Original Research Article

The Impact of Digital Finance on Import and Export Trade In 31 Provinces in China - Based on the PVAR Model

ABSTRACT

This article provides an analysis of the current state of digital finance in China and the import and export trade situation in various provinces. Through an examination of relevant literature, the article identifies the different stages of development that digital finance has undergone in China. To further explore the relationship between digital finance and import/export trade, a PVAR model is constructed. In this model, the Digital Inclusive Finance Index (2011-2020) calculated by the Peking University Digital Finance Center research group is used as the core explanatory variable, while the import and export trade volume of 31 provinces and cities (excluding Hong Kong, Macao, and Taiwan) is selected as the explained variable. Our findings suggest that: (1) Our current state of foreign trade is relatively mature and in a period of high-quality development and transformation, and digital inclusive finance is in the high growth period. (2) The development of digital finance has little impact on the development of foreign trade, while the development of foreign trade will make significant effects of digital inclusive finance.Based on these conclusions, we provide policy recommendations to achieve common prosperity through the use of digital finance and foreign trade.

Keywords: Digital Inclusive Finance ; Foreign Trade ; PVAR model

1. INTRODUCTION

In 2005, the United Nations proposed the concept of financial inclusion at the first time: Financial inclusion seeks to unlock development opportunity and improve the lives of all, especially the poor, by expanding access to quality financial tools. Affordable, effective, and safe financial services—savings, insurance, payments, credit, and more—can play a transformative role by fostering equitable growth and furthering vital development goals such as poverty reduction, job creation, gender equality, and food security. In 2016, during the G20 leaders' summit, Three important documents on digital financial inclusion were discussed ,which become guiding documents for the development of financial inclusion. In 2015,The State Council issued China's first national-level strategic planning document for the development of inclusive finance, "Promoting the Development Plan of Inclusive Finance (2016-2022)", which pointed out that "Inclusive finance refers to providing appropriate and effective financial services to all social strata and groups with financial service needs at affordable costs, based on the requirements of equal opportunity and the principle of commercial sustainability". Since then, digital financial inclusion has been elevated to the national strategic level in finance.

2. Methods

BACKGROUND OF TOPIC SELECTION AND RESEARCH SIGNIFICANCE

On the one hand, under the dual background of government policy support and rapid developments in science and technology, China's digital inclusive finance has been flourishing in recent years.The impact of COVID-19 has left small and micro enterprises facing a multitude of challenges, including but not limited to cash flow problems, slow progress in resuming work and production, as well as sharp declines in foreign trade orders. Chinese government has issued a series of policy documents aimed at promoting financial support for small and micro-enterprises. These policies are designed to encourage financial institutions to increase their lending efforts towards these businesses and help alleviate the negative impacts of COVID-19.The Chinese government has released various policy documents to address the issue and encourage financial institutions to increase their lending to small and micro enterprises. The central bank has also launched two innovative monetary policy tools and emphasized the development of first-time borrowers, supply chain financing, and pure online credit loans. These efforts demonstrate the regulators' firm commitment to guide financing for small and micro enterprises.

On the other hand,the impact of the COVID-19 pandemic persists, especially as many of our foreign trading partners have inadequate epidemic prevention measures. This has resulted in a slow economic recovery and has had an adverse effect on cooperation between our foreign trade enterprises and their partners.Especially many private and small to medium-sized enterprises are facing a survival crisis, which is particularly concerning as they are a crucial component of our country's economy.In 2020, private small and micro enterprises, which make up over 90% of China's physical enterprises, played a crucial role in contributing approximately 50% of the tax revenue, over 60% of the GDP, over 70% of the technological innovation achievements, and driving over 80% of urban employment. But private small and micro enterprises are rarely involved in the financial market. Therefore, it is necessary for China's digital inclusive finance to fully leverage its advantages in digitization, efficiency, and broad customer coverage. In doing so, it can make significant contributions to mitigating the impact of the pandemic, maintaining the normal operation of the economy and society, serving vulnerable groups, and driving economic and social development.Linking the low-cost and high-efficiency benefits of digital inclusive finance to the development of China's small and medium-sized foreign trade enterprises is a crucial issue that demands attention. We can drive economic growth and propel China towards success only by doing this. This article uses empirical research to study the relationship between digital inclusive finance and foreign trade in China. Based on the empirical results, targeted recommendations are provided, which can serve as important references and guidelines for the development of

digital inclusive finance in China. This research is also of practical significance for the promotion of foreign trade, especially for small and medium-sized enterprises in China.

3. EMPIRICAL ANALYZE

3.1Model Design

The Panel Vector Autoregression (PVAR) model was first proposed by Holtz-Eakin, Newey, and Rosen in 1988 to address the challenge of establishing the interaction between variables in panel data using non-structural methods. Since then, scholars such as Pesaran, Smith, Mccoskey, Kao, and Joakim have continued to research and refine the model, making it an essential tool for analyzing the dynamic relationships between variables in panel data.he PVAR model is particularly useful for dealing with endogenous treatment of target variables, quantitative analysis, and short time series lengths. Overall, the PVAR model is a powerful and widely used approach for modeling complex relationships in panel data.The Panel Vector Autoregression (PVAR) model is an extension of the traditional Vector Autoregression (VAR) model that takes into account the unique characteristics of panel data. One of the key advantages of the PVAR model is that it fully considers the unobservable heterogeneity among individuals by setting all variables as endogenous variables, without requiring the prior specification of causal relationships between variables. This makes it a powerful tool for modeling complex relationships in panel data. By incorporating the strengths of the VAR model and accounting for the specific features of panel data, the PVAR model provides a flexible and robust framework for analyzing dynamic relationships between variables.In addition,the PVAR model is flexible in dealing with short time series and large cross-sectional data.the PVAR model provides a more accurate representation of the interactions between variables, making it a valuable tool for analyzing complex relationships in panel data. Overall, the PVAR model is a powerful and flexible framework for modeling dynamic relationships between variables in panel data, and its ability to handle short time series data makes it particularly useful in real-world applications.

To investigate the dynamic relationship between digital inclusive finance development and China's import and export trade, this study utilizes panel data from 31 provinces in China between 2011 and 2020. A PVAR2 model is constructed, with digital inclusive finance development indicators and the import and export trade volume of each province in China as endogenous variables. while other control variables are included in the error term.The mathematical model constructed is as follows: $Y_{it} = A + \sum_{j=1}^{k} A_j * Y_{t-j} + \gamma + \theta_t + \varepsilon_t$,"Where t represents the year, k represents the lag order, Y_{it} is a column vector of two endogenous variables, A_j is the coefficient matrix of the lagged variables, Y_{t-j} represents the j -th lagged variable, γ represents the fixed effect, θ_t represents the time effect, and ε_t represents the regression residual of the model.

3.2Variable selection and data sources are as follows

To ensure the accuracy and credibility of the data used in this study, we carefully considered various sources before making our final selection. After careful consideration, we chose to use the digital inclusive finance index for 2011-2020, which was published by the Digital Finance Center at Peking University and is represented by IFI.In addition, the import and export trade volume data for the 31 provinces in China from 2011 to 2020 was sourced from the statistical yearbooks of each province, which are widely recognized as reliable and accurate sources of data. By using these high-quality data sources, we can ensure that our analysis is based on the most accurate and reliable information available.Based on these data sources, we constructed a Panel Vector Autoregression (PVAR) model, with digital inclusive finance development and import/export trade volume represented as FIF and XM, respectively.

Table 1. Descriptive statistics for each variable

Variable		Mean	Std. Dev.	Min	Max	Observations
XM	Overall	1.34e+07	2.19e+07	13031	1.09e+08	N=310
	Between		2.21e+07	109070.4	1.02e+08	n=31
	Within		2307333	2780743	2.65e+07	T=10
FIF	Overall	216.9045	95.9866	16.22	431.93	N=310
	Between		24.4845	185.909	280.955	n=31
	Within		92.905322	16.13948	367.8795	T=10

An analysis of the table and original data shows that there is considerable variation in digital inclusive finance development across the 31 provinces in China from 2011 to 2020. The average digital finance index for this period is 216.9045, with the lowest value of 16.22 recorded in Tibet in 2011, and the highest value of 431.93 recorded in Shanghai in 2020. Comparing the inter-group data of the 31 provinces, the minimum value is 185.909 and the maximum value is 280.955, indicating that the level of digital finance development across different regions in China is uneven. In terms of the intra-group data over the past 10 years, the minimum value is 16.13948, the maximum value is 367.8795, and the standard deviation is 92.905322, indicating a high degree of dispersion and significant differences in the level of digital inclusive finance development. This suggests that China's digital inclusive finance development has been booming over the past decade, but there are still significant disparities in its development across different regions. Overall, these findings highlight the need for continued efforts to promote the growth of digital finance and reduce regional disparities in its development.

From 2011 to 2020, the average total import and export trade volume in China was about 134,000,000,000 USD. The highest value was recorded in 2013, with Guangdong Province's import and export trade reaching 1,091,822,000,000 USD, while the lowest value was recorded in 2011, with Tibet's import and export trade reaching 130,310,000 USD.Looking at the data from a regional perspective, the maximum total import and export volume between provinces in China was approximately 102 billion USD, while the minimum was 109 million USD. This shows that there is a significant development gap in foreign trade between provinces, with an unbalanced geographical distribution. The regions with advantages in foreign trade development in our country are mainly concentrated in the southeast coastal cities.From a temporal perspective, the minimum value of China's import and export trade development data from 2011 to 2020 was 27.8 billion USD, while the maximum value was 265 billion USD, with a standard deviation of approximately 2.3 billion. This indicates that China's foreign trade scale has been steadily expanding over the past decade.

3.3 Stability testing

To ensure that all variables are stationary during the estimation of the PVAR model and to avoid the common problem of spurious regression and estimation bias in panel data estimation, which can affect the validity of the results, it is necessary to test the stationarity of each panel series. The most common method for testing data stationarity is the unit root test. In this study, we used the Stata software to perform the most commonly used unit root test on the basic model described above.

Table 2. Unit root test

Variables	Observations	coefficient	t-value	t-star	P > t

FIF	N,T= (31,10); Obs=248	-0.68959	-0.68959	-9.29583	0.0000
XM	N,T= (31,10); Obs=248	-0.49588	-9.135	-4.76833	0.0000

Table (2) shows that the null hypothesis H0 assumes the presence of a unit root between the digital inclusive finance index (FIF) and the import and export trade volume (XM). The table indicates that the p-values for the unit root test of each variable are 0.0000 (<0.05), which rejects the null hypothesis H0. Therefore, all variables are stationary, and subsequent steps such as the Granger causality test and determination of the optimal lag order can be performed directly.

3.4 GMM estimation

The sample selected for this study, with N>T, is a typical case of short panel data. ince the sample size is smaller than the number of time periods, the optimal lag order must be determined before performing the PVAR model. A lag order that is too short or too long can reduce the accuracy of the results. To determine the optimal lag order, this study used AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion), and HQIC (Hannan-Quinn Information Criterion) criteria. The results showed that a 4th order lag is optimal for all variables.

Table 3. Estimation of GMM

lag	AIC	BIC	HQIC
1	0.7751	41.7101	41.1515
2	44.2893	45.3795	44.7297
3	42.0738	43.3571	42.5938
4	40.0941*	41.6256*	40.7162*
5	40.4908	42.3558	41.2484

Using the system GMM method, the PVAR model was estimated to examine the relationship between the digital inclusive finance index and import and export trade, as shown in Table (4). The results indicate that the impact of digital inclusive finance development on import and export trade is weak when it is the dependent variable. However, a one-period lag in import and export trade has a positive impact on the digital inclusive finance index, with an estimated coefficient of 0.1936625. Import and export trade has a significant impact on the digital inclusive finance index at a 5% level, with an increase of one unit in import and export trade leading to an increase of 0.3806283 units in the digital inclusive finance index.

Table 4. GMM estimation

Explanatory variable	dlnFIF			dlnXM		
	Variable coefficient	Standard deviation	P>|t|	Variable coefficient	Standard deviation	P>|t|
dlnFIF				0.3806283	0.1911741	0.046
dlnXM	0.1936625	0.0819555	0.018			
$dlnFIF_{t-4}$	0.2225739	0.0114927	0.000			
$dlnXM_{t-4}$				0.0982425	0.1654583	0.000

3.5 Granger causality test

The GMM estimation of the PVAR model can only provide a macroscopic view of the correlation and dynamic simulation process among variables. It cannot explain the specific causal logic relationship, dynamic transmission mechanism, impact path, and contribution of shock variables to corresponding variables.To further investigate the dynamic relationship between variables, additional analysis steps, such as panel Granger causality test, impulse response function analysis, and variance decomposition, were used.The results of the Granger causality test are presented below:

Table 5. Granger causality test

Null hypothesis	df	Prob > F
XM does not Granger-cause FIF	4	0.000
FIF does not Granger-cause XM	4	0.000

The results in Table (5) show that both the development of digital inclusive finance and the total import and export trade volume in each province of China reject the null hypothesis at a 5% level of significance, indicating a causal relationship between them. Specifically, the Granger causality test results suggest that the development of digital inclusive finance is a Granger cause of foreign trade development at a national level, meaning that the former variable can be used to predict the latter variable. This indicates that the development of digital inclusive finance can have a positive impact on foreign trade development in China.Moreover, the development of import and export trade is also a Granger cause of digital inclusive finance, indicating that the former variable can also be used to predict the latter variable. This suggests that the development of import and export trade can have a positive impact on the development of digital inclusive finance in China.

3.6 differential decomposition

After conducting the Granger causality test and impulse response analysis, the relationship between the two variables in each region has been well explained. To further analyze the contribution of structural shocks to the volatility of endogenous variables, variance decomposition is used. The results of 200 Monte Carlo simulations are presented in Table (6). The dynamic responses between variables in the 5th and 6th periods are similar, indicating that the model system consisting of two variables tends to be stable after the 5th period. Therefore, the dynamic response in the 5th period lag will not affect the result analysis. Based on this, the variance results of the 6th period are chosen to illustrate the contribution of structural shocks to the volatility of endogenous variables.

Table 6. Monte Carlo simulation method

Impulse variable	Number of periods	Impulse variable	
		LNXM	LNFIF
LNXM	1	1.00	0.000
LNFIF	1	0.534	0.466
LNXM	2	0.982	0.018
LNFIF	2	0.873	0.127
LNXM	3	0.990	0.010
LNFIF	3	0.909	0.091
LNXM	4	0.991	0.009
LNFIF	4	0.955	0.045

LNXM	5	0.992	0.008
LNFIF	5	0.980	0.020
LNXM	6	0.992	0.008
LNFIF	6	0.985	0.015

From Table (6), it appears that digital inclusive finance has a negligible impact on changes in import and export trade volume as a whole. For instance, during the first period, the changes in the development of import and export trade were entirely driven by internal factors, and digital inclusive finance had almost no contribution to these changes.While internal factors continued to play a larger role in the development of foreign trade during the second period, FIF did make a noticeable contribution to XM. This contribution remained relatively stable, hovering around 1% throughout the period.In contrast, The development of digital inclusive finance is not primarily reliant on its own contribution rate.Instead, the development of import and export trade in different provinces of China has a much greater impact on the development of digital finance. XM accounted for 53.4% of the contribution to FIF from the first period, while FIF's own contribution rate was only 46.6%. Moreover, from the second period onwards, foreign trade accounted for over 90% of the contribution to the digital inclusive finance index.In conclusion, the development of digital inclusive finance has a minimal effect on the development of local import and export trade, whereas the development of local import and export trade has a significant impact on the development of digital inclusive finance.

4.CONCLUSION AND RECOMMENDATIONS:

Based on panel data from Chinese provinces spanning from 2011 to 2020, a panel vector autoregression model was utilized to conduct an empirical analysis of the relationship between digital inclusive finance and import and export trade in each province. The research findings are summarized below:(1)The descriptive statistics reveal that over the past decade, China's foreign trade has matured significantly, but there remains significant regional imbalance. Digital inclusive finance is still in its nascent stage of rapid development, with significant growth potential in terms of its rate of expansion. However, in terms of overall level, there is still room for further development.(2)The system GMM estimation reveals that the influence of digital inclusive finance on the development of import and export trade is relatively weak. However, the import and export trade volume from the previous period has a positive impact on the digital inclusive finance index.(3)The results of the Granger causality test suggest that there is a significant bidirectional causal relationship between the development of digital inclusive finance and import and export trade in Chinese provinces. Specifically, the test indicates that digital inclusive finance is a cause of the development of import and export trade, while import and export trade is also a cause of the development of digital inclusive finance.(4)After conducting a differential decomposition analysis, it was found that the progress of digital inclusive finance has a negligible effect on the advancement of import and export trade in the local area. Conversely, the growth of local import and export trade has a substantial impact on the development of digital inclusive finance.

Based on the above conclusion, the author provides several recommendations to further promote the development of digital inclusive finance and local import and export trade. These suggestions are as follows:The first recommendation is to further improve the financial market system and strengthen the construction of financial infrastructure. n China, the financial instruments available are primarily designed to serve large corporations and industries, leaving only a small percentage of the population able to benefit from financial tools in their business activities. As a result, the Chinese government has placed great emphasis on the development of digital and inclusive finance, recognizing that access to financial services is critical to promoting economic growth and reducing poverty. By leveraging technology and expanding access to financial services, China aims to create a

more inclusive financial system that benefits a wider range of individuals and businesses, promoting greater financial stability and sustainable economic growth.In order to meet the diverse financial needs of various enterprises for their business activities, finance must develop in both the digital and inclusive aspects. To achieve this, it is necessary to improve the financial market and build a unified and convenient financial information sharing platform based on digital technology. By accelerating the integration of digital information technology and traditional finance, we can enhance the accurate service capability of digital finance for high-quality development of foreign trade. Additionally, expanding the coverage and depth of use of digital finance in all fields is crucial for its continued growth and success.

The second aspect is to establish a strong economic and trade connection between foreign trade and financial development.The ultimate goal of financial industry development is to serve the real economy. In the current era of rapid development of internet finance, China needs to leverage modern financial tools to promote high-quality foreign trade and enhance the core competitiveness of its import and export industries. This requires transitioning from traditional processing and trading to modern trade. Internet finance can play a key role in this transition by influencing the financial structure and foreign direct investment, ultimately impacting import and export trade.

Finally, under the macroeconomic regulation of the government, it is necessary to increase policy support for small and micro enterprises in a reasonable manner.From the government's point of view, it is important to maintain a balance between regulating the financial industry and promoting economic growth. By lowering the entry barriers for digital inclusive finance within a reasonable range, more industries and enterprises can participate and compete, leading to a more vibrant market. This can have a positive impact on China's foreign trade, as it can help to increase investment and boost economic growth. Therefore, it is crucial for the government to carefully consider the appropriate level of regulation while also encouraging innovation and competition in the financial sector.Banks care more about making money than keeping funds safe, so they only provide financial support to big, established companies. This means that most businesses don't have access to financial tools. It's important to find ways to make financial support available to a wider range of businesses, including smaller ones, so that everyone can have a fair chance to grow and succeed.Small and medium-sized foreign trade enterprises, especially those in high-tech and innovative industries, often struggle to receive support from banks. This is because the traditional financial system, which is largely dominated by banks, does not prioritize or effectively support the technological advancement and innovation capabilities of these businesses.

As a result, it can be difficult for these companies to improve their technology and innovate, hindering their growth and competitiveness in the global market.Therefore,digital inclusive finance has the potential to bring financial services to private and small and medium-sized enterprises, which are often overlooked by traditional financial institutions. By providing access to financial tools and services, digital inclusive finance can help promote financial inclusion and drive economic growth. This is particularly important for developing countries, where small and medium-sized enterprises are key drivers of economic development. By leveraging digital technology, inclusive finance can help bridge the gap between traditional financial institutions and underserved businesses, creating a more inclusive and sustainable financial system.

CONSENT (WHERE EVER APPLICABLE)

Author Wang Lv, Li Xinru and Gu Jiaqi designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author Xu Yongqi managed the literature searches. All authors read and approved the final manuscript.

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