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How digital finance affects the financial asset allocation of brick-and-mortar businesses

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ABSTRACT

The recent integration of digital technology and financial services has given rise to the newly emerging modality of digital finance. However, does digital finance improve the efficiency of financial services while influencing the investment behavior of brick-and-mortar businesses? With the help of the data about Chinese listed companies, this paper uses multiple regression analysis, instrumental variables, and other methods to empirically test whether and how digital finance affects the financial asset allocation decisions of brick-and-mortar enterprises. The findings suggest that digital finance has a galvanizing effect on financial asset allocation. However, this effect mainly stems from the fact that firms allocate more illiquid financial assets and has a dampening effect on liquid financial assets. Path analysis shows that easing financing constraints is a causal pathway through which digital finance dampens firms' liquid financial asset allocation. Moreover, rising risk exposure levels partially mediate the stimulus of digital finance, motivating firms to allocate illiquid financial assets. This paper contributes to the research on the economic consequences of digital finance and provides policy recommendations on how digital finance can better serve the real economy.

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1. Introduction

China's present and future economic efforts focus on preventing the 'accelerated and untimely' contraction of the manufacturing sector's share of the real GDP. According to the Outline of the 14th Five-Year Plan (2021–2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China, China should focus more on the real economy, accelerate industrial modernization, and consolidate and strengthen the real economy. However, according to the National Bureau of Statistics (2021), the share of China's manufacturing industry in the GDP peaked at

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32.45% in 2016, followed by a fluctuating decline to 26.18% in 2020. The year-over-year added value of the financial industry in 2020 was still as high as 7.0%, accounting for 8.6% of the GDP. The above data show that financial asset allocation activities are widespread among Chinese firms and the intensification of the financial shift from the real to the virtual economy. In this regard, preventing excessive financialization of non-financial firms and guiding the financial industry to return to serving the real economy has become the focus of China's current economic efforts and has also aroused widespread concern in academia.

According to the 2021 statistics of the Zhongguancun Internet Finance Institute, the penetration rate of China's digital finance (also known as 'digital financial inclusion') remained the world's leading position in 2020, reaching 87%, and the number of digital finance patent applications accounted for more than 40% of the global total. China has 63 digital finance unicorns, ranking second in the world. This shows that China's digital finance has developed rapidly by relying on information technologies, such as big data, artificial intelligence, and blockchain technology. Unlike traditional finance, dominated by state-owned banks, digital finance can fully integrate with the Internet and information technology to innovate financial services and make up for the shortcomings of traditional finance, with distinct characteristics of financial inclusion (Huang & Huang, 2018; Wang et al., 2021). Thus, the plight of firms being rejected by financial institutions due to the lack of collateral and low level of information disclosure in the traditional financial environment has been eased.

At the micro-business level, the advantages of digital finance over traditional finance are mainly reflected in its powerful data mining and processing capabilities, which significantly mitigate adverse selection and moral hazards arising from information asymmetry between financial institutions and borrowing firms. Hence, digital finance can effectively alleviate the financing constraints of firms (Huang et al., 2020), thus improving their innovation investment (Nie et al., 2021; Tang et al., 2020) and risk level (Ma & Du, 2021) and ultimately facilitating high-quality economic development (Teng & Ma, 2020). The influence of digital finance on micro-businesses is manifold. Can the development of digital finance influence firms' decisions to allocate financial assets and guide them back to the real economy? If yes, how? Insufficient attention has been paid to this problem in the existing literature. There are liquid and illiquid financial assets, and firms' motives to allocate financial assets can be divided into savings-driven and profit-driven (Yan & Chen, 2018). Under the influence of digital finance, will firms change their allocation strategies for different types of financial assets? Which becomes an important channel for testing the economic effects of digital finance.

Existing research has paid little attention to how the development of digital finance influences corporate financial asset allocation decisions and helps firms return to the real economy. In fact, there is a difference between liquid and non-liquid financial assets, and there is a distinction between 'pooling' and 'profit-seeking' motives for firms to allocate financial assets (Yan & Chen, 2018). Will businesses change their asset allocation strategies for different types of financial assets in response to the impact of digital finance? Not only will the answer to this question enrich research findings on the economic effect of digital finance, but it will also provide a vital way

to examine the relationship between changes in the financial environment and the allocation of financial assets of firms. To accurately portray the influence of digital finance on firms' financial asset allocation, this paper divides financial assets into liquid and illiquid financial assets according to liquidity. Moreover, it takes the listed companies of Shanghai and Shenzhen A Shares from 2010 to 2020 as the study samples to address the aforementioned question.

Compared to previous research, the theoretical contributions of this paper are reflected in the following two aspects: First, this paper enriches the research related to the microeconomic effects of digital finance. Although existing research has examined the effects of digital finance on corporate investment from the perspectives of investment level and investment efficiency (Lin et al., 2022; Yang et al., 2022), it has not yet focused on the relationship between digital finance and corporate investment in financial assets. This paper also enriches the research on the economic consequences of digital finance by exploring the impact of digital finance on corporate financial asset allocation in light of the fact that brick-and-mortar businesses have swept into the financial industry while the share of the manufacturing industry has declined rapidly. Second, this paper enriches research on the factors that influence the financial asset allocation of firms. There is rare literature discussing the relationship between the financial environment and the financialization of firms, this paper explores the impact of the development of digital finance on firms' allocation of financial assets, extending previous research that has focused on internal factors like executive background (Ge et al., 2021) and diversified operation (Feng et al., 2022). This paper investigates the impact of the development of digital finance on firms' allocation of financial assets and extends the related research by considering the financial environment as a potential influence factor of firms' financial asset allocation.

The findings of this paper have policy implications for how we enhance the ability of digital finance to serve the real economy and galvanize the return of firms to the real economy. For example, this paper finds that digital finance can significantly dampen liquid financial asset allocation by alleviating firms' financing constraints. This indicates that alleviating the financing difficulties and high financing costs of firms, especially small- and medium-sized enterprises (SMEs), can effectively restrain borrowing firms' funds flow to the financial market, preventing the excessive financialization of brick-and-mortar businesses.

The subsequent organization of this paper is as follows: Part I is a literature review, Part II is a theoretical analysis and hypothesis formulation, Part III describes the model design and sample selection, Part IV analyzes empirical results, Part V is a mechanism test, Part VI conclusion and implications of the article.

2. Literature review

2.1. Microeconomic consequences of digital finance

Stephen (1978) coined the term 'economic consequences,' which mainly refers to the impact of changes in the internal and external environments or factors on the decision-making behavior of firms and their stakeholders. For micro-businesses, the existing literature posits that digital finance mainly exerts resource and governance effects,

which have been further explored in some studies. In terms of resource effects, most of the literature asserts that digital finance can absorb funds lying idle in society and increase financial resources (Laeven et al., 2015; Wang et al., 2021; Yue et al., 2022). Moreover, digital finance can alleviate the information asymmetry between firms and financial institutions through technologies, such as cloud computing and blockchain technology, thus broadening the sources of corporate financing and reducing corporate financing costs (Amir et al., 2022; Demertzis et al., 2018; Gomber et al., 2017; Lu, 2018). Especially for private firms and SMEs (Huang et al., 2020), the role of digital finance in improving the financing environment is more obvious. In terms of governance effects, digital finance has ex-ante and ex-post oversight functions. With the help of big data, cloud computing and other information technologies, digital finance can quickly and cheaply obtain the 'digital footprint' left by borrowers on the Internet before lending occurs and apply that information to lending decisions, thereby greatly reducing the information asymmetry between firms and financial institutions (Duarte et al., 2012; Hawaldar et al., 2019). In an effort not to be excluded from digital financial services, firms will check risks ex-ante, which helps guide firms to focus more on their own operational and financial risks (Hussain & Avraam, 2022; Norden et al., 2014; Xie et al., 2018). Once loans are made, financial institutions are motivated to use big data and other technological tools under the digital finance format to track information such as the use of funds loaned by firms and operational risks, thus effectively improving productivity and risk control (Li et al., 2020; Tang et al., 2020). In addition, firms will boost the level of information disclosure with powerful data mining and processing capabilities of digital finance (Wu et al., 2020), which is conducive to alleviating information asymmetry between management and shareholders, thereby curbing the opportunistic behavior of management (Demertzis et al., 2018). Finally, some literature has also extended the research based on digital finance's resource and governance effects. For example, Ma and Du (2021) found that digital finance can significantly improve firms' risk level, and Tang et al. (2020) specified that digital finance has a galvanizing effect on corporate innovation investment, and so on.

2.2. Influencing factors of firms' financial asset allocation

The factors influencing non-financial firms' financial asset allocation have chiefly been explored in literature in three aspects: institutional environments, markets, and micro-businesses. From the aspect of institutional environments, firms will enhance financial asset allocation to hedge against risks arising from economic policy uncertainties (Feng, 2001; Yan & Cespedes, 2013); firms supported by industrial policies have significantly reduced their financial asset allocation activities based on arbitrage motives (Nie et al., 2020); macroprudential policies dampen firms' financial asset allocation by restricting bank credit (Ma and Chen, 2020); and environmental regulations have a reinforcement effect on firms' financial asset allocation (Cai et al., 2021). From the aspect of markets, macroeconomic cycles and stock market indices are significantly negatively correlated with firms' financial asset allocation, suggesting that the main purpose of firms' financial asset allocation is 'savings-driven' rather

than 'profit-driven' (Almeida & Campello, 2004). In addition, interest rate control and money supply can influence firms' financial asset allocation activities (Peng et al., 2018; Han and Li, 2021). From the aspect of micro-businesses, research on the factors influencing firms' financial asset allocation is more abundant. For example, Yan and Chen (2018) pointed out that firms with poor corporate governance, overconfident executives, and diversified operations are more inclined to allocate financial assets. Meanwhile, Meng and Hou (2020) found that firms' social responsibility performance has a 'financialization effect,' which will galvanize financial asset allocation. Furthermore, institutional investors' shareholding ratio, CEO's financial background, and shareholding structure are important factors influencing firms' decisions to allocate financial assets (Du et al., 2019; Ye & Li, 2021).

Although the existing literature has investigated the economic consequences of digital finance and financial asset allocation from multiple aspects, few have paid attention to the correlation between changes in the financial environment and financial asset allocation. Moreover, no studies have elaborated yet on the influence of digital finance on the allocation activities of different types of financial assets and their causal pathways. The aforementioned issues provide the basis for which this paper will conduct its discussion, where it will further elaborate on the micro influence of digital finance on brick-and-mortar businesses from the perspective of financial asset allocation, to make a useful supplement to the existing literature base.

3. Theoretical analysis and hypothesis formulation

Based on the division of liquidity, financial assets can be divided into liquid and illiquid financial assets. Non-financial firms' liquid financial asset allocation is mostly out of the savings-driven motive, whereas their illiquid financial asset allocation is mainly out of the 'profit' motive (Duchin et al., 2017). The purpose and economic consequences of non-financial firms' allocation of different financial assets are significantly different. Under the new form of digital finance, the financing environment and information acquisition capabilities of firms have been significantly improved. Will it influence firms' financial asset allocation activities based on liquidity risk prevention and profit motives?

3.1. Digital finance and liquid financial asset allocation

Liquid financial assets refer to financial assets that can easily be converted into cash, such as transactional financial assets. When facing losses or financing constraints, firms can quickly liquidate these assets to alleviate the pressure on cash demand (Demir, 2009; Hu et al., 2017). Therefore, firms subject to stronger financing constraints are more motivated to allocate liquid financial assets. Existing studies have shown that digital finance development can significantly alleviate firms' financing constraints. First, digital finance can broaden the source of external financing and increase effective supply. Many small- and medium-sized investors in the financial market have small and scattered capital holdings. In the traditional financial environment, such investors lack investment channels and find it difficult to enter the

financial market. However, with the help of information technology, digital finance allows them to easily access and obtain investment channels, thus increasing the supply of financial resources and broadening the source of external financing. Second, digital finance can greatly alleviate the information asymmetry between financial institutions and borrowers. Information asymmetry is one of the main reasons for firms' financing constraints (Kaplan & Zingales, 1997). In the era of traditional bank-dominated finance, hard information was the main medium for firm financing, such as real estate mortgages. However, due to poor business records and lack of high-value collateral, many SMEs were excluded from traditional financial services, forming a 'tail risk group.'

Meanwhile, digital finance effectively addresses information asymmetry by mining soft information, such as the 'Internet traces' of firms and their management, to provide loans to firms with growth potential. For example, Lin and Siva (2013) found that borrowers with more online friends are more likely to obtain loans, and lenders fully use soft information such as online friendships in their lending decisions. China's e-banks (e.g., MYBank and XWBank) have also openly claimed that they use information from borrowers on the Internet in their lending decisions. Liquid financial assets have high liquidity but limited profitability. When a firm's financing constraint is alleviated, it can quickly raise funds when facing a demand for funds. Therefore, for savings-driven purposes, its motivation to allocate liquid financial assets will be greatly weakened, and it will be more motivated to allocate funds to projects with high returns. Therefore, based on the aforementioned analysis, the following hypothesis is proposed.

H1: Digital finance development dampens brick-and-mortar businesses' liquid financial asset allocation.

3.2. Digital finance and illiquid financial asset allocation

Unlike liquid financial assets, for illiquid financial assets, high returns are accompanied by high risks. On the one hand, the value of financial assets is influenced by market and policy factors to a large extent. For example, changes in interest and exchange rates and fiscal policy adjustments can cause fluctuations in the value of financial assets. On the other hand, the value of illiquid financial assets is also micro-influenced by the investees. For example, the realizable value of the held-to-maturity securities purchased by firms largely depends on the investees' moral hazard and business performance. The high-risk characteristics of illiquid financial assets place high demands on firms' risk levels. At the micro-level, resources and information acquisition capabilities are important influencing factors for firms' risk level (Almeida and Murillo, 2007; John and Litov, 2008). Firms' activities under risk require substantial resource support (Bargeron et al., 2010; He et al., 2019). As aforementioned, digital finance development can alleviate firms' financing constraints and improve firms' resource acquisition capabilities, ultimately weakening management's risk aversion tendencies. In addition, as activities under risk have high uncertainty, firms are less willing to make venture investments due to information asymmetry (Ma & Du, 2021). Digital finance has inherent advantages in acquiring and analyzing information. With the support of big data, artificial intelligence, and blockchain technology,

digital finance can acquire and process information at a very low cost. For example, it uses text mining technology to transform unstructured information into a structured format, thus providing an information basis for management's decision-making under risk and helping them take advantage of investment opportunities. Although digital finance helps management obtain market information, it also exposes management's information to shareholders and other stakeholders, which helps mitigate management's adverse selection and moral hazard caused by information asymmetry. Moreover, it compresses the space for opportunistic behavior, thus increasing the management's risk appetite and reducing the conservatism in investment decision-making. Against the backdrop of overcapacity, rising costs, and declining profits, brick-and-mortar businesses have sufficient motivation to transfer funds to the financial sector to obtain high returns, and the increased risk level of firms under digital finance will undoubtedly prompt them to allocate illiquid financial assets. Therefore, based on the above analysis, the following hypothesis is proposed.

H2: Digital finance development galvanizes brick-and-mortar businesses' illiquid financial asset allocation.

4. Research design

4.1. Sample selection and data sources

In 2011, the Institute of Digital Finance of Peking University and Ant Group started to compile and publish the Index of Digital Financial Inclusion (IDFI), which has been updated to the 2020 edition. Therefore, this paper selected A-share listed companies from 2011 to 2020 as the research sample. To ensure the quality of empirical results, we screened the samples in the following order: first, eliminating the listed companies in the financial insurance and real estate categories; second, eliminating the ST/PT samples; and third, eliminating the samples with missing variables. Finally, 19,538 observations of unbalanced panel data were obtained. To mitigate the impact of extreme values on the empirical results, this study winsorized all continuous variables at the upper and lower 1%. The digital finance data were obtained from the IDFI (2021) published by the Institute of Digital Finance of Peking University, and the financial and corporate governance data were obtained from the China Stock Market & Accounting Research Database.

4.2. Model construction and variable definitions

To test H1 and H2, this study constructed the following model:

$$Fin_{i,t} = \alpha_0 + \alpha_1 Dig_{i,t} + \alpha_i Controls_{i,t} + \sum Id + \sum Year + \varepsilon_{i,t} \quad (1)$$

In Equation (1), Dig is the exogenous variable, which indicates the digital financial index of the listed company's location. In this paper, it is measured by the overall digital financial index (*Dig_index*) in the IDFI. The larger the index, the greater the influence of digital finance on the listed company. In addition, the IDFI contains two sets of provincial- and municipal-level data. We use provincial data for the principle component regression and municipal data for the robustness test.

Fin is the explained variable, which indicates the degree of firms' financial asset allocation. In reference to Du et al. (2019), Fin is measured by the share of financial assets to the total assets of listed companies in this paper. This paper measures Fin at three levels: the degree of liquid financial asset allocation (Fin1, the ratio of liquid financial assets to total assets), the degree of illiquid financial asset allocation (Fin2, the ratio of illiquid financial assets to total assets), and the total degree of financial asset allocation (Fin3, the ratio of all financial assets to total assets). Specifically, liquid financial assets include transactional assets, entrusted loans, wealth management products, and trust products. Illiquid financial assets include available-for-sale securities, derivatives, held-to-maturity investments, long-term equity investments in financial firms, and real estate investments.

Meanwhile, corporate finance and corporate governance are important factors influencing firms' decisions to allocate financial assets. By referencing Meng and Hou (2020) and Yu (2021), this study selected the following control variables: degree of financial asset allocation in the previous period (*Fin_lg*, financial assets at the beginning of the period/total assets at the beginning of the period), company size (*Size*), asset-liability), leverage ratio (*Lev*), return on assets (*Roa*), development capacity (*Growth*), capital intensity (*Capint*), percentage of shares held by the largest shareholder (*Big*1), percentage of shares held by executives (*Mshare*), book-to-market ratio (*Mb*), and nature of ownership (*Soe*). In addition, this study controls for year-fixed effects (*Year*) and individual firm-fixed effects (*Id*). Table 1 defines the specific variables.

5. Empirical results and analysis

5.1. Descriptive statistics

The descriptive statistics of the main variables are presented in Table 2. Taking the Dig_index as an example of digital finance, this study obtains the following: its mean, minimum, and maximum values are 5.435, 3.479, and 6.068, respectively. This indicates that digital finance varies greatly among different provinces, which also provides conditions for this paper to examine the influence of digital finance on firms' decisions to allocate financial assets. For the ratio of firms' financial asset allocation to total assets (Fin3), the mean, minimum, and maximum values are 0.049, 0.000, and 0.549, respectively, indicating that large differences exist in the sample companies' decisions to allocate financial assets. Moreover, the mean values of Fin1 and Fin2 are 0.014 and 0.035, respectively, which indicates that non-financial listed companies in China prefer illiquid financial assets when allocating financial assets. This also indicates that the main purpose of brick-and-mortar businesses in the financial market is profit-driven. In addition, the values of control variables are generally consistent with the existing literature, which indicates that the data in this paper are well distributed.

5.2. Results of baseline regression

Table 3 presents the regression results of the influence of digital finance on firms' financial asset allocation. It shows that digital finance significantly increases firms' financial asset allocation in general; after differentiating financial assets by liquidity,

Table 1. Definition of variables.

Type	Name	Definition
Endogenous variables	Fin1	Ratio of liquid financial assets at the end of the period to total assets at the end of the period
	Fin2	Ratio of illiquid financial assets at the end of the period to total assets at the end of the period
	Fin3	Ratio of financial assets at the end of the period to total assets at the end of the period
Exogenous variables	Dig_index	Digital financial index, obtained from the Index of Digital Financial Inclusion (IDFI) (2021) published by the Institute of Digital Finance of Peking University
Control variables	Fin_lg	Degree of financial assets allocation in the previous period; financial assets at the beginning of the period divided by total assets at the beginning of the period
	Size	Company size; natural logarithm of total assets at the end of the period
	Lev	Leverage ratio; total liabilities at the end of the period divided by total assets
	Roa	Return on assets; net income after tax at the end of the period divided by total assets at the end of the period
	Growth	Growth, annual growth rate of operating income
	Capint	Capital intensity, net fixed assets at the end of the period divided by total assets at the end of the period
	Big1	Percentage of shares held by the largest shareholder; number of shares held by the largest shareholder divided by total number of shares
	Mshare	Percentage of shares held by executives; number of shares held by executives divided by total number of shares
	Mb	Book-to-market ratio; the ratio of book value at the end of the period to market value
	Soe	Nature of ownership, state-owned firms score a 1, otherwise it is a 0

Source: Author's Source.

we obtain the results indicating that digital finance significantly dampens firms' liquid financial asset allocation and significantly galvanizes illiquid financial asset allocation. These regression results are not affected by the inclusion of control variables. The baseline regression results show that under the effect of digital finance, the savings-driven motive of firms to allocate financial assets decreases and the profit-driven motive increases significantly, which preliminarily verifies H1 and H2.

In addition, under the influence of digital finance, firms will allocate less liquid financial assets, indicating that the resource effects of digital finance can, to a certain extent, replace the savings-driven function of liquid financial assets. Digital finance can prompt firms to allocate more illiquid financial assets, indicating that digital finance development enhances the profit-driven motive of firms through financial asset allocation. Then, how does digital finance influence firms' decisions to allocate financial assets? Under what circumstances do firms use the positive economic effects of digital finance to develop their core business better rather than investing in the financial market? These questions will be answered in the following section.

5.3. Robustness tests

5.3.1. Treatment of endogeneity problems

This paper uses instrumental variables (2SLS) regression and controls for omitted variables to control endogeneity problems caused by reciprocal causation and omitted variables. Drawing on the study of Zhang et al. (2019), this paper uses the spherical distance

Table 2. Results of descriptive statistics.

variables	N	Mean	Sd	Min	Med	Max
Fin1	19538	0.014	0.016	0.000	0.002	0.374
Fin2	19538	0.035	0.066	0.000	0.012	0.549
Fin3	19538	0.049	0.079	0.000	0.012	0.549
Dig_index	19538	5.435	0.543	3.479	5.590	6.068
Dig_bread	19538	5.341	0.587	2.916	5.497	5.984
Dig_depth	19538	5.465	0.508	3.640	5.582	6.192
Dig_degree	19538	5.589	0.684	2.754	5.800	6.117
Size	19538	22.096	1.258	19.822	21.923	26.002
Lev	19538	0.412	0.205	0.050	0.402	0.914
Roa	19538	0.041	0.068	−0.271	0.040	0.217
Growth	19538	0.309	0.740	−0.721	0.131	5.087
Capint	19538	0.214	0.156	0.003	0.182	0.697
Big1	19538	0.344	0.147	0.088	0.323	0.742
Mshare	19538	0.154	0.208	0.000	0.016	0.693
Mb	19538	0.947	0.977	0.086	0.632	5.800
Soe	19538	0.313	0.464	0.000	0.000	1.000

Notes: This table presents summary statistics for the variables. We tabulate the number of observations (N), the sample average (mean), the standard deviation (sd), the minimum (min), the median (median), and the maximum (max). All continuous variables are winsorized at the 1% and 99% levels. See Table 1 for all variable definitions.
Source: Author's Source.

Table 3. Regression results of digital finance and firms' financial asset allocation.

	(1)	(2)	(3)	(4)	(5)	(6)
variables	Fin1	Fin2	Fin3	Fin1	Fin2	Fin3
Dig_index	−0.001**	0.033***	0.032***	−0.002**	0.010***	0.007**
	(−2.488)	(7.026)	(11.274)	(−2.111)	(3.687)	(2.482)
Fin_lg				0.845***	0.024***	0.877***
				(64.390)	(4.258)	(43.149)
Size				−0.001	0.001***	−0.000
				(−1.548)	(2.837)	(−0.945)
Lev				−0.026***	−0.004***	−0.007**
				(−10.148)	(−3.282)	(−2.417)
Roa				0.003	−0.001	−0.030**
				(0.391)	(−0.373)	(−2.548)
Growth				−0.002***	−0.000***	−0.002***
				(−3.158)	(−2.600)	(−2.978)
Capint				−0.025***	−0.004***	−0.015***
				(−10.979)	(−3.580)	(−5.558)
Big1				0.003	0.001	−0.006**
				(1.004)	(0.525)	(−2.044)
Mshare				0.000	−0.003***	−0.002
				(0.070)	(−3.291)	(−0.940)
Mb				0.001*	−0.000	0.000
				(1.806)	(−1.075)	(0.675)
Soe				0.000	−0.001***	0.001
				(0.011)	(−3.390)	(0.568)
Constant	−0.115***	−0.000	−0.141***	0.003	0.003	−0.024
	(−10.221)	(−0.103)	(−7.323)	(0.229)	(0.490)	(−1.607)
Year&Id	Control	Control	Control	Control	Control	Control
N	19538	19538	19538	19538	19538	19538
R2	0.128	0.106	0.111	0.618	0.723	0.619

Notes: Columns (1)–(3) report the univariate regression results of digital finance and corporate financial asset allocation. Columns (4)–(6) report the multiple regression results of digital finance and corporate financial asset allocation. See Table 1 for the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. The t-statistics are calculated based on robust standard errors clustered by the firm and are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Author's Source.

Table 4. Treatment of endogeneity problems.

	First stage	Second stage	Second stage	Second stage
	(1)	(2)	(3)	(4)
variables	Dig_index	Fin1	Fin2	Fin3
Distance	−0.107***			
	(−66.370)			
Dig_index		−0.001***	0.024***	0.029***
		(−3.507)	(3.620)	(4.354)
Fin_lg	0.051***	0.029***	0.877***	0.843***
	(5.197)	(4.669)	(43.095)	(60.884)
Size	0.011***	0.001***	−0.002***	−0.002***
	(12.481)	(3.675)	(−2.893)	(−3.069)
Lev	−0.040***	−0.005***	−0.003	−0.021***
	(−8.283)	(−4.967)	(−1.193)	(−8.120)
Roa	−0.055***	−0.002	−0.020*	0.004
	(−4.576)	(−0.465)	(−1.844)	(0.540)
Growth	0.002**	−0.000***	−0.002***	−0.002***
	(2.092)	(−2.639)	(−3.213)	(−3.421)
Capint	−0.078***	−0.005***	−0.012***	−0.022***
	(−14.359)	(−5.935)	(−4.788)	(−8.899)
Big1	0.034***	−0.002*	−0.003	0.004
	(6.289)	(−1.802)	(−1.061)	(1.482)
Mshare	0.041***	−0.004***	−0.004	−0.002
	(9.975)	(−3.493)	(−1.448)	(−0.745)
Mb	−0.009***	0.000	0.001	0.001**
	(−7.050)	(0.360)	(0.937)	(2.363)
Soe	−0.007***	−0.002***	0.003***	0.002**
	(−3.334)	(−4.807)	(2.604)	(2.292)
Constant	4.569***	−0.016*	−0.058***	−0.090***
	(216.929)	(−1.847)	(−2.690)	(−3.235)
Year&Id	Control	Control	Control	Control
N	19538	19538	19538	19538
R2	0.920	0.629	0709	0.600

Notes: Column (1) reports the first-stage regression results for instrumental variables. Columns (2)–(4) report the second-stage regression results for instrumental variables. Columns (5)–(7) report the regression results after including the control variables. See Table 1 for the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. The t-statistics are calculated based on robust standard errors clustered by firms and are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Author's Source.

(Distance) from the registered place of listed companies to Hangzhou as instrumental variables. On the one hand, because China's digital finance originated in Hangzhou and the digital finance data used in this paper is sourced from the Ant Group, the closer the distance from the location of the listed company to Hangzhou, the higher the level of its digital finance development should be. On the other hand, no direct correlation exists between the spherical distance from the location of the listed company to Hangzhou and firms' decisions to allocate financial assets. Therefore, Distance satisfies the relevance principle and exogeneity principle of instrumental variables. The results of regressing the instrumental variables (2SLS) are shown in columns (1) to (4) of Table 4. As shown in Table 4, in the first stage, the Wald F-statistic is 441.655, which is much larger than the empirical value of 10, indicating no weak instrument problem for Distance. Moreover, Distance is significantly negative, indicating that the farther the distance from the location of the listed company to Hangzhou, the lower the level of its digital finance development. Thus, the regression results are consistent with expectations. In the second stage, the sign and significance of digital finance coefficients are not significantly different from

Table 5. Regression results of changing the method to measure key variables.

variables	(1) Fin1	(2) Fin2	(3) Fin3
Dig_index	−0.002**	0.009***	0.009***
	(−2.033)	(3.318)	(3.378)
Fin_lg	0.024***	0.878***	0.845***
	(4.266)	(43.269)	(64.434)
Size	0.001***	−0.000	−0.001
	(2.808)	(−0.852)	(−1.533)
Lev	−0.004***	−0.008**	−0.026***
	(−3.291)	(−2.557)	(−10.182)
Roa	−0.001	−0.030**	0.003
	(−0.394)	(−2.527)	(0.394)
Growth	−0.000**	−0.002***	−0.002***
	(−2.480)	(−3.017)	(−3.193)
Capint	−0.004***	−0.015***	−0.025***
	(−3.634)	(−5.403)	(−10.773)
Big1	0.000	−0.006**	0.002
	(0.484)	(−1.998)	(0.975)
Mshare	−0.003***	−0.002	−0.000
	(−3.265)	(−0.956)	(−0.067)
Mb	−0.000	0.000	0.001*
	(−1.040)	(0.614)	(1.832)
Soe	−0.001***	0.001	−0.000
	(−3.348)	(0.462)	(−0.039)
Constant	0.002	−0.021	−0.010
	(0.313)	(−1.441)	(−0.643)
Year&Id	Control	Control	Control
N	19538	19538	19538
R2	0.617	0.723	0.619

Notes: Columns (1)–(3) report the regression results with municipal-level digital financial index as the explained variable. See Table 1 for the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. The t-statistics are calculated based on robust standard errors clustered by the firm and are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Author's Source.

the basic regression results. The above regression results indicate that the main findings of this paper remain unchanged after controlling for endogeneity problems.

5.3.2. Changing the key variable metric

To mitigate the impact of the measurement bias of key variables on the empirical results, this paper measures the level of digital finance development in the location of the listed company with the municipal-level data from the IDFI (2021) published by Peking University. Table 5 presents the regression results. It shows that the coincidence and significance of the correlation coefficients do not change significantly after changing the method to measure exogenous variables, which again indicates the robustness of this paper's main findings.

6. Mechanism test

In the theoretical analysis and hypothesis formulation, this study considers that financing constraints and firms' risk level are the paths through which digital finance development influences firms' liquid and illiquid financial asset allocation, respectively. To empirically test the rationality of the two paths, this study constructs the following mechanism test model by referring to the mediation test method proposed by Baron and Kenny (1986):

Table 6. Test results of the causal pathways of financing constraints.

variables	(1) Fin1	(2) SA	(3) Fin1	(4) Fin1	(5) KZ	(6) Fin1
KZ						0.011**
						(2.332)
SA			0.011*			
			(1.851)			
Dig_index	−0.002**	−0.036**	−0.001**	−0.002**	−0.040***	−0.001**
	(−2.235)	(−2.379)	(−2.213)	(−2.206)	(−2.655)	(−2.200)
Fin_lg	0.010***	−0.375***	0.010***	0.008***	−0.385***	0.008***
	(4.563)	(−11.915)	(4.545)	(4.588)	(−11.715)	(4.528)
Size	0.000***	0.008***	0.000***	0.000***	0.005*	0.000***
	(4.491)	(3.193)	(4.548)	(3.954)	(1.907)	(3.962)
Lev	−0.002***	−0.147***	−0.002***	−0.001***	−0.145***	−0.001***
	(−3.763)	(−11.825)	(−3.741)	(−3.123)	(−11.612)	(−3.105)
Roa	0.001	−0.152***	0.001	0.001	−0.143***	0.001
	(0.831)	(−5.064)	(0.739)	(1.171)	(−4.767)	(1.144)
Growth	−0.000**	0.008***	−0.000**	−0.000**	0.008***	−0.000**
	(−2.383)	(3.643)	(−2.325)	(−2.483)	(3.895)	(−2.485)
Capint	−0.002***	0.022*	−0.002***	−0.002***	0.005	−0.002***
	(−5.064)	(1.701)	(−5.053)	(−4.490)	(0.415)	(−4.493)
Big1	−0.000	0.277***	0.000	0.000	0.273***	0.000
	(−0.000)	(21.440)	(0.348)	(0.083)	(20.820)	(0.124)
Mshare	−0.002***	0.207***	−0.001***	−0.001***	0.188***	−0.001***
	(−3.535)	(21.282)	(−3.369)	(−2.685)	(19.368)	(−2.637)
Mb	0.000	0.042***	0.000	0.000	0.046***	0.000
	(1.248)	(11.232)	(1.422)	(1.426)	(12.009)	(1.438)
Soe	−0.001***	−0.045***	−0.001***	−0.001***	−0.036***	−0.001***
	(−3.604)	(−10.109)	(−3.635)	(−2.885)	(−8.014)	(−2.892)
Constant	−0.001	−4.167***	−0.004	−0.005	−4.116***	−0.005
	(−0.356)	(−42.662)	(−1.108)	(−1.602)	(−41.616)	(−1.636)
Year&Id	Control	Control	Control	Control	Control	Control
N	18433	18433	18433	17595	17595	17595
R2	0.618	0.193	0.619	0.615	0.191	0.615

Notes: Columns (1)–(3) report the results of the indirect effect test when the SA index measures financing constraints. Columns (4)–(6) report the results of the indirect effect test when the KZ index measures financing constraints. See Table 1 for the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. The t-statistics are calculated based on robust standard errors clustered by the firm and are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Author's Source.

$$FC/Risk_{i,t} = \delta_0 + \delta_1 Dig_{i,t} + \delta_i Controls_{i,t} + \sum Id + \sum Year + \varepsilon_{i,t} \quad (2)$$

$$Fin_{i,t} = \eta_0 + \eta_1 Dig_{i,t} + \eta_2 FC/Risk_{i,t} + \eta_i Controls_{i,t} + \sum Id + \sum Year + \varepsilon_{i,t} \quad (3)$$

where FC denotes the degree of financing constraints. To obtain more robust results, we measured FC using the KZ index proposed by Kaplan and Zingales (1997) and the SA index proposed by Hadlock and Pierce (2010). The larger the SA index and KZ index, the greater the financing constraint on the firm. Risk indicates firms' risk level. Referring to Yu et al. (2013), we measured risk using firm's earnings volatility. We first calculate the (ROA) ratio of firm's earnings before interest and tax to total assets, taking three years as an observation period, and then, we subtract the average value of ROA of the industry in which the firm is in that year. Finally, we calculate the standard deviation of ROA to measure risk. Larger risk value denotes a higher risk level of the firm.

Table 7. Path coefficients of risk level.

variables	(1) Fin2	(2) Risk	(3) Fin2
Risk			0.910*
			(1.865)
Dig_index	0.019***	0.010**	0.016***
	(5.191)	(2.332)	(5.174)
Fin_lg	0.298***	−0.033***	0.298***
	(13.591)	(−3.579)	(13.602)
Size	−0.001	0.001	−0.001
	(−1.566)	(1.397)	(−1.592)
Lev	0.002	−0.008	0.002
	(0.804)	(−1.559)	(0.830)
Roa	0.008	0.504***	0.003
	(1.483)	(24.455)	(0.539)
Growth	−0.001	0.002**	−0.001
	(−1.589)	(2.441)	(−1.643)
Capint	−0.009***	0.011***	−0.009***
	(−4.982)	(2.832)	(−5.041)
Big1	−0.012***	0.008**	−0.012***
	(−5.225)	(2.281)	(−5.253)
Mshare	−0.007***	0.012***	−0.007***
	(−3.988)	(3.379)	(−4.047)
Mb	0.000	0.014***	0.000
	(0.398)	(18.376)	(0.053)
Soe	0.001	0.009***	0.001
	(1.481)	(7.595)	(1.386)
Constant	−0.038**	−0.153***	−0.036**
	(−2.331)	(−6.757)	(−2.258)
Year&Id	Control	Control	Control
N	16205	16205	16205
R2	0.323	0.290	0.323

Notes: Columns (1)–(3) report the results of the indirect effect test for the level of risk-taking. See Table 1 for the variable definitions. All continuous variables are winsorized at the 1% and 99% levels. The t-statistics are calculated based on robust standard errors clustered by firm and are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Source: Author's Source.

6.1. Digital finance, financing constraints, and liquid financial asset allocation

The test results of the causal pathways of financing constraints are reported in Table 6. Taking the KZ index as an example, this study shows that the coefficient of Dig_index is significantly negative in column (2), indicating that digital finance development can significantly alleviate the financing constraints firms face, which is consistent with the results of Huang et al. (2020). When the financing constraint variable is added to the model (1), the coefficients of both SA and Dig_index are significant, and the absolute value of the coefficient of Dig_index is smaller than that in column (1), indicating that financing constraints play a partially mediating role in digital finance dampening of firms' liquid financial asset allocation. When using KZ to measure firms' financing constraints, the relevant regression results are largely consistent with those under the SA index. These regression results indicate that digital finance can effectively improve the financing environment for firms and thus mitigate their need to enhance liquid financial asset allocation to prevent liquidity pressure, which indicates that digital finance can replace the savings-driven function of liquid financial assets to a certain extent.

6.2. Digital finance, risk level, and illiquid financial asset allocation

Table 7 reports the path coefficients of the risk level. As shown in column (2), the coefficient of Dig_index is significantly positive, which indicates that digital finance development significantly enhances firms' risk level; Ma and Du (2021) have found similar results. As shown in column (3), after risk level was added to model (1), the coefficients of both Risk and Dig_index are significant, and the absolute value of the coefficient of Dig_index decreases compared to that in column (1). The regression results indicate that the risk level has passed the mediation test. The pursuit of profits is the first duty of firms. Under the background of economic transformation and development and declining profits of the real economy, firms are motivated to seek high profits through the financial market. High profits come with high risks, which discourages many firms. Nevertheless, with its efficient data mining capability and resource effects, digital finance significantly enhances firms' risk levels and further motivates firms to invest more in the financial market.

7. Conclusions and implications

Under the background of the recent booming development of digital finance, this paper takes the listed companies of Shanghai and Shenzhen A Shares from 2011 to 2020 as the study samples. Moreover, it refers to the existing literature on the micro-economic consequences of digital finance and the influential factors of firms' financial asset allocation, to empirically examine the correlation between digital finance development and firms' allocation of different types of financial assets. The study found that digital finance generally has a galvanizing effect on firms' financial asset allocation. Specifically, after distinguishing financial assets by liquidity, we found that digital finance significantly dampens firms' liquid financial asset allocation, and the alleviation of financing constraints plays a partially mediating role. Digital finance significantly galvanizes firms' illiquid financial asset allocation, and one of the causal pathways is the increase in firms' risk levels.

Based on the aforementioned findings, the policy implications of this paper are as follows. First, we should view the micro effects of digital finance dialectically. On the one hand, digital finance is inclusive and can alleviate firms' financing constraints, thus dampening their liquid financial asset allocation. On the other hand, digital finance development can enhance firms' risk level and galvanize them to allocate more illiquid financial assets, showing a certain tendency of 'shifting from real economy to virtual economy.' Therefore, enterprises should fully understand the development trend of digital finance, strengthen and improve the related supporting mechanisms, and fully use the inclusive-finance function of digital finance to effectively alleviate the financial pressure and financing constraints enterprises face. However, while enjoying the benefits of digital finance, enterprises must also recognize the risks behind digital finance and make reasonable use of it for financing activities to achieve their business goals. In addition, to improve the serving capabilities of digital finance for brick-and-mortar enterprises and guide enterprises to return to the physical economy, the regulatory authorities should strengthen the supervision of the capital flow of lending enterprises, so that they can prevent the GDP proportion of

the physical economy, especially the manufacturing industry, decline too early and too quickly. Second, we should view firms' behavior of liquid financial asset allocation from a dialectical standpoint. This paper found that digital finance development has the effect of alleviating firms' financial risks, and firms' liquid financial asset allocation can amplify such effect, which indicates that firms' liquid financial asset allocation has a certain function of preventing financial risks. Thus, it is conducive to the healthy and stable development of firms. Revealing that, in the process of preventing finance 'shifting from the real economy to virtual economy,' regulators should correctly view the savings-driven function of liquid financial assets and bring out the positive effects.

The shortcomings of this paper are as follows. First, there are still some problems in measuring corporate financial assets in this paper. The measurement of corporate financial assets in existing research is not standardized. Scholars still have not yet agreed upon the definition and connotation of corporate financial assets. As a result, the measurement of corporate financial assets is not accurate enough, which may affect future related research. Second, this paper only proves the mechanism of financing constraints and risk-taking levels in the impact of digital finance on corporate financial asset allocation. Further research and analysis are needed for other possible mechanisms. Third, the research on the internal management factors of corporate financial asset allocation decisions is insufficient in this paper. For example, issues like whether the characteristics of managers, internal control, and other factors will affect the role of digital finance in corporate financial asset allocation decisions need to be further studied in the future.

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