Research on the Impact of Data Production Factors on China’s Green Transition

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Abstract

Since the 21st century, the digital economy has developed by leaps and bounds. As a key factor of production in the digital economy era, data plays an important role in China’s green transformation. Based on the panel data of 282 prefecture-level cities in China from 2011 to 2019, this paper studies the relationship between data elements and green transformation. The results show that data elements can significantly promote green transformation by improving technical efficiency and achieving technological progress. Based on the above conclusions, all regions should speed up the infrastructure construction of digital economy, train digital talents, reduce resource dependence, improve the green, low-carbon and circular development system, formulate a digital economy development strategy considering local economic development levels, improve resource utilization efficiency and labor productivity, and actively promote green transformation.
Keywords

data – factors of production – China – resource dependence – the digital economy –
green transformation

1 Introduction

Since the reform and opening, China's economy has made remarkable achievements. During 1979–2000, the average growth rate of China's GDP was as high as 9.2%, and during 2001–2020, the average growth rate of GDP was 8.7%. With the changes in the international and domestic economic environment, China's economy has changed from a high-speed growth stage to a high-quality development stage, from relying on traditional production factors to relying on scientific and technological innovation and human capital. The constraints of resources and environment on economic development have been strengthened, and major social contradictions have also been transformed. That is, the contradiction between the people's ever-growing material and cultural needs and backward social production has been translated into the contradiction between the people's ever-growing needs for a better life and unbalanced and inadequate development, which determines to promote green transformation and realize green economic growth. It has become the focus of China's future economic development.

In 2020, the “Opinions of the Central Committee of the Communist Party of China and the State Council on Building a Better System and Mechanism of Market-oriented Allocation of Factors” was released. For the first time, data, and traditional factors such as land, labor, capital, and technology were listed as production factors, and it was clearly stated at the beginning: “Data is a national basic strategic resource and an important production factor.” The “14th Five-Year Plan” and the outline of the long-term goal for 2035 put forward that it is necessary to give full play to the advantages of massive data and rich application scenarios and establish and improve the market rules of data factors.

In the era of digital economy, globalization has brand-new characteristics. The new round of scientific and technological revolution represented by cloud computing, big data, Internet of Things, artificial intelligence and blockchain have brought about great changes in industry, and even the whole society.

This process not only stimulates the development vitality of traditional industries, but also promotes the sustained and rapid growth of digital
economy, and the ability of data collection, storage, teaching, statistics, and analysis is constantly improved. When the effective information contained in the data can be truly extracted and used for economic development, it gradually has the mission of production factors and becomes a modern production factor juxtaposed with traditional production factors such as labor, capital, land, and technology. Through the “blessing” of capital and technology, data has gradually evolved into a new engine to transform the world. As a new factor of production, how does data affect the green transformation, and does the “resource curse” exist? How to correctly understand the economic value of data as a factor of production. This paper attempts to explore the relationship between data production factors and green transformation under the introduction of resource endowment variables.

2 Literature Review

2.1 Analysis of Contribution of Data Production Factors

From the perspective of the overall development trend of economics, the research hotspot of the contribution of data production factors to modern economic development has been formed, and a few important documents have mushroomed. From the existing research results, it can be roughly divided into two viewpoints, one is that data improves labor productivity. Pei Changhong et al. (2019) believes that “for these production processes, it is the technical means of data information and its transmission that determines the productivity". Wu Huan and Lu Lige (2016) think that data is a production factor that can be compared with land and capital and put forward that “data cannot produce new material products, but it can improve productivity". Philip Stubb (2019) also believes that digital monopoly capitalism has developed new technologies to improve labor productivity. Another view is that data directly creates value. Zhang Li (2019) believes that “data, together with other factors of production such as labor, land and capital, creates value for economic and social development", that is, data directly participates in the production process and creates the value of goods together with various factors of production. So, which view is scientific?

To answer this question, we need to take Marxism as the guide, correctly understand the contribution of data production factors, and accurately grasp the scientific connotation of General Secretary Xi Jinping's important exposition on the contribution of data production factors, to maximize the contribution of data production factors.


2.2 Research on the Action Mechanism of Data Production Factors on Economic Transformation

The impact of data production factors on economic transformation is not only reflected in improving the efficiency of production factors such as labor and capital, but also achieving the most allocation of resources through substitution and precise matching among production factors, thus driving high-quality economic development (Wang Juan, 2019). Then, what is the internal logic and mechanism of data production factors affecting economic growth? Some foreign scholars focus on whether the digital upgrading of production factors can help developing countries achieve catch-up strategy. Etoundi, Onana and Olle, etc. (2016) believe that digital economy is a new opportunity for developing countries to catch up with developed countries. Liu Shuchun (2019) found that the impact of data production factors on economic growth is not limited by space by comparing the maps of digital economy strategies of major countries in the world. At present, countries have raised the digital economy to an important strategic height of technological innovation and industrial upgrading. Sun Baowen (2019) believes that the micro-mechanism of data production factors promoting economic growth lies in the scale effect and long tail effect required by economic growth formed by technologies such as Internet, big data, and cloud computing. Du Qinchuan (2022) clarified the role of data elements in promoting economic digital transformation and improving economic governance and efficiency by constructing an economic growth model \( Y = DAF(K^a L^b) \) containing data elements.

Xu Xiang et al. (2021) analyzed the influence of data production factors on micro-enterprise decision-making and production efficiency, industrial organization problems related to data factors and the role of data in reducing information friction in financial markets. From the existing research results, it is the result of the evolution of social production relations that data production factors become key production factors, which has a profound impact on the economy at the micro level. However, the research on the interaction mechanism between data production factors and other traditional production factors, the participation of data production factors in production, their contribution to production functions and externalities is still fragmented and not systematic enough, and these theoretical problems are the basis of digital economy related research.

2.3 Digital Economy and Green Transformation

The “14th Five-Year Plan” proposes to promote the comprehensive green transformation of economic and social development, comprehensively improve the efficiency of resource utilization, and vigorously develop the green economy.
Regarding the connotation of green transformation, the research group of Institute of Industrial Economics, Chinese Academy of Social Sciences (2011)\(^1\) think that green transformation is supported by technological innovation, guided by intensive use of resources and environmental friendliness, realizing green production process, and achieving a win-win situation of economic and environmental benefits.

Fan Dan and Sun Xiaoting (2020)\(^2\) believe that green transformation needs to promote the harmonious development of nature and society and achieve sustainable growth. Therefore, green transformation takes green innovation as the core, relies on efficient, intensive, and green economic growth mode, realizes sustainable economic development, promotes harmonious coexistence between human and nature, and promotes win-win development of economic benefits, social benefits, and ecological benefits.

In the era of digital economy, data, as a brand-new factor of production, participates in all aspects of economic and social development. With its strong permeability, the digital economy is deeply integrated with various industries. At the same time, due to the network effect, it can achieve rapid matching between supply and demand, improve resource allocation efficiency and labor productivity, improve energy use efficiency, reduce carbon emissions, reduce environmental pollution and ecological damage, and achieve coordinated development of economy and environment.\(^3,4\)

The development of digital economy is conducive to the realization of common prosperity. At present, there is an imbalance in economic development among regions. The development of digital economy promotes the free flow of data and information and makes the industrial chain more dispersed. For the economically underdeveloped central and western regions, the traditional agricultural products market is small and restricted by transportation. The development of digital economy reduces information asymmetry, reduces

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transaction costs and logistics costs, promotes the increase of farmers’ income, and narrows the income gap.\(^5\)

3 The Economic Analysis of the Contribution of Data Production Factors

3.1 The Inevitability of Data Becoming Factors of Production

Factors of production are a historical category. In the era of digital economy, it is inevitable that data will become a factor of production. This is the basic law of human society and the result of the movement of basic social contradictions. With the vigorous development of digital economy, it is reasonable and inevitable for data to become a modern factor of production.

The importance of data has become increasingly prominent in the context of globalization. Despite the undercurrent of anti-globalization, from the perspective of economic flow and interdependence among countries in the world, the trend of economic globalization is irreversible and is the inevitable trend of future world development. Adam Smith believed that all policies and measures to restrict free trade must hinder the division of labor, thus hindering the improvement of productivity and social welfare. Obviously, from the perspective of resource allocation, economic globalization is a choice in line with the overall interests of the world. The idea of building a community with shared future for mankind put forward by Xi Jinping pushes globalization to a height including political, economic, cultural, and social integration, which reflects China’s role in the future development of globalization.\(^6\)

In 2021, China’s digital economy industry continued to grow, and its development resilience was significantly enhanced. In 2021, China made a new breakthrough in the development of digital economy. The scale of digital economy reached 45.5 trillion yuan, a nominal increase of 16.2% year-on-year, which was 3.4 percentage points higher than the nominal growth rate of GDP in the same period, accounting for 39.8% of GDP. The position of digital economy in the national economy is more stable and its supporting role is more obvious. From


a global perspective, the scale of the global digital economy continued to rise from 2018 to 2021, as shown in Figure 1.7

In June 2022, the prosperity index of service trade released by WTO was significantly higher than that of goods trade, showing the resilience of global service trade, in which the proportion of digital trade increased greatly, and about half of global service trade was digitalized. The emergence of data production factors has greatly extended the spatial dimension and time dimension of market scope, providing more opportunities for cooperation among countries. Service trade and digital globalization will become the new engines of economic globalization. According to IDC’s forecast, by 2023, the output value of digital economy will account for 62% of global GDP, and the penetration rate of digitalization to global economy will further increase. The global economy will

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At present, in the field of digital economy, China has built a macro legal system, improved, and perfected the rules of cross-border data flow, established a personal information protection system, and intensified the reform of anti-monopoly legislation in the network field.

In the future, China will further promote the integration of digital economy into the new pattern of global development and inject new kinetic energy into the common development of global digital economy. It is the general trend for data to enter the field of economic production in an all-round way and promote the digital transformation of economy, which objectively requires data to become a modern factor of production.

In the digital economy era, the potential of traditional production factors to drive economic growth is weakened. The development of production factors runs through the development of economic growth theory. The development process of economic growth theory is the process that economists constantly study the motivation of economic growth. Different economic growth theories pay attention to different production factors. From the development process of economic growth theory, around the difference of production factors that play a leading role in economic growth, economic growth theory has developed from classical to neoclassical and then to endogenous economic growth theory, and the research on the source of economic growth has deepened from the increase of factor quantity to the improvement of factor quality.

In the era of digital economy, the potential of relying on the expansion of the input scale of traditional production factors to pull economic growth is getting smaller and smaller, especially the traditional production factors such as labor and capital, which have the characteristics of marginal output and diminishing returns to scale. With the in-depth development of the new generation of information technology, the digital economy is developing rapidly, and is becoming a key force to reorganize global factor resources, reshape the global economic structure and change the global competition pattern. Like the role of labor, capital and technological production factors in previous industrial revolutions, data production factors will be applied to production, distribution, exchange, and consumption on a large scale, and become the key factors to promote economic and social development.
Data becoming a factor of production is the result of social contradiction movement. Factors of production are evolving historical categories. Land and labor are important factors of production in the era of agricultural economy. After the Industrial Revolution, capital has become the most important factor of production in the era of industrial economy. With the further development of productivity and scientific and technological level, technology has become an independent factor of production. With the advent of the digital economy era, data elements have become the new engine of economic development. In different stages of social development, the importance of each factor of production is different, and new factors of production will be produced.

According to historical materialism, the basic social contradiction is the fundamental driving force of social development, which is the contradiction between productivity and production relations, economic base and superstructure, among which productivity is the most basic driving force in the movement of basic social contradictions and the ultimate decisive force for the development of human society. Furthermore, the connotation of productivity is analyzed. Productivity is the ability of human beings to use nature, transform nature and obtain material data from nature. It includes three elements: labor force, labor data and labor object. It is a comprehensive concept. The production factors discussed in this paper, such as land, labor, capital, technology, and data, are all the contents covered by productivity.

In the era of digital economy, new changes have taken place in productivity and production relations. Under the premise of uncertainty in human economic activities, the contradiction between inefficient local resource allocation and efficient potential overall resource allocation runs through the whole process of economic development. Under the high-speed developed market economy, this contradiction has become increasingly prominent, and it has also become the main driving force for the transformation and evolution of productivity and production relations, and the breakthrough of the transformation lies in improving the efficiency of resource allocation. Data production factors can empower personalized products, services, and the whole industrial chain with their advanced ability to connect and match supply and demand, improve the efficiency of resource allocation in the whole society, and provide new sources and growth space for economic growth.

3.2 Contribution Analysis of Data Production Factors
Data production factors are not only special and key production factors in the digital economy era, but also can integrate with other traditional production factors, change the mode and degree of traditional production factors' action on economic growth, and play a multiplier role and release data dividends
with new factor combinations and factor structures. The integration of data and other factors of production can be manifested in the following forms: on the one hand, the integration of data and labor. Marx put forward the “three elements of labor process”, which holds that “the simple elements of labor process are purposeful activities or labor itself, labor objects and labor materials.”

The combination of data and production activities accelerates the innovation of labor tools, laborers, and labor objects, and promotes the transformation of productivity and the reconstruction of production methods. Data drives manufacturing production, R&D, design, operation, and service improvement, and transforms or even subverts traditional business models, management models, and organizational models through digital transformation of manufacturing industries to help build manufacturing powers and network powers.

The development of digital infrastructure and digital technology, which “forced” data to become a factor of production, is based on capital investment, and digital technology and capital are combined to form digital capital (Huang Peng, Chen Liang, 2021). Digitalization reshapes the new pattern of competition in the financial industry and brings new changes in the capital market. On the other hand, the integration of data and technology. The relationship between data and technology is closer. Data is not only the result form of technology application, but also the object of technology application. With the development of technology, it is easier to obtain data, or to get conclusions from existing data that cannot be found before. Therefore, data relying on technology has become the core element of big data application and the key to the development of big data industry.

Marx’s labor value theory points out that commodities have two factors: use value and value, which are determined by the duality of labor embodied in commodities. Concrete labor forms the use value of commodities, while abstract labor forms the value of commodities, which is the only source of value. Therefore, the contribution of data production factors needs to be understood from two aspects: use value and value. Like other factors of production, the participation of data in distribution according to the contribution of factors of production has its specific forms.

Data, like capital, technology, and other factors of production, does not create value by itself, but improves the production efficiency of use value, which means that workers produce more use value at the same time. The contribution of data production factors is reflected in accelerating the production process and circulation process, changing the problem of low efficiency, creating

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new goods, services, and business models, and creating new economic growth points in the process. Adequate data information can greatly solve the problem of information asymmetry between supply side and demand side, improve the decision-making ability of workers, managers, retailers, and consumers, match scattered resources and fragmented time with demand at low cost, improve the efficiency of resource allocation in the whole society, and provide new sources and growth space for economic growth.

Digital economy gives Marx’s labor theory of value a new connotation, reflects the new characteristics of the contemporary labor field, interprets the economic and social changes brought by digital economy and its reshaping of the labor market. Digital Labour has proved to be Marxist productive Labour, mainly because, although it presents itself as unpaid “producers and consumers”, it is in fact part of what Marx called the “aggregate worker,” not free from the control and exploitation of capital. In addition, digital labor process is the way of surplus value production under the background of digital economy, which reflects the new development of surplus value theory. Different from the previous labor process, data is added to its means of production, which is incorporated into the value production process as an important factor of production, and the capitalization and commercialization of data become the prerequisite of value production.

In the process of digital labor, the scope of labor is expanded, the boundary between production and consumption is more blurred, the field of capital exploitation is greatly extended, the degree of exploitation is deepened and more hidden, which is conducive to capital accumulation, but at the same time, the internal contradictions of capitalist economy will be further accumulated and amplified.

4 Empirical Analysis

4.1 Model Setting

To verify the impact of data production factors on green transformation, the following model is established:

\[ GTFP_{it} = \alpha_0 + \alpha_1 \text{dig}_{it} + \gamma X_{it} + \lambda_i + \eta_t + \varepsilon_{it} \]  

(a)

Among them, \( GTFP_{it} \) represents the green transformation in the T year of the I region; \( \text{dig}_{it} \) indicates the economic development level of the i-th region in the t-th year; \( X_{it} \) represents a series of control variables that affect green
transformation; $\lambda_i$ denotes the regional fixation effect; $\eta_t$ denotes the time-fixed effect; $\varepsilon_{it}$ is a random error term.

To analyze the influence mechanism of digital economy on green transformation and clarify whether allocative efficiency plays a leading role or technological progress plays a leading role, the following model is further constructed in this paper:

$$\text{GEC}_{it} = b_1 + b_2 \text{dig}_{it} + b_3 \text{X}_{it} + \lambda_i + \eta_t + \varepsilon_{it}$$  \hspace{1cm} (b)

$$\text{GTC}_{it} = c_0 + c_1 \text{dig}_{it} + c_2 \text{M}_{it} + c_3 \text{X}_{it} + \lambda_i + \eta_t + \varepsilon_{it}$$  \hspace{1cm} (c)

### 4.2 Variable Selection

Explained variable: green transition (GTFP), in this paper, green total factor productivity is used to measure the development level of green transformation. Specifically, SBM model is adopted to measure green total factor productivity. Input includes capital, labor and resources, and output consists of expected output and non-expected output, among which, expected output is measured by GDP. The undesirable output is calculated from three aspects: solid waste, sulfur dioxide and wastewater.

Explanatory variable: Digital Economy (dig). Bo Peiwen and Zhang Yun (2020) designed indicators from the four aspects of digital industry activity, digital user activity, digital innovation activity and digital platform activity to measure the digital economy.\(^9\) Based on China’s digital inclusive finance Index, Zhao Tao et al. (2020) added the Internet penetration rate, relevant employees and output, mobile phone penetration rate and other indicators to calculate the digital economy development index with the method of principal component analysis.\(^10\) Based on the availability of data, this paper draws on the method of Zhao Tao (2020) and uses entropy weight method to synthesize the above five indicators to get the development index of digital economy.

Control variables. Fixed asset investment (inv), measured as a ratio of fixed asset investment to GDP; The level of urbanization (urb) is measured by the ratio of urban population to total population. Financing environment (fin), measured as a ratio of total lending by financial institutions to GDP; Openness is measured by the ratio of foreign direct investment to GDP.

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4.3 Data Sources and Descriptive Statistics

Due to the large number of variables involved, the availability of data was considered this paper Eliminates prefecture-level cities in Xinjiang and Tibet and Sansha and Danzhou in Hainan Province and selects 287 prefecture-level cities as the research object. The data mainly come from China Urban Statistical Yearbook, statistical yearbooks of prefecture-level cities, EPS database and so on. The descriptive statistical results of each variable are shown in Table 1.11

4.4 The Result Analysis

This paper uses Stata15 to process and analyze the data. The following tables are the analysis results obtained by Stata15 software. In this paper, Stata is considered as a complete and integrated statistical software that provides its users with data analysis, data management, and professional charting, which contributes greatly to the research topic of this paper.

11 The data mainly come from China City Statistical Yearbook, Statistical Yearbook of prefecture-level cities, EPS database, etc.
4.4.1 Baseline Regression

Table 2 reports the baseline regression results of the impact of data elements on green transition. In column (1) and column (2), OLS was used for regression. As can be seen from Table 2 (1), data factor coefficient of core explanatory variables was significantly positive, which verified that data factor had a significant positive promoting effect on green transformation. After control variables were added to Table 2 (2), this conclusion was still valid. In column (3) and column (4), fixed effects were used for regression. It can be seen that the coefficient of data factors is still positive and passes the significance level of 1%. This is because, under the traditional economic development mode, the development mode is mainly extensive, which often relies on the massive input of energy, capital, labor and other factors to achieve economic growth. Digital economy can promote the transformation of industrial economy to information economy through information and communication technology and form a new technology-economy paradigm. The development of cloud computing,

<table>
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<td>(0.023)</td>
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<td>0.064***</td>
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<td>(0.0243)</td>
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<tr>
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<td>(0.023)</td>
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<td>-0.909</td>
<td>(0.722)</td>
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<td>(0.396)</td>
<td>(0.722)</td>
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<td>(0.034)</td>
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<td>0.013</td>
<td>0.136</td>
<td>0.152</td>
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artificial intelligence and other new technologies can reduce the uncertainty in transactions, reduce transaction costs, realize the rapid matching of information between suppliers and demanders, improve market efficiency. The integration of digital technology and the real economy is conducive to improving labor productivity, optimizing the efficiency of resource allocation, and promoting green transformation.

4.4.2 The Influence Mechanism of Data Factors on the Impact of Green Transformation

Further, the green transformation, that is, the green total factor productivity, is decomposed into green efficiency improvement effect and green technology progress effect, so as to explore the sources of green total factor productivity growth. Table 3 (1)–(2) reports the impact of data factors on green technology efficiency. It can be seen that the average coefficient of data factors is significantly positive, indicating that data factors can promote the improvement of green total factor productivity through improving green

<table>
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<td>dig</td>
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<tr>
<td>R²</td>
<td>0.076</td>
<td>0.109</td>
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technology efficiency. The development of digital economy strengthens the links between regions and industries, thus accelerating the free flow of data, capital, technology, labor and other factors. Meanwhile, digital economy can act on the growth through digital industrialization and industrial digitization. The in-depth development of digital technology can optimize the organizational mode and management system, thus improving the efficiency of production and resource allocation. We will optimize and upgrade the industrial structure. Table 3 (3)–(4) reports the impact of data elements on green technology progress. It can be seen that the results of data elements are still significantly positive regardless of whether control variables are added, which indicates that data elements can promote green transformation by promoting green technology progress. The development of digital economy is conducive to promoting technological innovation, stimulating scientific research and innovation subjects to actively carry out innovative activities, and innovation subjects to protect intellectual property rights to provide a fair and just environment for innovation, so as to improve innovation efficiency.

4.4.3 Robustness Test
To ensure the stability and credibility of the empirical results, robustness test is needed.

4.4.3.1 Elimination of Extremes
When there is a large difference between the maximum value and the minimum value of a variable in the sample, these extreme values tend to affect the empirical results, and even lead to the inaccurate regression results. Considering this factor, this paper carries out 2% bilateral tail reduction for the sample data. The robustness test results are shown in columns (1) and (2) of Table 4. It can be seen that the estimation coefficients and symbols of data factors have not changed significantly, and the conclusion that data factors can significantly promote the improvement of green total factor productivity is valid.

4.4.3.2 Lag One Stage
Considering that green transformation takes a certain amount of time, this paper selects data elements for one-stage lag processing, and replaces the core explanatory variable with its one-stage lag for regression. The results are shown in columns (3) and (4) of Table 4. It can be seen that the results
are consistent with the baseline regression, indicating that data elements can indeed promote green transformation, and the basic conclusion of this paper is robust.

4.4.3.3 Endogeneity Problem Handling

When endogeneity problems exist in the model, empirical results will be biased, so appropriate instrumental variables should be selected for processing. In this paper, the method proposed by Zhao Tao et al. (2020) is used for reference, and the two-stage least square method is used for processing. Here, the historical post and telecommunications data of each city in 1984 is selected as the instrumental variable of the development level of digital economy. The product of the number of Internet users in the previous year and the number of Internet users in the current year can be used as an instrumental variable to reduce the endogeneity problem.

Table 4

<table>
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<th>Variable</th>
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<td>dig</td>
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<td>1.3444***</td>
<td>2.873***</td>
<td>1.862***</td>
<td>1.051**</td>
<td>2.768**</td>
</tr>
<tr>
<td></td>
<td>(0.280)</td>
<td>(0.360)</td>
<td>(0.589)</td>
<td>(0.753)</td>
<td>(0.512)</td>
<td>(1.403)</td>
</tr>
<tr>
<td>Control variables</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Urban fixed effect</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year fixed effect</td>
<td>N</td>
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<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Kleibergen-Paaprk</td>
<td>42.193</td>
<td>17.578</td>
<td></td>
<td></td>
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<tr>
<td>LM statistic</td>
<td>[0.000]</td>
<td>[0.000]</td>
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<tr>
<td>Wald F statistic</td>
<td>{16.38}</td>
<td>{16.38}</td>
<td></td>
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</tr>
<tr>
<td>N</td>
<td>2296</td>
<td>2296</td>
<td>2009</td>
<td>2009</td>
<td>1760</td>
<td>1760</td>
</tr>
<tr>
<td>R²</td>
<td>0.136</td>
<td>0.152</td>
<td>0.119</td>
<td>0.197</td>
<td>0.076</td>
<td>0.024</td>
</tr>
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</table>
of telephones per 10,000 people in each city in 1984 was used as the instrumental variable to estimate the results, as shown in columns (5) and (6) in Table 4. It can be found that, after considering the endogeneity problem, the coefficient of data elements is still significantly positive, consistent with the baseline regression result, so the robustness of empirical results can be proved.

5 Conclusions and Recommendations

Through the above analysis, this paper argues that digital economy and digital labor have promoted the further development of Marx’s labor theory of value. Digital labor, like general productive labor, can create value and drive the development of digital economy and real economy. Data production factors are conducive to promoting green transformation. Therefore, we should improve the green and low-carbon circular development system and actively promote digital construction.

According to local conditions, based on the differences in digital industry foundation, popularization and application of digital technology and data resources in different regions, the development strategy of digital economy is formulated in combination with the local economic development level; Properly handle the relationship between government and market, and build a transformation planning decision-making mode with equal emphasis on government regulation and market regulation.

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