ISSN: 2688-8653

Digital Economy and Dual Circular Development: From the Perspective of Digital Industrialization and Industrial Digitalization

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Abstract

The digital economy is of great significance to the high-quality development of China's economy, and how it empowers the development of the double cycle has become a hot topic of theoretical attention. This paper takes 30 Chinese provinces as research objects, and analyzes its impact on the double cycle and the transmission mechanism from two perspectives: digital industrialization and industrial digitization, based on measuring the double cycle in different dimensions using spatial econometric models. The study finds that digital industrialization and industrial digitization have significant promotion effect and positive spatial spillover effect on the inner cycle, and significant promotion effect and negative spatial spillover effect on the outer cycle, and the former is significantly more important to the double cycle than the latter. Different from the findings of previous theoretical studies, the promotion effect of digital industrialization and industrial digitization on the double cycle is in the same pace in the north-south region, coastal and inland regions, and neither exacerbates the imbalance of regional development, nor maintains the same relative importance in different regions. In terms of the transmission mechanism of digital industrialization and industrial digitization, from the level of "building a long board", the two have different degrees of promotion and spatial spillover effects on the inner and outer cycles through technology introduction and independent innovation; from the level of "making up a short board", the two can At the level of "making up for the shortcomings", the two can promote the double cycle and spatial spillover effects to different degrees by improving the level of poverty reduction and governance.

Keywords

Digital Industrialization; Industrial Digitization; Dual Circulation; Transmission Mechanism; Spatial Spillover Effect.

1. Introduction

The concept of digital economy was first introduced in 1996 as an economic activity related to or driven by ICT (Tapscott, 1996), and as the breadth of digital technology applications continues to be extended and the depth of applications continues to be broadened, the definition of digital economy has been further revised to mean the creation of economic output through the provision of key digital services and digital goods, and By integrating applications from other fields, digital technology will reach a wider range of industries (Williams, 2021). As the future direction of global development and the new engine of high-quality economic development, the digital economy has an unprecedented degree of impact and radiation. From the perspective of industrial form, the digital economy can be divided into two aspects: digitalization of industry and digital industrialization, the former refers to the integration of digital technology with the real economy, so that the output and efficiency of traditional

ISSN: 2688-8653

industries can be significantly improved in the process of applying digital technology and data resources; the latter refers to the provision of digital technology for the development of the former and various economic activities that can be carried out only by relying entirely on digital technology and data elements The latter refers to the provision of digital technologies, products, services, infrastructure and specific solutions for the development of the former and various economic activities that can only be carried out by relying solely on digital technologies and data elements. According to the "White Paper on the Development of China's Digital Economy (2021)": in 2020, the scale of digital industrialization reaches 7.5 trillion yuan, accounting for 7.3% of GDP, and the proportion of the digital economy decreases from 25.7% in 2015 to 19.1% in 2020; the scale of industrial digitization is even higher at 31.7 trillion yuan, accounting for 31.2% of GDP and the proportion of the digital economy of the digital economy from 74.3% in 2015 to 80.9% in 2020. Thus, it can be seen that digital The speed and scale of development of industrialization and industrial digitization are significantly different, and confusing the two may overlook the difference of their empowerment.

From a spatial spillover perspective, this paper examines the empowerment intensity, mechanism and regional impact of the two industrial forms on the domestic and international double cycle. The possible marginal contributions are: first, it distinguishes the development characteristics and relative importance of digital industrialization and industrial digitization from the perspective of industrial forms, clarifies the different roles played by the two in the double cycle development pattern, as well as their direct impact and spatial spillover on the double cycle It provides theoretical support for optimizing the spatial layout of digital industry, improving the incentive policies for industrial digital transformation, and adjusting the development direction of digital economy. Second, we analyze the transmission mechanism of digital industrialization and industrial digitization in the double cycle from the aspects of "building a long board" for innovation and "making up a short board" for poverty reduction. It also examines how digital industrialization and industrial digitization can promote the development of the double cycle by stimulating independent innovation capacity, expanding the scale of technology introduction, and improving the effect of poverty reduction and governance, and provides a reliable path for the smooth flow of domestic and international Third, to provide a reliable path for resolving the possible problems of the digital economy. Third, in order to address the concern that the digital economy may aggravate the uneven regional development in China, the impact of digital industrialization and industrial digitization on the double cycle in the north-south and coastal inland regions is discussed by region, which verifies more clearly the spatial development trend and law of the digital economy and provides theoretical support for the future development planning of the digital economy.

2. Theoretical Analysis and Hypothesis Derivation

2.1. Digital industrialization and digitalization of industry empowerment of the double cycle

Industrial digitization enables data elements to flow rapidly between different industries, which not only eliminates data barriers between industries (Lai, Xiaobing, and Yue, Shujing, 2022; Curran, 2018), but also provides a new engine for double-cycle development by achieving a higher level of optimal resource allocation, breaking the constraints of the localization cycle, smoothing the industrial cycle, and optimizing the global economic division of labor (Zhu, Hailiang, and Wang, Chunjuan, 2018). 2021). On the one hand, industrial digitization is conducive to the transformation and upgrading of traditional industries and the overtaking of traditional industries. The combination of digital technology and traditional industries not only changes the original production and operation mode of enterprises (Veile et al., 2022), but also improves the accuracy of control processes, reduces quality errors, improves product quality

ISSN: 2688-8653

and production efficiency through digital technology (Zhou, Xiawei et al., 2022), so that it can meet the needs of consumers at different stages, stimulates the potential of service consumption, and becomes a long-term driving force for consumption. It can also make full use of the potential of the huge domestic market scale, reduce the pressure brought by the return of manufacturing industries from developed countries, and open up the internal cycle of service consumption (Liu Yi and Xia Jiezhang, 2021), which will help the economy maintain high and stable growth (Myovella et al., 2020). On the other hand, industrial digitization enhances the matching of service supply and demand and expands the scope of trade. Industry digitization uses digital technology to empower the development of industry platforms, strengthen social network connections, and simplify the transaction mechanism, which is conducive to improving the efficiency of information access and reducing the time cost of transactions (Yin et al., 2019), improving the efficiency of social resource flow and transforming non-tradable industries into tradable states from the traditional perspective, which is not only an important grasp to promote internal circulation (Zhu Hailiang and Wang Chunjuan, 2021), but also provides a convenient transaction channel for international trade, which enables the original labor-intensive export structure to be adjusted (Dang, Lin et al., 2021) and promotes the rise of the global division of labor and the continuous optimization of the trade pattern of the industrial chain, which in turn smooths the external circulation and realizes the development pattern of "both internal and external". Accordingly, this paper proposes the following hypotheses:

H1: Digital industrialization and industrial digitization have a facilitating effect on the development of both internal and external circulation.

2.2. The Regional Impact of the Dual Cycle of Digital Industrialization and Industrial Digital Empowerment

Industrial digitization enables key technologies technologies and resources are continuously integrated and reorganized in space to achieve regional synergistic development. For one, industrial digitization is conducive to accelerating the digital transformation of high-energy-consuming industries. Influenced by the effect of economy of scope, industrial digitization is more inclined to transfer a large number of highly polluting, dangerous and repetitive operations to mechanical operations and to aggregate relevant data information and services to professional platforms, which not only reduces the degree of dependence on labor but also activates the transformation and upgrading of local traditional industries to knowledge-intensive and green low-carbon (Zhou et al., 2021), so that the internal structure of the three industries can be continuously optimized. . Second, industrial digitization can reduce the spatial gap of public resource allocation to a certain extent. The regional connectivity effect exerted by industrial digitization enables public services and key information to flow across spatial scales in a short period of time, which to a certain extent compensates for the uneven allocation of regional public service resources due to differences in economic development bases, thus having the opportunity to realize the common construction and sharing of public services on a larger scale and create a more equitable development pattern (Zhang Keyun et al., 2022). Third, industrial digitization helps realize the transformation of physical space scale to digital space scale, which improves the traditional industry in the central and western regions. New industries and new models derived from industrial digitization break local protection and regional barriers to a certain extent, integrate individuals, networks, and production materials efficiently, cross geographical boundaries and market segmentation, and establish extensive articulation of the whole factor, whole industrial chain and whole value chain, realizing a new situation in which the scale of digital space keeps expanding while the scale of physical space gradually shrinks (Wang Juanjuan, 2022; Zhou Xiawei et al. , 2022). Especially in the central and western regions, where the distribution of traditional industries in China is more concentrated, the huge industrial base and urgent industrial transformation needs have created a late-stage

ISSN: 2688-8653

advantage in the development of industrial digitization, so that the application of digital technology and the sharing of data elements make the economy more closely connected, and also give the advantageous industries in the eastern regions the opportunity to be extended to the central and western regions through the industrial chain, thus achieving the effect of narrowing the regional gap. Therefore, digital industrialization and industrial digitization can promote different regions to step into the double-loop threshold together and become an important opportunity to realize inter-regional synergistic development; therefore, digital industrialization and industrial digitization do not aggravate the regional development gap. Accordingly, the following hypothesis is proposed:

H2: Digital industrialization and industrial digitization do not aggravate the development gap of the double cycle between different regions.

2.3. The mechanism of action of the double cycle of digital industrialization and industrial digital empowerment

Technology introduction enhances the scale advantage of international market competition. Influenced by factors such as technical barriers and intellectual property protection, the source of technology introduction is relatively single. Because of this, after relying on technology introduction to improve the production process, the standard and quality of products produced in different regions are basically the same. The advantage is that at the end of the production and operation of the product, i.e., the product sales process, the domestic production standards can break through the geographical restrictions and match the international market. In addition, the introduction of technology increases the spatial density of products in the process of increasing product homogeneity, so that domestic enterprises have a better chance to take advantage of scale in the international market after completing knowledge accumulation and achieving secondary innovation (Ma, Haiyan, and Yu, Mengyu, 2018), and to a certain extent, consolidate the international supply chain division of labor status. Accordingly, the following is proposed

Hypothesis:

H3: Digital industrialization and industrial digitization have a catalytic effect on the development of the inner and outer cycle by promoting the introduction of technology effect.

3. Empirical study design

3.1. Variable selection and description

3.1.1. Explained variables

Combining the new development pattern and role system of the double loop, the inner loop (Incir) and the outer loop (Excir) as the explanatory variables, respectively. Specifically, the scale of exports of intermediate goods is used to characterize the impact of China's productive capacity on the world economy; the scale of exports of foreign direct investment enterprises is used to characterize China's participation in the global division of labor; and the scale of exports of processing trade is used to characterize the trade pattern of China's participation in the global industrial chain. At the specific operation level, referring to the idea of Li, Ping and Jiang, Li (2015), the subcategories with codes 111, 121, 21 , 22, 31, 32, 42 and 53 in the BEC taxonomy are considered as intermediate goods, and on this basis, the BEC codes are matched with HS codes, so as to screen the export scale of intermediate goods in 30 provinces of China; referring to Fan, Ziying and Tian, Binbin (2014) for processing trade definition, the sum of incoming processing trade exports and incoming processing trade exports is used to reflect the scale of processing trade exports.

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3.1.2. Core explanatory variables

Given the measurability of variables and the availability of data, this paper analyzes the mechanism of the digital economy's effect on the double cycle in terms of digital industrialization (Digin) and industry digitization (Inddi). In the quantification process, the digital industrialization is measured in four dimensions: the scale of development of electronic information manufacturing industry, the scale of development of telecommunication industry, the scale of development of software and information technology service industry, and the scale of development of Internet, combining the ideas of Fan Yichang et al. (2022) and Wei Lili and Hou Yuqi (2022) on the measurement of digital industrialization.

3.1.3. Intermediate variables

Technology introduction scale (ift): technology introduction can break through technological barriers in a short period of time, achieve technological spillover through imitation of secondary schools, and make up for the lack of development in some fields, so the cost of foreign technology introduction is used to measure the scale of technology introduction; independent innovation capability (ini): independent innovation of enterprises is not only the key to building an innovative country, but also the key to making enterprises in domestic and international markets with competitive advantages in domestic and international markets Therefore, the expenditure on new product development of industrial enterprises above the scale is used to measure the independent innovation capacity of enterprises; poverty reduction governance (poa): the main goal of poverty reduction governance is to reduce the number of poor people and improve the living standard of residents in less developed areas, and the level of poverty rate directly reflects the effect of poverty reduction governance. Therefore, the incidence of poverty is positivized to measure the effect of poverty reduction governance.

3.1.4. Control variables

Using local government (dep); energy consumption (million tons of standard coal) to measure the degree of environmental protection (ecd); road mileage to measure the level of infrastructure (inl); urban population density to measure the The urban population density is used to measure the scale of urban development (upd); and the water penetration rate is used to measure the living standard of residents (lsr).

3.2. Data sources and descriptive statistics

Comprehensive data availability, this paper takes 2012-2018 as the research interval and selects 30 provinces (municipalities directly under the central government) in China as the research subjects, excluding Tibet, Hong Kong, Macao and Taiwan, where data are more seriously missing. The data were mainly obtained from China Customs database, National Bureau of Statistics, China Regional Statistical Yearbook, and China Environment Statistical Yearbook.

4. Empirical Results and Discussion

4.1. Return to Basics

By constructing a spatial Durbin model to estimate the impact of digital industrialization and industry digitization on the inner and outer cycles, respectively and external circulation by constructing a spatial Durbin model. In general, digital industrialization and industrial digitization have a significant promoting effect and positive spatial spillover effect on inner circulation, and a significant promoting effect and negative spatial spillover effect on outer circulation, i.e., digital industrialization and industrial digitization can promote the development of inner and outer circulation in the region, and will form a positive interaction with the inner circulation in neighboring regions, but will cause some conflict with the outer circulation in neighboring regions, and the hypothesis H1 is partially confirmed.

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4.2. Robustness tests

By constructing a spatial Durbin model to estimate the impact of digital industrialization and industry digitization on the inner and outer cycles, respectively and external circulation by constructing a spatial Durbin model. In general, digital industrialization and industrial digitization have a significant promoting effect and positive spatial spillover effect on inner circulation, and a significant promoting effect and negative spatial spillover effect on outer circulation, i.e., digital industrialization and industrial digitization can promote the development of inner and outer circulation in the region, and will form a positive interaction with the inner circulation in neighboring regions, but will cause some conflict with the outer circulation in neighboring regions, and the hypothesis H1 is partially confirmed.

To ensure the reliability of the underlying regression results, robustness tests were conducted in the following three ways:

First, the instrumental variable method. In this paper, the sudden change in natural environment is considered as an instrumental variable for digital industrialization, measured by the area affected by floods, landslides, mudslides and typhoons, and the level of rural Internet development is considered as an instrumental variable for industrial digitalization, measured by the number of rural broadband access users. On this basis, the spatial-geographic relationships of provinces are included in the regression model, and possible endogeneity is tested using the generalized spatial panel two-stage least squares method. After adding the two instrumental variables of sudden change in natural environment and rural Internet development level, the result of F-statistic is much larger than 10 indicating that there is no problem of under-identification and weak instrumental variables, and the selection of instrumental variables meets the requirements, and the effects of both digital industrialization and industrial digitization on the double cycle remain consistent with the results of the underlying regression, proving that the conclusions of this paper are not affected by the endogeneity problem.

Second, sensitivity analysis. In the process of studying the impact of digital industrialization and industrial digitization on the double cycle, there may be other factors that also affect the double cycle, such as the degree of understanding of the double cycle development pattern by social residents, the degree of matching between the industrial policies formulated by local governments and the double cycle development strategy, and whether the existing laws and regulations and local government regulations can provide guarantees for the smooth operation of the double cycle? Obviously, these influencing factors cannot be measured in the short term, yet they do exist in the economy and society. For this reason, this paper uses sensitivity analysis to measure the strength of these omitted variables needed to have an impact on the underlying regression results

and the scale of urban development is used as a comparison variable for the omitted variables. The results of the sensitivity analysis show that when the effect of the omitted variables reaches one, two or even three times the size of urban development, the results of the base regression still hold, proving that the findings of this paper are not affected by the omitted variables.

Third, the seemingly uncorrelated test. In the base regression model, we incorporate the inner and outer cycles into two regression models to study the effects of digital industrialization and industrial digitization on the inner and outer cycles respectively, but whether the interaction relationship between the inner and outer cycles has an impact on the veracity of the regression results is also a matter of concern. To this end, this paper conducts a joint test of the underlying regression using the likelihood-free correlation estimation to verify the impact of the correlation of the disturbance terms on the regression results. Considering that the direct effect coefficients and spatial spillover effect coefficients resulting from the decomposition of main effects by the spatial Durbin model may face selectivity problems in comparison with the

ISSN: 2688-8653

coefficients of the seemingly uncorrelated test, and it has been confirmed in Table 4 that the regression results of ordinary least squares remain consistent with those of the direct effects of the spatial Durbin model, i.e., the conclusions of this paper are not influenced by the regression method. In view of this, the paper compares the single regression coefficient derived from the ordinary least squares regression with the seemingly uncorrelated regression coefficient. The results in Table 4 show that the coefficients estimated separately for the inner and outer loops using ordinary least squares are highly identical to those estimated jointly by the seemingly uncorrelated test, indicating that the significance is basically consistent with the base regression, proving that even if there is an interaction between the inner and outer loops, it does not affect the results of the base regression, verifying the good robustness of the conclusions of this paper.

4.3. Mechanism Analysis

The above study validates the impact of digital industrialization and industrial digitization on the dual cycle The above study validates the impact of digital industrialization and industry digitization on the double cycle and The heterogeneity of digital industrialization and industrial digitization is explored. However, how do digital industrialization and industrial digitization transmit their effects to the dual cycle? In order to clarify this question, this paper further analyzes the mechanisms of digital industrialization and industrial digitization mentioned in the theoretical framework. To clarify this question, this paper further analyzes the mechanisms of digital industrialization and industrial digitization mentioned in the theoretical framework.To test the hypotheses presented above, the following model was established.

$$Instaff_{it} = \alpha_i + v_i + \beta_0 + \beta_1 compre_{it} + \beta_2 ssr_{it} + \sum \beta control_{it} + \varepsilon_{it} \quad (1)$$

$$Instaff_{it} = \alpha_i + v_i + \beta_0 + \beta_1 compre_{it} + \beta_2 ssr_{it} + \beta_3 soindus_{it} \times compre_{it} + \sum \beta control_{it} \varepsilon_{it} \quad (2)$$

4.4. Intermediary Effect

4.4.1. Intermediary effect of technology introduction

Digital industrialization focuses on promoting the development of internal circulation by expanding the scale of technology introduction, and there is a positive spatial spillover effect; while the digitalization of industry promotes the development of double circulation by expanding the scale of technology introduction, and there is a positive spatial spillover effect on internal circulation and a negative spatial spillover effect on external circulation, thus hypothesis H3 is partially confirmed. The reason may be that the information revolution initiated by digital industrialization has accelerated the depth and breadth of information sharing, so that operators in different regions and even different countries can pay attention to the technological development trend of their own industry and competitors' business information at the first time, and thus implement technology introduction strategies in a more targeted manner. The improvement of technology level will reduce the production cost of enterprises, which in turn will meet the needs of different types of consumers, release the consumption potential of the domestic market and promote the development of the internal cycle. The demonstration effect of technology introduction will also lead neighboring regions to join the technology exchange market and promote the level of internal circulation development in neighboring regions. In the face of digital transformation and upgrading of industries, technology introduction has become a key factor in the development of the domestic market. In the face of digital transformation and upgrading of industries, technology introduction has become an important way for industries to improve digital technology and

ISSN: 2688-8653

achieve intelligent production, manufacturing and sales of products in a short period of time, which not only provides an opportunity to promote the upgrading of traditional industries and break the barriers that restrict the flow of products from different regions, but also improves the competitiveness of products in the international market. However, influenced by the policy orientation, there is still a certain competitive effect on the participation of enterprises from different regions in the outer circle.

4.4.2. The mediating effect of autonomous innovation capability

The following panel data model is established.

$$Infor_{it} = \alpha_t + v_i + \beta_1 cit_{it} + \beta_2 var_{it} + \beta_3 gov_{it} + \beta_4 ssr_{it} + \sum \beta_i \, control_{it} + \varepsilon_{it} \quad (3)$$

Digital industrialization can promote the development of internal circulation by expanding independent innovation capacity. Digital industrialization can promote the development of the inner cycle by expanding independent innovation capability, but has a significant inhibitory effect and negative spatial spillover effect on the outer cycle; digitalization of industry can promote the development of the double cycle by improving independent innovation capability, but the spatial spillover effect is not obvious, thus hypothesis H3 is partially confirmed. The reason may be that digital industrialization and industrial digitalization can stimulate enterprises to continuously improve their independent innovation capability, increase R&D investment, and focus on creating "first-mover advantage", so that new products and technologies can be continuously introduced to the domestic market to meet the needs of consumers at different levels, and inject new vitality into the development pattern of the inner cycle. The development pattern of the internal cycle to inject new vitality. However, digital industries are mostly technology-intensive industries with high initial investment in the process of innovation and R&D. In addition, due to the influence of professional and technical barriers and intellectual property protection, the possibility of technology spillover is weak, which makes them more competitive in the market within a certain period of time and brings impact to the markets of neighboring regions, thus causing a certain negative impact on the internal circulation of neighboring regions. Subject to the low added value of production and processing intermediate goods, the proportion of labor-intensive products among export products in the division of labor in the global value chain is large, and they are vulnerable to the influence of trade policies of other countries, and it is difficult to develop overseas markets for new products and technologies in a short period of time. The radiation of industrial digitalization is wider, especially the labor-intensive industries such as primary and secondary industries, which are more profoundly affected by industrial digitalization, are more likely to combine digital technology to improve production efficiency, reduce the dependence on labor, improve the added value of export products, and promote the benign development of double cycle.

4.4.3. The mediating effect of poverty reduction governance

Digital industrialization promotes the development of double cycle by reducing poverty level, but the spatial spillover effect is not significant; industrial digitization can promote the development of double cycle by reducing poverty level, but there is a negative spatial spillover effect on the external cycle, thus hypothesis H4 is partially confirmed. The reason may be that digital industrialization and industrial digitization provide new ideas for China to carry out poverty eradication. Specifically, the increasing level of digital industrialization has largely expanded the space and channels of information dissemination, giving the less developed areas with closed information the opportunity to connect with the fast-growing cities and towns, and providing opportunities to integrate into the relevant industrial chain. In addition, with the strategic concept of "going global", the advantageous products and industries of less developed

ISSN: 2688-8653

regions can be promoted to the world, which can also add new momentum to the development of external circulation. At the same time, the development of digital industry can help less developed regions combine their original production and sales models. The introduction of digital technology can increase the scale of production of agricultural products in less developed regions, reduce the dependence on labor, and expand the scale of product sales through e-commerce platforms or live streaming, so that product sales are no longer limited to the local or surrounding markets, but can spatially span through online channels, thus expanding the market to the whole country and even the world, so that the cause of poverty eradication is integrated into a double-loop development pattern. However, because neighboring regions have basically the same geographical environment and similar products, most of them have a single poverty alleviation industry and lack of diversity, leading to a certain degree of competitive effect in neighboring regions.

5. Conclusions and Policy Recommendations

5.1. Conclusion of the study

This paper takes 30 Chinese provinces as the research objects, selects 2012-2018 as the research interval, and analyzes the digital industrialization and industrial digitization respectively on the basis of measuring the inner cycle from four dimensions of production, distribution, circulation and consumption, and measuring the outer cycle from three dimensions of international impact of production capacity, global division of labor system and global industrial chain trade pattern The intensity, mechanism and regional impact of the digital economy empowering the dual cycle. The study finds that:

(1) Digital industrialization and industrial digitization significantly promote the development of local internal and external circulation, and can form a new situation of synergistic development with the development of internal circulation in the surrounding areas, but will have a certain degree of negative impact on the external circulation in neighboring areas, and digital industrialization plays a significantly more important role than industrial digitization.

(2) In terms of regional influence, the direct effect of digital industrialization and industrial digitization on the double cycle is basically the same in the southern and northern regions, i.e., the development of both does not further increase the gap between the north and the south, and the difference is mainly reflected in the spatial spillover effect of the outer cycle, and the spatial spillover effect of digital industrialization on the outer cycle in the northern region is significantly better than that in the southern region; the direct effect of digital industrialization and industrial digitization on the double cycle in coastal and inland regions The direct effect and spatial spillover effect of digital industrialization and industrial digitization on double circulation are basically the same in coastal and inland regions.

(3) In terms of "building a long board", digital industrialization can promote the development of internal circulation by expanding the scale of technology introduction, and there is a positive spatial spillover effect, while industrial digitization can promote the development of double circulation by expanding the scale of technology introduction, and there is a positive spatial spillover effect on internal circulation and a negative spatial spillover effect on external circulation Digital industrialization can promote the development of internal circulation by expanding independent innovation capability, but has a significant inhibiting effect and negative spatial spillover effect on external circulation, while industrial digitalization can promote the development of double circulation by improving independent innovation capability, but the spatial spillover effect is not obvious.

(4) In the aspect of "mending the shortcomings", digital industrialization promotes the development of the double cycle by reducing the poverty level, but the spatial spillover effect is

ISSN: 2688-8653

not significant. The digitalization of industry can promote the development of the double cycle by reducing the poverty level, but there is a negative spatial spillover effect on the external cycle.

5.2. Policy Recommendations

The conclusions of this paper have certain policy implications: first, to enhance the demonstration effect of digital industrialization and industrial digitization in terms of the strength of external circulation empowerment. Local governments should give full play to the guidance of the digital industry, through tax incentives, talent introduction policies and financing support policies, to enhance the competitive advantages of the local digital industry, promote the expansion of the scale of the digital industry, form industrial cluster spillover effects, enhance the resilience of the industrial chain, and promote the synergistic development of upstream and downstream enterprises. At the same time, we should increase the investment in "common technology" to solve the common technical barriers faced by the digital transformation of industries and help traditional industries to break through the technical barriers. In addition, the establishment of a think tank service platform for industrial digital transformation should be strengthened to provide guidance for the personalized problems faced by different enterprises in digital transformation. Second, stimulate the potential of independent innovation cooperation and strengthen the secondary innovation after technology introduction. Enterprises should be encouraged to establish a sound innovation management mechanism and R&D management system, improve their innovation capability as a whole through talent training, cooperation between industries, universities and research institutes, etc., complete product development, design and manufacturing links with independent intellectual property rights as the core, improve To enhance the technical complexity of products and lay a solid foundation for developing international markets. At the same time, it should improve the absorption and secondary innovation ability after technology introduction, advocate different regions to introduce advanced technologies that are in line with their own development plans by combining their previous development advantages, and avoid problems such as blind purchase of new technologies, which leads to unreasonable introduction structure and homogeneous products of output distorting market competition. In addition, the spatial linkage effect of rural revitalization should be strengthened. From the perspective of the spatial spillover effect of rural revitalization, encourage or assign village cadres with rich experience in rural governance to station in neighboring less developed areas for guidance and experience exchange, or pair up villages with other less developed areas in the vicinity to help each other, so as to enhance the spatial spillover effect of rural revitalization by integrating advantageous resources and "driving the rich after the rich first". Through the integration of advantageous resources and "the first rich drive the latter rich", the penetration, radiation and demonstration effects of rural revitalization are enhanced. Thirdly, combining with the development of regional advantages, the layout of digital industry should be reasonably arranged. In the next development process, the government should optimize the layout of digital industry by combining local capital, land, labor and other factor endowments, industrial structure and development planning, so that the development of digital industry can become a driving force for local economic transformation and upgrading. At the same time, it should make full use of online education, digital medical care, digital tourism and other digital applications that are relatively mature in development, cross spatial and geographical constraints to obtain advantageous resources, fill the gap of local economic development, and activate relatively weak industries in local development through "Internet+" to fully release the potential of economic development.

ISSN: 2688-8653

References

[1] Liu Jun, Wang Jiawei, Yang Haochang. The impact of industrial agglomeration on urban-rural income gap between urban and rural areas--an empirical study based on provincial panel data in China[J]. An empirical study based on provincial panel data in China[J]. Rural Economy, 2015(5):44-49.

[2] Liu, S.-S., Ling, W.-Spokes. Multi-mediation model and its application[J]. Psychological Science, 2009(2):433-435.

[3] Tao Yuan. Urbanization and urban-rural labor income gap - An empirical study based on provincial panel data in China[J]. Economic Issues Exploration, 2020(8):87-96.

[4] Lichtenberg F R.The Effect of Government Funding on Private Industrial Research and Development：A Re-Assessment[J].Journal of Industrial Economics, 1987（1）：97-104.

[5] Feldman M P, Kelley M R.The Ex Ante Assessment of Knowledge Spillovers：Government R&D Policy, Economic Incentives and Private Firm Behavior[J].Research Policy, 2006（10）：1509-1521.

[6] Zhou Guofu, Chen Hanbin . Analysis of the threshold effect of industrial structure upgrading on urban-rural income gap [J]. Statistical Research, 2021(2): 15-28.