Digital Inclusive Finance and Enterprise Total Factor Productivity—Based on the Perspective of Enterprise Innovation and Human Capital Upgrading

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Abstract. In the wave of China's financial digitalization reform, deepening the quality and efficiency of financial services to the real economy has become the key to achieving high-quality development of China 's economy. This paper selects listed companies from 2011 to 2020 as research samples to test the impact and mechanism of digital inclusive finance on total factor productivity of enterprises. The study finds that digital inclusive finance improves the total factor productivity of enterprises by promoting enterprise innovation and human capital upgrading; the heterogeneity test shows that digital inclusive finance has effectively played its ' inclusiveness ', which is more conducive to improving the total factor productivity of SMEs and medium-sized urban enterprises; further analysis shows that the impact of digital inclusive finance on the total factor productivity of enterprises has an inverted U-shaped feature. Therefore, the state should pay attention to the productivity improvement effect of digital inclusive finance, provide digital financial services according to local conditions for different regions and enterprises, and strengthen supervision to curb the impairment of financial risks on enterprise efficiency.

Keywords: Digital inclusive finance; total factor productivity; enterprise innovation; human capital upgrade.

1. Introduction

The report of the 20th National Congress of the Communist Party of China pointed out that ' accelerating the construction of a modern economic system and focusing on improving total factor productivity '. As China enters the stage of high-quality economic development, total factor productivity has become the core engine for improving comprehensive national strength and promoting sustainable economic growth (Fang Cai, 2013) [1]. From 1978 to 2008, the contribution of China 's total factor productivity to economic development continued to grow. However, in recent years, with the gradual weakening of the demographic dividend and the change of population structure, the growth rate of total factor productivity has slowed down, and its role in promoting economic growth has also shown a downward trend (Yang Lu, 2021) [2]. At the critical stage of China 's modernization, it is of great practical significance to deeply study the core driving force of total factor productivity to promote high-quality economic development. As the micro-foundation of national macroeconomic activities, the improvement of total factor productivity of enterprises is crucial to the realization of high-quality economic development (Fang Cai, 2018) [3]. Therefore, exploring how to effectively improve the total factor productivity of enterprises plays an important role in promoting the high-quality development of the country 's overall economy. As a key element of economic development, finance plays a vital role in the transformation and development of the real economy and high-quality economic growth. However, China 's financial system is not perfect, the proportion of indirect financing is too large, the imbalance between financial supply and demand, the development of financing efficiency and financing scale is lagging behind, which restricts the improvement of enterprise efficiency (Xiaodong Lu, 2008) [4].

However, the above situation has been improved in recent years. With the continuous integration of digital technologies such as artificial intelligence, big data, and blockchain with finance, emerging digital financial formats have been spawned. Digital inclusive finance, as an innovative achievement

of cross-border integration of digital technologies and financial services, can effectively solve the structural mismatch problems existing in traditional finance, optimize the channels for financial support for the development of the real economy, and improve the efficiency of capital allocation (Tang et al., 2020) [5]. It is also a positive response to and in-depth implementation of ' adhering to the focus of economic development on the real economy '. Therefore, in-depth study of the impact of digital inclusive finance on the total factor productivity of enterprises and its mechanism of action has important theoretical significance and practical value for improving China 's digital financial development system, promoting the improvement of total factor productivity of enterprises and achieving high-quality economic development.

Scholars have conducted in-depth and extensive discussions on the relationship between digital inclusive finance and total factor productivity. From a regional perspective, the development of digital inclusive finance reduces the threshold of financial services and improves the efficiency of financial services. At the same time, it can further promote regional total factor productivity growth by improving the level of technological innovation, promoting the upgrading of industrial structure, alleviating resource mismatch, enhancing technology spillover effect and reducing carbon emissions (Hui Xianbo, 2021; Hou&Li, 2020; He&Yang, 2021) [6,7,8]. Especially for regional agricultural total factor productivity, scholars have conducted extensive discussions and believed that digital inclusive finance promotes agricultural total factor productivity by improving agricultural technical efficiency and deepening agricultural capital (Yan Liu, 2021; Ren&Lei, 2022) [9,10], the popularity of the Internet has a positive moderating effect (Jinchun Zhao, 2024) [11]. In areas with good natural resource endowments and advanced agricultural production models, the development of digital inclusive finance has a stronger role in promoting agricultural total factor productivity (Tang et al. , 2022) [12]. From the perspective of enterprises, digital inclusive finance promotes the growth of total factor productivity of enterprises by promoting enterprise innovation, alleviating financing constraints, reducing financial risks, expanding revenue and increasing self-motivation of enterprises. This growth effect is more obvious for enterprises with higher quality of information disclosure, more obvious financing constraints, eastern regions, capital-intensive and state-owned property rights (Rao&Wu, 2022; Jiang&Jiang, 2021; Chen&Jiang, 2021; Lu et al., 2023) [13,14,15,16].

The above results provide strong theoretical support and method reference for the related issues studied in this paper. The existing research has reached a basic consensus on the view that digital inclusive finance has a promoting effect on the total factor productivity of enterprises. However, there are still few articles paying close attention to the following issues: Does digital inclusive finance effectively play its ' inclusive ' role in promoting micro-enterprise productivity? What mechanism does digital inclusive finance promote the improvement of total factor productivity of enterprises? Is there a risk of excessive development while digital inclusive finance is changing with each passing day, which limits the improvement of total factor productivity of enterprises, thus making its impact nonlinear? In view of this, by combing the existing relevant literature, this paper first analyzes from the theoretical level, and then collects relevant data from the empirical level for research and in-depth discussion, trying to answer the above questions and expand the existing research from both theoretical and empirical levels.

In view of this, the possible marginal contributions of this paper are: First, it enriches the perspective of the factors affecting the total factor productivity of enterprises. From the perspective of digital inclusive finance, this paper provides theoretical support and empirical evidence for high-quality economic development from the perspective of micro-enterprises. Secondly, different from the existing literature, which mostly focuses on technological innovation and financing constraints, this paper incorporates the key factor of enterprise human capital, expands the possible mechanism of digital inclusive finance affecting enterprise total factor productivity, and provides clear target guidance and practical implementation strategies for promoting enterprise total factor productivity. Thirdly, it examines the core of the ' inclusiveness ' of digital inclusive finance. This paper discusses the sample of city scale and enterprise scale, which provides a useful reference for the key targets of future policy implementation. Fourth, it overcomes the limitations of previous studies on the single

linear impact of digital inclusive finance. This paper incorporates the quadratic term of the digital inclusive finance index into the research, reveals the nonlinear inverted U-shaped characteristics of its impact, and provides inspirational references and suggestions for the future development of digital inclusive finance and its potential risks.

2. Theoretical analysis and research hypothesis

First of all, digital inclusive finance has broadened the financing channels of enterprises. Through new formats, digital inclusive finance has got rid of its dependence on the complex traditional financial system, enriched the types of financial instruments, provided diversified savings instruments, expanded the coverage and depth of use of financial services, and its advantages of convenient services and diversified application scenarios have broken through the boundary constraints of traditional finance and lowered the threshold of financial services (Zhang et al. , 2019; Laeven et al. , 2015) [17,18], and focused on the financial needs of small and micro enterprises, agriculture-related entities, and individual businesses, deeply explored internal and external data information resources, provided appropriate financial products and services, and improved the financing availability of ' long tail customers '. The idle funds are gathered and effectively matched through various ways of digital inclusive finance, so that enterprises can more easily obtain financing from various channels to meet the needs of their development and transformation, improve their resource allocation efficiency and production and operation efficiency, and promote their economic quality and efficiency. Secondly, digital inclusive finance reduces the financing cost of enterprises. With the layout of the new format of digital inclusive finance, the launch of the digital platform has reduced the transaction costs and supervision costs between financial institutions and enterprises, better identified the risks of credit services provided by various types of enterprises, built a more robust enterprise credit evaluation system based on information technology, and established a more accurate and efficient enterprise risk assessment mechanism to accelerate the reform of financial institutions and improve the efficiency of financial services, thereby promoting the improvement of total factor productivity of enterprises. Finally, digital inclusive finance alleviates the information asymmetry of enterprises. Information asymmetry between traditional financial institutions and enterprises is the key reason for corporate financing difficulties (Kaplan&Zingales, 1997) [19], and the emergence of digitization has reduced the cost of information collection and analysis of both borrowers and lenders, alleviated information asymmetry, and enabled investors to have a more comprehensive understanding of enterprises. To allocate funds more efficiently (Koffi, 2016) [20], facilitate financing for high-quality projects, improve financing efficiency, and promote total factor productivity of enterprises.

Secondly, the growth of digital inclusive finance can effectively support enterprises ' innovation activities and R & D investment, and inject power into boosting total factor productivity. This is because enterprise innovation and R & D have the characteristics of long cycle and high risk. The process of R & D innovation requires a lot of funds, but the internal funds of enterprises are not enough to meet the huge capital needs of their innovative R & D activities. Therefore, external financing has become an indispensable source of funds for enterprise innovation (Hall B H, 2002) [21]. The emergence of digital inclusive finance can timely relieve the financial constraints of enterprises in the process of innovation, solve the problem of " difficult financing and expensive financing " of enterprises, and promote the innovation and development of enterprises. Innovation is the core driving force of economic growth. Technological innovation is an indispensable key factor for enterprises to achieve total factor productivity growth (Tang et al. , 2014) [22].

In addition, as China 's population structure is undergoing major adjustments, the ' demographic dividend ' is gradually fading, and the ' talent dividend ' is emerging. The accumulation and quality upgrading of human capital has become an effective way to empower total factor productivity (Fang Cai, 2013) [23]. Previous studies have shown that financial development has a positive effect on human capital (Dutta&Sobel, 2018) [24]. On the one hand, digital inclusive finance promotes the flow of financial resources into the field of education, promotes human capital investment, fills the

gap of educational inequality, and provides the possibility of human capital accumulation and quality improvement in financially empowered societies (Zhang et al. , 2023) [25]. The development of digital inclusive finance has improved the availability of labor credit funds, eased people 's budget constraints and liquidity constraints, and led to residents ' expenditure on cultural education (Yi&Zhou, 2018) [26]. Residents will be more actively involved in skills training and academic qualifications, especially for those who are difficult to bear the cost of education and training due to lack of funds. Labor groups, digital inclusive finance has provided credit support to enable them to invest in areas such as education and vocational skills training, thereby improving their skills level (Guanchun Liu, 2017) [27] and promoting human capital upgrading in the labor market. On the other hand, according to the ' capital skill complementarity ' hypothesis (Griliches Z, 1969) [28], there is a complementary relationship between capital and high-skilled human capital. With the development of digital inclusive finance, the financing convenience of enterprises is improved, and more capital elements are put into production, which leads to the increasing demand for high-skilled human capital, thus accelerating the process of upgrading human capital (Guangjun Shen, 2017) [29]. Furthermore, the upgrading of enterprise human capital promotes the improvement of enterprise total factor productivity through technological progress effect and resource allocation effect. Specifically, high-skilled human capital has higher knowledge spillover (Zhuo&Zhou, 2015) [30]. It benefits more from the agglomeration effect of human capital, promotes the exchange of information and knowledge, and promotes technological innovation and achievement transformation. At the same time, because of its strong externality (Lucas Jr R E,1988) [31], while learning new knowledge and new technology, high-skilled human capital with high innovation spirit and practical ability produces more innovative ideas and accelerates the expansion and transformation of innovation achievements. At the same time, high-level human capital has good resource allocation ability, which can promote the flow of production factors from low-efficiency departments to high-efficiency departments (Huang et al., 2013) [32], thus promoting the total factor productivity of enterprises.

Therefore, the following research hypotheses are proposed:

H1: Digital inclusive finance promotes the improvement of total factor productivity of enterprises.

H2: Digital inclusive finance promotes the improvement of total factor productivity by promoting enterprise innovation and enterprise human capital upgrading.

3. Research design

3.1. Model setup

3.1.1 Baseline model

In order to investigate the impact of digital inclusive finance on the total factor productivity of enterprises, this paper sets the following regression model.

$$TFP_{i\tau t} = \alpha_0 + \alpha_1 Index_{\tau t} + \sum \alpha_j Control_{jit} + \sum year + \sum ind + \sum year * ind + \varepsilon_{it} \quad (1)$$

In the formula, $TFP_{i\tau t}$represents the total factor productivity of i enterprises in the τ region in the t-year, and $Index_{\tau t}$ reflects the digital inclusive financial index of the τ region in the t-year. $Control$ represents the set of control variables, and ε is the random error term. In order to minimize the problem of missing variables and make the estimation results more robust, this paper controls the year fixed effect $\sum year$, the industry fixed effect $\sum ind$ and the industry year combined fixed effect $\sum year * ind$ to better absorb the influence of time, industry and industry-level unobservable factors that change over time.

3.1.2 Mechanism model

Among them, Mechanism is the mechanism variable (enterprise innovation and enterprise human capital upgrading), and the meaning of the remaining variables is the same as before.

3.2. Variable definition

3.2.1 Dependent variable

The explained variable of this paper is the total factor productivity (TFP) of enterprises. The estimation methods of total factor productivity of enterprises mainly include GMM, OP, LP and OLS. Among them, there are problems such as simultaneity bias and sample selection bias under the OLS method. The GMM method is suitable for samples with a long time span, while the OP method (Olley&Pakes, 1992) [33] and the LP method (Levinsohn&Petrin, 2003) [34] are less limited in correcting the endogenous problem of the model. Therefore, this paper uses the OP method to estimate the total factor productivity of enterprises in the benchmark regression, and uses the LP method to estimate the robustness test below.

3.2.2 Independent variable

The explanatory variable of this paper is the digital inclusive financial index (Index). The index is released by the Digital Finance Research Center of Peking University. It not only covers the total index (Index) at the provincial, municipal and some county levels, but also includes three sub-dimension indexes of digital inclusive coverage (Coverage), depth of use (Usage) and degree of digitization (Digital) (Guo et al. , 2020) [35]. The following will be based on the total index and three sub-dimension indexes at the city level. In order to eliminate the influence of data dimension and magnitude difference on model estimation, this paper divides the total digital finance index and each sub-index by 100.

3.2.3 Mechanism variables

The mechanism variables of this paper are enterprise innovation and enterprise human capital upgrading. Enterprise patents are divided into three types: invention patents, utility model patents and appearance patents. The former is high-end and substantive innovation, which can better reflect the core innovation ability of enterprises. The latter two are relatively low-end and quantitative innovation (Tang et al. , 2020) [5]. In view of this, from the perspective of enterprise R & D output, this paper uses the number of invention patents (Patent _ 1), utility model patents (Patent _ 2) and design patents (Patent _ 3) independently applied by enterprises as the proxy variables of enterprise innovation, reflecting the level of enterprise innovation.

Human capital is the sum of physical strength, knowledge, experience and other skills with workers as the carrier. The educational level and technical level of the labor force can reflect the skill level of the labor force. Therefore, in view of the measurement of enterprise human capital upgrading, referring to the practice of (Liu&Zhao, 2020) [37] and (Ye et al., 2022) [38], the ratio of the number of employees in the technical department of the enterprise to the total number of employees in the enterprise (H_skill) and the ratio of the number of laborers with bachelor 's degree or above to the total number of laborers (H_edu) are used to measure the upgrading of enterprise human capital.

3.2.4 Control variables

In order to reduce the estimation bias caused by missing variables, this paper includes multiple variables as control variables. It includes company size (Size, the natural logarithm of total assets), asset-liability ratio (Lev, total liabilities at the end of the year divided by total assets at the end of the year), total asset profit margin (Roa, net profit divided by the average balance of total assets), fixed assets ratio (Fixed, net fixed assets divided by total assets), the proportion of independent directors (Indep, the number of independent directors divided by the total number of directors) and the number of years of listing (Listage, the year of the year minus the year of listing plus one after the natural logarithm).

3.3. Sample selection and data sources

The digital financial index of this paper is derived from the ' Peking University Digital Inclusive Financial Index '. The enterprise-level data are derived from the 2011 ~ 2020 CSMAR database and the Wind database, and the samples are processed as follows: eliminate the enterprise samples with

serious missing data, eliminate the enterprise samples of the financial industry and eliminate the ST and *ST enterprise samples.

3.4. Descriptive statistic

Table 1. Descriptive statistics

Variable	N	mean	sd	min	max
TFP_LP	25,711	8. 333	1. 134	0	13. 00
TFP_OP	25,711	6. 652	0. 948	0	11. 43
Index	26,337	2. 174	0. 710	0. 213	3. 345
Coverage	26,337	2. 156	0. 679	0. 0510	3. 265
Usage	26,337	2. 147	0. 748	0. 125	3. 498
Digital	26,337	2. 282	0. 859	0. 0339	5. 812
Size	26,337	22. 15	1. 335	14. 94	28. 64
Lev	26,337	0. 418	0. 212	0. 00708	1. 957
Roa	26,336	0. 0419	0. 0758	-1. 324	0. 880
Fixed	26,337	0. 206	0. 162	0	0. 971
Indep	26,299	0. 376	0. 0559	0. 167	0. 800
ListAge	26,337	2. 029	0. 931	0	3. 434

4. Analysis of empirical results

4.1. Baseline regression result

According to the model setting in formula (1), this paper conducts panel regression under the interaction fixed effect of year, industry and industry year. The results are shown in Table 1. It can be seen from Column (1) that the coefficient of the digital inclusive financial index is significantly positive at the 1 % level, indicating that it effectively promotes the improvement of total factor productivity of enterprises, and H1 is verified. Columns (2), (3) and (4) show the estimation results of three different dimensions of the digital inclusive financial index. The coefficients of digital financial coverage breadth and digital financial use depth are significant at the level of 1 %, indicating that both coverage breadth and use depth significantly promote the total factor productivity of enterprises, but the coefficient of digitization degree is not significant. This situation is similar to the conclusion of ' Peking University Digital Inclusive Finance Index (2011-2020) ', which means that in the process of digital finance development, with the increasing saturation of digitalization, the rapid development trend in its early stage has been difficult to reproduce. Financial institutions can only expand a broader space for development by constantly refining the application scenarios and service models of digital finance.

Table 2. Baseline regression results

Variable	(1) TFP_OP	(2) TFP_OP	(3) TFP_OP	(4) TFP_OP
Index	0. 201***			
	(0. 041)			
Coverage		0. 132***		
		(0. 032)		
Usage			0. 211***	
			(0. 035)	
Digital				-0. 051
				(0. 035)
Size	0. 382***	0. 382***	0. 381***	0. 384***
	(0. 013)	(0. 013)	(0. 013)	(0. 013)
Lev	0. 676***	0. 672***	0. 686***	0. 670***
	(0. 073)	(0. 073)	(0. 073)	(0. 073)
Roa	1. 569***	1. 572***	1. 566***	1. 579***
	(0. 160)	(0. 160)	(0. 161)	(0. 159)
Fixed	-1. 143***	-1. 149***	-1. 139***	-1. 177***
	(0. 133)	(0. 133)	(0. 135)	(0. 132)
Indep	-0. 081	-0. 083	-0. 067	-0. 066
	(0. 106)	(0. 107)	(0. 105)	(0. 106)
ListAge	0. 010	0. 009	0. 011	0. 004
	(0. 015)	(0. 015)	(0. 015)	(0. 015)
_cons	-2. 344***	-2. 199***	-2. 358***	-1. 832***
	(0. 291)	(0. 291)	(0. 291)	(0. 276)
Year FE				
Ind FE		control		
Year*Ind FE				
N	25626	25626	25626	25626
R^2	0. 580	0. 579	0. 581	0. 578

Note: The report value in parentheses is the robust standard error of industry cluster. *, * * and * * * represent the significance level of 10 %, 5 % and 1 %, respectively. The same below.

4.2. Robustness test

4.2.1 Endogenous treatment

In order to alleviate the endogenous problems caused by missing variables, this paper selects appropriate instrumental variables and uses the two-stage least squares method to deal with them. Referring to the method (Huang et al., 2019) [39], the number of fixed telephones per 100 people in each city in 1984 (Phone) is selected as the instrumental variable of the regional digital inclusive financial index. This is because, on the one hand, the start and development of China 's Internet technology can be traced back to the widespread popularity of fixed-line telephones. The degree of perfection of telecommunications infrastructure, including technological innovation and the formation of people 's habits, has had a profound impact on the promotion and application of subsequent Internet technology. In view of this, the number of fixed-line telephones is used as a tool variable to measure the level of Internet development in the region, which is both logical and meets the requirements of relevance. On the other hand, with the gradual decrease in the frequency of use, the impact of traditional telecommunications tools such as fixed telephones on economic development has become increasingly weakened. The number of fixed telephones has historically had a significant impact on the total factor productivity of enterprises. However, this impact has gradually subsided. At present, the number of fixed telephones has been difficult to have a significant impact on the productivity of enterprises, which meets the exogenous requirements.

Columns (1) and (2) of Table 2 report the estimation results of the IV-2SLS method. Among them, the coefficient of Phone in the first stage regression is significantly positive at the 1 % level, indicating that the instrumental variables selected in this paper meet the correlation conditions. At the same time, in the second stage regression, the estimated coefficient of Index is significantly positive, indicating that the main conclusions of this paper are still valid. In addition, for the weak identification test of instrumental variables, the P value of the K-Prk LM statistic is 0. 000, which rejects the null hypothesis; in the test of weak instrumental variables, the K-P rk Wald F statistic is greater than the critical value at the 10 % level of the Stock-Yogo weak identification test. The above test shows the rationality of selecting the number of fixed telephones per 100 people in each city in history as the instrumental variable of the digital inclusive financial index. The above results show that after considering endogeneity, the promotion effect of digital inclusive finance on the total factor productivity of enterprises is still robust and reliable.

4.2.2 Replace the dependent variable

Refer to the LP method (Levinsohn&Petrin, 2003) [34]to recalculate the total factor of the enterprise and put it into the model estimation. The results of column (3) of Table 2 show that the coefficient of digital inclusive finance is still significantly positive, indicating that the results are robust.

4.2.3 Change the number of samples

In order to avoid the difference in the order of magnitude between variables and eliminate the influence of outliers, all continuous variables are truncated by 1 % up and down, and the processed samples are re-estimated and tested. The results are shown in Column (4) of Table 2. The results are consistent with the previous ones, indicating that the results are robust.

4.2.4 Lag independent variable

Considering the possible time lag when digital inclusive finance acts on the total factor productivity of enterprises, this paper estimates the digital financial inclusion index by one-period lag. The results are shown in Column (5) of Table 3, which is consistent with the benchmark regression conclusion and the results are robust.

Table 3. Robustness test

Methods	Endogenous treatment-instrumental variable		Replace dependent variable	Change the number of samples	Lag independent variable
	(1)	(2)	(3)	(4)	(5)
Variable	Index	TFP_OP	TFP_LP	TFP_OP	TFP_OP
Phone	0. 093***				
	(0. 006)				
Index		0. 169*	0. 129***	0. 206***	0. 201***
		(0. 088)	(0. 047)	(0. 041)	(0. 041)
Size	0. 000	0. 381***	0. 556***	0. 387***	0. 382***
	(0. 003)	(0. 014)	(0. 014)	(0. 010)	(0. 013)
Lev	-0. 014	0. 676***	0. 843***	0. 694***	0. 676***
	(0. 018)	(0. 078)	(0. 079)	(0. 068)	(0. 073)
Roa	0. 084**	1. 593***	1. 905***	2. 118***	1. 569***
	(0. 035)	(0. 158)	(0. 189)	(0. 161)	(0. 160)
Fixed	-0. 088***	-1. 172***	-1. 278***	-1. 115***	-1. 143***
	(0. 032)	(0. 134)	(0. 134)	(0. 130)	(0. 133)
Indep	0. 007	-0. 084	-0. 235**	-0. 025	-0. 081
	(0. 038)	(0. 113)	(0. 115)	(0. 100)	(0. 106)
ListAge	-0. 020***	0. 007	0. 007	0. 004	0. 010
	(0. 003)	(0. 015)	(0. 017)	(0. 013)	(0. 015)
Year FE					
Ind FE			control		
Year*Ind FE					
N	24,406	23834	25626	25,626	25,626
R^2	0. 950	0. 440	0. 653	0. 612	0. 580
K-P rk LM statistic	24. 48				
K-P rk Wald F statistic	240. 60				

4.3. Mechanism analysis

In order to verify that enterprise innovation and human capital upgrading are effective mechanisms for digital inclusive finance to promote the total factor productivity of enterprises, this paper draws on the ideas of (Ting Jiang, 2022) [40] to test the mechanism.

4.3.1 The mechanism test of enterprise innovation

Enterprise patents are divided into three types: invention patents, utility model patents and design patents. The former is a high-end substantive innovation, which can better reflect the core innovation ability of the enterprise, and the latter two are relatively low-end strategic innovations (Li&Zheng, 2016) [41]. The results of Table 4 show that only the coefficient of the number of invention patents representing the ' substantive innovation ' of the enterprise is significant, while the coefficient of the ' strategic innovation ' represented by the enterprise 's utility model and design patents is not significant. It is the consensus of scholars that technological innovation has a significant role in promoting enterprise productivity, which indicates that enterprise innovation is an effective mechanism for digital inclusive finance to promote enterprise productivity, but mainly through substantive core technological innovation. This conclusion further shows that the development of digital economy has the ability to alleviate the phenomenon of " innovation bubble, " and helps to promote the transformation of technological innovation from " number " to " quality, " thus becoming the key driving force of China 's " structural " innovation (Tang et al. , 2020) [5].

4.3.2 The mechanism test of enterprise human capital upgrading

The results are shown in columns (4) and (5) of table 4, and the coefficient of human capital upgrading of enterprises is significantly positive at the level of 1 %, indicating that digital inclusive finance can significantly promote the upgrading of human capital of enterprises. High-skilled human capital with higher technical level and educational level brings many benefits such as the acceleration of technological progress, the optimization of organizational management and the improvement of resource allocation efficiency. Adequate human capital accumulation and the optimization of human capital structure can improve the technological level of enterprises, thus promoting the improvement of total factor productivity (Ping Li, 2016) [42]. This result shows that the upgrading of corporate human capital is an effective mechanism for digital inclusive finance to promote corporate productivity.

Table 4. Mechanism analysis

	(1)	(2)	(3)	(4)	(5)
Variable	Patent_1	Patent_2	Patent_3	H_skill	H_edu
Index	0. 090**	-0. 010	0. 003	0. 047***	0. 075***
	(0. 041)	(0. 022)	(0. 009)	(0. 013)	(0. 016)
Size	19. 685***	10. 446**	3. 052**	0. 035	1. 499***
	(7. 324)	(4. 003)	(1. 215)	(0. 267)	(0. 379)
Lev	-11. 219*	-3. 415	0. 069	-4. 597**	-4. 451*
	(6. 308)	(4. 835)	(1. 014)	(1. 766)	(2. 384)
Roa	17. 499	32. 108	19. 877**	-0. 499	3. 193
	(24. 611)	(28. 343)	(8. 556)	(2. 316)	(3. 708)
Fixed	-17. 341	-6. 166	-5. 596*	-12. 250***	-23. 792***
	(14. 740)	(7. 446)	(3. 058)	(4. 624)	(8. 069)
Indep	0. 151	3. 721	2. 314	2. 675	4. 162
	(29. 089)	(12. 165)	(3. 624)	(2. 833)	(4. 274)
ListAge	0. 223	-0. 843	-0. 081	0. 105	0. 100
	(1. 670)	(1. 164)	(0. 338)	(0. 294)	(0. 455)
_cons	-434. 958***	-216. 420**	-65. 120**	13. 214**	-17. 492**
	(161. 873)	(88. 011)	(26. 825)	(6. 117)	(8. 267)
Year FE					
Ind FE			control		
Year*Ind FE					
N	26249	26249	26249	26,249	26,249
R^2	0. 073	0. 094	0. 086	0. 456	0. 445

4.4. Heterogeneity analysis

In order to verify whether digital inclusive finance has effectively exerted its ' inclusiveness ', whether it has especially promoted the total factor productivity of smaller enterprises and the total factor productivity of enterprises in smaller cities, this paper divides and verifies the samples from the perspectives of enterprise scale and city scale.

4.4.1 Analysis of enterprise scale heterogeneity

In this paper, the sample enterprises are divided into four groups of samples of different sizes based on the quartile of the average total assets of enterprises in each year during the period of investigation, and regression is carried out respectively. Table 5 shows that the scale of enterprises gradually increases from column (1) to column (4). The results show that when the scale of enterprises increases, the coefficient of the digital inclusive financial index decreases and the significance decreases, which indicates that the digital inclusive finance has a better and more significant promotion effect on smaller enterprises. This result confirms the ' inclusiveness ' of digital inclusive finance. This is because larger companies themselves have a wide range of funding sources, and the emergence of digital inclusive finance has less impact on their financing channels, scale and costs. For small and medium-sized enterprises with fewer financing channels, digital inclusive finance can significantly reduce their financing threshold and cost. Through online financing services, SMEs can more easily obtain the required funds without spending a lot of time and money on tedious communication and application between traditional financial institutions. At the same time, digital inclusive financial platforms can usually provide more transparent and reasonable interest rates and reduce the financing costs of SMEs. Secondly, digital inclusive finance can provide more flexible financing methods. Especially for small and medium-sized enterprises, such as supply chain finance, accounts receivable financing and other channels to better meet their financing needs. In addition, digital inclusive finance can also improve the financing efficiency of SMEs. Through big data, cloud computing and other technical means, digital inclusive financial platform can more accurately assess the credit status and risk level of small and medium-sized enterprises, so as to speed up the speed of financing approval and lending, so that small and medium-sized enterprises can obtain the required financial support faster.

Table 5. Heterogeneity of enterprise scale

	(1)	(2)	(3)	(4)
Variable	0%~25%	25%~50%	50%~75%	75%~100%
Index	0. 240***	0. 233***	0. 207***	0. 146*
	(0. 056)	(0. 064)	(0. 065)	(0. 080)
Size	0. 253***	0. 403***	0. 442***	0. 374***
	(0. 038)	(0. 043)	(0. 049)	(0. 025)
Lev	0. 754***	0. 706***	0. 661***	0. 675***
	(0. 108)	(0. 090)	(0. 098)	(0. 139)
Roa	1. 923***	1. 811***	2. 021***	2. 957***
	(0. 173)	(0. 243)	(0. 244)	(0. 265)
Fixed	-0. 902***	-1. 274***	-1. 072***	-1. 067***
	(0. 179)	(0. 159)	(0. 173)	(0. 210)
Indep	0. 051	-0. 228	-0. 244	0. 154
	(0. 199)	(0. 206)	(0. 244)	(0. 168)
ListAge	-0. 055***	0. 019	0. 029	0. 043
	(0. 020)	(0. 022)	(0. 022)	(0. 027)
_cons	0. 205	-2. 853***	-3. 703***	-2. 234***
	(0. 779)	(0. 999)	(1. 112)	(0. 634)
Year FE				
Ind FE		control		
Year*Ind FE				
N	6,143	6,261	6,415	6,453
R^2	0. 323	0. 367	0. 420	0. 502

4.4.2 Analysis of urban scale heterogeneity

According to the " Notice on Adjusting the Standard of City Size Division " issued by the State Council in 2014, according to the city where the enterprise sample is located, it is divided into four groups: super-large and mega-cities, large cities, medium-sized cities and small cities, and grouped for heterogeneity test. The results of Table 6 show that digital inclusive finance only has a significant effect on the total factor productivity of enterprises in medium-sized cities. This result also verifies the ' inclusiveness ' of digital inclusive finance. This is because for super large, super large and large cities, the degree of marketization is high, the quality of enterprises is generally good, the financing channels are relatively rich, the financing scale is relatively large and the financing efficiency is relatively high, so the marginal impact of digital inclusive finance on the total factor productivity of such enterprises is not so significant. For medium-sized cities, traditional financial institutions may be difficult to cover all medium-sized cities due to the limitations of physical outlets, while digital inclusive finance breaks geographical restrictions through digital technologies such as the Internet and mobile devices, enabling enterprises to have more convenient access to financial services. Secondly, digital inclusive finance can reduce the threshold and cost of corporate financing in small and medium-sized cities. Through big data analysis, digital inclusive finance can more accurately assess the credit status and risk level of enterprises, so that more enterprises in medium-sized cities can obtain financing opportunities. Therefore, from the perspective of city size, the impact of digital inclusive finance on the total factor productivity of enterprises is heterogeneous, especially reflecting its ' inclusive ' characteristics.

Table 6. Heterogeneity of city size

	(1)	(2)	(3)	(4)
Variable	Super-large and mega-cities	Large cities	Medium-sized cities	Small cities
Index	0. 060	-0. 004	0. 189**	0. 167
	(0. 109)	(0. 222)	(0. 078)	(0. 109)
Size	0. 348***	0. 436***	0. 404***	0. 375***
	(0. 016)	(0. 028)	(0. 011)	(0. 023)
Lev	0. 757***	0. 535***	0. 793***	0. 528***
	(0. 131)	(0. 137)	(0. 089)	(0. 125)
Roa	1. 912***	1. 743***	2. 159***	2. 400***
	(0. 207)	(0. 522)	(0. 198)	(0. 278)
Fixed	-1. 344***	-1. 218***	-1. 212***	-0. 666***
	(0. 229)	(0. 274)	(0. 120)	(0. 218)
Indep	-0. 138	0. 770	0. 032	-0. 076
	(0. 225)	(0. 528)	(0. 178)	(0. 285)
ListAge	0. 041*	0. 032	-0. 024*	0. 024
	(0. 024)	(0. 040)	(0. 014)	(0. 025)
_cons	-1. 330***	-3. 368***	-2. 854***	-2. 193***
	(0. 283)	(0. 694)	(0. 299)	(0. 513)
Year FE				
Ind FE		control		
Year*Ind FE				
N	7526	1929	11484	2714
R^2	0. 606	0. 685	0. 645	0. 658

4.5. Further analysis

Some scholars have discussed the possible nonlinear characteristics of the impact of digital inclusive finance on the total factor productivity of enterprises, and found that there is a U-shaped relationship between the sub-dimension of digitization and total factor productivity (Duan&Gao Wenyu, 2022) [43]. In order to further explore whether there are non-linear characteristics in the

impact of digital inclusive finance on the total factor productivity of enterprises, this paper introduces the digital inclusive finance index and the quadratic terms of the coverage breadth and use depth of two sub-dimensions on the basis of the benchmark regression model, so as to further explore the characteristics of its impact effect.

It can be found from Table 7 that the regression coefficients of the digital inclusive financial index and its two sub-dimensions of coverage breadth and use depth are significantly greater than zero, and the coefficients of the second term are significantly negative, which indicates that their effects on the total factor productivity of enterprises are not a simple linear relationship, but an inverted U-shaped feature. This may be because in the early stage of the development of digital inclusive finance, with the rapid expansion of the coverage and depth of use of digital inclusive finance, the ' digital divide ' has been narrowed, and the problem of resource mismatch has been alleviated to some extent. Secondly, the rise of digital finance has produced a significant ' catfish effect ', which has increased the competitive pressure of traditional financial institutions such as banks, subverted the existing interest distribution structure of traditional financial industry, and weakened the monopoly position of traditional commercial banks. Therefore, enterprises no longer rely too much on traditional financial institutions to obtain credit support. This change further aggravates the cross-industry cooperation and competition situation of the financial industry, promotes the rational allocation of credit resources, and enables enterprises to carry out financing activities within a more fair and reasonable cost range (Ruan et al., 2020) [44]. Thirdly, the emergence of digital inclusive finance has promoted information sharing, reduced the degree of information asymmetry between enterprises and financial institutions, and eased financing constraints. The relief of corporate financing difficulties is conducive to technological innovation, thereby improving the total factor productivity of enterprises. However, with the rapid development of digital inclusive finance, there are some potential challenges and risks that inhibit the total factor productivity of enterprises, thus making it show an inverted U-shaped impact. First of all, some local fiscal weakness and imperfect digital infrastructure limit the role of digital inclusive finance, resulting in inadequate implementation of agricultural credit incentive policies for financial institutions, lagging social credit system, uneven distribution of bank outlets and non-cash settlement tools, and lack of data information, thus limiting the role of digital inclusive finance. Secondly, the development of digital inclusive finance will induce excessive financialization of non-financial enterprises (Li&Yang, 2021) [45], resulting in increasingly serious structural problems that do not match the development of the virtual economy and the real economy. It will hinder enterprise innovation (Wang et al. , 2017) [46], inhibit main business performance (Du et al. , 2017) [47], increase the risk of stock price crash (Peng et al., 2018) [48], and lead to a decline in total factor productivity of enterprises (Wang&Guo, 2022) [49]. Finally, digital inclusive finance can provide financing support for more enterprises, including those that are difficult to obtain loans in traditional financial institutions. Therefore, some zombie enterprises may obtain financing through digital inclusive financial platforms to maintain their survival, resulting in an innovation crowding-out effect on other enterprises (Tang et al. , 2020) [36], resulting in distortions in the allocation of labor resources (Qiao&Song, 2022) [50], inhibiting the investment scale of non-zombie enterprises (Tan et al. , 2017) [51], while financialization will also induce the formation of more non-state-owned zombie enterprises (Zhuo&Miao, 2020) [52], and ultimately reduce the total factor productivity of enterprises (Wang et al. , 2018) [53].

Table 7. Further analysis

Variable	(1) TFP_OP	(2) TFP_OP	(3) TFP_OP
$Index^2$	-0. 086***		
	(0. 020)		
Index	0. 590***		
	(0. 103)		
$Coverage^2$		-0. 062***	
		(0. 014)	
Coverage		0. 390***	
		(0. 069)	
$Usage^2$			-0. 095***
			(0. 020)
Usage			0. 654***
			(0. 104)
Size	0. 381***	0. 382***	0. 380***
	(0. 013)	(0. 013)	(0. 013)
Lev	0. 681***	0. 676***	0. 693***
	(0. 073)	(0. 073)	(0. 073)
Roa	1. 574***	1. 577***	1. 569***
	(0. 160)	(0. 160)	(0. 161)
Fixed	-1. 142***	-1. 150***	-1. 137***
	(0. 133)	(0. 132)	(0. 136)
Indep	-0. 077	-0. 078	-0. 057
	(0. 106)	(0. 106)	(0. 106)
ListAge	0. 010	0. 008	0. 012
	(0. 015)	(0. 015)	(0. 015)
_cons	-2. 732***	-2. 432***	-2. 806***
	(0. 319)	(0. 296)	(0. 332)
Year FE			
Ind FE		control	
Year*Ind FE			
N	25626	25626	25626
R^2	0. 580	0. 580	0. 582

5. Conclusion and suggestions

5.1. Conclusion

This paper clarifies the effect and mechanism of digital inclusive finance on the total factor productivity of enterprises, and uses the data of urban digital inclusive finance index and A-share listed companies from 2011 to 2020. The following main conclusions are drawn: (1) The development of digital inclusive finance, especially its coverage breadth dimension and use depth dimension, has significantly improved the total factor productivity of enterprises, but the influence of digitization degree dimension is not significant; (2) Digital inclusive finance promotes the development of total factor productivity of enterprises through substantive innovation of enterprises, that is, the number of invention patents is the mechanism and promotes the upgrading of human capital of enterprises. Small and medium-sized enterprises and medium-sized cities are most significantly affected by digital inclusive finance; (3) Digital inclusive finance has effectively exerted its ' inclusiveness ', and SMEs and medium-sized cities are most significantly affected by digital inclusive finance; (4) Further analysis shows that the impact of digital inclusive finance on the total factor productivity of

enterprises is not a linear relationship but an inverted U-shaped relationship. Specifically, the rapid expansion of digitalization in the early stage of development has narrowed the ' digital divide ' and improved the rationality of resource allocation, thus rapidly improving the total factor productivity of enterprises in a short period of time. Then the excessive development of digital inclusive finance may lead to excessive financialization of enterprises, hinder enterprise innovation, give birth to more zombie enterprises, and reduce the total factor productivity of enterprises.

5.2. Suggestions

This paper summarizes the existing research and the research conclusions drawn in this paper, and summarizes some empirical methods used to improve the productivity of enterprises. The specific policy recommendations are as follows: (1) The government should vigorously support the development of digital finance in small and medium-sized cities, mobilize resources, and add policy-oriented projects such as government policy subsidies and margin financing for small and medium-sized enterprises; secondly, enterprises should focus on the development of substantive innovation, give priority to the development of innovative projects with callable resources, and realize the improvement of total factor productivity of enterprises in the long run; (3) Enterprises should increase their efforts to introduce high-skilled human capital and cooperate with capital elements to improve efficiency; (4) The government should also pay attention to the development of digital inclusive finance at the micro level, and provide more accurate financial resource allocation; (5) The government should support relevant strong regulatory means and policies to curb the " barbaric growth " of digital finance and ensure the healthy development of digital inclusive finance to promote enterprise efficiency.

References

[1] Cai Fang. Understanding the past, present and future of China 's economic development - based on a coherent growth theoretical framework. Economic Research, 2013, 48(11): 4-16 + 55.

[2] Lu Yang. Trends and countermeasures of China 's demographic dividend. People 's Forum, 2021, (17): 70-73.

[3] Cai Fang. The logic of successful experiences in China 's reform. Chinese Social Sciences, 2018, (01): 29-44.

[4] Lu Xiaodong. Does financial resource misallocation hinder China 's economic growth. Financial Research, 2008, (04): 55-68.

[5] Tang Song, Wu Xuchuan, Zhu Jia. Digital finance and enterprise technology innovation-structural characteristics, mechanism identification and effect differences under financial supervision. Management World, 2020, 36(05): 52-66 + 9.

[6] Hui Xianbo. Digital inclusive financial development and urban total factor productivity - empirical evidence from 278 cities. Investment Research, 2021, 40(01): 4-15.

[7] Hou Jie, Li Beiwei. Does fintech improve total factor productivity-empirical evidence from Peking university digital inclusive finance index. Financial Science, 2020, (12): 1-12.

[8] He Maobin, Yang Xiaowei. Digital inclusive finance, carbon emissions and total factor productivity. Financial Forum, 2021, 26(02): 18-25.

[9] Liu Yan. The impact of digital inclusive finance on agricultural total factor productivity. Statistics and decision-making, 2021, 37(21): 123-126.

[10] Ren Jianhua, Lei Hongzhen. Digital inclusive finance, capital deepening and agricultural total factor productivity. Social Scientist, 2022, (06): 86-95.

[11] Zhao Jinchun. Can digital inclusive finance improve agricultural total factor productivity? - Empirical evidence based on cross-country panel data. Modern Economics Discussion, 2024, (03): 109-121.

[12] Tang Jianjun, Gong Jiaowei, Song Qinghua. Digital inclusive finance and agricultural total factor productivity - from the perspective of factor flow and technology diffusion. China 's Rural Economy, 2022, (07): 81-102.

[13] Rao ping, Wu Qing. The impact of digital inclusive finance on total factor productivity of enterprises. Statistics and decision-making, 2022, 38(16): 142-146.

[14] Jiang Hongli, Jiang Pengcheng. Can digital finance improve the total factor productivity of enterprises? - Empirical evidence from Chinese listed companies. Journal of Shanghai University of Finance and Economics, 2021, 23(03): 3-18.

[15] Chen Zhongfei, Jiang Kangqi. Digital finance development and enterprise total factor productivity. Economic dynamics, 2021, (10): 82-99.

[16] Lu Xiaofan, Dou Qianbin, Wang Renwen. Encouraging and forcing: Research on the impact of digital finance on total factor productivity of enterprises. Journal of Harbin University of Commerce (Social Science Edition), 2023, (02): 46-61.

[17] Zhang Xun, Wan Guanghua, Zhang Jiajia, etc. Digital economy, inclusive finance and inclusive growth. Economic Research, 2019, 54(08): 71-86.

[18] Laeven L, Levine R, Michalopoulos S. Financial innovation and endogenous growth. Journal of Financial Intermediation, 2015, 24(1): 1-24.

[19] Kaplan S N, Zingales L. Do investment-cash flow sensitivities provide useful measures of financing constraints?. The quarterly journal of economics, 1997, 112(1): 169-215.

[20] Koffi H W S. The fintech revolution: an opportunity for the west african financial sector. Open Journal of Applied Sciences, 2016, 6(11): 771-782.

[21] Hall B H. The financing of research and development. Oxford review of economic policy, 2002, 18(1): 35-51.

[22] Tang Weibing, Fu Yuanhai, Wang Zhanxiang. Technological innovation, technology introduction and transformation of economic growth mode. Economic Research, 2014, 49(07): 31-43.

[23] Cai Fang. How does China 's economic growth turn to total factor productivity-driven. China Social Sciences, 2013, (01): 56-71 + 206.

[24] Dutta N, Sobel R S. Entrepreneurship and human capital: The role of financial development. International Review of Economics & Finance, 2018, 57: 319-332.

[25] Zhang Yingying, Peng Shuoyi, Bai Dongbei. The impact of digital financial development on the upgrading of urban export structure. Statistics and decision-making, 2023, 39(16): 141-146.

[26] Yi Xingjian, Zhou Li. Does the development of digital inclusive finance significantly affect household consumption-micro evidence from Chinese households. Financial Research, 2018, (11): 47-67.

[27] Liu Guanchun. The transmission mechanism of financial structure affecting urban-rural income gap-a study based on the dual perspectives of economic growth and urbanization. Finance and trade economy, 2017, 38(06): 98-114.

[28] Griliches Z. Capital-skill complementarity. The review of Economics and Statistics, 1969: 465-468.

[29] Shen Guangjun, Ouyang Yiling, Li Lixing. Regional differences in skill structure: a financial development perspective. Financial Research, 2017, (07): 45-61.

[30] Zhuo Jiafeng, Zhou Liang. Do big cities pay higher wages?. Economics (Quarterly), 2015, 14(04): 1467-1496.

[31] Lucas Jr R E. On the mechanics of economic development. Journal of monetary economics, 1988, 22(1): 3-42.

[32] Huang Yanping, Liu Yu, Wu Yiqun, et al. Differences in regional economic growth in China: Based on the effect of graded education. Economic Research, 2013, 48(04): 94-105.

[33] Olley S, Pakes A. The dynamics of productivity in the telecommunications equipment industry. 1992.

[34] Levinsohn J, Petrin A. Estimating production functions using inputs to control for unobservables. The review of economic studies, 2003, 70(2): 317-341.

[35] Guo Feng, Wang Jingyi, Wang Fang, etc. Measuring the development of digital inclusive finance in China: index compilation and spatial characteristics. Economics (Quarterly), 2020, 19(04): 1401-1418.

[36] Tang Fujie, Chen Yue, Jiang Xuanyu. Do zombie firms have a crowding-out effect on corporate innovation? - Empirical evidence based on Chinese A-share companies. Journal of Central University of Finance and Economics, 2020, (03): 53-69.

[37] Liu Qiren, Zhao Can. Tax policy incentives and corporate human capital upgrading. Economic Research, 2020, 55(04): 70-85.

[38] Ye Yongwei, Li Xin, Liu Guanchun. Digital transformation and human capital upgrading. Financial research, 2022, (12): 74-92.

[39] Huang Qunhui, Yu Yongze, Zhang Songlin. Internet development and manufacturing productivity improvement: internal mechanism and Chinese experience. China 's industrial economy, 2019, (08): 5-23.

[40] Ting Jiang. The mediating effect and moderating effect in the empirical study of causal inference. China 's industrial economy, 2022, (05): 100-120.

[41] Li Wenjing, Zheng Manni. Substantive innovation or strategic innovation? The impact of macro industrial policies on micro-enterprise innovation. Economic Research, 2016, 51(04): 60-73.

[42] Li Ping. The path and influencing factors of improving total factor productivity-combing analysis from the perspective of growth accounting and frontier decomposition. Management World, 2016, (09): 1-11.

[43] Duan Junshan, Gao Wenyu. Research on the impact of digital financial development on total factor productivity of enterprises. Contemporary Finance and Economics, 2022, (05): 51-62.

[44] Ruan Jian, Shen Mei, Fan Zhongbao. How to drive corporate debt financing to reduce costs-utility identification, heterogeneity characteristics and mechanism test based on digital finance. Financial economics research, 2020, 35(01): 32-44.

[45] Li Zhijun, Yang Qiuping. Digital finance and enterprise financialization. Journal of Yunnan University of Finance and Economics, 2021, 37(12): 52-70.

[46] Wang Hongjian, Cao Yuqiang, Yang Qing, etc. Does the financialization of real enterprises promote or inhibit enterprise innovation- An empirical study based on Chinese manufacturing listed companies. Nankai Management Review, 2017, 20(01): 155-166.

[47] Du Yong, Zhang Huan, Chen Jianying. The impact of financialization on the future development of the main business of real enterprises: promoting or inhibiting. China 's industrial economy, 2017, (12): 113-131.

[48] Peng Yuchao, Ni Xiaoran, Shen Ji. Firm 's ' de-reality ' and financial market stability - from the perspective of stock price crash risk. Economic Research, 2018, 53(10): 50-66.

[49] Wang Hua, Guo Siyuan. Research on the impact of financialization of real enterprises on total factor productivity. Statistics and Information Forum, 2022, 37(01): 55-64.

[50] Qiao Xiaole, Song Lin. Zombie firms, labor resource misallocation and macro efficiency loss - From the perspective of inter-firm labor resource flow. Industrial economics research, 2022, (02): 71-84.

[51] Tan Yuyan, Tan Zhibo, Huang Yiping. The investment crowding-out effect of zombie firms: Evidence from Chinese industrial firms. Economic Research, 2017, 52(05): 175-188.

[52] Zhuo Yue, Miao Long. Does financialization induce the formation of new zombie enterprises?. Journal of Xiangtan University (Philosophy and Social Sciences Edition), 2020, 44(06): 67-73.

[53] Wang Yongqin, Li Wei, Dai Yun. How do zombie firms affect firm innovation? - Evidence from Chinese industrial enterprises. Economic Research, 2018, 53(11): 99-114.