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Research on the Impact of Digitization on the Economic Resilience of Cities

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Abstract: *Based on the panel data of 285 prefecture-level and above cities in China from 2008 to 2021, this paper constructed a comprehensive evaluation index system of digitization and urban economic resilience, adopted the entropy weight TOPSIS for the processing, and used the panel fixed-effects model and mediated-effects model to explore the impact of the level of digitization development on the economic resilience of the city, and the results show that:(1) The benchmark test found that digitization has a significant positive impact on the improvement of urban economic resilience. (2) Heterogeneity analysis found that the development of digitization would show heterogeneity due to different geographic locations, city sizes, and city levels, and relatively speaking, the promotion effect of digitization development on urban economic resilience is larger in northeastern regions, small and medium-sized cities, and sub-provincial cities. (3) The mediation effect test finds that digitalization can enhance urban economic resilience through two paths: promoting innovation and entrepreneurship and improving social security. In summary, to better exert the positive effect of digitization on urban economic resilience, the relevant departments should actively promote the digital transformation of industries, and promote the integration and development of digitization with the real economy and the social security system to enhance urban economic resilience.*

Keywords: *Digitalization, Urban Economic Resilience, Mediating Effects*

1. Introduction

A resilient economy can perceive external risks in time, resist the negative impact of external shocks, and quickly adjust the development path to realize stable operation again. Since China began to implement the policy of reform and opening up, the market economy has experienced several external shocks that hindered the momentum of development, such as the Asian financial turmoil, the global economic crisis, the U.S.-China trade disputes, as well as the New Crown Epidemic, etc., and China's economy has been able to withstand several strong impacts and adapt to the changing external environment mainly due to its strong economic resilience [1]. The Chinese economy has been able to withstand several strong shocks and adapt to the changing external environment mainly because of its strong economic resilience [1]. Therefore, the state and the government hope to have a strong economic system, can maintain its state after the shock, absorb the negative impact of the shock, quickly recover the original state after the crisis, adjust the long-term balanced development track, to avoid falling into a deep predicament [2]. The theory of economic resilience provides new thinking for the healthy development of urban systems, and enhancing economic resilience and improving economic resilience, resistance, renewal, and reorganization in the post-epidemic era [3] has become an important way for China to grasp the initiative of economic development and achieve high-quality development.

Digitization means that in the tide of the information revolution, a production factor with information and knowledge as the core, using the Internet as the main carrier, through the efficient use of information and communication technology to improve efficiency and promote the optimization of the economic structure. 2021, the national "Fourteenth Five-Year Plan" explicitly proposed to seize the opportunity of the development of the digital economy, to accelerate the process of digitalization. Accelerate the process of digitalization. Digital technology is an important bridge that connects traditional and emerging industries, promotes the deep integration and symbiosis between digital technology and traditional industries, and is a new economic growth mode of integration and innovation. Under the new development pattern, accelerating digital transformation and enhancing the

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city's economic resilience is the key to coping with external shocks and realizing high-quality development. In the context of accelerating digital transformation and achieving high-quality economic development, the role played by digital transformation in the field of urban economic resilience has also attracted increasing attention. Given this, based on the panel data of 285 prefecture-level and above cities in China from 2008 to 2021, this paper constructs a comprehensive evaluation index system of digitalization and urban economic resilience, adopts the entropy weight TOPSIS method for processing, and applies the panel fixed effect model and the mediation effect model to explore the impact of the level of digitalization development on the economic resilience of the city, to promote the digitalization in the field of urban economic resilience It provides the theoretical basis and practical guidance for promoting digitalization in the field of urban economic resilience, to enhance urban economic resilience and promote high-quality economic and social development at an early date. Combined with the analysis of existing literature, we believe that digitalization can enhance urban economic resilience, and can indirectly enhance economic resilience by promoting regional innovation and entrepreneurship activity and improving the level of social security, which are specifically divided into the following aspects(Figure 1).

1.1 The Direct Impact of Digitization on the Economic Resilience of Cities

Digitization can directly enhance the resilience of urban economies because the widespread use of digital technologies can improve the ability of urban economic systems to adapt and recover from external shocks. First, digitization facilitates the rapid flow and sharing of information, enabling urban economies to respond quickly to external economic shocks by adjusting their economic structures and operating modes to reduce the negative impacts of external shocks. Second, digitization also promotes the diversification of urban economies, reducing dependence on a single economic sector through the rise of new businesses such as digital platforms and e-commerce, thus enhancing the stability of the economic system in the face of fluctuations. In addition, the application of digital technology also promotes the intelligent upgrading of urban infrastructure and services, which enhances the city's ability to cope with emergencies, and the city's resistance and resilience will be better[4], further enhancing the resilience of the urban economy. Based on this, this paper proposes hypothesis one.

H1: There is a significant direct positive impact of digitization on the economic resilience improvement of cities

1.2 Indirect Effects of Digitization on the Economic Resilience of Cities

Digitalization has an indirect positive impact on the economic resilience of cities by promoting innovative and entrepreneurial activity. On the one hand, digital technology lowers the threshold of entrepreneurship and provides a convenient entrepreneurial environment and market access opportunities for micro and small enterprises and start-ups, thus stimulating innovation and entrepreneurial enthusiasm in cities. These new enterprises and business forms not only enrich the structure of the city's economy, but also inject new growth momentum into the city's economy. In the face of external economic shocks, this innovation and entrepreneurial activism can facilitate rapid economic adjustment and transformation, and improve the adaptability and resilience of urban economies. On the other hand, the important role of innovation in the economic resilience of a city is that it allows it to quickly enter a period of regional repair and redevelopment after a crisis [5]. The reason is that although this kind of shock has caused a blow to creativity, it also represents the possibility of releasing all kinds of resources, and regions with high innovation can more quickly carry out new production activities and form new comparative advantages after obtaining these resources, thus opening up new growth paths [3], and thus enhancing the resilience of the city's economy. Based on this, this paper proposes hypothesis two.

H2: Digitization enhances urban economic resilience by improving innovation and entrepreneurship activities

Digitalization can also indirectly enhance urban economic resilience by improving and increasing the level of social security. Digital technology makes social security services more convenient and efficient, such as online medical services, distance education, and smart social assistance, etc. The enhancement of these services can help alleviate the direct impact of economic shocks on the lives of urban residents and enhance their sense of security and happiness. At the same time, an efficient social security system can provide necessary support to the unemployed and low-income groups during economic downturns and mitigate the impact of economic fluctuations on social stability. In addition, a

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sound social security system can also promote social equity, enhance social cohesion, and provide a solid social foundation for the sustained and healthy development of the urban economy, thereby enhancing the resilience of the urban economy. Based on this, the paper proposes hypothesis three.

H3: Digitization enhances urban economic resilience by promoting the level of social security

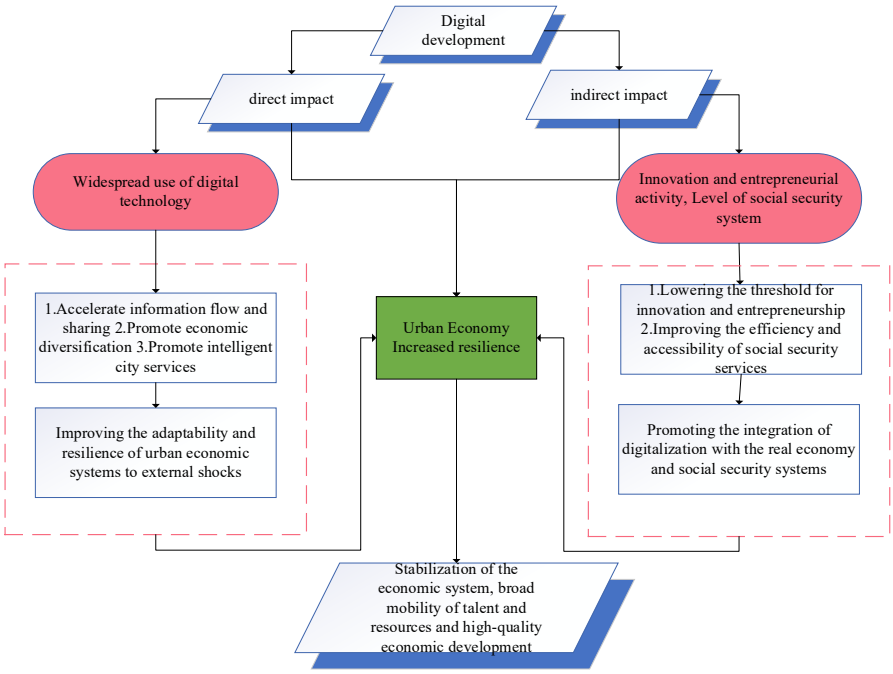

Figure 1: Research framework diagram

In summary, digitization positively affects the resilience of urban economies through direct and indirect paths, which not only enhances the adaptive capacity and resilience of urban economies but also provides strong support for the sustainable development of urban economies.

2. Models, Variables, and Data

2.1 Empirical Model Construction

2.1.1 Basic regression model

To examine the direct impact of digitization on the economic resilience of cities, this paper constructs a panel fixed effects model:

$$UER_{it} = \alpha_0 + \alpha_1 DIGI_{it} + \alpha_c Z_{it} + \alpha_c Z_{it} + \varepsilon_{it} \tag{1}$$

Where UER is the explanatory variable, i.e., urban economic resilience; $DIGI$ is the digitization index; Z is a series of control variables; ε denotes the random perturbation term; if the regression coefficient α_1 is significantly positive, then it proves that there is a direct positive and significant impact of digitization on the enhancement of urban economic resilience.

2.1.2 Mediation effects model

To explore the mechanism of the role of digitization on the economic resilience of cities, we selected two variables to moderate the innovation and entrepreneurial activities and the level of social security:

$$Entr_{it} = \beta_0 + \beta_1 DIGI_{it} + \beta_c Z_{it} + \varepsilon_{it} \tag{2}$$

$$UER_{it} = \gamma_0 + \gamma_1 DIGI_{it} + \gamma_2 Entr_{it} + \gamma_c Z_{it} + \varepsilon_{it} \tag{3}$$

$$Sse_{it} = \omega_0 + \omega_1 DIGI_{it} + \omega_c Z_{it} + \varepsilon_{it} \tag{4}$$

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$$UER_{it} = \eta_1 DIGM_{it} + \eta_2 Sse_{it} + \eta_c Z_{it} + \varepsilon_{it} \tag{5}$$

Among them, innovation and entrepreneurship activity ($Entr$) and social security level (Sse) are mediating variables, and the meanings of other variables are equivalent to (1). If the regression coefficients $\beta_1, \gamma_1, \gamma_2, \omega_1, \eta_1$ η_2 are significantly positive, it proves that innovation entrepreneurial activity and social security level assumes a mediating role in the improvement of economic resilience of cities by digitalization, and the role is significant.

2.1.3 Variable description

Explained variable: urban economic resilience (UER). The essence of urban economic resilience refers to its ability to maintain its health and stability without widespread economic disorder and order restoration when it suffers a huge external shock. This paper draws on the practice of drawing He Guosheng [6] to measure urban economic resilience by constructing the urban economic resilience index system(Table 1).

Explanatory variables: digitalization ($Entr$). At present, in the specific measurement of the level of development of the digital economy, direct specific measures are less common, and the level of digitalization development is measured from five indicators, namely, R&D personnel, the number of students enrolled in general undergraduate and tertiary institutions, the number of employees in the information transmission, computer services, and software industry, the share of internal expenditure on R&D in GDP and the number of patents granted.

Mediating variables: innovation and entrepreneurship activity ($Entr$), this paper takes the ratio of the total number of urban private and self-employed workers to the urban resident population to represent; the level of social security (Sse), concerning the practice of Wang Yannan et al. (2020) [7], the ratio of the number of people insured in each of the unemployment insurance and medical insurance to the total population is selected to calculate the mean value to represent its overall level.

Control variables: To more comprehensively analyze the impact mechanism of digitization on urban economic resilience, this paper constructs five control variables to more systematically analyze the mechanism of digitization on urban economic resilience. They are the level of economic agglomeration, as the ratio of gross regional product to the land area of the administrative region; the level of infrastructure, as the proportion of total investment in fixed assets to GDP; the degree of government intervention, as the proportion of local financial expenditure in the general budget to GDP; the industrial structure, as the proportion of value added of secondary and tertiary industries to GDP; and the human capital, as the proportion of professional and technical personnel to the total urban labor force.

Table 1: Comprehensive system of indicators of Digitization and urban economic resilience

Variables	Indicators	Unit	Weights
Digitize	R&D staff	ten thousand people	0.1864
	Number of students enrolled in general undergraduate programs	ten thousand people	0.1601
	Number of employees in the information transmission, computer services, and software industry	ten thousand people	0.3050
	Internal expenditure on R&D as a share of GDP	%	0.1019
	Number of patents granted	piece	0.2466
Urban Economic Resilience	Per capita GDP	ten thousand yuan	0.1206
	Urban registered unemployment rate	%	0.0001
	Savings balance of urban and rural residents as a share	ten thousand	0.1362

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	of GDP	yuan	
	Total retail sales of consumer goods as a share of GDP	ten thousand yuan	0.1484
	Deposit balances of financial institutions as a percentage of GDP at the end of the year	ten thousand yuan	0.1891
	Expenditure on education as a share of GDP	ten thousand yuan	0.1082
	Science expenditure as a share of GDP	ten thousand yuan	0.2974

By performing descriptive statistics on the sample information of all the variables in the research topic, which contains the mean, standard deviation, minimum and maximum values of the core explanatory variables, the explanatory variables, and the explained variables, these indicators are shown in Table 2.

Table 2: Results of descriptive statistics for each variable

Var Name	Obs	Mean	SD	P5	Median	P95
Urban economic Resilience	3990	0.0546	0.0646	0.0100	0.0384	0.1469
Digitize	3990	0.0287	0.0549	0.0020	0.0107	0.1248
Level of economic agglomeration	3990	2687.9282	5979.2176	128.4279	1109.6589	9290.1592
Level of infrastructure	3990	0.8995	0.5326	0.3063	0.7892	1.8706
Degree of government intervention	3990	0.1971	0.1287	0.0893	0.1672	0.3924
Industrial structure	3990	87.4627	8.0825	72.8700	88.5950	98.3100
Human capital	3990	0.0079	0.0068	0.0020	0.0060	0.0208

2.2 Data Sources

To reflect the resilience and recovery ability of each place after being hit by the economic crisis, the financial crisis of 2008 is taken as the boundary, and the impact caused by the new Crown pneumonia epidemic in 2020 is also taken into account, so the period of 2008-2021 is taken as the sample period for the study of economic resilience; and 285 sub-provincial cities, municipalities directly under the central government and prefectural-level cities across the country are also taken as the objects of the study, and some of the samples with serious data deficits are excluded. The data involved in calculating the digitization and economic resilience values and the relevant variables used in the empirical part are all obtained from the Cathay Pacific database, China Urban Statistical Yearbook, China Statistical Yearbook, China Urban Construction Yearbook, and China Regional Economic Statistical Yearbook, provincial statistical yearbooks, the national economic and social development statistical bulletins of various cities and municipalities, and the relevant data of the National Bureau of Statistics, etc. Individually, the missing data are filled in using the interpolation method to fill in.

3. Empirical Results

3.1 Baseline Regression Analysis

Table 3 demonstrates the results of the benchmark regression of digitization affecting urban economic resilience under the panel fixed effects model. The findings show that the coefficients of the

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relationship between digitization and urban economic resilience are all significant, which suggests that digitization has a positive effect on urban economic resilience, initially testing the previous hypothesis 1. Specifically, column (2) is the result of not adding any control variables, and the result shows that the coefficient of the core explanatory variable is 0.7520, and it passes the test at the 1% level of significance, which suggests that digitization has a significant contributing effect on urban economic resilience has a significant contributing effect. The resilience, resistance, renewal, and re-organization [2]of cities are increasing in the process of digital transformation and digital development. Column (4) is the result after adding the level of economic agglomeration, the level of infrastructure, the degree of government intervention, industrial structure, and human capital as control variables regression, the data show that for every 1 unit increase in digitalization of a city, the economic resilience of the region will rise by 0.5769 units simultaneously. It shows that the development of digitalization is an important factor affecting the economic resilience of cities and shows a positive correlation, and the development of digitalization accelerates the flow of information in the city, improves the proportion of high-skilled labor, and optimizes the allocation of resources, which can effectively enhance the economic resilience of cities.

Table 3: Impact of digitization on the economic resilience of cities

Variables	Urban economic resilience			
	(1)	(2)	(3)	(4)
Digitize	0.7555***	0.7520***	0.5824***	0.5769***
	(53.0331)	(52.6771)	(27.8765)	(27.3308)
Level of Economic agglomeration			0.0000***	0.0000***
			(16.6130)	(16.1672)
Level of infrastructure			0.0002	-0.0022
			(0.1508)	(-1.2980)
Degree of government intervention			0.0300***	0.0251***
			(4.5872)	(3.7763)
Industrial structure			0.0002	0.0001
			(1.5445)	(0.8912)
Human capital			-0.2121	-0.1539
			(-1.6185)	(-1.1608)
_cons	0.0329***	0.0330***	0.0110	0.0201**
	(27.7708)	(37.5479)	(1.0998)	(1.9702)
Time/city fixed	NO	YES	NO	YES
N	3990	3990	3990	3990
R^2		0.4111		0.4551
Adj. R^2		0.4090		0.4525

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% statistical levels, respectively; t-values are in parentheses. Tables 4-11 are identical.

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3.2 Robustness Tests

3.2.1 Changing the Methodology for Measuring the Economic Resilience of Cities

This study draws on Zhao Chunyan's approach to measuring the economic resilience of cities using the indicator system method to overcome the shortcomings caused by the single measurement method currently used. By calculating the real GDP growth rate of each city in each year and the real GDP growth rate in 2008. However, the difference is that the larger the difference indicates the stronger the economic resilience of the city. As can be seen from column (1) of the estimation results in Table 4, digitization is still significantly positive for city economic resilience after replacing the city economic resilience measurement method, and the results are robust.

3.2.2 Data for cities excluding municipalities

Considering that this paper is using data at the prefecture-level city level and that there is not much difference between the data of China's municipalities and provinces, to avoid statistical errors, the remaining 281 cities after excluding the four municipalities of Beijing, Shanghai, Chongqing, and Tianjin are reanalyzed by regression analysis on the sub-sample. The results are shown in column (2) of Table 4. It can be found that the digitization is still significant at the 1% level, which again verifies the robustness of the results.

3.2.3 Carry out the indentation process

To eliminate the effect of outliers on the results of the baseline regression, all variables were subjected to 1% and 99% quantile shrinkage and the regression analysis was re-run and the results, as shown in Column (3) of Table 4, show that the digitized coefficients are still significant at the 1% level and the magnitude of the coefficients did not change significantly, which further tests the robustness of the results of the study.

Table 4: Robustness regression results

Variables	(1)	(2)	(3)
Digitize	12.7392***	0.8440***	0.8321***
	(5.0310)	(37.4940)	(36.0715)
Level of economic agglomeration	0.0001***	0.0000***	0.0000***
	(5.3827)	(14.2000)	(7.3948)
Level of infrastructure	0.1857	-0.0025*	-0.0026
	(0.9191)	(-1.8272)	(-1.5754)
Degree of government intervention	5.1964***	0.0342***	0.0383***
	(6.5089)	(6.2672)	(4.6383)
Industrial structure	-0.0237*	-0.0002**	-0.0001
	(-1.7653)	(-2.1255)	(-0.7778)
Human capital	-15.7194	0.3771***	-0.4207***
	(-0.9886)	(3.4146)	(-3.4481)
_cons	-10.2618***	0.0352***	0.0320***
	(-8.3755)	(4.2172)	(3.1792)
Time/city fixed	YES	YES	YES
N	3990	3934	3990
R^2	0.0420	0.5575	0.5068
Adj. R^2	0.0374	0.5554	0.5044

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3.2.4 Excluding the effect of the 2008 financial crisis as well as the epidemic (2019-2021)

To test whether the results are affected by the financial crisis in 2008 and the epidemic in 2019-2021, this paper excludes the data of these two periods of time to regress the remaining samples respectively, and the size and significance of the digitized coefficients do not change significantly from columns (1) and (2) of Table 5, and the regression results are robust.

Table 5: Robustness regression results

Variables	(1)	(2)
	Removing the effects of the financial crisis	Removing the impact of the epidemic
Digitize	0.5739***	0.6032***
	(26.1251)	(25.3884)
Level of economic agglomeration	0.0000***	0.0000***
	(15.6007)	(17.0984)
Level of infrastructure	-0.0021	-0.0028
	(-1.2062)	(-1.0314)
Degree of government intervention	0.0242***	0.0295***
	(3.5178)	(4.5605)
Industrial structure	0.0001	0.0000
	(0.8706)	(0.1458)
Human capital	-0.1642	-0.1849
	(-1.1615)	(-1.4343)
_cons	0.0205*	0.0244**
	(1.8740)	(2.4135)
Time/city fixed	YES	YES
N	3705	3135
R^2	0.4551	0.4775
Adj. R^2	0.4524	0.4748

3.2.5 Endogeneity test: instrumental variables approach

This paper adopts a double fixed-effects model for the test, which reduces the endogeneity problem to a certain extent, but digital development is conducive to shaping the city's economic resilience, and cities with higher economic resilience are more likely to capture the spillover effects of digital technology and thus promote the development of the local digital industry, and there may be mutual causation between digital development and the city's economic resilience, leading to endogeneity problems [8]. Therefore, this paper draws on Nunn and Qian (2014) [9], and uses historical data on post and telecommunications at the end of 1984 as an instrumental variable for the digital development indicator. As digitization is an extension of traditional communication technology, local historical communication facilities will be from the level of technology that will affect the subsequent application of digitization; and traditional communication tools such as postal and telecommunication telephones have a minimal impact on future economic development to satisfy exclusivity. The estimation results are shown in Table 6, the Craagg-Donald Wald F-value is 1187.781>10, which excludes the problem of weak instrumental variables and satisfies the condition of instrumental variable use. After adjusting for endogeneity, the role of digital development in increasing the economic resilience of cities remains and is significant at the 1% level of significance. Overall, the above tests confirm the robustness of the

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impact of digital development.

Table 6: Endogeneity test

Variables	(1)	(2)
	Digitize	Urban economic resilience
Iv	0.0116***	
	(34.4642)	
Digitize		0.9012***
		(19.9192)
Control	YES	YES
Time/city fixed	YES	YES
Anderson canon. corr. LM statistic	915.630	
Cragg-Donald Wald F statistic	1187.781	
_cons	-0.1582***	
	(-22.0660)	
N	3990	3990
R^2	0.6738	0.4227
Adj. R^2	0.6722	0.4198

3.3 Heterogeneity Test

Differences in factors such as geographic location, city size, and city level lead to different degrees of informatization; at the same time, faced with the same external stimuli, their resilience will also show different performances. On this basis, this paper argues that it is necessary to distinguish between differences in geographic location, city size, and city level to test the differential impact of digitalization on the economic resilience of cities.

3.3.1 Analysis of geographic heterogeneity

According to the natural conditions, economic foundation, level of development, and degree of opening to the outside world of each region. China's economic regions are divided into four major regions: east, central, west, and northeast. As can be seen from Table 7, the impact of digitization on the economic resilience of cities in the east, west, central, and northeastern regions all pass the 1% significance test, and the estimated coefficient values of their driving roles are 0.6053, 0.6032, 0.9831, and 2.0895, which indicates that the impact of digitization in different regions on enhancing economic resilience has a significant enhancement, and its enhancement varies with region shows greater variability. Throughout the sample period, the Northeast region has the strongest digitization-driven effect, followed by the West and East regions, and the Central region is the weakest. The reason for such regional differences may lie in the fact that the central region has a weaker foundation for socio-economic development, such as the level of economic agglomeration and infrastructure, and is subject to resource constraints and a more backward model of regional economic development, limiting the quality of regional digitalization, and thus has a limited ability to leverage digitalization on the city's ability to carry out innovative activities, develop new industries, and a range of consumer needs in the post-crisis period. The central and north-eastern regions, with their regional advantages, industrial structures, infrastructure levels and national policies, and close inter-city interactions, have been able to promote the improvement of the efficiency of inter-city factor allocation and linkage development, and have been able to adjust the direction of their urban structures promptly to fully adapt to external changes and to help stabilize and efficiently operate their urban economic systems.

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Table 7: Regression results for different cities in affiliated regions

Variables	(1)	(2)	(3)	(4)
	Urban economic resilience			
Digitize	0.6053***	0.6032***	0.9831***	2.0859***
	(25.5155)	(25.3884)	(23.3337)	(23.1302)
Level of economic agglomeration	0.0000***	0.0000***	-0.0000***	-0.0000***
	(17.7399)	(17.0984)	(-5.0562)	(-13.4284)
Level of infrastructure	0.0009	-0.0028	0.0088***	0.0018
	(0.3426)	(-1.0314)	(3.6257)	(0.5410)
Degree of government intervention	0.0315***	0.0295***	-0.0701***	-0.1320***
	(4.8989)	(4.5605)	(-3.7539)	(-4.1885)
Industrial structure	0.0001	0.0000	0.0001	0.0008***
	(0.5928)	(0.1458)	(0.6372)	(3.5655)
Human capital	-0.2102	-0.1849	0.0935	0.6290***
	(-1.6381)	(-1.4343)	(0.4161)	(2.8950)
_cons	0.0167*	0.0244**	0.0254*	0.0074
	(1.6998)	(2.4135)	(1.9501)	(0.3190)
N	3135	3135	1120	476
R^2		0.4775	0.5835	0.6138
Adj. R^2		0.4748	0.5763	0.5977

3.3.2 Analysis of City Size Heterogeneity

Table 8: Regression results for cities of different city sizes

Variables	(1)	(2)	(3)
	Urban economic resilience		
Digitize	-0.4878	0.5769***	0.5834***
	(-0.7321)	(27.3308)	(24.7028)
Level of economic agglomeration	0.0000***	0.0000***	0.0000***
	(12.4986)	(16.1672)	(14.5969)
Level of infrastructure	-0.0135***	-0.0022	-0.0008
	(-3.5814)	(-1.2980)	(-0.3765)
Degree of government intervention	0.0398***	0.0251***	-0.0148
	(2.7347)	(3.7763)	(-1.0561)
Industrial structure	-0.0013***	0.0001	-0.0001
	(-3.0411)	(0.8912)	(-0.6225)
Human capital	-1.1599**	-0.1539	-0.2494
	(-2.1760)	(-1.1608)	(-1.6417)
N	70	3990	3304
R^2	0.9109	0.4551	0.4520
Adj. R^2	0.8770	0.4525	0.4488

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Differences in the size of cities, which make them different in terms of resource factor agglomeration and economic resilience, may lead to heterogeneity in the role of digitization in enhancing the economic resilience of cities. When unpredictable crises and shocks occur, cities can rely on economic activities brought about by digitization to buffer the disruption of external shocks to the urban economy, and they can also rely on an abundant labor market to enable enterprises to make more rapid adjustments to adaptive economic outcomes after being hit by shocks, thus improving the resilience and recovery of the urban economy. Therefore, according to the city size division criteria in the 2014 Notice of the State Council on Adjusting the City Size Division Criteria (Guo Fa [2014] No. 51), the city data is divided into large cities, medium-sized and small cities. As can be seen from Table 8, the estimated coefficient of the regression of digitization on urban economic resilience for large and above cities is -0.4878, the effect of digitization on urban economic resilience for medium-sized cities is significantly positive at the 1% level with an estimated coefficient of 0.5769, and the estimated coefficient of the regression of digitization on urban economic resilience for small-sized cities is 0.5834, which is significantly positive at the 1% level of confidence. This indicates that digitization drives urban economic resilience in small and medium-sized cities, but not in large cities and that digitization drives small cities more than medium-sized cities. The possible reasons for this are that small and medium-sized cities are smaller in size and volume compared to large cities and that industrial incentives, economic base, and productivity improvements brought about by the development of digitization have a more pronounced effect on economic resilience.

3.3.3 Analysis of city-level heterogeneity

In this paper, the sample is divided into two categories sub-provincial cities (including municipalities directly under the central government) and prefectural cities according to the administrative level of cities according to national regulations. The estimation results of the impact of digitization on the economic resilience of cities under different city levels are shown in Table 9, from which it can be seen that the digitization coefficients of sub-provincial cities (including municipalities directly under the central government) and prefectural-level cities both pass the significance test of 1%, and the estimated coefficients of their driving effects are 0.7911 and 0.6996, respectively, which indicates that the impact of digitization on the enhancement of the economic resilience of cities under different city administrative levels all have significant enhancing effect, and the driving effect of digitization is stronger in sub-provincial cities (including municipalities directly under the central government) than in prefecture-level cities throughout the sample period. The reason for this may be that for sub-provincial cities and municipalities, the level of urban economic agglomeration is higher, and the level of infrastructure, human capital, and other factors of production agglomeration in the city is also higher; furthermore, under the national policy and government intervention, the city's R&D investment, innovation capacity, and digitization are increasing, which contributes greatly to the harmonious development of all kinds of industries in the city. In terms of consumption, consumers tend to choose more diversified cities. The digitalization process of manufacturing and the development of consumer digitalization form a positive feedback and self-enhancing internal mechanism, which promotes the digitalization of provinces (municipalities directly under the central government) and the development of the urban economy, and thus strengthens the economic resilience of cities.

Table 9: Regression results for different levels of the city

Variables	(1)	(2)
	Urban economic resilience	
Digitize	0.7911***	0.6996***
	(6.2302)	(27.2366)
Level of economic agglomeration	0.0000***	0.0000***
	(6.6618)	(15.9699)
Level of infrastructure	0.0513	-0.0034***
	(1.6033)	(-3.4450)
Degree of government intervention	0.0079	0.0361***

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	(0.0357)	(9.2382)
Industrial structure	-0.0304***	-0.0001
	(-8.4080)	(-0.8305)
Human capital	-3.4923***	0.3786***
	(-3.2426)	(4.6145)
N	266	3724
R^2	0.3860	0.4317
Adj. R^2	0.3386	0.4288

3.4 Intermediary Mechanism Test

The previous section answered the question of whether digitization affects urban economic resilience by identifying strategies and robustness analysis. Then, through what channels does digitization have an impact on urban economic resilience? By combing through them we find that innovation entrepreneurial activity and social security level are important elements that affect economic resilience.

3.4.1 Innovation and entrepreneurship activation role path

According to the regression results in Table 10, the coefficients of the impact of digitization on the indicators of urban economic resilience are all significantly positive at the 1% confidence level, indicating that there is a significant positive impact of digitization on urban economic resilience. Specifically, column (1) is the core explanatory variable coefficient estimate of 0.4005 without adding control variables and double fixed model, and passed the test at a 1% significance level, indicating that digitization has a significant contributing effect on urban economic resilience. Meanwhile, comparing the direct regression coefficient of digitization on urban economic resilience to 0.2685, when innovation and entrepreneurship activity is used as a mediating variable, the coefficient of column (3) decreases compared to column (1), indicating that innovation and entrepreneurship activity is an effective mediating mechanism for digital economic development to promote the enhancement of urban economic resilience.

Table 10: Analysis of the results of the moderating effect of digitization on innovation and entrepreneurship activity

Variables	(1)	(2)	(3)
	Innovation and entrepreneurship activity		
Digitize	0.4005***	0.3967***	0.2685***
	(21.5486)	(21.4553)	(10.3609)
Level of economic agglomeration			0.0000***
			(7.5567)
Level of infrastructure			-0.0143***
			(-6.9349)
Degree of government intervention			0.0062
			(0.7605)
Industrial structure			0.0023***
			(16.6144)
Human capital			-2.2413***
			(-13.7706)
_cons	0.1056***	0.1057***	-0.0649***
	(27.3371)	(92.7857)	(-5.1764)
N	3990	3990	3990
R^2		0.1038	0.2545
Adj. R^2		0.1006	0.2509

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3.4.2 Path of Effect on Social Security Level

As can be seen from Table 11, the effect of digitization on the level of social security is significantly downward at the 1% level, i.e., digitization has a significant positive effect on the overall level of social security in the city. Comparison with the regression coefficients in column 2(3) of Table 2 reveals that the latter digitalization has a stronger effect on the economic resilience of the city compared to the former, indicating that the level of social security has a significant role in driving the economic resilience of the city. It can be seen that the level of social security serves as an effective medium to influence urban economic resilience through digitization.

Table 11: Analysis of the results of the moderating effect of digitization on the level of social security

Variables	(1)	(2)	(3)
	Level of Social Security		
Digitize	0.7197***	0.7205***	0.2874***
	(31.5689)	(31.6032)	(9.1574)
Level of economic agglomeration			0.0000***
			(12.8515)
Level of infrastructure			-0.0344***
			(-13.7293)
Degree of government intervention			-0.0076
			(-0.7679)
Industrial structure			0.0029***
			(17.3121)
Human capital			-0.4229**
			(-2.1460)
_cons	0.1352***	0.1351***	-0.0771***
	(19.2556)	(96.2355)	(-5.0765)
N	3990	3990	3990
R^2		0.2008	0.3590
Adj. R^2		0.1980	0.3560

4. Conclusions and Recommendations

Based on the panel data of 285 prefecture-level and above cities in China from 2008 to 2021, this paper evaluates them using the entropy weight TOPSIS method, explores the mechanism of the degree of digitalization development on the economic resilience of the cities through the panel-fixed effect and mediated effect models, and conducts empirical analysis on them, and the empirical results show that digitalization plays a positive role in the enhancement of the resilience of the cities. Through the heterogeneity analysis, it is found that the development of digitalization will show heterogeneity because of the different geographic locations, city sizes, and city levels, and comparatively speaking, the digital development of the Northeast, small and medium-sized cities, and sub-provincial cities have a greater effect on the promotion of urban economic resilience. Finally, in the mediation effect test found that digitalization can enhance urban economic resilience through two paths promoting innovation and entrepreneurship and improving social security. In summary, to better exert the positive effect of digitization on urban economic resilience, the relevant departments should actively promote the digital transformation of industries, and promote the integration and development of digitization with the real economy and the social security system to enhance urban economic resilience.

Promote industrial digital transformation. First, the state can increase support for the research development and application of digital technology. It can support enterprises to accelerate the pace of

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digital transformation by increasing investment in scientific research, setting up special funds, and formulating relevant policies and regulations. At the same time, it encourages cooperation among industries, universities, and research institutes, promotes the transformation and application of scientific and technological achievements, and promotes the innovative development of the urban economy. Secondly, the development of a digital economy cannot be separated from a good information infrastructure, the state can increase investment in the construction of infrastructure such as the Internet, 5G networks, big data centers, etc., to improve the level of informatization in the city and provide strong support for the digital transformation of industries. In addition, the state can promote the upgrading and transformation of related industries. For different industries, it should formulate corresponding digital transformation plans and policy measures, prompting enterprises to increase the application of digital technology, improve production efficiency and product quality, and enhance the competitiveness and resilience of the city's economy. Strengthen the training and introduction of talents. First of all, digital transformation requires the support of a large number of professionals, the state can set up relevant training programs to enhance the digital skills and application capabilities of talents, and at the same time encourage the introduction of international talents to promote the development of the city's digital economy. In addition, the state can strengthen policy guidance to encourage enterprises to increase their investment in digital transformation. Through tax incentives, subsidy support, and reduced approval procedures, enterprises are incentivized to actively participate in digital transformation to promote sustainable growth of the city's economy.

Promote the integration and development of digitalization with the real economy and the social security system. The state can encourage real economy enterprises to increase the application of digital technology to improve productivity and product quality while reducing costs and enhancing market competitiveness. For example, promoting industrial Internet and Internet of Things technologies to digitize and intellectualize the production process, improve the overall efficiency and flexibility of the industry, and promote the widespread application of digital technologies in the real economy. Second, the management and operation of the social security system can be optimized with the help of big data and artificial intelligence technologies to improve service efficiency, reduce management costs, ensure timely and accurate distribution of welfare benefits, and further enhance the quality of life and sense of well-being of urban residents.

Promote the deep integration of the sharing economy and digitalization. The development of the sharing economy model requires the support of digital technology, and the state can encourage relevant enterprises to make use of big data, cloud computing, and other technical means to optimize the operation mechanism of the sharing economy platform, improve the security, convenience, and service quality of the platform, promote the efficient use of shared resources, and inject a new impetus into the development of the urban economy. Meanwhile, with the deep integration of digitalization with the real economy and the social security system, data security and privacy protection have become particularly important. The state can improve relevant laws and regulations, establish a sound data security management system, strengthen the protection of personal information, and ensure the legal, standardized, and safe use of data in digitalization and the development of the real economy.

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References

[1] Cainelli G, Ganau R, Modica M. Industrial relatedness and regional resilience in the European Union [J].Papers in Regional Science, 2017, 98(2).
[2] Dawley S, Pike A, Tomaney J. Towards the resilient region? policy activism and peripheral region development[J].SERC Discussion Papers, 2010.
[3] Martin R, Sunley P, Tyler P. Local growth evolutions: recession, resilience and recovery[J]. Cambridge Journal of Regions, Economy, and Society, 2015, 8(2):141-148.
[4] Duranton G, Puga D. Diversity and Specialisation in Cities: Why, Where and When Does it Matter [J]. Urban Studies, 1999, 37(3).
[5] Boschma R. Towards an evolutionary perspective on regional resilience[J].Papers in Innovation

ISSN 2616-5902 Vol. 6, Issue 3: 32-46, DOI: 10.25236/AJBM.2024.060304

Studies, 2014.
[6] He Guosheng, Yan Jiani. The impact of digital finance on the economic resilience of cities--an empirical analysis based on spatial econometric model[J]. Exploration of Economic Issues, 2023 ,(03):97-110.
[7] Wang Yanan, Tan Zhuohong, Zheng Lekai. Research on the impact of digital inclusive finance on social security[J]. Research on Quantitative and Technical Economics, 2020,37(07):92-112.
[8] MAO Fengfu,HU Chengchen,WEI Yafei. Digital industry development and urban economic resilience [J]. Financial Science, 2022,(08):60-75.
[9] Nathan Nunn†,Nancy Qian‡.Aiding Conflict: The Unintended Consequences of U.S. Food Aid on Civil War[J].[2024-03-05].http://econ.as.nyu.edu/docs/IO/18627/NunnQian_03222011.*