

# Impact of Digital Economy Development on Financialization of Firms: Empirical Evidence from PVAR Model

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**Abstract:** In this paper, we select several indicators to measure the level of the digital economy in cities, the index of digital inclusive finance in cities and the degree of financialization of enterprises, we apply variables mentioned above to analyze the complex relationship between multiple variables based on the PVAR model, we firstly suppose a unique order and use impulse response function (IRF) and variance decomposition measures to predict the impact of the relationship between variables, so as to provide a reference for policy making and risk prevention. and use impulse response and variance decomposition methods to predict the future direction of the relationship between variables, so as to provide certain reference significance for policy making and risk prevention.

**Keywords:** Enterprise Financialization, Digital Economics, PVAR model.

## 1. Introduction

Under the rapid development of digital techniques, the thriving digital economy has become an all-encompassing area in recent years, digital economy develops rapidly with an in-depth integration with the real economy, of the background of the times gradually become an indispensable and effective improving force for economic development in all over the world, for enterprises to improve the total factor generation rate and thus have an advanced progress on the development of the real economy. By the way, the progress of digital technology has promoted the rise of digital finance, further accelerating the expansion of corporate financial assets. Based on the data shown in Shanghai and Shenzhen Stock Exchange listed non-financial enterprises and kinds of researches about relationships between virtual economy and real economy, we already drawn the conclusion that the real economy has shown a trend of "deconstruction to de-virtualization". This paper researches the relationship and degree of influence between the elements of the digital economy and the financialization of enterprises, which is conducive to identifying the different motives for the financialization of enterprises, which is pretty conducive to ameliorating the balanced development of the real economy and the virtual economy, then supporting China's economically high-quality development; and the prediction of the degree of the financialization of enterprises is conducive to enhancing the crisis awareness of the non-financial enterprises in preventing the risk of bubbles and providing certain empirical support for the financial supervisory departments. It also provides financial regulators with some empirical support, and do favors in alleviating the "deconstruction to de-virtualization" phenomenon in China's economy.

The VAR model is suitable for the interrelationships between variables in time series and the dynamic analysis of the system of randomly disturbed variables. In terms of better accuracy, in this study, in order to better analyze the actual situation of different enterprises and consider the individual

effect and time effect in a more comprehensive perspective, we select the PVAR model for panel data analysis. The PVAR model is a non-structural equation model, which was proposed by Holtz Eakin in 1988. The model is based on vector autoregressive (VAR) model for predicting and explaining the interactions among macroeconomic variables. Using PVAR model to do economic researches is highly effective for us to estimate the relationships among all the endogenous variables dynamically, and is widely used to analyze the tendencies of economic variables which are beneficial to the high-quality development of China.

## 2. Literature Review

First of all, regarding the interrelationship between the development of digital economy and the enterprise financialization, academics mainly carry out research from the following perspectives. On the one hand, some scholars have constructed a whole index system to measure the level of a region's digital economy, and then studied the impact on the financialization of enterprises. Shi Shuyu (2023), Fan Jingshu (2023) and others, for the purpose of focusing on reckoning the digital economy as one of the latest factors of economic growth, selecting the relevant financial data and digital financial inclusion indexes of 12,942 listed enterprises on the Shanghai and the Shenzhen Stock Exchange and based on the existing research's evaluation mode of index system which is used to calculate the value of digital economy in some region. Besides, there were plenty of scholars drawn the conclusion with the use of panel data fixed-effects model for empirical analysis: the regional digital economy development on the financialization of enterprises make a preternatural contribution on promoting, and the impact on the non-state-owned entity enterprise's greater role in the conclusion. On the other hand, more scholars concentrate on the impact of digital finance that is generated by the gradually mature combination of digital technology and the financial industry on the financialization of enterprises. Zhong Kai (2022), in the context of digital finance which is set for every single economic agent is a key link for the financial economy to

better serve the real economy and realize the high-standard development, using the relevant financial data of Shanghai and Shenzhen Stock Exchange's A-share non-financial listed companies and the "Digital Inclusive Finance Index", created by Digital Finance Institute from Peking University, and based on the baseline regression methodology and the mechanism testing methodology, it is the Digital Finance like I've mentioned above has a certain inhibitory effect on the financialization of real enterprises, and this negative effect will be more obvious when the return rate of financial investment is higher and the scale of shadow banking is larger. Gao et al. (2023) focus on the problem of systemic risk of financialization of real economy, characterize digital finance through the technology of machine learning, which is realized mainly by grab such information in the business scope of SMEs, and the research evidence concluded from the outcomes based on panel fixed effect shows that the Digital Finance prominently confines SMEs' financialization and reduces SMEs' insolvency risk by alleviating financing constraints.

Then, regarding the proposed research methods to study the interrelationship between the development of digital economy and the enterprise financialization and their prediction, there are several main ones. In the field of economics research, panel data fixed effects modeling is widely used to study the relationship of the influence of one variable on another. Yang Lisheng et al. (2023), An Jie (2023), Min Zhihui et al. (2023) and other scholars from different starting points, using different samples, based on the panel fixed effects model and mediated effects analysis methods to find the relationships of the level of the regional digital economy on enterprise financialization, and obtained that the digital economy is a crucial promotional effect on the enterprise financialization and through the alleviation of financial constraints. To explain further, that means alleviating the dilemma of gathering financial support, reducing financing costs and playing a fully mediating role in the financialization effect. The PVAR model, as a panel data analysis model for trending time series, is more suitable for analyzing complex relationships among multiple variables. Oguzhan Ozcebe (2018) paid attention to the dynamic correlation problem of the money market and financial market, selected the exchange rate data of 10 OECD countries, the growth rate of industrial production, CPI, short-term interest rates and stock payback to construct the PVAR model, and obtained that exchange rate fluctuations and inflation have a small impact on the financial market and positively contribute to the growth of the real economy.

Combing through the existing domestic and international studies, it can be found that the existing studies on the relevance between the digital economy and enterprise financialization mostly focus on the consideration of the role of the regional or the level of digitalization in an enterprise on the impact of enterprise financialization and the mechanism of the reasons, and less on the dynamic correlation between the two or more variables, so the use of the PVAR model, which considers all variables as endogenous variables, to study the issue can, to some extent, to fill the gap in this research field. In addition, different criteria for the selection of variables characterizing the different measurement of digital economy can also lead to different research conclusions. For example, studies that select the degree of digital economy measured by the constructed regional digital economy development evaluation index system for empirical

analysis mostly conclude that there is a positive correlation between the level of digital economy and the enterprise financialization. The study that selects the digital financial index for almost civil or the level of scientific finance as the variable of the level of digital economic development concludes that there are both positive and negative effects, and the reason for this phenomenon is still unclear and needs to be further researched accurately. At the same time, in the context of China's real economy facing the "de-realization to virtualization", it is of practical significance to use appropriate forecasting methods to predict and measure the degree of financialization of enterprises, and thus the Holt index smoothing method, is given surfeit of hope that it can be useful for the policy formulation of the financial regulatory agencies and the capitalization of non-financial enterprises. policy making and capital allocation of non-financial enterprises.

### 3. Research Methodology

The PVAR model is a mathematical combination of a traditional panel data model and a traditional VAR model in which all variables are considered endogenous, which is a unique advantage for examining bidirectional causation problems. The formality of the model is set up as follows:

$$Y_{it} = \beta_0 + \beta_1 Y_{i,t-1} + \dots + \beta_p Y_{i,t-p} + f_i + \varepsilon_i + u_i$$

where  $Y_{it}$  is a multidimensional column vector containing multivariate time-series data,  $i$  is the cross-section individual, and  $t$  is time. the one-dimensional column vector  $\{Z_{it}\}_{i=1}^T$  is usually considered as the time series of the longitudinal profile of cross-section individual  $i$ . Also,  $\{Z_{it}\}_{i=1}^N$  is referred to as the cross-section data of the province  $N$  in the  $t$  th year.  $Z_{i,t-p}$  is a  $p$ th-order lag in the  $Z_{i,t}$  term.  $f_i$  is a fixed effect indicating the variability of individuals in the cross-section.  $\varepsilon_i$  is a column vector indicating the time effect of individuals in the cross-section.  $u_i$  is the random error term. Table 1 demonstrates the Descriptive statistics of the core variables.

**Table 1.** descriptive statistics for variables

VARIABLES	N	mean	std	min	Max
DIG	979	0.123 4698	0.072 1113	0.015 8271	0.5610 589
DIF	979	201.5 486	74.46 9	27.08	359.68
FINRATIO	979	0.151 3694	0.466 7543	0	4.4902 11

In my study,  $Y_{it}$  is a vector of three endogenous variables: DIG denotes the level of regional digital economy, drawing on Zhao Tao et al.'s (2020) study, which uses principal component analysis to construct a comprehensive development evaluation index system for the digital economy, and used the evaluation system they set up measures the regional digital economy development index; DIF denotes the regional digital financial inclusion index, drawing on Guo Feng et al.'s (2020) construction of the Digital Financial Index System by Digital Finance Institute from Peking University, and calculated the digital inclusive finance index of each region with the evaluation system above; FINRATIO denotes the degree of comprehensive regional financialization, drawing on Du Yong et al. (2018), the financialization of enterprises is measured using the proportion of the relevant

financial assets of non-financial entity enterprises (money funds are excluded, and investment real estate is added) to the total assets, and then the proportion of the total assets of each enterprise to the total assets of the enterprises in the region is used as the weight to calculate the weighted average, and finally get the comprehensive financialization degree of the region. Since the number of individuals is much larger than the number of year series, there is no need to carry out the unit root test in the process of building the PVAR model, and the robustness test shows that the PVAR model is robust, and the Helmert program is used to remove the fixed effects in the model we will use for later analysis. Before the next series of analyzing methods, we have to suppose that there is a rudimentary order of the main variables. In another words, we suppose a typical influence institution: DIG → DIF → FINRATIO. First, the optimal lag order was determined to be first order according to three kinds of rules: AIC, BIC and HQIC criteria, and Granger causality tests were performed for each equation that PVAR model included. Then, we use the GMM method to evaluate the coefficients of every variable and attached p value. Finally, impulse response functions and variance decomposition methods are used to further analyze the current and expected relationships between variables.

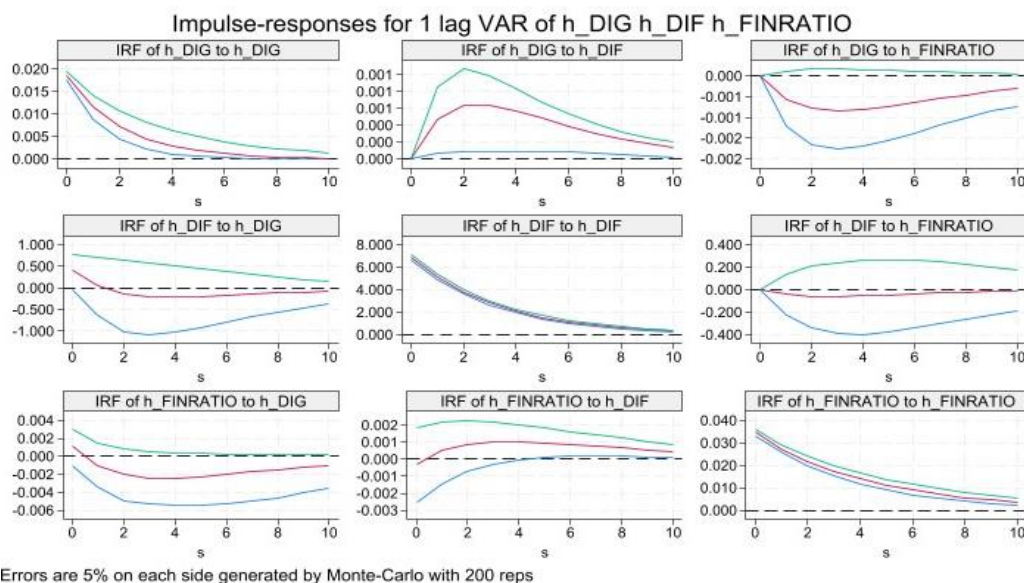
## 4. Results and Discussion

### 4.1. Granger Causality

First, I give the results of the Granger causality test between the variables, as shown in Table 2.

**Table 2.** Granger causality tests

	DIG	DIF	FINRATIO
DIG		11.7520***	8.2218***
DIF	5.8e-07		7.2354***
FINRATIO	0.2294	0.5855	
ALL	0.2303	12.0740***	8.2739**



**Figure 1.** IRFs of DIG, DIF and FINRATIO. Based on PVAR (1).

### 4.3. Impulse Response Analysis Results

I estimate the IRF and FEVD using the same order as in the estimation of the PVAR model. The IRF results are shown in Figure 1.

It can be found from the impulse response diagram that the

The tests are based on the PVAR (1) model, \*\*\*denotes significance at the 1% level, \*\* denotes significance at the 5% level, \* denotes significance at the 10% level.

From the results, it can be seen that the degree of financialization shows a significant bidirectional relationship with both the regional digital financial index and the regional digitalization level, while the regional digital finance index shows a unidirectional relationship with the regional digital economy level. Therefore, the set response mechanism of DIG→DIF→FINRATIO is valid.

### 4.2. PVAR Results

I then give the results for the estimated PVAR (1) and GMM coefficients as shown in Table 3.

**Table 3.** PVAR (1) coefficient estimates

Dependent variable	DIG	DIF	FINRATIO
DIG (1)	0.6275*** (0.0842)	-14.7248 (16.3658)	-0.1060* (0.0617)
DIF (1)	0.0000675** (0.0000348)	0.7433*** (0.0086)	0.0001015*** (0.0000329)
FINRATIO (1)	-0.0160* (0.0114)	-1.2522 (3.0467)	0.7935*** (0.0203)

No. of obs.=979, No. of panels=89. The PVAR model estimated 1 lag according to the AIC Rule. \*\*\*denotes significance at the 1% level. \*\*denotes significance at the 5% level. \*denotes significance at the 10% level.

Table 3 shows that the level of regional digital economy development does not have a significant effect on the performance of digital financial inclusion, but it has a slight negative influence on the financialization of enterprises. In contrast, digital inclusive finance has a positive effect on regional financialization, which may mainly originate from MSMEs. Using FINRATIO as the dependent variable, it is observed that the GMM coefficients of both DIG and DIF are significant.

regional digital economy development level, regional digital finance index and financialization degree of their own lagged variables all show significant positive effects, DIG tends to eliminate the impact from the 6th period, and DIF and FINRATIO tend to eliminate the impact from the 8th period.

DIG shows a prominent positive effect on digital financial inclusion in the near future and a negative influence on the degree of financialization. FINRATIO shows a negative effect on DIG in the long term and a positive function on DIF in the medium term, but no significant effect of DIF on FINRATIO is observed.

#### 4.4. Variance Decomposition Analysis Results

Table 4 shows the variance decomposition for the basic PVAR model after stages 5, 10, 15, and 20.

**Table 4.** Variance Decomposition

Response variable & Forecast horizon	Impulse variable		
	DIG	DIF	FINRATIO
<b>DIG</b>			
5	0.993	0.002	0.004
10	0.990	0.003	0.007
15	0.989	0.003	0.007
20	0.989	0.003	0.007
<b>DIF</b>			
5	0.003	0.997	0.000
10	0.004	0.996	0.000
15	0.004	0.996	0.000
20	0.004	0.996	0.000
<b>FINRATIO</b>			
5	0.006	0.001	0.993
10	0.010	0.002	0.988
15	0.011	0.002	0.987
20	0.011	0.002	0.987

It can be observed that the contribution of changes in the level of regional digital economy to changes in regional financialization increases gradually from the short to the long term to 1.1 per cent, while the impact of changes in digital finance on regional financialization remains at a weak level in the long term. Changes in corporate financialization have a slight impact on changes in digital economic development in the short and long term, but do not affect digital financial inclusion.

## 5. Conclusions

This paper considers the PVAR method's various advantages to study the relationship between the level of digital economy and the level of enterprise financialization in 89 prefecture-level cities, and constructs IRFs for the period of 2011-2021, and then conducts FEVD analysis on each variable. According to existing domestic and international studies, this paper may be the initial study that uses the PVAR model to analyze the relevance between regional digital economy development, regional digital financial inclusion level and enterprise financialization. The results of the study show less-eminent conclusion that regional digital economic development is the main force pushes the level of enterprise financialization, while digital finance does not show a significant impact. I try to explain this phenomenon according to the research line: on the one hand, the current facially digital finance in China is mainly oriented to the objects of micro and small enterprises, low-income people, the disabled groups and so on, particularly people or organizations who are struggling for living. However, the sample data selected in this paper mainly comes from Shanghai and Shenzhen listed non-financial entity enterprises, there is a large gap between the two. On the other hand, the degree of comprehensive financialization in this paper is obtained from the weighted average, and the financialization of enterprises with a larger

share of total assets contributes to comprehensive financialization to a higher degree, while they are not the service objects of inclusive finance. In addition, the degree of financialization of enterprises presents a negative effect on regional digital economic development and a positive effect on regional digital financial inclusion, possibly because other factors in the evaluation system's part of digital economy are more affected. Variance decomposition and Granger causality analysis further cement the conclusions on the relevance between digital economy and financialization, although regional digital economy development exhibits weak levels on the degree of financial inclusion and enterprise financialization. This paper constructs a mathematical model for predicting and measuring the degree of financialization of real enterprises, so as to explore the interaction and transmission mechanism between the digital economy and the financial economy, which is conducive to providing certain reference significance for other studies on the interrelationship between the real economy and the virtual economy, and helps to provide certain guidance for the formulation of the management system by the financial regulatory authorities, and for the selection of investment decisions which are accessible for the real enterprises to meet the needs of their main business, which can help to alleviate the "de-realization" and financialization. This will help to alleviate the phenomenon of the "deconstruction to virtualization" of the economy, thereby supporting the advocates for integrating the real economy and the virtual economy to chase better development.

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