

Research on the Influence of Digital Finance on the E-Commerce Development in China

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Abstract. In recent years, digital finance and e-commerce are concepts that often appear together with a strong development momentum. For such a heated-discussed concept, what is the relationship between digital finance and e-commerce? In addition to using the objective entropy weight method based on theoretical analysis to construct China's e-commerce total index and adopting panel data of 30 provinces from 2011 to 2020 as samples, this paper selects appropriate control variables, controls year effect and province effect, uses bidirectional fixed effect model for regression analysis, and finally carries out robust test. Through the empirical analysis of this paper, it is found that digital finance has significantly promoted the e-commerce development in China. The three different dimensions of digital finance have enhanced the e-commerce development in China with various promotion effects. Meanwhile, the coverage breadth is greater than the depth of use and the degree of digitalization. The promotion of digital finance to China's e-commerce has regional heterogeneity, with less effect on the eastern region characterized by the high-level e-commerce development and greater effects on the central and western regions characterized by the low-level development. On this premise, this paper proposes relevant suggestions on how to improve the digital finance and promote its development.

Keywords: Digital Finance; E-Commerce; Provincial Panel; Entropy Weight Method.

1. Introduction and Literature Review

E-commerce refers to the trade activities between two parties who can't meet each other based on the current network and servers, including online shopping, online transactions, online electronic payment, etc. With the characteristics of universality, coordination, security, extensibility, integration, and high efficiency, e-commerce appears and develops naturally. E-commerce is a new form of trade in the modern environment. At present, China attaches great importance to e-commerce and has issued many favorable related policies. Up against the rapid development of the Internet, big data, and the digital economy, Internet-based e-commerce has enjoyed many dividends, which promotes the China's e-commerce industry. With the rapid development of Chinese science and technology, new concepts such as Internet +, Digital +, and 5G are constantly emerging, boosting the e-commerce development to a certain extent. The digital economy is one of the hottest concepts at present. As one of the engines to facilitate China's economic growth, the development of the digital economy promotes e-commerce. At the same time, the prosperity of e-commerce platforms represented by Taobao and JD.COM has brought huge profits to Internet enterprises, which endows greater motivation and funds to develop e-commerce, thus generating a virtuous circle. The rapid development of e-commerce has brought great changes to China's logistics industry, sales industry, and production industry. Together with e-commerce, these changes have provided convenience for ordinary people in life and production, and greatly consolidated the China's economy development simultaneously.

At present, China is in the stage of high-quality development and transformation, with digital finance playing an indispensable role. After more than ten-year joint efforts of scientific and technical personnel, China's digital finance has reached the world's leading level. Digital finance is a popular concept at present, and China has also issued many policies to promote its development. It is the product of the increasingly prosperous information age, and the organic combination of traditional financial fields, the Internet, and information technology. Compared with the traditional financial field, digital finance makes extensive use of emerging technologies such as big data, cloud computing, blockchain, 5G, and mobile Internet. Moreover, digital finance brings better financial services and

consumption experiences to customers. Meanwhile, digital finance is constantly improving the current financial market structure, creating new financial products, and changing the way of financial supply, which improves the efficiency of capital use and brings a brand-new outlook to China's financial industry. As one of the important stepping stones of China's current economy, digital finance is characterized by convenience, inclusiveness, and accuracy. Meanwhile, digital finance also emphasizes the advantages of sharing, low cost, and fewer barriers to entry. These remarkable characteristics make it provide strong support and convenience for the real economy and the broad masses. Especially for Internet enterprises and e-commerce, the role of digital finance is self-evident.

In academia, some scholars have been paying close attention to the e-commerce development in China and its influencing factors. Through questionnaires and field research, Zhang Xiaoheng (2022) believes that the government plays a vital role in developing cross-border electronic commerce. Therefore, the government needs to enhance its awareness of cross-border e-commerce, pay more attention to it, and formulate policies to promote its development in light of local conditions. Li Jinhua (2022) believes that China should strengthen the integration of rural e-commerce resources in the future, and help rural areas build e-commerce systems and brands, in addition to strengthening cooperation with overseas e-commerce and creating diversified e-commerce models. Xing Yi and Qiu Zhiping (2022) constructed the evaluation index system for e-commerce development. Through empirical research, they found that spatial differences have a significant impact on e-commerce, while time differences have little impact on e-commerce development. From the perspective of space, the e-commerce development decreases from east to west; From the perspective of time, the inter-provincial differences in the e-commerce development decrease with time. Jiang Peipei and Wai Shum (2022) take Zhejiang Province which has a high level of e-commerce development as an example. They believe that influencing factors of e-commerce development are roughly similar to those influencing online merchants. However, they're different from those affecting the online-shopping development. From the perspective of the mechanism types of influencing factors, it can be divided into internal factors, external factors, natural factors, and humanistic environment factors.

In addition to the e-commerce development and its influencing factors, the impact assessment of digital finance is also widely discussed in academia. After taking non-financial listed companies as samples for empirical analysis, Jiang Hongli and Jiang Pengcheng (2021) concluded that digital finance can solve enterprises' financing difficulties, accelerate their scientific and technological innovation, and thus improve their total factor productivity. Therefore, the state should attach importance to developing digital finance and providing more favorable policies to support digital finance. Zhang Xun and Yang Tong et al. (2020) concluded through empirical analysis that digital finance can significantly stimulate residents' consumption and benefit China's economic growth. Moreover, digital finance mainly promotes residents' consumption by making it more convenient for residents to pay, rather than relaxing liquidity constraints. Through theoretical discussion and empirical analysis, Wu Tongtong and Wang Renceng (2021) concluded that digital finance intensified the competition of small and medium-sized commercial banks and increased the risks of banks. Feng Sixian and Song Qiuyun (2021) used provincial data to verify the impact of digital finance on residents' life quality. Digital finance has significantly improved such life quality, especially reflected in the coverage of digital finance and third-party payment. The effect of digital finance on the life quality of urban residents is greater than that of rural areas, especially urban residents in the eastern region. Therefore, China should promote the establishment of digital financial information infrastructure, increase the popularization of digital finance, and implement different policies for different regions.

Different from the previous literature, this paper focuses on the impact of digital finance on e-commerce development in China and studies the degree of this impact from different perspectives. At present, the research on e-commerce development in China by digital finance is mostly based on theoretical analysis, which has not been fully explained. Furthermore, related empirical analysis is still relatively few. The contributions of this paper may exist in the aspects as follows. First, the relationship between digital finance and e-commerce development in China has not been discussed

in depth in the past. From the theoretical and empirical perspectives, this paper investigates the impact of digital finance on e-commerce development in China, which has important practical significance for understanding the impact of digital finance. Secondly, this paper has vitally enlightening conclusion. This paper finds that digital finance can promote e-commerce development in China, but this influence is different in various dimensions and regions. Thus, it is necessary to implement targeted policies to promote e-commerce development in China.

2. Impact Mechanism of Digital Finance on E-commerce

Obviously, digital finance is key to the e-commerce development in China. First of all, from the consumers' point of view, consumers can easily purchase the required items on the e-commerce platform through the payment tools provided by digital finance, thus improving consumption. In the real economy, the broad masses of people have become accustomed to using Alipay, WeChat, and other payment tools relying on digital finance to purchase e-commerce products on Taobao, Tmall, JD.COM, and other platforms. On this basis, due to the rapid e-commerce development and the improvement of people's purchasing power, some special concepts have been derived from various platforms, such as Double Eleven and Double Twelve Shopping Festivals. During the Double Eleven Shopping Festival in 2021, the data showed that the transaction volume of the whole network was 965.12 billion yuan, up 12.22% year-on-year. The total turnover of Tmall Double Eleven Shopping Festival was fixed at 540.3 billion yuan, and the accumulated order amount in JD.COM exceeded 349.1 billion yuan. It can be seen that the e-commerce development in China is very dynamic, which can provide many conveniences for consumers so that consumers can buy high-quality goods at low prices at home. However, if China's digital finance is not so developed without payment platforms like Alipay and WeChat, the e-commerce development in China is bound to slow down or even struggle. Because without such a convenient and quick payment method, people will lengthen the waiting time for online purchases, thus losing the time advantage compared with physical stores, so some consumers may turn to physical stores. Because digital finance is characterized by low cost, fewer barriers to entry, and sharing, consumers are provided with a convenient payment platform and are willing to buy things online, thus promoting the development of Chinese e-commerce. Therefore, the spread of digital finance through consumers has profoundly affected e-commerce in China, with more and more consumers using e-commerce as a shopping platform, which is the main driving force for the development of e-commerce.

Generally, Chinese e-commerce enterprises, such as Alibaba, JD.COM, and Pinduoduo, need to rely on digital financial platforms to develop, because digital finance provides a large number of financial products for the growth of these enterprises. Meanwhile, these enterprises can easily obtain financial products including loans and financial services on the digital financial platform. Under the traditional financial mode, some cumbersome procedures and high costs, such as transaction cost, transaction mode, and mortgage loan, may hinder the sustainable development of enterprises. However, with the development of digital finance, e-commerce enterprises can easily get the latest information and related services from the information platform, thus improving the allocation of financial resources, which makes digital finance a crucial driving force for improving Chinese e-commerce enterprises. At the same time, Chinese e-commerce enterprises can also release their new products on the digital financial platform, after which consumers can easily see these new products through their mobile phones and purchase these products through payment software. Thus, enterprises can obtain more economic profits, thus expanding the scale of the company and promoting e-commerce development in China. As a result, from the perspective of enterprises, if digital finance is lost, the development of e-commerce in China is the castle in the air.

3. Measurement of E-commerce in China

For many people, e-commerce is a simple and single concept, but it has rich connotations and characteristics in fact. E-commerce is a comprehensive concept, which is not only manifested in the sales of simple commodities, but also in the infrastructure of e-commerce. Based on a deep understanding of the connotation and characteristics of e-commerce, this paper constructs an e-commerce evaluation system from different dimensions in conformity with the principles of data availability, operable capacity, comparability, guidance, and scientific features, which consists of seven indexes, including the length of long-distance optical cable lines, the number of websites owned by every 100 enterprises, the number of enterprises with e-commerce transactions, the number of express delivery, the sales volume of e-commerce, the purchase amount of e-commerce, and the income of the express delivery business.

3.1 Index System Construction and Measurement Method

Table 1. Index System of E-commerce

E-commerce	Indicators	Unit	Type
	Length of long-distance optical cables	Kilometers	+
	Number of websites per 100 enterprises	/	+
	Number of enterprises with e-commerce transactions	/	+
	Quantity of express delivery	10, 000 pieces	+
	E-commerce sales	100 million yuan	+
	E-commerce procurement amount	100 million yuan	+
	Income from express delivery business	10, 000 yuan	+

There are many methods of e-commerce evaluation system weighting, consisting of principal component analysis, analytic hierarchy process, entropy weight method, etc. This paper uses the objective entropy weight method to weight the index system. The objective weighted entropy method is an improved version of the subjective weighted entropy method, which has two advantages. Firstly, it avoids the interference of subjective factors in the subjective weighted method. Secondly, it increases the evaluation of index differences, so that the evaluation results are more accurate and consistent with the facts. Assuming that there are m objects and n evaluation indexes, x_{ij} represents the j -th index value of the i -th object. Given the difference between positive and negative orientations and dimensions among the indexes, the original data are standardized at first.

The processing method for positive indicators is as follows:

$$x_{ij} = \frac{a_{ij} - \min(a_{ij})}{\max(a_{ij}) - \min(a_{ij})}$$

The treatment method of negative indicators is as follows:

$$x_{ij} = \frac{\max(a_{ij}) - a_{ij}}{\max(a_{ij}) - \min(a_{ij})}$$

The index value will be 0 after the original data is standardized, which will have adverse effects on the later calculation. Therefore, this paper carries out coordinate translation by adding one to the standardized index. After that, calculate the proportion of the i -th index value in the j -th index:

$$p_{ij} = x_{ij} / \sum_{i=1}^m x_{ij}$$

Calculate the entropy value of the j -th item:

$$e_j = -(\ln m)^{-1} \sum_{i=1}^m (p_{ij} \ln p_{ij})$$

Calculate the weight of the j -th item:

$$\omega_j = (1 - e_j) / \sum_{j=1}^n (1 - e_j)$$

Where $1 - e_j$ is the different coefficient of j-th $1 - e_j$.

According to the above calculation, we can get the comprehensive index of China's e-commerce:

$$Ec_i = \sum_{j=1}^n \omega_j x_{ij}$$

3.2 Explanation of Measurement Results

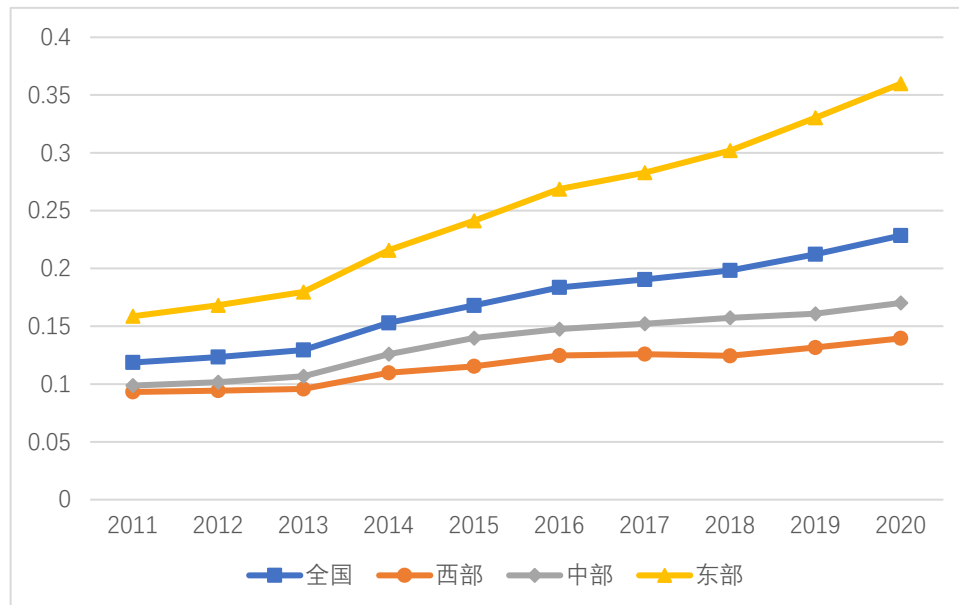


Figure 1. Development Trend of E-commerce in China

First of all, through the charts drawn, this paper finds that China's e-commerce is on a rise from 2011 to 2020 from the national perspective. By calculating the annual average index growth rate of e-commerce, this paper obtains that the average growth rate of e-commerce in China is about 7.6% in the sample period, which has increased from 0.119 in 2011 to 0.229 in 2020, indicating that e-commerce in China is developing continuously from the data. Concerning the reasons for the development of e-commerce in China, this paper thinks that it may be because China pays special attention to the national development of e-commerce, taking it as one of the main stimulus of China's economic development. Therefore, some favorable policies for e-commerce have been introduced to support the e-commerce enterprises. At the same time, China is also striving to build a good digital platform and financial platform to provide motivation for e-commerce development. From the perspective of consumers, up against the continuous development of the digital economy and Internet +, people continuously improve their living standards and have more funds and time to buy products on the e-commerce platform. E-commerce has become an indispensable part of daily life. Therefore, consumer consumption has accelerated the e-commerce development in China.

In terms of different regions, this paper can clearly find that the eastern China has the highest e-commerce and strong growth momentum, the central China has the second e-commerce and the middle growth momentum, while the western China has the lowest e-commerce and weak growth momentum. Moreover, the e-commerce development and the growth rate in the eastern region are higher than that in the whole country, while the e-commerce development and the growth rate in the central and western regions are lower than that in the whole country. It can be found from the above that there is a big gap in e-commerce in the eastern, central, and western regions of China, which is completely in line with the expectation of this paper. Because the eastern region has high economic development and people's income as well as many high-tech industries and rapid development of

science and technology, people can use more funds to build a digital economic platform, establish e-commerce enterprises, buy e-commerce products, etc., so as to consolidate the e-commerce. In contrast, due to the low economic development in the central and western regions, people's income is low and the scientific and technological development is relatively backward, which leads to the backward infrastructure construction of e-commerce. People are more inclined to buy products in offline stores and unwilling to invest in building e-commerce enterprises, so their development of e-commerce is relatively low.

4. Empirical Design

4.1 Setting of Econometric Model

In order to analyze the relationship between digital finance and e-commerce, this paper constructs a two-way fixed effect model for regression analysis:

$$Ec_{it} = \beta_0 + \beta_1 Df_{it} + X_{it}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}$$

In the following table, i represents the province and t represents the year. Ec_{it} is an explanatory variable, which represents the comprehensive index of e-commerce obtained by the objective entropy weight method in the t period of i province. Because its data is too small, it is not conducive to regression, so this paper multiplies it by 100 in regression. Df_{it} is the core explanatory variable, representing the digital financial index of i province at t time. $X_{it}\gamma$ represents a series of control variables, including the proportion of urban population representing the urbanization level in each province and period to the total population (Urban), the logarithm of patents representing the technical level in each province (Patent), the secondary industry representing industrial structure in each province (Second), the ratio of fixed assets and GDP representing Investment level in each province (Investment), and the ratio of R&D internal expenditure and GDP representing a technical level in each province (RD). This paper focuses on the coefficient β_1 , which means that every increase of one unit in the digital financial index of i province in the t period will lead to the change of one unit β_1 in the comprehensive index of e-commerce of i province in the t period. α_i represents the province-fixed effect, which controls some provincial variables that do not change with time but have an impact on the comprehensive index of e-commerce. λ_t is a year-fixed effect, which controls the variables that will change over time and have an impact on the total index of e-commerce. ε_{it} is a random perturbation term.

4.2 Variable Description

(1) Explained Variable

The explanatory variable of this paper is the comprehensive index of e-commerce, which is an index constructed by the objective entropy weight method mentioned above and a synthesis of seven indexes, such as the length of long-distance optical cable lines, the number of websites owned by every 100 enterprises, the number of enterprises with e-commerce transactions, the number of express deliveries, e-commerce sales, e-commerce purchases, and express delivery business income.

(2) Explanatory Variable

The explanatory variable of this paper is the digital inclusive financing index. The index and data are from the Peking University Digital Inclusive Financing Index (2011-2020) released by the Peking University Digital Finance Research Center, which specifically includes the total index of digital finance, coverage breadth, usage depth, and digitalization degree.

(3) Control Variable

Referring to previous scholars' research, this paper mainly selects control variables from the aspects of investment, techniques, urbanization rate, and industrial structure. First, the level of investment. Investment is an important factor affecting the development of e-commerce in China. This paper selects the proportion of fixed assets investment and GDP to measure the investment level. Secondly, the technical level. The development of technology has promoted the development of e-

commerce in China. In this paper, the input and output of technology are selected to measure the level of technology, in which the input of technology is expressed by the ratio (RD) of internal expenditure on research and development to GDP, and the output of technology is expressed by the logarithm of Patent (Patent). Third, the urbanization rate. Generally speaking, the higher the urbanization rate, the higher the level of economic development and the greater the possibility of people using e-commerce platforms. Meanwhile, the more perfect the infrastructure of e-commerce, the higher the level of e-commerce development. In this paper, the proportion of the Urban population to the total population (Urban) is selected to measure the urbanization rate. Finally, the industrial structure. Generally speaking, the greater the proportion of the secondary industry, the more perfect the e-commerce infrastructure and the higher the e-commerce level. This paper selects the secondary industry in all industries to measure the industrial structure (Second).

4.3 Data Description

This paper selects the panel data of 30 provinces in China from 2011 to 2020 as analysis samples. Due to the lack of data, the samples from Tibet, Hong Kong, Macao, and Taiwan are not included. All the data come from China Statistical Yearbook, Peking University Digital Inclusive Financing Index (2011-2020), China Science and Technology Statistical Yearbook, China Population and Employment Statistical Yearbook, and Statistical Yearbooks of various provinces. Descriptive statistics of all data are as follows.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Df	300	217.246	96.968	18.33	431.93
Breath	300	198.010	96.334	1.96	397
Depth	300	212.036	98.106	6.76	488.68
Dig	300	290.238	117.644	7.58	462.23
Urban	300	59.006	12.218	35.03	89.6
Patent	300	58602.22	89366.55	502	709725
Second	300	43.126	8.766	15.8	59
Investment	300	79.301	25.782	20.999	147.955
RD	300	1.672	1.131	0.411	6.444
Ec	300	0.171	0.121	0.061	0.899

5. Analysis of Empirical Results

5.1 Full Sample Analysis

This paper starts with the total index of digital finance and observes the impact of digital finance on China's e-commerce. According to the step-by-step regression results of the bidirectional fixed-effect model provided in Table 3, with the gradual increase of control variables from a single control variable to two control variables to four control variables and finally using five control variables, the coefficient of digital finance is always significantly positive at the level of 1%, which shows that digital finance has indeed significantly promoted the development of e-commerce in China. The reason is that digital finance can provide enterprises with financing channels, publicity platforms, and many financial products, which can well meet the development needs of Chinese e-commerce enterprises, thus promoting the overall level of e-commerce in China. In addition, digital finance also provides consumers with mobile payment platforms, such as WeChat, Alipay, and other quick

payment software, which enables consumers to better purchase products from Chinese e-commerce enterprises, thus promoting the growth of the overall level of e-commerce in China.

Table 3. Test Results of Full Sample

	EC (1)	EC (2)	EC (3)	EC (4)
DF	0.266*** (7.18)	0.259*** (7.05)	0.213*** (5.17)	0.164*** (4.10)
Urban	-0.980*** (-5.59)	-0.858*** (-4.77)	-0.990*** (-5.21)	-0.981*** (-5.44)
Patent		-3.237*** (-2.60)	-3.913*** (-3.09)	-3.826*** (-3.19)
Second			0.296*** (2.58)	0.239** (2.18)
Investment			0.018 (0.86)	0.008 (0.39)
RD				9.364*** (5.44)
Constant Term	53.148 (5.36)	76.961*** (5.74)	76.258*** (5.53)	67.217*** (5.10)
Year Fixed-Effect	Control	Control	Control	Control
Provincial Fixed-Effect	Control	Control	Control	Control
R2	0.5849	0.5955	0.6061	0.6470
N	300	300	300	300

5.2 Dimensional Analysis

At the same time, this paper also pays attention to the results of different dimensions of digital finance, which are the coverage breadth, usage depth, and digitalization degree of digital finance. Table 4 shows the regression results of three different dimensions, and the control variables used in this model are still the aforementioned. According to the regression results, the coefficients of coverage breadth, usage depth, and digitalization degree of digital finance are significantly positive. The first two are significantly positive at the level of 1%, while the latter is significantly positive at the level of 5%, which shows that the three dimensions of digital finance have largely promoted the development of China's e-commerce. However, there are obvious differences in the promotion of these three dimensions to China's e-commerce. In terms of their promotion, the coverage of digital finance is greater than the depth of usage and greater than the degree of digitalization. Coverage breadth refers to the ability of word finance to be contacted by customers. Obviously, the more it can be contacted by customers, the more likely customers are to use digital finance as a tool to purchase e-commerce products, thus promoting the development of e-commerce in China. Usage depth is the extension of coverage breadth, which refers to the degree to which the word financial services can be used by customers. The more digital financial services can be used by customers, the more they can meet their needs for digital finance, so customers will use this service to purchase e-commerce products, thus improving the e-commerce development in China. However, customers will choose whether to use digital finance only after it is exposed to customers, so the impact of usage depth on China's e-commerce will be less than coverage breadth. A digitalization degree is an index reflecting whether digital finance is convenient, efficient, or costly advantageous. The higher the digitalization

degree, the more obvious these advantages are. Therefore, this dimension can also promote the development of e-commerce in China. But the infrastructure of digital finance is not perfect and the popularization and deepening of digital technology are lagging behind, which leads to less promotion of digitalization to the e-commerce development in China than the other two dimensions.

Table 4. Dimensional Estimated Results

	EC (1)	EC (2)	EC (3)
Breath	0.208*** (3.81)		
Depth		0.073*** (3.10)	
Dig			0.031** (2.10)
Urban	-1.413*** (-8.15)	-0.925*** (-4.62)	-1.114*** (-6.05)
Patent	-4.940*** (-4.14)	-4.101*** (-3.38)	-3.948*** (-3.14)
Second	0.242** (2.19)	0.338*** (3.20)	0.338*** (3.12)
Investment	0.023 (1.18)	0.015 (0.75)	0.021 (1.01)
RD	11.497*** (6.79)	9.390*** (5.30)	10.032*** (5.66)
Constant Term	95.707*** (7.40)	64.630*** (4.56)	73.954*** (5.39)
Year Fixed-Effect	Control	Control	Control
Provincial Fixed-Effect	Control	Control	Control
R2	0.6440	0.6374	0.6301
N	300	300	300

5.3 Regional Heterogeneity Analysis

In order to investigate the influence of digital finance on the development of e-commerce in China in different regions, this paper divides 30 provinces into eastern regions and central and western regions. Table 5 shows the regression results of the eastern region and the central and western regions. From the regression results, the digital financial coefficient in the eastern region is positive but not significant, while the digital financial coefficient in the central and western regions is significantly positive at the level of 1%. The results show that digital finance has no obvious promotion effect on the development of e-commerce in the eastern region. But for the central and western regions, digital finance can significantly promote the development of e-commerce. It is because the eastern region has a high level of economic development, people's income, as well as scientific and technological development. The development level of e-commerce in the eastern region is already very high. Digital finance is only one of the necessary conditions for the development of e-commerce in the eastern region. Meanwhile, it has already been popularized in the eastern region and there are a large number of supporting information infrastructures. Therefore, digital finance may have released its role in the development of e-commerce long ago. During the period of text study, the main driving force of e-

commerce development in the eastern region may have other new factors, just like the funds mentioned above, which may be one of the main factors to promote the development of e-commerce. For the central and western regions, although the development momentum of its e-commerce is still not as good as that of the eastern region, due to their backward economic development, people's income level is low, and the level of science and technology is relatively backward. With the low penetration rate and backward infrastructure, digital finance has not fully released its promotion role. Digital finance can better provide financing, loans, and payment services for enterprises and individuals in the central and western regions, thus facilitating enterprises and individuals and promoting the development of e-commerce. Therefore, the central and western regions can better absorb the promotion of digital finance, thus having a key impact on e-commerce development.

Table 5. Analysis of Regional Heterogeneity

	Eastern Areas (1)	Central and Western Areas (2)
DF	0.148 (1.28)	0.125*** (5.30)
Urban	-0.940** (-2.15)	0.313* (1.85)
Patent	-2.912 (-0.77)	-3.884*** (-6.42)
Second	0.697* (1.87)	-0.136** (-2.43)
Investment	0.0381881 (0.63)	-0.0062115 (-0.62)
RD	11.456*** (2.80)	6.572*** (6.42)
Constant Term	39.536 (0.74)	25.892*** (3.48)
Year Fixed-effect	Control	Control
Provincial Fixed-Effect	Control	Control
R2	0.6848	0.7440
N	110	190

5.4 Robustness Test

In order to verify whether the empirical results of this paper are reliable, this paper adopts different robustness test methods, with the test results shown in Table 6. First of all, this paper uses the explanatory variables of the lag period to replace the explanatory variables of the current period for re-regression. The results in Column (1) of Table 6 show that the digital financial coefficient of the lag period is still significantly positive at the level of 1%. After that, this paper adopts the instrumental variable method to continue the test. In order to overcome the endogenous problem, this paper takes the explained variable lagging one period as the instrumental variable to estimate the two-stage least squares. The results in Column (2) of Table 6 show that the coefficient of digital finance is still significantly positive at the level of 1%. Finally, this paper deletes several special samples (Beijing, Shanghai, Tianjin, and Chongqing) for re-regression. The results in Table 6 (3) show that the coefficient of digital finance is still significantly positive at the level of 1%. Through the test of the above methods, it is found that the empirical results are stable, which proves that digital finance can significantly promote the development of e-commerce in China.

Table 6. Robustness Test

	Hysteresis Effect (1)	Instrumental Variable Method (2)	Replace Samples (3)
DF	0.176*** (4.08)	0.256*** (4.84)	0.180*** (4.08)
Urban	-1.073*** (-5.52)	-0.947*** (-3.58)	0.278*** (-4.89)
Patent	-3.772*** (-2.92)	-3.315*** (-3.24)	-3.924*** (-3.17)
Second	0.321*** (2.72)	0.170* (1.67)	0.123 (1.08)
Investment	0.020 (0.99)	-0.006 (-0.40)	0.024 (1.14)
RD	8.654*** (4.62)	8.043*** (3.59)	12.899*** (6.54)
Constant Term	69.504	47.844	85.809
Year Fixed-Effect	Control	Control	Control
Provincial Fixed-Effect	Control	Control	Control
R2	0.6191	0.9267	0.6088
N	270	270	260

6. Conclusion and Recommendations

In recent years, digital finance and e-commerce are very popular concepts. This paper focuses on whether digital finance has an impact on the development of e-commerce in China. On the basis of theoretical analysis and taking the provincial panel data of 30 provinces (including municipalities and autonomous regions) from 2011 to 2020 as samples, the objective entropy weight method is first used to construct the total index of China's e-commerce. After that, the data is empirically analyzed by using the bidirectional fixed effect model and the findings in this paper are as follows. 1. Digital finance can significantly promote the development of e-commerce in China. Meanwhile, this conclusion is still popular and robust after being tested by methods such as lag variable replacement, instrumental variable estimation, and deletion of municipalities directly under the central government. 2. Different dimensions of digital finance, namely, coverage breadth, usage depth, and digitalization degree, have significantly promoted the development of e-commerce in China, although their promotion effects are different. 3. Digital finance has regional heterogeneity in the development of e-commerce in China. As for the eastern region, the promotion of digital finance to the development of e-commerce is not obvious, while digital finance has a significant promotion effect on the development of e-commerce for the central and western regions.

Digital finance is an important engine of current economic development, while e-commerce is the main way people live and consume. Therefore, according to the previous theoretical analysis and empirical results, this paper puts forward some suggestions on how to promote the development of digital finance and e-commerce. (1) Vigorously develop digital finance and continuously improve the coverage, usage depth, and digitalization of digital finance. The development of these three dimensions of digital finance is different, so is its promotion effect on e-commerce. From the previous results, the coverage breadth of digital finance is greater than the depth of usage and the degree of digitalization. Therefore, it is necessary to strengthen the construction of different dimensions of

digital finance in a targeted manner and continuously consolidate the relatively perfect coverage of digital finance. Furthermore, we should focus on the digitalization degree of digital finance which is temporarily weak, and put more resources into the development of the digitalization degree of digital finance. Therefore, the government needs to provide funds to build information infrastructure and increase the publicity of digital finance, so that people in more regions can understand and use digital finance when digital finance provides convenience for ordinary people and drive the development of e-commerce in China. (2) Strengthen policy support and promote the deep integration of digital finance and the real economy. There is a big difference in the development of digital finance and e-commerce between the eastern region and the central and western regions. Apart from strengthening the support for the development of digital finance and e-commerce in the central and western regions, the government should consolidate the construction of information infrastructure in the central and western regions, adhere to overall coordination, and form a digital financial platform for regional mutual assistance, so that the eastern regions can help the development of digital finance in the central and western regions. The government should also call on large e-commerce enterprises to set up branches in the central and western regions, improve the development of e-commerce in the central and western regions, and provide appropriate subsidies to local e-commerce enterprises in the central and western regions, so as to increase the vitality of these enterprises and ensure their survival, facilitate consumers, and improve people's living standards. (3) E-commerce enterprises should increase digital investment and make better use of digital financial technology to improve development performance. E-commerce enterprises should convert part of their income into investments in digital technology. Digitalization has brought new opportunities to the development of e-commerce in China and enterprises should seize the opportunities. First of all, Chinese e-commerce enterprises should strengthen data collection, mining, and processing. They also need to build a digital financial platform and use digital financial technology to provide convenience and attract consumers, so as to encourage consumers to buy e-commerce products, obtain profits for e-commerce enterprises, and improve their performance, thus promoting a mutually virtuous circle of profit-to-investment and perfect the development of e-commerce in China.

7. Research Limitations and Future Prospects

There may still be some limitations in this paper and breakthroughs can be made from the following aspects in the future. First of all, considering the availability and explanation of data, this paper will use the data of micro-enterprises to examine the impact of digital finance on e-commerce development in China and expect more microdata to test it. Secondly, this paper may build a mathematical model or macroeconomic model to investigate the impact of digital finance on e-commerce development in China from a theoretical point of view. Finally, this paper may further explore the influence mechanism and path of digital finance on e-commerce development in China. All the above aspects are what this paper can do in the future and are interested in further deepening.

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