advanced analytical tools, especially extensive data processing and machine learning, should be used to strengthen governance and decision-making and to build a predictive policy framework and impact evaluation systems. The construction of policy simulation models and performance monitoring platforms will help ensure that policies evolve with changing circumstances and play a truly guiding and enabling role.

This can help ensure that the regulatory measures will be appropriate to the situation of constant change and can fulfil the directive and facilitative function of the regulation in accordance with the strategic term of the Proposals of the Central Committee of the Communist Party of China for Formulating the 14th Five-Year Plan for the National Economy.

In the spirit of the important strategy proposed in "Social Development and the Long-range Objectives through the Year 2035," Chongqing should rapidly build an innovative economy with the domestic economic cycle in the leading position and at the same time promote mutually beneficial relations between national and international markets. Chongqing should clearly find its position and play its own strengths to fulfill its part in implementing certain important national development programs. It is necessary to remove the obstacles to production, distribution, logistics, and consumption to ensure smoother and more efficient circulation in the region is a fundamental condition for unleashing the enabling effects of the digital economy. The findings reveal that the enabling effects of the digital economy can only be fully realized through the organic

circulation across all relevant links.

With respect to manufacturing, we should reinforce the industrial cluster model of "the leading firms leading and the supporting firms following." The region should consolidate its advantages in its two pillar industries — electronic information and automobiles — while promoting emerging industries, such as biotechnology, aerospace, and advanced materials, thereby establishing itself as a well-recognized base for high-end manufacturing in China.

Regarding distribution, we should continue the market-oriented reform of production factors, raise the proportion of labor income in the initial distribution, refine the mechanisms of redistribution, and broaden the scope of the middle class will provide momentum for the ongoing improvement of consumption patterns.

Regarding distribution networks, the development of the New International Land-Sea Trade Route should be exploited, along with the use of advanced transport infrastructure and digital technologies to create a complete single-contract freight management system. Digital connections should be incorporated into the Chongqing–Europe Railway Express route to improve logistics operations and reduce distribution costs.

With respect to the consumer market, the "Chongqing – The City That Never Rests" concept as a unique brand can help achieve the digital transformation of the traditional retail environment and develop emerging businesses such as smart commerce, heritage tourism, and drug innovation. Developing consumer demand should drive innovative supply solutions, which would in turn generate fresh market demands as a feedback loop.

Taking advantage of the present phase of the development of Digital Chongqing, we see the opportunity to expand from this pilot phase in one location to implementing similar projects across the country. This constitutes a strategic priority for future development.

The municipality is currently in a phase in which the foundational work will transition into a phase of rapid growth. The priority initiatives should then focus on certain directions, such as the following:

First, it is important to accelerate the establishment of the new AI areas - Dual Institutes and One Bay of Chongqing, which could address the basic challenges obstructing the advancement of AI, such as a lack of talent and the gap between technological research and industrial application. We hope to establish a good innovation ecosystem by integrating input from industry, academia, research, and application.

Second, by leveraging the Western Data Exchange Center, Chongqing should actively explore frameworks for data ownership verification, data asset value, data transaction rules, and market price mechanisms. At this stage, Chongqing should become a model of efficient data resource allocation. This model can provide replicable and scalable experiences for the development of national data factor markets to establish a strong and flexible framework to encourage the development of a data element market in China.

Third, it is also necessary to improve and deepen the integration of digital services in local government operations and to use available technological tools to promote the governance structure and competence within the metropolis.

In other words, we can see that in the digital age, Chongqing's economic development relies on the digital economy as the main driving force.

However, it must be controlled and coordinated with local policies while ensuring favorable basic conditions that enable it to be achieved. From the findings of our research, we see that it is essential to facilitate cooperation and coordination between regional governance and the digitalization of the economy to change the focus from traditional spatial planning to the establishment of a complete digital ecosystem. This is the basic strategy for retaining digital benefits while improving the quality of overall development. In this way, Chongqing should be able to cultivate new competitive edges in the world of changing economic trends while adhering to innovation-driven development, coordinating urban-rural integration, and fostering internal-external linkages. In the future, the basic principles of adapting measures to local conditions, the optimization of collaboration, and adaptation and refinement to ensure continuous synchronization between digital transformation and regional development targets. Such strategic coordination should generate durable growth drivers to promote high-quality economic development in Chongqing while making it an example for other inland areas to make digital transformation a driver of modernization of their regions.

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