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Research and Empirical Verification of the Path of Digital-real Integration on High-quality Economic Development

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Abstract

The integrated development of the digital economy and the real economy provides important support and impetus for high-quality economic development. Taking the Huaihe River Eco-Economic Belt as an example, this paper sorts out the impact mechanism and path of the development of "digital-real integration" on high-quality economic development, and collects the panel data of 25 provinces in the Huaihe Eco-Economic Belt from 2010 to 2020, and uses the entropy TOPSIS method to calculate the high-quality economic development index and the "digital-real integration" development index, and then uses the PVAR model and panel data regression model to conduct an empirical study on the relationship between the two. The results show that the "integration of data and reality" is the reason for the high-quality economic development in the short term, and the impact of the integrated development of the two on the high-quality economic development continues to increase in the long run. "Digital-real integration" has a positive effect on high-quality economic development, but there are regional differences in the impact, especially in the Huaihai Economic Zone in the north, and weaker in the inland rising areas in the central and western regions.

Keywords

Digital Economy; The Real Economy; Huaihe River Ecological Economic Belt; High-quality Economic Development.

1. Introduction

With the rapid development of information technology and the advent of the digital age, data has become an important driving force for economic development and decision-making. How to make full use of a large amount of data, integrate data resources, and guide economic decision-making and promote economic development from a more comprehensive and systematic perspective has become an urgent task in front of us. The integration of digital economy and real economy, as the combination of information technology and economic development, provides us with a new perspective. Use advanced information technology to integrate the traditional real economy and digital technology, so that the two interact and form a virtuous circle, and jointly promote high-quality economic development. "Digital-real integration" can provide comprehensive and multi-angle information support for economic development, and has shown great potential in many fields. Combining digital technology with the real economy is not only a need for China's economy to achieve high-quality development, but also an inevitable choice for China to meet the world's unprecedented major changes in a century.

At present, there are many theoretical studies on the "digital-real integration" in the academic circles, but there are few studies on the mechanism and empirical verification of the development of "digital-real integration" to promote high-quality economic development. Firstly, this paper takes the current development status and trend of digital-real integration as

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the starting point, and systematically analyzes the theoretical support of digital-real integration for high-quality economic development. Secondly, this paper will discuss from multiple levels, including the impact of digital-real integration on economic decision-making, the promotion of innovation ability, and the promotion of resource integration and coordinated development. The empirical analysis of the ultimatum illustrates the actual impact of digital-real integration on high-quality economic development and the future development trend. The real economy constitutes the core of the growth of the digital economy, and the digital economy provides a solid support for the further growth of the real economy. The research in this paper will help to deeply understand the mechanism of digital-real integration on high-quality economic development, and promote academic research and practical exploration in related fields.

2. Literature References

2.1. Research on the Integrated Development of "Digital and Real Integration"

With the rapid development and extensive application of information technology, the digital economy is gradually infiltrating into all fields of the traditional real economy, which makes the integration and interaction between the two closer, and the "integration of data and reality" has gradually become the mainstream direction of current economic growth[1]. Regarding the integrated development of the digital economy and the real economy, scholars' research mainly focuses on the following three aspects.

2.1.1. The Connotation of the Integration of Digital and Real

The integration of the digital economy and the real economy refers to the use of modern information technology such as digital technology, the Internet, big data, and artificial intelligence to promote the upgrading and transformation of traditional industries, promote the development of new forms of business and new models, and realize the transformation of economic growth momentum and the optimization of economic structure. Fu Y[2]pointed out that the digital economy and the real economy are inseparable, and the two complement each other and interact with each other, and that digital industrialization and industrial digitization are the direct manifestations of the digital economy acting on the real economy. Based on the industrial cooperation of the Eurasian Economic Union countries, Aleksander E. Karlik[3] pointed out that through the introduction of digital economy technology, industrial cooperation should be deepened, a new paradigm of enterprise competition and cooperation will be formed, and the role of digital economy in industrial production will be clarified. Ponte D[4] examines the convergence of brick-and-mortar supermarkets with digitalization, which can reduce queues and save time. Chen Y[5] discussed the relationship between the digital economy and the real economy, emphasizing that the two penetrate and promote each other, and that the integration of digital and real is not only a simple superposition of technology, but also a deep-seated change in the industrial structure, involving innovation in production methods, management models, marketing strategies and other aspects.

2.1.2. A Measure of the Fusion of Numbers and Realities

The integration of the digital economy and the real economy is an important trend of today's economic development, and the integration of the two is a complex process, involving technology, economy, society and other aspects. Based on the coupled evaluation model, Guo H[6] divided the digital economic system into four dimensions: digitalization, networking, intelligence, and platformization, and divided the real economic system into four dimensions, including development scale, market scale, economic benefits, and development potential. Based on the coupling evaluation model, Hu R[7] divided the digital economy into five dimensions: digital infrastructure, digital industrialization, industrial digitization, digital technology environment, and digital technology talents, and divided the real economy into six

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major industries: agriculture, industry, construction, transportation, post and telecommunications, wholesale and retail, and accommodation and catering. Zeng P[8] started from the four levels of integration foundation, integration scale, integration structure, and integration efficiency, and constructed a comprehensive evaluation index system for the level of digital-real integration based on eight dimensions: digital economy foundation, real economy foundation, digital industrialization scale, industrial digital scale, digital economy structure, real economy structure, digital economy efficiency, and real economy efficiency,the Dagum Gini coefficient and variance decomposition method were used to investigate the magnitude and source of the difference between number and reality fusion.

2.1.3. The Significance of the Integration of Digital and Real

The integration of the digital economy and the real economy can achieve industrial upgrading and economic structure optimization, which is of great significance for promoting economic development, improving production efficiency, promoting innovation and enhancing international competitiveness. Aleksandr P. KUPRYUSHIN[9] pointed out that the fusion of data and reality can change the structure of technology, thereby benefiting imports and exports. Cheah C[10] pointed out that in the era of Industry 4.0, it is necessary to improve the efficiency of solid waste management through digital and mechanical applications, and effectively eliminate, recycle and reuse waste. Rocca R[11] also points out that automation and digitalization are forcing companies to rethink their business strategies and models from the perspective of the circular economy and the Industry 4.0 paradigm. Liu W[12] pointed out that the integration of digital and real presents obvious regional characteristics, which balances the sharing of resources between regions while continuously increasing the quality and efficiency of the economy, so as to achieve the goal of common prosperity. Yang X[13]pointed out that the integration of the digital economy and the real economy can produce the effect of "reducing costs and increasing efficiency", improve the roundabout degree of production and added value, and lead to the birth of new formats, new organizations, and new models, thereby enabling the high-quality development of the industry. Xia J[14] pointed out that the integration of data and reality is an important way to realize industrial transformation and upgrading, which can realize the digitalization, networking, intelligence, and greening of the industry, promote the transformation and upgrading of the industry, and help build a modern industrial system.

2.2. Research on High-quality Economic Development

High-quality economic development is the economic development concept put forward by China after entering the new era, which refers to the development model centered on improving the quality and efficiency of economic development, promoting the optimization and upgrading of economic structure, and achieving sustained and healthy economic development. The proposal of this concept is an important reflection on the rapid growth in the past, and it is also a clear plan for the future development path. Research on high-quality economic development mainly focuses on the following three aspects.

2.2.1. The Connotation of High-quality Economic Development

High-quality economic development refers to the inevitable trend of a country or region pursuing more efficient, fairer and more sustainable growth in the process of economic development, which emphasizes the quality and efficiency of development and transcends the traditional economic growth model. Yang Y[15] sorted out the practical and theoretical logic of China's high-quality economic transformation from three aspects: the long-term path and driving factors of economic growth, the target system of high-quality development, and the high-quality development and modern governance system. Barro R[16] and Sabatini F [17] analyze high-quality economic development from the aspects of society, culture, science and technology, religion, social capital, and ecological environment. Chen J[18] systematically sorted out the process of high-quality economic development in the process of Chinese-style

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modernization, that is, three stages: "formation" to "turn" and then to "promotion". Zhang Zhang Z[19] sorted out the process of high-quality economic development from proposal to implementation, and gave a way to achieve it throughout production, distribution, circulation, and consumption.

2.2.2. A Measure of High-quality Economic Development

The measurement of high-quality economic development usually involves multiple dimensions and indicators, which are designed to comprehensively reflect the performance of an economy in terms of quality, efficiency, and sustainability. In terms of the construction of the index system, more scholars will combine the five development concepts of China's high-quality economic development to study the dynamic mechanism of balanced and full economic development. Based on the multi-dimensional connotation of high-quality economic development, Huang J[20] and Wang S[21] constructed an evaluation index system covering five dimensions: innovation, coordination, green, openness, and sharing, and analyzed the differences and sources of high-quality economic development in China. Rokhim R[22] measured the level of regional economic development in Indonesia in terms of human resources, infrastructure, social capital, and financial capital. Saleem H[23] uses the production function to obtain total factor productivity, which reflects economic growth. Li M[24] selected secondary indicators from the perspectives of input and output, and used the SBM-GML method to measure the level of high-quality economic development.

2.2.3. Factors Influencing High-quality Economic Development

In terms of exploring the influencing factors of high-quality development, Shi D[25] and others believe that green finance has an important impact on high-quality economic development, and green finance refers to financial activities that support environmental protection and sustainable development, which promotes green total factor productivity and green transformation of economic structure, thereby promoting high-quality economic development. Similarly, Qu X[26] and Lin B[27] once again demonstrated the importance of green and sustainable development to high-quality economic development from the perspective of environmental decentralization, and from the perspective of carbon neutrality. Gina L[28] examines the economic situation in Romania and Moldova, noting the importance of economic management policies and structural reforms in promoting economic growth. Secundo G[29] discussed the importance of digital technology for sustainable economic development, and digital technology can help enterprises better grasp market information and provide new growth drivers for sustainable economic development. Li E[30] verified the role of digital financial inclusion in promoting economic growth, and there is a significant spatial impact. Zheng H[31] studied the spatial effect of financial openness on high-quality economic development, and pointed out that financial openness has a positive spatial effect on high-quality economic development, which can enhance the ability to provide financial services to the real economy and help build a new development pattern.

2.3. Research on the Promotion of High-quality Economic Development by "Digital and Real Integration".

"Digital-real integration" is an inevitable choice to promote high-quality economic development, so how does "digital-real integration" promote high-quality economic development, and what is the specific mechanism of action? Based on Schumpeter's endogenous growth theory, Tian X[32] believe that the "integration of data and reality" promotes the development of high-tech industries in the short term and promotes long-term macroeconomic growth. Chen H[33], Ren B[34] and others believe that promoting "digital and real integration" can effectively improve total factor productivity, which can stimulate innovation vitality and optimize the industrial structure, thereby promoting rapid economic growth.

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Through the review of the existing literature, it can be seen that the academic community has carried out rich research on the theoretical connotation, influencing factors and measures of the evaluation system of the integration of the digital economy and the real economy, which provides rich literature support and theoretical basis for the research of this paper, but there are few empirical studies on the integration of the two to promote the high-quality development of the economy. Finally, based on the analysis results, countermeasures and suggestions are given.

3. Analysis of the Mechanism of the Integration of the Digital Economy and the Real Economy to Promote High-quality Economic Development

The digital economy is an important force to promote the upgrading and innovative development of traditional industries, and the real economy is the main body of the national economy. In this paper, the mechanism is analyzed from the following three aspects.

3.1. Economic System

"Digital-real integration" can promote the high-quality development of the economy in terms of innovation and openness. Through data collection, processing, and analysis, enterprises can better gain insight into market needs and trends, accurately grasp business opportunities, and achieve innovation-driven development. Under the framework of digital and real integration, the sharing and exchange of data is possible, which helps to break down information silos and promote collaborative innovation between industries. At the same time, the extensive sharing of data can promote more accurate and efficient decision-making process of government departments, thereby improving the quality of public services and accelerating the modernization of government management capabilities.

3.2. Social Systems

"Digital-real integration" can promote the high-quality development of the economy in coordination and sharing. First of all, the integration and sharing of data can help improve the efficiency of resource allocation and promote the coordinated development of various industrial elements. Building a data sharing system across different sectors and industries helps to achieve the optimal allocation of resources, promote the efficient use of resources, and enhance the operational efficiency and economic results of the entire production system. Enterprises, governments, scientific research institutions and other different subjects can realize the exchange and sharing of information by sharing data resources, so as to realize the benign interaction between the government and enterprises and promote the common development of the economy.

3.3. Ecosystem

First of all, the collection and analysis of data can help enterprises to assess the environmental impact more comprehensively and accurately, and realize the efficient use and recycling of resources. Secondly, the "integration of data and reality" can also promote the development and growth of green industries. Through data analysis, companies can gain insight into the expectations and preferences of consumers who advocate green, so as to create products and services that are more in line with the concept of eco-friendliness and sustainable development, so as to meet the expectations of the market and promote the development of green industries.

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4. Model Setting and Variable Selection

4.1. Research Methods

In this paper, the PVAR model and the benchmark regression model are used to study the following models.

$$y_{i,t} = a_0 + \sum_{p=1}^{n} a_p \, y_{i,t-p} + \varepsilon_{i,t} \tag{1}$$

$$Edq_{i,t} = b_0 + b_1 Dri_{i,t} + b_2 Control_{i,t} + \varepsilon_{i,t} \tag{2}$$

where, i denotes the region,t denotes the year;$y_{i,t}$ denotes Vectors representing the level of integrated development of the digital economy and the real economy and the level of high-quality development;p denotes the lag order, $y_{i,t-p}$ denotes the order lag term; Control represents the set of control variables, $\varepsilon_{i,t}$ are random perturbation terms.

4.2. Variable Selection

4.2.1. Core Explanatory Variables

The high-quality development of the economy is mainly reflected in five aspects: innovation, coordination, green, openness, and sharing, and most scholars [35][36] have also constructed indicators from these five aspects.After considering the accuracy and availability of data, this paper selects the following 19 secondary indicators to construct an index evaluation system for high-quality development level, and the score of high-quality economic development level of each city is measured by Entropy-TOPSIS method.

Table 1. Evaluation index system for high-quality development level

Level 1 Indicators	Level 2 Indicators	Weights
innovation	Number of scientific and technological workers	0.05293
	Technology spending	0.077468
	Educational spending	0.043268
harmonize	Number of people in institutions of higher learning	0.039747
	Ratio of per capita disposable income between urban and rural areas	0.01723
	Industrial rationalization	0.054244
	Urbanization rate	0.026334
green	Green coverage	0.004601
	Sewage treatment rate	0.006902
	Harmless treatment rate of domestic waste	0.008396
	Expenditure on energy conservation and environmental protection as a proportion of GDP	0.04172
opening	Number of foreign-invested projects	0.12896
	The speed of development of the number of foreign-invested projects	0.03964
	Total imports and exports	0.116254
	Actual utilization of foreign capital	0.063776
share	Number of books per 100 people	0.199714
	Beds per 10,000 people GDP per capita	0.026579
	Proportion of education	0.048501
	expenditure in fiscal expenditure	0.003737

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On the basis of the entropy method, the entropy-TOPSIS model is used to calculate the comprehensive value of the high-quality economic development level of each city from 2010 to 2020, and the results are shown in Table 2.

Table 2. The comprehensive value of the high-quality economic development level of each city

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Huai'an	0.2184	0.3141	0.1885	0.3131	0.3175	0.4233	0.7920	0.3085	0.2605	0.2741	0.2282
Yancheng	0.3757	0.5066	0.2689	0.6251	0.6391	0.7883	0.9219	0.7304	0.7433	0.7415	0.7486
Suqian	0.1026	0.1064	0.0593	0.2104	0.2150	0.1727	0.2576	0.1455	0.1730	0.1897	0.2319
Xuzhou	0.4563	0.6472	0.3098	0.6474	0.6890	0.7355	0.9303	0.8135	0.8700	0.9266	0.8571
Lianyungang	0.3329	0.3309	0.1495	0.3729	0.4199	0.4628	0.7677	0.4292	0.4290	0.5126	0.3896
Yangzhou	0.8035	0.7776	0.9105	0.7526	0.7791	0.7125	0.9595	0.8277	0.8027	0.8589	0.7281
Taizhou	0.5884	0.6557	0.2644	0.5698	0.5009	0.5806	0.8536	0.8069	0.7869	0.8223	0.7240
Zaozhuang	0.0583	0.0469	0.0235	0.0555	0.0613	0.0631	0.2372	0.0516	0.0443	0.0483	0.0620
Jining	0.3088	0.3817	0.1295	0.3776	0.3557	0.4017	0.5539	0.4547	0.3646	0.4128	0.3945
Linyi	0.2163	0.3002	0.1320	0.4224	0.4729	0.4458	0.8437	0.5052	0.4233	0.5327	0.6836
Heze	0.1128	0.1009	0.0457	0.0947	0.1109	0.1413	0.2581	0.1877	0.2663	0.2031	0.1680
Bengbu	0.1413	0.1405	0.0748	0.2527	0.2391	0.3077	0.2190	0.2374	0.1749	0.2017	0.1750
Huainan	0.0902	0.0861	0.0401	0.0877	0.0781	0.0641	0.0578	0.0492	0.0471	0.0495	0.0391
Fuyang	0.0986	0.0949	0.0423	0.0939	0.0780	0.0931	0.0550	0.0804	0.0660	0.1016	0.0592
Lu'an	0.0430	0.0882	0.0374	0.0700	0.0523	0.1563	0.0917	0.1369	0.1278	0.1492	0.0985
Bozhou	0.1763	0.1755	0.0655	0.1871	0.1247	0.1261	0.1201	0.0995	0.1181	0.0832	0.0833
Suzhou	0.0466	0.0526	0.0150	0.0544	0.0675	0.1154	0.1252	0.1169	0.0697	0.0698	0.0564
Huaibei	0.0796	0.0781	0.0273	0.0514	0.0758	0.0827	0.0922	0.0740	0.0450	0.0358	0.0356
Chuzhou	0.0507	0.0640	0.0316	0.0797	0.1000	0.1306	0.1400	0.2060	0.2131	0.2671	0.2228
Xinyang	0.1614	0.1447	0.0710	0.1613	0.1490	0.1706	0.2082	0.1398	0.1155	0.1332	0.1424
Zhumadian	0.1304	0.1144	0.0400	0.1054	0.0803	0.0904	0.0797	0.0793	0.0656	0.0862	0.1616
Zhoukou	0.1184	0.0934	0.0615	0.0735	0.0610	0.0909	0.0717	0.0828	0.0698	0.0696	0.0815
Luohe	0.0904	0.0774	0.0294	0.0641	0.0653	0.0896	0.0384	0.0583	0.0567	0.0602	0.0659
Shangqiu	0.1960	0.1551	0.0492	0.0937	0.0984	0.1354	0.1443	0.0912	0.0761	0.1254	0.1224
Pingdingshan	0.1002	0.0890	0.0357	0.0790	0.0734	0.0859	0.2623	0.0709	0.0630	0.0669	0.0530

As can be seen from Table 2, there is an upward trend in the economic development level of each city during the study period. In terms of degree, cities with a high level of economic development include Yancheng, Xuzhou, Yangzhou, Lianyungang, Taizhou, Jining, Linyi and other cities, and the comprehensive score value of economic development level is generally above 0.5, while the overall high-quality development level of the rest of the cities is low, and the comprehensive score value is lower than 0.5.

4.2.2. Explanatory Variables

Referring to the research content of other scholars[37], this paper analyzes from the aspects of agriculture, construction, transportation, wholesale and retail, and service industry, and comprehensively selects 13 secondary indicators from these five aspects to construct an index evaluation system for the development level of the real economy, and selects 8 secondary indicators in the digital economy to construct an index evaluation system for the development level of the digital economy and also uses the entropy method to measure them. Therefore, this paper refers to the practice of Chen Jiang et al. [11], first measures the coupling degree of the real economy and the digital economy, and constructs the integration degree model on the basis of the coupling degree model, that is, the coupling degree is determined first, and then the fusion degree is determined.

The specific calculation formula is as follows:

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(1) Calculate the degree of coupling C

$$C = \frac{2\sqrt{Dd * Rd}}{Dd + Rd} \tag{3}$$

(2) Calculate the fusion index T

$$T = n_1 Dd * n_2 Rd \tag{4}$$

(3) Calculate the degree of fusion Dri

$$Dri = \sqrt{C} * T \tag{5}$$

Dd represents the level of development of the digital economy, Rd represents the level of development of the real economy, and n_1, n_2represent the contribution coefficient of the digital economy and the real economy (both taken as 0.5).

The degree of "digital-real integration" is shown in Table 3, and the development level of "digital-real integration" in each city has an upward trend during the study period.

Table 3. The comprehensive value of the development level of "digital and real integration" in each city

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Huai'an	0.4791	0.4721	0.4868	0.4287	0.5922	0.5826	0.5635	0.5450	0.5313	0.5832	0.5658
Yancheng	0.7601	0.8344	0.8037	0.6610	0.8435	0.8361	0.8324	0.7919	0.8356	0.8060	0.8062
Suqian	0.2347	0.2374	0.2656	0.2855	0.3889	0.3878	0.3770	0.3822	0.4094	0.4499	0.4749
Xuzhou	0.8168	0.7865	0.8229	0.7136	0.9026	0.8572	0.8648	0.8232	0.8598	0.8642	0.8739
Lianyungang	0.6976	0.6421	0.6102	0.6223	0.5490	0.5333	0.5200	0.4963	0.5162	0.4770	0.6613
Yangzhou	0.5152	0.6331	0.6076	0.6565	0.8122	0.7875	0.7890	0.7823	0.8339	0.8326	0.8729
Taizhou	0.5178	0.4821	0.5758	0.5063	0.7470	0.7212	0.7532	0.7644	0.8111	0.7823	0.8372
Zaozhuang	0.3597	0.3247	0.2789	0.2854	0.3852	0.3468	0.3264	0.2955	0.3075	0.5095	0.3664
Jining	0.4294	0.4532	0.4833	0.4434	0.6589	0.6077	0.5668	0.5264	0.5832	0.5767	0.6342
Linyi	0.6158	0.6508	0.6778	0.6176	0.7738	0.7317	0.7370	0.6472	0.6789	0.6598	0.7103
Heze	0.3874	0.3978	0.4193	0.3281	0.4460	0.4393	0.4284	0.4214	0.4315	0.4651	0.4917
Bengbu	0.1981	0.3204	0.1983	0.2047	0.2912	0.2758	0.2490	0.2446	0.2729	0.2991	0.3308
Huainan	0.2066	0.2189	0.2361	0.2055	0.2980	0.3532	0.2979	0.2783	0.2882	0.2831	0.2738
Fuyang	0.3229	0.2641	0.2712	0.3268	0.3292	0.3260	0.3051	0.3056	0.3530	0.3871	0.4298
Lu'an	0.5248	0.3169	0.2691	0.2636	0.3796	0.3739	0.3064	0.3171	0.3310	0.3762	0.3783
Bozhou	0.1799	0.1643	0.1804	0.1923	0.2769	0.2726	0.2497	0.2742	0.2740	0.3028	0.3263
Suzhou	0.2798	0.2552	0.3463	0.2441	0.4028	0.7948	0.6471	0.3364	0.3427	0.3501	0.3753
Huaibei	0.1530	0.1555	0.1738	0.1769	0.2775	0.2321	0.2141	0.2084	0.2262	0.2729	0.2774
Chuzhou	0.3256	0.3129	0.3763	0.2796	0.4129	0.3980	0.3576	0.3466	0.3642	0.3543	0.3809
Xinyang	0.4741	0.4232	0.4640	0.4466	0.5663	0.5335	0.5787	0.5270	0.5268	0.5321	0.5647
Zhumadian	0.3461	0.2928	0.3381	0.3362	0.5431	0.5449	0.4859	0.5807	0.5822	0.5033	0.5285
Zhoukou	0.5152	0.4682	0.4401	0.4685	0.6261	0.5430	0.5050	0.5594	0.5198	0.5773	0.6459
Luohe	0.1144	0.1352	0.1371	0.1802	0.2159	0.1868	0.1846	0.1967	0.2054	0.2081	0.2480
Shangqiu	0.3604	0.3095	0.3584	0.3293	0.4715	0.5318	0.5139	0.5512	0.5160	0.5613	0.5755
Pingdingshan	0.2462	0.2222	0.2386	0.2398	0.3299	0.3051	0.2924	0.2966	0.2903	0.2872	0.3176

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4.2.3. Control Variables

In this paper, the following control variables are introduced: (1) the degree of urban development (Cdd), which is measured by the proportion of the tertiary industry in GDP; (2) the degree of openness to the outside world (Op), which is expressed as the proportion of total imports and exports to GDP; (3) fiscal intervention (Gov), which is measured as a proportion of GDP in general public budget expenditure; (4) the level of financial development (Fd), which is measured by the proportion of domestic and foreign currency deposits of financial institutions in GDP; (5) The degree of greening (Af) ,which is based on the area of green space.

4.2.4. Data Source

In this study, 25 provinces in the Huaihe River Eco-Economic Belt were selected as the research sample, and various index data were collected from 2010 to 2020 for estimation. The original data came from the China Statistical Yearbook, the China City Statistical Yearbook, the provincial statistical yearbooks, etc., and a small number of missing data were supplemented by interpolation.

Table 4. Evaluation index system of digital economy and real economy development level

Level 1 Indicators	Level 2 Indicators	Weights
Digital economy	Revenue from telecommunications services	0.080624
	Revenue from telecommunications services as a percentage of GDP	0.131438
	Number of employees in computer services and software for information transmission	0.187159
	Number of Internet broadband access users	0.203824
	Internet broadband home intensity	0.17996
	Number of mobile phone subscribers	0.074367
	Density of mobile phone subscribers	0.033719
	Financial Inclusion Index	0.10891
agriculture	Number of people employed in agriculture	0.14823
	Gross output value of agriculture, forestry, animal husbandry and sideline fisheries	0.047425
	The growth rate of the total output value of agriculture, forestry, animal husbandry and sideline fisheries	0.025285
Construction	Number of employees in the construction industry	0.117138
	The number of construction enterprises	0.071101
	Gross output value of the construction industry	0.134607
Transportation industry	Number of traffic personnel	0.043484
	Highway mileage	0.044774
Wholesale and retail trade	Number of wholesale personnel	0.067227
	Total wholesale value	0.108894
	The growth rate of total wholesale value	0.019248
Accommodation industry	Number of people employed in accommodation	0.069186
	Gross output value of the accommodation sector	0.103401

4.2.5. Descriptive Analytics

Descriptive analysis of the level of high-quality development and the level of integrated development of digital economy and real economy was carried out, and the mean, standard deviation, maximum and minimum values were obtained.

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Table 5. Descriptive statistical analysis of variables

The name of the variable	High-quality development level	The level of integrated development of "digital and real integration".
Variable symbol	Edq	Dri
mean	0.2028	0.4124
standard deviation	0.0948	0.1355
minimum	0.0600	0.0957
maximum	0.5257	0.6947

5. Empirical Research

5.1. Empirical Analysis of PVAR Model

5.1.1. Stationarity Test

First, the LLC/IPS unit root test is performed on each data. As can be seen from Table 6, the original data is stable, so the PVAR model estimation is performed on the original data.

Table 6. Stationarity test results

	Scheme 1			
	T-star	P-value	W[t-nar]	P-value
Edq	-4.9231	0.0000	-4.6986	0.0000
Ed	-4.4278	0.0000	-0.8669	0.1930
Dd	-5.5565	0.0000	-4.1574	0.0000

5.1.2. Select the Optimal Lag Order

Secondly, the AIC, BIC, HQIC information criteria are used to determine the optimal lag order. According to the results in Table 7, order 1 is selected as the optimal lag order.

Table 7. Lag order test results

Lag order	AIC	BIC	HQIC
Lag 1st order	-1.396694	-37.52432	-16.0742
Lag 2nd order	-2.01192	-26.097	-11.79692
Lag 3 orders	-3.259697	-15.30224	-8.152198

5.1.3. Granger Causality Test

Causal direction: The Grange causality test is first performed to determine the causal direction between the two. Table 8 shows the null hypothesis and test results. The P values were 0.030 and 0.649, respectively, which indicated that the development level of "digital and real integration" was the reason for the growth of high-quality economic development level , while the high-quality development level had no obvious impact on the growth of "digital and real integration" development level .

Table 8. Results of the Granger causality test

Null hypothesis	Chi-square statistic	P-value	result
Dri is not the reason for Edq	4.73	0.030	refuse
Edq is not the reason for Dri	0.207	0.649	accept

GMM estimates:GMM estimates were then performed and the results are shown in Table 9.

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Table 9. GMM Estimation Results

variable	Edq	Dri
Lag 1 Edq	0.3076	0.6649
Lag 2 Edq	0.2700	-0.1172
Lag Stage 1 Dri	0.0070	0.5488
Lag 2 stage Dri	0.2281	0.2006

Table 9 shows that with the development level of "digital-real integration" as the explanatory variable, high-quality economic development has a slight negative impact on the development of "digital-real integration" when it lags for 2 periods, with a coefficient of 0.1172, but it becomes a positive impact when it lags for 1 period, with a coefficient of 0.6649, which may be due to various problems such as institutional constraints, improper resource allocation, improper technology application and insufficient market demand in the early stage of high-quality development, which will have certain restrictions on the development of "digital-real integration". However, in the later period, various regions gradually explored a model that can promote high-quality economic development, which can effectively promote the development of "digital and real integration". The development of "digital-real integration" with a lag of 2 and 1 has a positive impact on itself, which indicates that the "digital-real integration" is getting closer and closer. Taking the current level of high-quality development as the explanatory variable, the high-quality development of the lagging period 2 and lagging the 1st period has a positive impact on its own growth, with coefficients of 0.27 and 0.3076, respectively, indicating that the economy has been growing steadily, forming a virtuous circle, and the economic growth potential is huge. The development of "digital-real integration" with a lag of 2 and 1 has a positive effect on high-quality economic development, which may be due to the fact that promoting "digital-real integration" can promote industrial upgrading, innovate products and services, and enhance social benefits, thereby effectively promoting high-quality economic development.

5.1.4. Impulse Response Analysis

In order to analyze the dynamic impact between high-quality economic development and the development of "digital-real integration", this paper performs 500 Monte Carlo simulations for two variables with a lag of 8 periods, and the results are shown in Figure 2, and the four functions are in a convergent state. According to Figure 2, in terms of the impact of the impact on itself, whether it is the impact of the high-quality development level or the impact of the development level of "digital-real integration", it will make itself fluctuate upward, and the effect is significant, the high-quality development level has a downward fluctuation process in the first period, and then enters an upward fluctuation, while the development level of "digital-real integration" is always an upward fluctuation, and both converge and equilibrium values during the investigation period. The results show that there is a certain inertia in the trend of high-quality economic development and the development trend of "digital-real integration", but high-quality economic development will have a short-term negative impact in the early stage, which may be related to the large upfront investment in the implementation of high-quality economy. Further analysis of the interaction between high-quality economic development and the development of "digital and real integration". According to Figure 2, both the impact of the development of "digital-real integration" on high-quality development and the impact of high-quality development on the development of "digital-real integration" will always fluctuate upward, and reach the maximum in the first period, and both converge to the equilibrium value during the review period. The above results show that "digital-real integration" can promote high-quality economic development, and high-quality economic development will further promote the development of "digital-real integration". In general,

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both the level of high-quality development and the development of "digital and real integration" can promote their own development, and can also promote each other's development, thereby promoting the sustainable development of the economy.

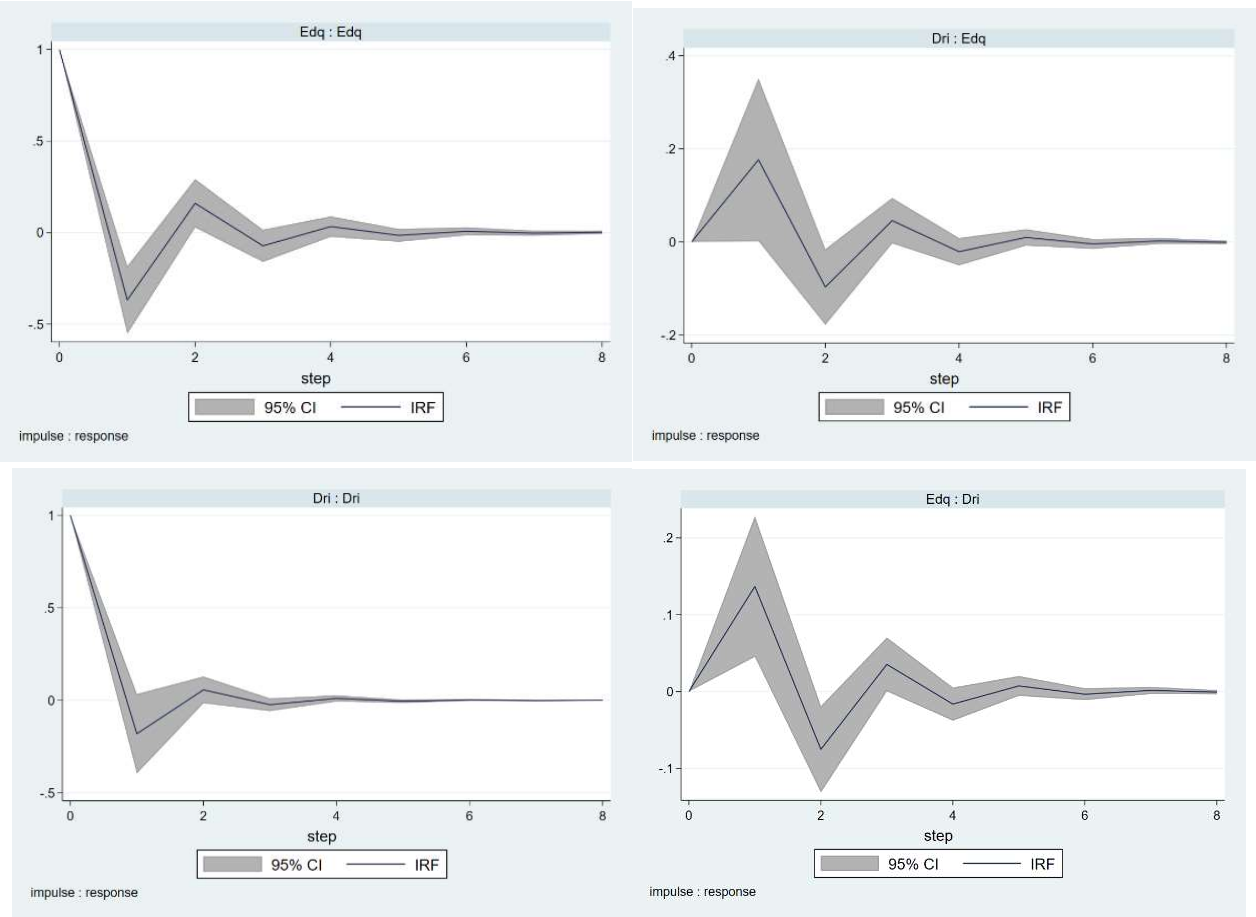

Figure 1. Impulse response between Delhi and Edek

5.1.5. ANOVA Analysis

In order to investigate the source of the overall variation of the variables and the long-term impact between the variables, the variance decomposition of the prediction errors of the integrated development level (Dri) and high-quality development level (Edq) of the digital economy and the real economy is carried out, and Table 10 shows the results of variance decomposition.

Table 10. Variance decomposition results

Forecast period	Edq		Dri	
	Edq	Dri	Edq	Dri
1	1	0.0000	0.1254	0.9875
10	0.6538	0.3462	0.5342	0.9466
20	0.6538	0.3462	0.5342	0.9466
30	0.6538	0.3462	0.5342	0.9466

As can be seen from Table 10, there is an obvious positive feedback on the level of high-quality development and the development level of "digital-real integration", with the contribution to the self reaching 100% and 98.75% in the first period, and remaining stable after the 10th period, with 65.38% and 94.66%, respectively. The possible reason is that high-quality

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development and the development of "digital and real integration" can promote technological innovation and improve productivity; All of them can strengthen market competition and optimize the allocation of resources, so as to promote their own growth. The contribution of the development level of "digital and real integration" to the level of high-quality development has shown an upward trend, from 0% in the first phase to 34.62% in the 10th phase, and has remained stable since then, probably because the application of digital technology to traditional industries has promoted the development of new formats and models, thereby promoting the high-quality development of the economy. The contribution of high-quality development to the development level of "digital-real integration" has also shown an upward trend, from 12.54% in the first phase to 53.42% in the 10th phase, and has remained stable since then.

5.2. Regression Analysis

5.2.1. Benchmark Regression

In this paper, a fixed-effect model was selected for estimation. Table 11 shows the benchmark regression results of the impact of "digital-real integration" on the high-quality development of the Huaihe River Eco-Economic Belt. According to column (1), it is found that the "integration of data and reality" promotes the high-quality development of the Huaihe River Ecological Economic Belt at a significance level of 1%, specifically, every 1% increase in the integration level of the digital economy and the real economy will significantly promote the high-quality development of the Huaihe River Ecological Economic Belt by about 0.4932 units. After the control variable was added to column (2), the conclusion of the study still holds. The above results show that the "integration of data and reality" plays a positive role in promoting the high-quality development of the Huaihe River Ecological Economic Belt.

Table 11. Benchmark regression results

Forecast period	Edq	Edq
	(1)	(2)
Dri	0.493***	0.345***
	(0.0301)	(0.0272)
CDD		0.00286***
		(0.000453)
OP		0.280***
		(0.0433)
GOV		-0.272***
		(0.0477)
FD		0.0294***
		(0.00742)
AF		1.07e-06
		(7.13e-07)
Constant terms	-0.000662	-0.0721***
	(0.0130)	(0.0180)
Fixed effect	Yes	Yes
Sample size	275	275
R^2	0.4967	0.6903

5.2.2. Robustness Test

In order to verify the reliability and stability of the study results, certain parameters or conditions need to be changed to see if the results of the analysis change significantly. If the results are consistent before and after the change, the results are considered to be robust. In this paper, the following three methods are used to test the robustness. First, the data were

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adjusted to shrink the explanatory variable and the explanatory variable by 1% before and after, as shown in Table (1) below. Second, the lagged period of the development level of "digital-real fusion" is used as the explanatory variable for robustness test, and the results are shown in Table (2) below. Thirdly, the method of measuring the explanatory variable and the explanatory variable is changed, the entropy value Top_sis method is used in this paper, and the gray correlation method is used to measure the regression method after the change, and the regression results are shown in Table (3). The three results show that the "digital-real fusion" promotes the high-quality development of the Huaihe River eco-economic belt at the significance level of 1%, so the benchmark regression results in this paper are robust and reliable.

Table 12. Robustness test results

variable	(1)	(2)	(3)
Dri	0.329***	0.318***	0.772***
	(0.0253)	-0.0258	(0.0517)
CDD	0.00223***	0.00312***	0.000223
	(0.000458)	-0.000507	(0.000219)
OP	0.164***	0.175***	0.0879***
	(0.0445)	-0.0448	(0.0190)
GOV	-0.428***	-0.359***	-0.120***
	(0.0528)	-0.0521	(0.0209)
FD	0.0631***	0.0493***	0.0132***
	(0.00920)	-0.00912	(0.00325)
AF	3.89e-06***	3.24e-06***	2.94e-07
	(7.74e-07)	-7.62E-07	(3.11e-07)
Constant terms	-0.0616***	-0.0759***	-0.0911***
	(0.0173)	-0.0177	(0.0293)
Fixed effect	Yes	Yes	Yes
Sample size	274	249	274
R^2	0.732	0.759	0.685

5.2.3. Heterogeneity test

Table 13. Results of regional heterogeneity test

variable	Huaihai Economic Zone in the north	The eastern Haijiang River and Lake linkage area	Midwest Inland Rising Zone
Dri	0.364***	0.304***	0.196***
	(0.0412)	(0.0854)	(0.0323)
CDD	0.00282***	-9.60e-05	0.00202***
	(0.000734)	(0.00245)	(0.000397)
OP	-0.00502	0.0843	0.838***
	(0.0608)	(0.172)	(0.144)
GOV	-0.499***	-0.674***	-0.216***
	(0.0909)	(0.152)	(0.0579)
FD	0.0568***	0.103***	0.0209**
	(0.0129)	(0.0320)	(0.00981)
AF	3.49e-06***	2.01e-05***	4.79e-07
	(9.44e-07)	(6.51e-06)	(1.28e-06)
Constant terms	-0.0712**	-0.0115	-0.0120
	(0.0282)	(0.0668)	(0.0195)
Fixed effect	Yes	Yes	Yes
Sample size	109	54	110
R^2	0.764	0.789	0.461

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Referring to the Development Plan of the Huaihe River Ecological Economic Belt, the Huaihe River Ecological Economic Belt was divided into three regions, and the regional heterogeneity test was carried out on the basis of this division. Baseline regressions were performed for each of the three regions, and the results are reported in Table 13. The integration of the digital economy and the real economy can still promote the high-quality development of the Huaihe River Ecological Economic Belt, especially in the Huaihai Economic Zone in the north, and weakly in the rising areas of the central and western interiors. Specifically, every 1% increase in the level of integration between the digital economy and the real economy will significantly promote the high-quality development of the Huaihai Economic Zone in the northern part of the Huaihe River Ecological Economic Belt by about 0.364 units, while the rise of the central and western inland areas will only increase by 0.196 units.

6. Conclusion

Taking 25 provinces in the Huaihe River Eco-Economic Belt as examples, this paper measures the level of high-quality development and the level of integrated development of the digital economy and the real economy, and constructs a model to conduct an empirical study on the relationship between the two. The growth of the high-quality development level of the Huaihe River Ecological Economic Belt has a negative impact on the level of integrated development of the digital economy and the real economy in the lag of the second phase, and will turn into a strong positive impact in the lag of the first phase. The integrated development of the digital economy and the real economy is mainly affected by its own fluctuations in the first phase, while the level of high-quality development is completely determined by its own fluctuations.

The development of "digital and real integration" plays an important role in promoting high-quality economic development, and can inject new vitality and impetus into the sustainable and healthy development of the economy. To this end, this paper puts forward the following suggestions: First, strengthen the integration of digital technology and the real economy. Through digitalization, intelligence, the Internet of Things and other technical means, we will realize the efficiency, intelligence and refinement of industrial production, and improve the quality and efficiency of the real economy. Second, we need to promote the cultivation of digital talents and application innovation. Strengthen the cultivation of digital talents, improve the professional skills and practical ability of digital talents, and promote the application and innovation of digital technology in the real economy. Third, we need to foster new forms of the digital economy. Actively develop new business formats such as digitalization, intelligence, and greening, including digital entertainment, sharing economy, and ecological agriculture, so as to promote the transformation and upgrading of the real economy. Fourth, pay attention to social equity and inclusiveness. In the process of integrating the digital economy and the real economy, it is necessary to pay attention to the consideration of social equity and inclusiveness. Encourage the wide application of digital technology, promote the improvement of digital capabilities of the whole people, ensure that the dividends of the integration of the digital economy and the real economy benefit more groups, and promote the common prosperity of society. By strengthening in-depth integration, promoting the cultivation and application innovation of digital talents, cultivating new forms of digital economy, and focusing on social equity and inclusiveness, we can promote the benign interactive development of the digital economy and the real economy, thereby promoting high-quality economic development.

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