**Frontiers in Business, Economics and Management**
ISSN: 2766-824X | Vol. 13, No. 3, 2024

# Study on the Influence of Digital Economy on High-quality Trade Development Under the "Double Cycle" Pattern

**Meiling Zuo**[1, *]

[1] School of International Trade and Economics, Anhui University of Finance and Economics, Bengbu 233030, China

[*] Corresponding author: Meiling Zuo (Email: 15556300723@163.com)

**Abstract:** With the deepening of globalization and the rapid development of digital technology, digital economy has become a new important force to promote economic growth. The new development pattern of "double cycle" proposed by China focuses on realizing the mutual promotion of internal circulation and external circulation on the basis of expanding domestic demand. This paper aims to explore in the "binary" development pattern, based on the benchmark regression study how digital economy has a positive impact on trade quality development, the results show that the digital economy to improve the level of trade facilitation, promote the trade structure optimization, accelerate the trade pattern innovation, and by promoting the proportion of trade in services effectively promote the high quality development of China's trade. At the end of the paper, the countermeasures and suggestions are put forward.

**Keywords:** Double cycle; Digital economy; Benchmark regression; High-quality development.

## 1. Introduction

In the new generation of international trade rules, the rules of cross-border data flow are undoubtedly the core issue. As data has a growing impact on a country's political, economic and cultural aspects, many economies move their data to national strategies and influence cross-border data flows through domestic rules. Over the past 40 years of reform and opening up, trade has been an important factor to promote economic growth. Therefore, China's trade tends to pursue quality and efficiency, and plays an important role in enhancing China's comprehensive strength and enhancing China's international status. The article aims to explore the path and mechanism of the digital economy to promote the high-quality development of trade, and analyze how the digital economy can help build a high-standard market system and promote the construction of a trade power by optimizing the trade structure, improving trade efficiency and deepening trade cooperation. At the same time, we will explore breakthroughs and development in digital fields such as technological innovation, digital infrastructure improvement, data resource integration and cross-border e-commerce, so as to provide new drivers for high-quality development of trade. Relevant studies have shown that the digital economy can significantly promote high-quality economic development, which can be realized by accelerating the upgrading of industrial structure and the construction of digital infrastructure (Chen Zhao et al., 2022)[1]Accelerating the digital economy is conducive to the formation of new advantages of the digital economy in the national competition. Supporting the "double cycle" with "double integration" can be started from the process of human resources marketization (Chang Jin and Lin Shuguang, 2022)[2], Analyze the core mechanism of the new development pattern of digital infrastructure, technology cluster, data resources and industrial integration driven by the combination of industries from four aspects of material basis, technical support, key production factors and main driving forces (Liu Xuan, 2021)[3]To give full play to the role of digital economy in driving the transformation and upgrading of the manufacturing industry, we should strengthen the construction of digital infrastructure in the manufacturing industry, and strengthen the integration and sharing of industrial chain data (Li Chunfa et al., 2020)[4]From the perspective of trade status, the lack of digital economy and high-quality development of trade.(Meng Qi and Shen Jiayu, 2021)[5], In cultivating a high level of human capital, accelerating the deep integration of digital technology with domestic industries, coordinating and deepening opening up and national security development can promote the high-quality development of trade (Xia Jiechang and Li Luanming, 2023)[6]. According to the relevant research, this study will try to demonstrate the internal relationship between the digital economy and the development of trade. And through overall planning and coordination of development resources, the results of high-quality development of trade is studied and analyzed.

In China, corresponding studies on international trade have also been conducted. Some scholars have predicted the import and export volume of China's international trade through the gray prediction combination of BP neural network (Duan Lei, 2017)[7]. The growth rate trend of China's export trade is studied through the Markov conversion model (Chen Rui, 2021)[8]. Through empirical analysis, it shows that digital economy can effectively reduce trade costs, but the development of digital economy will also increase the uncertainty of China's export trade, bringing opportunities and challenges (Fan Xin, 2020)[9]. The foreign research of international trade research method provides ideas for China to study international trade development. The research side uses machine learning for trade research, proposing new data-driven methods to select the most important terms and quantify their impact on trade flows (Breinlich H, 2022)[15], The later proposed artificial intelligence and machine learning began to be applied in the financial field, and their application in data analysis, prediction, classification and

other fields showed an upward trend (Ahmed S, 2022)[16], And to classify and summarize the machine learning methods used in existing papers (Tong Y, 2023)[17].

To sum up, the research significance of this paper is not only the theoretical level deepening "binary" and the understanding of the digital economy, but also for government agencies, enterprises and related organizations, promote digital economy depth fusion, promote the development of trade with high quality, and to realize China's economic development with high quality policy advice.

# 2. Data Source

The data of this study are from China National Bureau of Statistics, etc. In terms of data selection, the data are selected according to different research aspects.

# 3. Theoretical Basis

David Ricardo, a British economist, has pointed out that comparative advantage is the key basis for trade between countries. With the rapid development of the digital economy, China's high-quality development has highlighted its comparative advantages in all aspects. High-quality development of trade is a new mode of trade economic growth. It focuses on improving the quality and efficiency of trade growth. It is not only the expansion of trade scale, but also the optimization of trade structure, the enhancement of trade competitiveness, the improvement of trade efficiency and the improvement of trade environment.

The inner cycle refers to the economic activities with the domestic supply and demand cycle as the main axis, which means strengthening the construction of the domestic market, enhancing the coordinated development of domestic production, distribution, circulation and consumption, and cultivating a more powerful and self-sufficient domestic economic system. External circulation refers to economic activities such as international trade and investment, that is, the export-oriented part, which still emphasizes openness and international cooperation, but under the new pattern, external circulation serves the internal circulation, forming a pattern of mutual promotion between domestic and international sides. The inner and outer loops are not isolated from each other. Under the "double cycle" mode, they promote and support each other. The inner cycle provides a stable economic foundation and market demand for the external cycle, which is conducive to improving the competitiveness of goods and services in the international market. Through the circulation of the introduction of foreign capital, technology, talent and market to strengthen the modernization and high-quality development of the domestic industrial chain, and promote the overall upgrading and optimization of the domestic economy. The core of the "double cycle" development pattern lies in driving sustained and healthy economic growth through more balanced internal and external economic activities. In this environment can have a positive impact on the high-quality development of trade.

In the current global economic environment, the digital economy has become a key force to promote economic growth and boost the high-quality development of trade, and its development involves multiple factors. First, an important cornerstone of high-quality economic development is innovation-driven development. Given the current situation of international economic development, innovation-driven development has become the primary productive force. Innovation in the digital economy can bring about technological progress and product upgrading, and improve production efficiency and competitiveness. Driven by innovation, enterprises will pay more attention to research and development and technological innovation, digital economy market connectivity bring consumption growth, the optimization and upgrading of digital industry integration is an important influencing factors of trade quality development, digital data information increase the number of industry and rich form, is the performance of trade innovation and development, and is also the embodiment of market vitality, promote industrial upgrading and transformation. Second, digital market consumption triggers industrial integration and enhances trade competitiveness. The enrichment of digital resources improves the quality and efficiency of trade, which is reflected in the upgrading of human resources. The integrated development of digital economy and resources promotes the improvement of the comprehensive level of human resources, integrating high-quality human resources into the global trade value chain, and forming a new growth point for high-quality trade development. At the same time, innovation also includes innovation in business models and management methods, through optimizing resource allocation and increasing the momentum of economic growth. Secondly, highly skilled personnel are an important support for high-quality economic development. Improving the quality and quality of human capital and cultivating highly skilled personnel with innovative thinking and practical ability are crucial to promoting high-quality economic development. High-quality talents can promote enterprise innovation, improve labor productivity, and thus promote the sustained economic growth and the promotion of competitiveness. Third, trade development accelerates the construction of an open global economic circulation system, and the reduction of trade costs gradually deepens the cross-border flow between goods and production factors. Digital economy rapidly expands the full scale of global factors, reshaping the global economic structure, and more importantly, driving the change of the global competition pattern.

To sum up, in economic theory and " double-cycle realistic environment, the factors related to digital economy can change the influencing factors of high-quality development of trade, so relevant paths can be sought to explain the reasons why digital economy promotes high-quality development of trade and conduct empirical analysis.

# 4. Empirical Analysis

## 4.1. Model building

In order to test the direct effect of digital economy on high-quality development, the high-quality economic development index and digital economy development index are constructed through various relevant indicators under the "double cycle" pattern, and then the following benchmark regression model is constructed:

$$EHD_{\mathrm{t}} = \alpha_0 + \alpha_1 NEI_{\mathrm{t}} + \beta_t + \varepsilon_t \quad (1)$$

Where t represents time, EHD represents the index of high-quality economic development, and NEI represents the index of digital economy development. Considering the partial subjectivity of the digital economy index and the absence of potential variables, not all relevant variables are taken into

account, thus causing model bias.

## 4.2. Variable description and measures

### 4.2.1. Interpretation variables: Economic High-quality Development Index (EHD)

On high quality of economic development there are many, but different indicators of high quality development, some directly to GDP as the index of high quality development, this obviously does not conform to the current concept of high quality development "green", the current high quality development not only need to focus on the number of GDP, pay more attention to the sustainable development of the green economic development. This paper adopts the Malmquist index method based on data envelope analysis (DEA), and uses DEAP software to calculate the total factor productivity from 2012-2021, which is used to measure the high-quality economic development.

The specific calculation method is as follows: the output index is GDP, the GDP is GDP measured by expenditure method; the input index is labor input and capital input, labor input adopts total labor productivity, and capital input adopts total capital formation in the accounting of GDP.

**Table 1.** Related Data Table

| A particular year | Total GDP value (RMB 100 million) | Per capita GDP (Yuan) | GDP increment speed | Total labor productivity (Yuan / Person) | Investment (100 million yuan) |
|---|---|---|---|---|---|
| 2012 | 538580.00 | 39771.37 | 7.9 | 72817 | 248960 |
| 2013 | 592963.20 | 43496.61 | 7.8 | 78182 | 275129 |
| 2014 | 643563.10 | 46911.72 | 7.3 | 83586 | 294906 |
| 2015 | 688858.20 | 49922.33 | 6.9 | 89080 | 297827 |
| 2016 | 746395.10 | 53783.00 | 6.7 | 94825 | 318198 |
| 2017 | 832035.90 | 59592.25 | 6.9 | 115104 | 357886 |
| 2018 | 919281.10 | 65533.74 | 6.7 | 123248 | 402585 |
| 2019 | 986515.20 | 70077.69 | 6 | 131109 | 426679 |
| 2020 | 1013567.00 | 71828.15 | 2.2 | 134683 | 439550 |
| 2021 | 1149237.00 | 80975.79 | 8.1 | 146380 | 489897 |

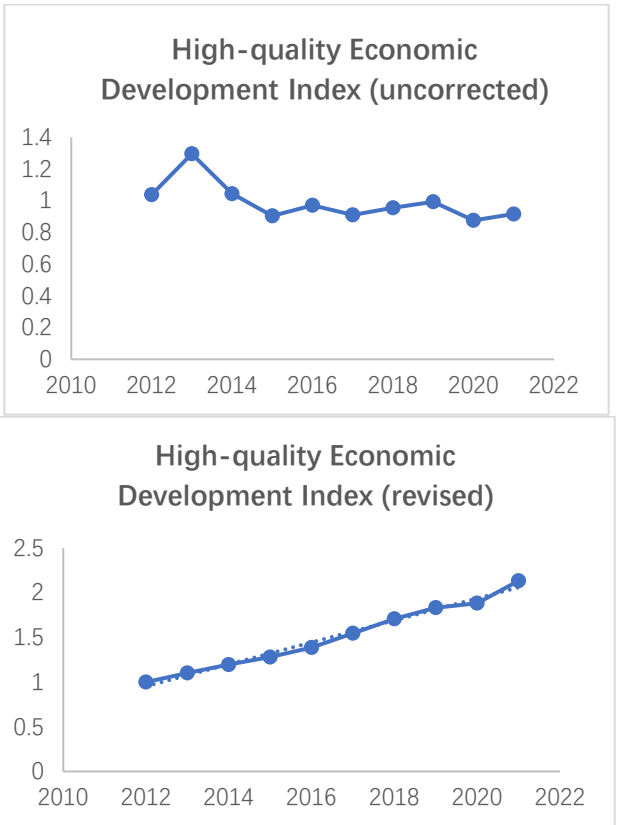



**Figure 1.** Revised comparative chart of the Economic Quality Development Index

Malmquist Index = Comprehensive Technical Efficiency Change Index (effch) Technical Progress Index (techcn)

Note: Because the index measurement method of data envelope analysis can not make full use of the characteristics of the data, the economic development index of this paper is corrected by the weighted synthesis of GDP growth rate.

2. Interpret variables

(1) Core explanatory variable: Digital Economy Development Index (NEI)

As an important new way of economic growth, digital economy has attracted the attention of all countries. There are a lot of scientific research on digital economy, so there are many ways to measure the development of digital economy. Most scholars use the construction of multiple indicators. There are many indicators that can reflect the development of digital economy, and different indicators reflect the

characteristics of digital economy. Through a large number of relevant literature review and according to their own actual situation, this paper has established a two-level index system. Based on the connotation of digital economy and considering the era and accessibility of data, three first-level indicators of digital industrialization, digital digitalization and digital infrastructure are selected from the macro level, and then refined into 14 second-level indicators (see table).

**Table 2.** Digital economic indicators table

| Level 1 indicators | Secondary indicators | data sources |
|---|---|---|
| Digital industrialization | Total telecom service volume (dx) | State Statistical Bureau |
| | Mobile phone end user (yd) | |
| | Number of postal business outlets (yz) | |
| | Number of manufacturing enterprises in the electronic information industry (dz) | |
| | Digital industry imports (nc) | |
| Industrial digitization | Value-added of the tertiary industry (zh) | State Statistical Bureau |
| | E-commerce transaction volume of industrial enterprises (gy) | |
| | National patent applications granted (zl) | |
| | Express volume (ep) | |
| | High-tech industrial export (gi) | |
| Digital infrastructure | Number of Internet broadband access users (ik) | State Statistical Bureau |
| | Telephone penetration rate (mc) | |
| | Internet penetration rate (ij) | |
| | Netizen scale (wg) | |

Basis for index construction: In order to fully measure the digital economy reasonably, we refer to the Statistical Classification of Digital Economy and Its Core Industries (2021) issued by the National Bureau of Statistics, the China Digital Economy Development Index Report (2021) and the digital economy index selected by scholar Chen Zhao. This paper divides the measurement of digital economy into three first-level indicators, digital industrialization, industrial digitalization and digital infrastructure. Considering the availability of data and the rationality and validity of the digital economy measure, this paper constructs 14 second-level indicators, which ensure the rationality of the selected indicators to the digital economy measure to different degrees.

This paper from the National Bureau of Statistics website, China securities investment fund association and predecessors have collated data, data from different places and different statistics under the same index data error, such as different statistical yearbook for the same year of service trade exports is different, take the latest statistical yearbook. The part of missing data and the unpublished data are predicted by index smoothing method, and the data can get the final data of each index through data cleaning and standardization.

**Table 3.** Results results of index indicators

| | *ik* | *ep* | *yd* | *wg* | *ij* | *zh* | *gi* | *nc* |
|---|---|---|---|---|---|---|---|---|
| *ik* | 1(0.000***) | 0.976(0.000***) | 0.967(0.000***) | 0.99(0.000***) | 0.989(0.000***) | 0.996(0.000***) | 0.825(0.003***) | 0.881(0.001***) |
| *ep* | 0.976(0.000***) | 1(0.000***) | 0.921(0.000***) | 0.99(0.000***) | 0.99(0.000***) | 0.97(0.000***) | 0.902(0.000***) | 0.933(0.000***) |
| *yd* | 0.967(0.000***) | 0.921(0.000***) | 1(0.000***) | 0.952(0.000***) | 0.95(0.000***) | 0.978(0.000***) | 0.797(0.006***) | 0.859(0.001***) |
| *wg* | 0.99(0.000***) | 0.99(0.000***) | 0.952(0.000***) | 1(0.000***) | 1(0.000***) | 0.985(0.000***) | 0.853(0.002***) | 0.896(0.000***) |
| *ij* | 0.989(0.000***) | 0.99(0.000***) | 0.95(0.000***) | 1(0.000***) | 1(0.000***) | 0.984(0.000***) | 0.849(0.002***) | 0.892(0.001***) |
| *zh* | 0.996(0.000***) | 0.97(0.000***) | 0.978(0.000***) | 0.985(0.000***) | 0.984(0.000***) | 1(0.000***) | 0.824(0.003***) | 0.878(0.001***) |
| *gi* | 0.825(0.003***) | 0.902(0.000***) | 0.797(0.006***) | 0.853(0.002***) | 0.849(0.002***) | 0.824(0.003***) | 1(0.000***) | 0.989(0.000***) |
| *nc* | 0.881(0.001***) | 0.933(0.000***) | 0.859(0.001***) | 0.896(0.000***) | 0.892(0.001***) | 0.878(0.001***) | 0.989(0.000***) | 1(0.000***) |

Note: * * *, * * and * represent the significance levels of 1%, 5% and 10%, respectively

The correlation between effective indicators is too strong, and at the significance level of 0.01 can reach 0.99, if do not consider the correlation of the index, the same index will be the digital economy index index distortion, so need to use method of different indicators give weight.

The empowerment methods of index weight include two categories: subjective empowerment and objective empowerment, objective empowerment includes information entropy method and coefficient of variation method. Considering that the diversity of this data has had a strong correlation, the objective empowerment method of information entropy method and subjective empowerment method are used to empower different indicators.

The information entropy method is a typical objective method. Entropy is the index to measure the uncertainty. The more the distribution of an information quantity tends to be consistent, the greater the uncertainty of the information provided. Definition of the entropy of a property:

$$E_J = -k\sum_{i=1}^{m} r_{ij} \ln r_{ij},\ k = 1/\ln m,\ j = 1,2,\cdots,n \quad (2)$$

The differentiation degree of the attributes:

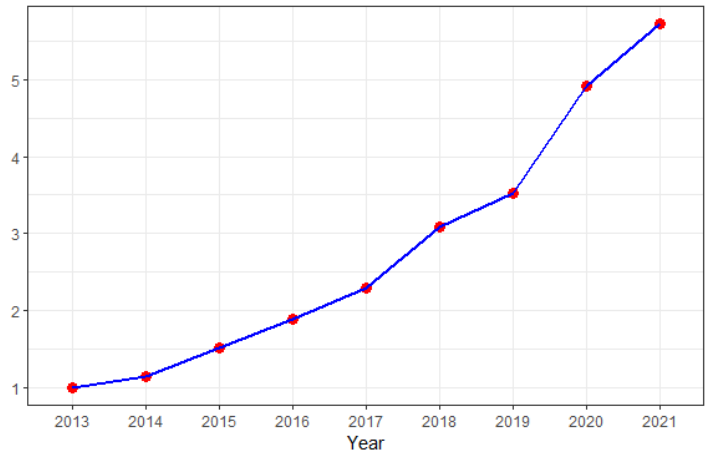
$$F_j = 1 - E_j, 0 \le E_j \le 1 \quad (3)$$

Differentiation degree normalization:

$$w_j = \frac{F_j}{\sum_{j=1}^{n} F_j} \tag{4}$$

Combining subjective empowerment with objective empowerment:

$$w_j = \frac{w_j^{(1)} w_j^{(2)}}{\sum_{j=1}^{n} w_j^{(1)} w_j^{(2)}} \tag{5}$$




1

**Figure 2.** Trend chart of digital economy development Index

R software is used to preprocess the data of each index in one time, unreasonable values are deleted and some data are coded, and then the data is used to determine the weight of each index, and then the data is weighted to get the digital Economy Development Index (NEI). From the figure, we can see that the development of digital economy is increasing year by year, especially in 2020, from 3.52 in 2019 to 4.91 in 2020, and increasing rapidly in 2021.

#### 4.2.2. Intermediation variables: industrial structure upgrading

In order to test the influence of intermediary variables on high-quality development, industrial structure upgrading was selected as the intermediary variable of digital economy affecting high-quality development according to the theoretical analysis. Digital economy promotes the high-quality development of economy through the transformation of industrial structure. In order to explore the influence mechanism of intermediary variables on high-quality development, it is necessary to measure the upgrading of industrial structure and conduct quantitative analysis. In order to measure the indicators of the industrial structure upgrading, consult the relevant literature and ask the relevant personnel, and the industrial structure upgrading (ry) is measured by the ratio of the added value of the tertiary industry to the added value of the secondary industry in each year. With the high-quality development of the economy, the proportion of services in the tertiary industry will become larger and larger, while the proportion of the secondary industry will become smaller and smaller. The adjustment of industrial structure will be mainly between the tertiary industry and the secondary industry. Of course, the primary industry also has an impact, but compared with the secondary industry, the degree of impact can be ignored.

#### 4.2.3. Control variables

In order to ensure the reliability of the empirical analysis, the need to control the factors of some potential variables, according to the factors with the development of high quality, this paper selects four control variables may significantly affect the development of economic quality, exchange rate level (hs), to the exchange rate level against the dollar, environmental protection (wi), using industrial pollution control investment to measure the development level of science and technology (tc), with high-tech products transactions, labor input (da), to the annual labor quantity.

### 4.3. Empirical test

#### 4.3.1. Benchmark regression analysis

For high quality development index and digital economy index benchmark regression analysis, according to the number of explanatory variables involved in the explanatory variables high quality development index for five regression analysis, each regression analysis control the different variables, in each benchmark regression analysis, control different variable regression, can be very good deep analysis of high quality development. The results are as follows. As can be seen from the table, in the first three regression analysis, the coefficient of digital economy for high-quality development was positive and all passed the significance level test of 0.01, indicating that digital economy can greatly promote the high-quality development of a country, which suggests that the development of high-quality is closely related to the development of digital economy. From the table, we can observe that the goodness of fit of each regression analysis is very good. In the first analysis, the certainty coefficient has reached 0.93. Only through a digital economy index, it also shows that the development of the digital economy is closely related to the high-quality development of the country. In addition to the digital economy indicators, it can be noted that the exchange rate level is also related to the high-quality development of the economy. In the fifth regression analysis, it passed the significance test at the significance level of 0.01. If the digital economy index is not included as an explanatory variable for high-quality development, none of the other explanatory variables obtained were significant.

**Table 4.** Table of digital economic explanatory variables

| variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| NEI | 0.216*** | 0.228*** | 0.243*** | | 0.033 |
| | (10.981) | (7.75) | (4.196) | | (0.627) |
| hs | | 0.02 | | 0.007 | 0.006*** |
| | | (1.471) | | (11.569) | (4.818) |
| wi | | 0 | | 0 | 0 |
| | | (1.594) | | (0.322) | (0.51) |
| tc | | | 0 | 0 | 0** |
| | | | (-0.013) | 14.845 | (3.967) |
| da | | | 0 | 0 | 0* |
| | | | (0.926) | (2.62) | (2.212) |
| constant term | 0.945*** | -0.517 | -6.43 | -16.686 | -15.273** |
| | (15.744) | (-0.638) | (-0.801) | (-3.692) | (-2.87) |
| $R^2$ | 0.938 | 0.965 | 0.946 | 0.992 | 0.993 |
| adjust $R^2$ | 0.93 | 0.947 | 0.918 | 0.986 | 0.984 |

Note: * * *, * * and * represent the significance levels of 1%, 5% and 10%, respectively

### 4.3.2. Indirect effect analysis

**Table 5.** Table of indirect effects of each industry

| A particular year | Secondary industry | Tertiary industry | Value-added value of the secondary industry | Value-added value of the tertiary industry | The ratio of the added value of the tertiary industry to that of the secondary industry |
|---|---|---|---|---|---|
| 2001 | 49659.38 | 45701.25 | 3995.71 | 5802.13 | 1.45209 |
| 2002 | 54104.09 | 51423.11 | 4444.71 | 5721.86 | 1.287342 |
| 2003 | 62695.76 | 57756.03 | 8591.67 | 6332.92 | 0.7371 |
| 2004 | 74284.98 | 66650.86 | 11589.22 | 8894.83 | 0.767509 |
| 2005 | 88082.18 | 77430.00 | 13797.20 | 10779.14 | 0.781256 |
| 2006 | 104359.23 | 91762.24 | 16277.05 | 14332.24 | 0.880518 |
| 2007 | 126630.54 | 115787.67 | 22271.31 | 24025.43 | 1.078761 |
| 2008 | 149952.94 | 136827.54 | 23322.40 | 21039.87 | 0.902131 |
| 2009 | 160168.81 | 154765.11 | 10215.87 | 17937.57 | 1.755853 |
| 2010 | 191626.52 | 182061.89 | 31457.71 | 27296.78 | 0.867729 |
| 2011 | 227035.10 | 216123.62 | 35408.58 | 34061.73 | 0.961963 |
| 2012 | 244639.07 | 244856.25 | 17603.97 | 28732.63 | 1.632168 |
| 2013 | 261951.61 | 277983.54 | 17312.54 | 33127.29 | 1.913485 |
| 2014 | 277282.82 | 310653.96 | 15331.21 | 32670.42 | 2.130975 |
| 2015 | 281338.93 | 349744.65 | 4056.11 | 39090.69 | 9.637483 |
| 2016 | 295427.80 | 390828.06 | 14088.87 | 41083.41 | 2.916019 |
| 2017 | 331580.46 | 438355.95 | 36152.66 | 47527.89 | 1.314644 |
| 2018 | 364835.21 | 489700.80 | 33254.75 | 51344.85 | 1.543985 |
| 2019 | 380670.62 | 535371.00 | 15835.41 | 45670.2 | 2.884055 |
| 2020 | 383562.35 | 551973.70 | 2891.73 | 16602.7 | 5.741442 |
| 2021 | 450904.47 | 614476.00 | 67342.12 | 62502.3 | 0.928131 |
| 2022 | 483164.00 | 638698.00 | 32259.53 | 24222 | 0.750848 |

Set the model:

$$ry = \alpha_0 + \alpha NEI + \beta + \varepsilon$$
$$EHD = \alpha_0^{'} + \alpha^{'} ry + \beta^{'} + \varepsilon^{'} \quad (6)$$

According to the above model as the benchmark regression, it can be seen that under the significance level of 0.05, the intermediary variable industrial structure upgrade (ry) and NEI and EHD have a significant positive correlation. The results obtained are consistent with the hypothesis of this paper, and then the hypothesis is verified.

### 4.3.3. Time-series analysis

Whether to build high quality economic development data, or digital economy data belong to time series data, this paper adopts time series analysis method, analysis of the relationship between high quality economic development and digital economy, and forecast the economic development index and digital economy index as we can see from the figure, both economic development index and digital economy development index has the trend of growth, so certainly is not smooth data, need for differential processing.

The Cramer decomposition theorem then theoretically ensures that the difference of the appropriate order can fully extract the deterministic information. According to the Carmer decomposition theorem, all non-stationary sequences can be decomposed into the following form:

$$x_t = \sum_{j=0}^{d} \beta_j t^j + \Psi(B) a_t \quad (7)$$

$\{a_t\}$ Where, is the zero-mean white noise sequence.

$$\nabla^d \sum_{j=0}^{d} \beta_j t^j = c \quad (8)$$

Expand the order 1 difference, yes

$$\nabla x_t = x_t - x_{t-1} \quad (9)$$

This means that the order one difference is essentially a order one order autoregressive process, which uses the historical data of the delayed period as the independent variable to explain the change of the current sequence value. The difference sequence measures the size of the random error generated in the order one autoregressive process. $\{x_{t-1}\}\{x_t\}\{\nabla x_t\}\{x_t\}$

After obtaining the stationary data, the difference sequence of order one. The pure randomness test of the model is the white noise test of the residual sequence. The null hypothesis and the alternative hypothesis are respectively:

$$\begin{aligned} &H_0:\ \rho_1=\rho_2=\cdots=\rho_m=0 \\ &H_1:\text{至少存在某个}\rho_k\neq 0, k\leqslant m \end{aligned} \tag{10}$$

Test statistic is LB (Ljung-Box)

$$LB=n(n+2)\sum_{k=1}^{m}\frac{\rho_k}{n-k}\sim\chi^2(m) \tag{11}$$

The test results showed that in the lag 2 stage, the p value was 0.03, which is less than the significance level, and in the lag 4 stage, the p value was 0.00, which is also less than the significance level, and the difference sequence is not white noise sequence, so the difference sequence after order 1 is smooth non-white noise sequence. The data was then fitted and self-fitted by R software to obtain the ARIMA (0,1,1) model and the ARIMA (0,1,1) model, and then started the prediction. The forecast results are as follows:

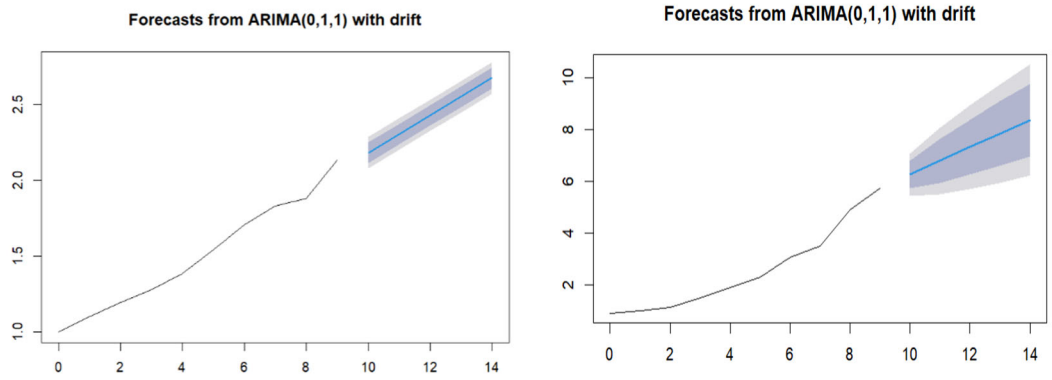



**Figure 3.** ARIMA prediction Fig

**Table 6.** Prediction results

| year | Index type | Forecast | Lo80 | Hi80 | Lo95 | Hi95 |
|---|---|---|---|---|---|---|
| | EHD | 2.182579 | 2.114847 | 2.250311 | 2.078991 | 2.286167 |
| 2022 | NEI | 6.266069 | 5.732354 | 6.799783 | 5.449823 | 7.082315 |
| | EHD | 2.305594 | 2.237862 | 2.373326 | 2.202006 | 2.409182 |
| 2023 | NEI | 6.792693 | 5.952366 | 7.63302 | 5.507523 | 8.077863 |
| | EHD | 2.428609 | 2.360877 | 2.496341 | 2.325021 | 2.532197 |
| 2024 | NEI | 7.319317 | 6.257503 | 8.381131 | 5.695413 | 8.943222 |
| | EHD | 2.551624 | 2.483892 | 2.619356 | 2.448036 | 2.655212 |
| 2025 | NEI | 7.845941 | 6.601455 | 9.090428 | 5.942663 | 9.74922 |
| | EHD | 2.674639 | 2.606907 | 2.742371 | 2.571051 | 2.778227 |
| 2026 | NEI | 8.372566 | 6.968982 | 9.776149 | 6.22597 | 10.51916 |

## 5. Discussion

Strengthening digital infrastructure construction: We will continue to increase investment in key digital infrastructure such as 5G networks, big data centers, artificial intelligence and the Internet of Things, improve network coverage and service quality, and provide a solid foundation for the development of the digital economy.

Strengthen international cooperation: promote international coordination and cooperation of digital rules, participate in the formulation of global rules for the digital economy, and promote an open, fair, equal and shared international environment for the digital economy. We will encourage and support the development of new business forms and models of the digital economy, such as the integration of online and offline services and digital experience, to enhance the added value and attractiveness of trade services.

Accelerate the construction of a "double cycle" pattern, promote investment, take pilot free trade zones and free trade ports as breakthrough points, promote trade liberalization and facilitation, attract foreign investment and multinational enterprises, and promote international trade and investment facilitation. Reduce administrative barriers, simplify the procedures for the establishment and operation of enterprises, and improve the fairness and transparency of market competition. We will establish a unified market rules and regulatory system, strengthen market supervision, and promote market-based allocation of resources.

## Acknowledgment

We would like to extend our sincere gratitude to the funding of the Undergraduate Research and Innovation Fund of Anhui University of Finance and Economics "Study on the influence of digital economy on high-quality trade

development under the ‘double cycle’ pattern" (XSKY23112). We also extend our thanks to Xiaojun Xing for his guidance. It was the school and the teachers who taught me to study and research problems.

Thank you to all who have contributed to the completion of this research project.

# References

[1] Chen Zhao, Chen Zhaoyong, Tan Weijie. Analysis of the mechanism of digital economy to promote high-quality economic development and its effect [J]. Journal of Guangdong University of Finance and Economics, 2022,37 (03): 4-20.

[2] Chang Jin, Lin Shuguang. Under the background of "double cycle", digital economy enables the internal talent marketization process: theoretical interpretation and practical exploration [J]. Journal of Xingtai University, 2022,37 (3): 101-109.

[3] Liu Xuan. Digital economy helps the new development pattern of double cycle: Core mechanism and innovation suggestions [J]. Social Sciences in Qinghai Province, 2021 (5): 98-105.

[4] Li Chunfa, Li Dongdong, Zhou Chi. The mechanism of digital economy driving the transformation and upgrading of manufacturing industry —— Analysis from the perspective of industrial chain. Business Research, 2020,0 (2): 73-82

[5] Meng Qi, Shen Jiayu. High-quality development of digital economy and trade —— From the perspective of GVC trade status [J]. Business Economics Research, 2021 (14): 145-148

[6] Xia Jiechang, Li Luanming. Digitization enables high-quality development of international trade: realistic challenges and implementation path of mechanism of action [J]. International Trade, 2023, No.493(01)：56-65.

[7] Duan Lei, Hu Mingli. Research on the Prediction of Total Import and Export of Foreign Trade based on BP neural network and discrete GM combination model [C] / / China Society of Optimization Method and Economic Mathematics, Nanjing University of Information Science and Technology, Institute of Science and Technology Strategy Consulting, Chinese Academy of Sciences, Editorial Department of China Management Science. Proceedings of the 19th Annual China Management Science Academic Conference.[Publisher unknown], 2017:659-664.

[8] Fan Xin. Digital economy development, the efficiency of international trade and trade uncertainty [J]. Finance and Trade Economy, 2020,41 (08): 145-160.

[9] Tian Chenlu, Liu Yechun, Yang Aixin, Han Chunxue, Wang Fan, Liang Lihua. Building energy consumption prediction method based on transfer learning and BiLSTM in small data scenarios [J]. Computer Age, 2023 (04): 62-66.

[10] Xie Guomin, Li Xu Shanda. Gas concentration prediction method based on BiLSTM algorithm [C] / / Coal Mine Automation Professional Committee of China Coal Society. Proceedings of the 30th National Coal Mine Automation and Informatization Academic Conference and the 11th China Coal Mine Informatization and Automation High-level Forum.[Unknown publisher], 2022:219-229.

[11] Zhang Xiaohang, Li Zheng, Zhu Xiaoming, Zhang Haifeng, Zhao Boyu. Trusted encrypted traffic classification method based on RBF neural network [J]. Computer and Modernization, 2022 (02): 45-51.

[12] Zhang Zhengting, Zhou Hengyu, Cui Cui, Yuan Long. Performance prediction of college professional core courses based on K-means- -BP neural network [J]. The Medical Education Technology of China, 2023,37 (02): 212-217 + 228.

[13] Han Zhao'an, Wu Haizhen, Zhao Jingfeng. Study on the coupled coordination measurement and evaluation of digital economy and high-quality development [J]. Statistics and Information Forum, 2022,37 (6): 22-34.

[14] Ahmed S, Alshater M M, El Ammari A, et al.Artificial intelligence and machine learning in finance: A bibliometric review[J].Research in International Business and Finance, 2022, 61: 101646.

[15] Breinlich H, Corradi V, Rocha N, et al.Machine learning in international trade research-evaluating the impact of trade agreements[J].2022.

[16] Tong Y.Literature Review in International Trade Forecasting Based in Machine Learning Method[C]//SHS Web of Conferences.EDP Sciences, 2023, 154: 03025.