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Impact of Digital Finance Inclusion on High-Quality Economic Development: Empirical Evidence from Urban China

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Abstract. In the context of the global digital economy system,digital inclusion financial (DFI) has played an important role in promoting China 's economy from fast-paced growth to high-quality development by improving financial accessibility and inclusiveness through scientific and technological means.Based on the panel data of 282 prefecture-level cities from 2011 to 2023,this paper constructs two models of fixed effect and mediating effect,and empirically examines how DFI affects the high-standard development of urban economy (HQED) and the mechanism and heterogeneity behind it.The study found that there is a strong positive correlation between DFI and urban HQED,and the coverage breadth and depth of use contribute equally to urban HQED.Mechanism analysis shows that DFI drives quality-oriented development by promoting technological innovation,optimizing industrial structure and stimulating entrepreneurial vitality.Further heterogeneity analysis shows that this promoting effect is amplified in cities with higher per capita GDP and urbanization rate,showing a regional pattern of the strongest in the central region,followed by the western region and the relatively weak in the eastern region.Based on this,this paper proposes to deepen the DFI system,enhance technology empowerment,and implement targeted policies to better support HQED.

Keywords: digital inclusive finance, high-quality economic development, panel data, China

1. Introduction

In the wave of global digital economy, digital inclusive finance and quality-oriented development constitute the twin engines of China 's economic modernization. DFI breaks financial service barriers through technology empowerment, while high-standarddevelopment represents a paradigm shift from quantity to quality. Understanding the relationship between them is crucial for cultivating new development paradigms and achieving common prosperity.

Whether DFI can promote quality-oriented development, if so, through what mechanism to promote quality-oriented development,remains to be tested. In addition, the heterogeneous impact of DFI in different spatial and economic backgrounds deserves further study. Despite the significant penetration of the Internet in daily life and the increasing integration of DFI in the national economy, there are still few rigorous empirical studies to assess its impact on HQED. The limited

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body of relevant literature primarily consists of theoretical discussions on implementation pathways, as well as analyses of DFI's role in upgrading industrial structures [1], its influence on household consumption levels [2], its spatial spillover contributions on total factor productivity [3], and subtopics concerning its contributions on industrial and regional high-standard development. In this context, it is of great theoretical and practical significance to systematically investigate the mechanism and path of DFI shaping HQED.

Based on this research gap, this study aims to explain the path of DFI cultivating HQED from three novel perspectives: promoting technological innovation, upgrading industrial structure and stimulating entrepreneurial vitality. Through further dimension analysis and heterogeneity analysis, this study puts forward targeted policy recommendations, which provides theoretical support for the healthy development of digital finance and the realization of HQED. This article is carried out in the following way. The second section introduces the theoretical path between DFI and HQED, and puts forward four research hypotheses on this basis. The third part describes the research design,including variable selection, model setting and data sources. The fourth part reports the empirical results, including benchmark regression, robustness test, endogenous analysis, mechanism test and heterogeneity analysis. The fifth part summarizes the research and puts forward policy recommendations based on the research conclusions.

2. Theoretical mechanisms

Quality-oriented development, a paradigm rooted in China's contemporary context, signifies a growth pattern characterized by higher quality, greater efficiency, enhanced equity, and sustainable development. DFI, underpinned by cutting-edge technological paradigms including internet infrastructure, big data analytics, artificial intelligence algorithms, and blockchain protocols, extends the reach of traditional finance, providing accessible and low-cost services to underserved populations [4]. While this inclusivity is evident across regions, its intensity varies, with significant implications for regional HQED. Beyond facilitating capital flows, DFI promotes the fluid movement of production resources: labor, technology, and information, between urban and rural regions through its convenience and accessibility [5]. Digital platforms enable self-employed individuals and small enterprises to secure credit for technological innovation and upgrades, fostering local technological progress that reduces pollution and energy consumption while empowering industrial transformation [6]. This injects enduring momentum into urban HQED. Accordingly, we propose hypothesis

H_1: DFI positively promotes urban HQED.

By serving as both an incremental supplement and an optimizer of the traditional financial system, DFI corrects issues of mismatched attributes, sectors,and stages, thereby alleviating corporate financing constraints and fostering technological innovation [7]. Digital credit and supply chain finance provide flexible capital for technology-oriented firms, supporting R&D and technological iteration. The proliferation of digital payments and platform finance lowers transaction costs, accelerating knowledge spillovers and industry-academia-research integration. Data-driven credit assessment and risk pricing enhance innovation risk management, incentivizing long-term R&D. In turn, technological innovation is widely recognized as a fundamental driver of HQED, facilitating green total factor productivity growth, industrial upgrading, and reduced capital misallocation [8]. Accordingly, by enabling these innovation-driven outcomes, DFI indirectly but powerfully contributes to quality-oriented development. From this reasoning, we derive Hypothesis

H_2: DFI promotes urban HQED by advancing technological innovation.

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The diffusion of DFI enhances financial institutions' capacity to integrate social resources and guide capital flows. While facilitating resource movement across economic sectors, it also optimizes resource allocation efficiency, reshaping capital transformation and allocation patterns to achieve industrial structure upgrading that maximizes returns [9]. Such upgrading optimizes the distribution of production factors-capital and labor-across industries, improving overall productivity. Furthermore, this transformation drives technological change and explores pathways to sustainable development. By fostering deep inter-sectoral interaction and integrated growth, the upgrading of industrial structure acts as a critical channel for empowering HQED, as it promotes innovation, reflects coordination, and prioritizes green development. Hence, we propose Hypothesis

H_3: DFI facilitates HQED through the optimization of industrial structure.

Different from the long-term cultivation of human capital accumulation, entrepreneurial vitality - measured by the density of newly established private enterprises - is an indicator based on flow and responds quickly to DFI. By alleviating financing constraints and reducing market entry barriers, DFI has significantly stimulated this vitality. Through digital credit, mobile payment and e-business platform, DFI provides entrepreneurs with accessible financial services, reduces transaction costs and expands market scope, thus realizing the direct micro-level transformation of financial resources to new market players [10]. These new ventures in turn promote the rapid redistribution of resources from inefficient sectors to emerging activities, fueling creative destruction at the city level. The improvement of entrepreneurial activity not only promotes employment and market participation, but also accelerates technology diffusion and industrial iteration, which injects continuous impetus into urban HQED. Consequently, we put forward the Hypothesis

H_4: DFI exerts a positive influence on urban HQED through the stimulation of entrepreneurial dynamism.

3. Research design

3.1. Variable selection

3.1.1. Dependent variables

HQED reflects the New Development Philosophy and strives to better satisfy the people's continuously growing demands for a better life. Within this framework, innovation is regarded as the principal engine, coordination as an inherent attribute, green development as a prevalent model, openness as the inevitable path, and sharing as the fundamental goal. It follows that the core of HQED lies in the principles of innovation, coordination, green development, openness, and sharing. These principles permeate the processes of economic operation, the transformation of economic drivers, the adjustment of economic structures, and the evolution of economic forms, with their interplay at different levels generating significant momentum [11]. Drawing on this, and in light of the accessibility of urban-level data, this paper, by referencing existing index systems, constructs an evaluation index system for China's urban HQED. This system comprises five primary indicators: Innovative Development, Coordinated Development, Green Development, Open Development, and Shared Development, which are further divided into 12 secondary indicators and 21 tertiary indicators. To systematically quantify the urban HQED index in China, this study employs the entropy weight method for comprehensive evaluation. The data employed for the construction of this indicator system are sourced from historical issues of the China City Statistical Yearbook and CNRDS.

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3.1.2. Explanatory variables

The main regressor of interest is the development level of DFI. This study employs the County-level DFI, jointly released by the Institute of Digital Finance at Peking University and Ant Group, as its proxy. This index ensures a comprehensive, timely, and reliable measurement of DFI development [12]. In further analyses, the main explanatory variable is substituted with its two sub-dimensions: coverage breadth (DCB) and usage depth (DUD).

3.1.3. Control variables

In addition to DFI, HQED may be influenced by other socioeconomic factors. To isolate the pure contribution of DFI, the following control variables are incorporated: (1) Economic development level (GDP), measured by per capita gross regional product (GRP), calculated as the ratio of GRP to the total year-end population; (2) Regional fiscal self-sufficiency (FSS), measured by the ratio of regional general budgetary expenditures to general budgetary revenues; (3) Regional financial resource efficiency (FRE), measured by the ratio of deposits to loans in regional financial institutions; (4) Regional openness, proxied by the actual utilized amount of foreign direct investment (FDI) and the gross industrial output value of foreign-invested enterprises (FGO).

3.2. Model specification

This study develops a fixed effects regression model as shown below, aiming to test the significance of DFI's effect on the level of HQED while controlling for unobserved individual heterogeneity and time-invariant factors that may bias the estimates:

$$Qua_{i,t} = \beta_0 + \beta_1 DFI_{i,t} + \theta X_{i,t} + \mu_t + \gamma_i + \varepsilon_{i,t} \quad (1)$$

where $Qua_{i,t}$ represents the level of HQED for city i in year t ; γ_i denotes the individual fixed effects; μ_t represents the time fixed effects; $\varepsilon_{i,t}$ is the stochastic disturbance term; $DFI_{i,t}$ indicates the level of DFI development for city i in year t ; and $X_{i,t}$ is a vector of control variables, primarily including GDP, FSS, FRE, FDI, and FGO.

3.3. Data sources

Data on urban DFI levels are obtained from the Digital Financial Inclusion Index, jointly compiled by Ant Group and Peking University. Data on gross regional product, total regional population, local general budgetary expenditures, local general budgetary revenues, deposits of financial institutions, loans of financial institutions, actual utilized foreign capital, gross output value of foreign-invested enterprises, regional industrial output value, industrial SO_2 releases, industrial smoke dust discharges, industrial effluent volumes, the regional resident count and broadband subscribers per 100 inhabitants are sourced from the China City Statistical Yearbook and the statistical bureaus of prefecture-level cities, with missing values reasonably supplemented using interpolation methods. This paper constructs a panel dataset covering 282 prefecture-level cities from 2011 to 2023 through multiple channels, focusing on the impact of DFI on urban HQED.

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Table 1. Descriptive statistical results of variables

Variable	count	mean	sd	min	max
QUA	3653	0.0859	0.0527	0.0451	0.3811
DFI	3434	0.1220	0.0575	0.0642	0.3933
DCB	3650	199.0089	85.8956	1.8600	408.2614
DUD	3650	191.7755	71.9230	12.4900	354.3049
PAP	3653	1.0211	2.4879	0.0000	32.0813
PGR	3653	0.7996	1.9832	0.0000	27.9533
IND	3640	0.4437	0.1014	0.1015	0.8934
IUP	3640	2.3298	0.1602	1.8312	4.1502
ENT	3640	134.3913	128.7254	17.5559	5079.5476
GDP	3640	0.0006	0.0004	0.0001	0.0026
FSS	3640	2.8797	1.7009	0.6488	14.2442
FRE	3640	1.5254	0.5427	0.1250	16.7327
FDI	3640	0.0009	0.0021	-0.0032	0.0243
FGO	3640	0.0560	0.1655	-0.0725	1.7982

4. Empirical results and analysis

4.1. Baseline regression

The regression results of the effect of DFI on HQED are shown in Table 2. Column (1) reports the results of using OLS estimation, while Column (2) reports the results of a two-way fixed effect model that includes individual and time fixed effects. On the basis of the two-way fixed effect model,column (3) shows the regression results after inclusion of control variables.

Overall, the estimated coefficients in columns (1) to (3) remain relatively stable, with values of 0.0002, 0.0005 and 0.0002, respectively, and are statistically significant at the 1 % level. In this study, the regression results in Column (3) are used as the baseline specification for the analysis, and the estimated coefficient of DFI on HQED is 0.0002. This finding shows that DFI can effectively promote urban HQED by reducing the threshold of financial services through technological empowerment, thus promoting the transformation of economic development model from focusing on " quantity " to focusing on " quality."

Table 2. Baseline regression results

	(1) QUA	(2) QUA	(3) QUA
DFI	0.0002***	0.0005***	0.0002***
	(0.0000)	(0.0001)	(0.0000)
GDP			21.9319***
			(4.0418)
FSS			-0.0000
			(0.0002)

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Table 2. (continued)

FRE			0.0001
			(0.0007)
FDI			6.7458***
			(1.0692)
FGO			0.0907**
			(0.0414)
Constant	0.0399***	-0.0124	0.0163*
	(0.0023)	(0.0142)	(0.0091)
Controls	NO	NO	YES
City FE	NO	YES	YES
Year FE	NO	YES	YES
Observations	3650	3650	3650
adj.R^2	0.114	0.961	0.981

Standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

Same notes for Tables 3-5.

4.2. Robustness tests

4.2.1. Cluster-robust standard errors test

This study uses robust standard errors clustered by year to re-run the benchmark regression, thereby reducing concerns about sequence dependence and time-varying variance. The results are shown in Table 3 column (3). Compared with the benchmark setting in Column (3) of Table 2, the coefficient of DFI is still significantly positive. Specifically, the estimated coefficient of ln_DFI is 0.0002, which is significant at the level of 1 %, which is consistent with the benchmark finding that digital inclusive finance promotes urban HQED. The size and significance of other control variables also show strong consistency with the benchmark results. The year clustering adjustment further relaxes the assumption that the error term is independent across time, and the results confirm that the conclusion is not driven by time correlation or missing time-level variables. In general, the positive impact of DFI is robust to the annual clustering standard error.

As an additional robustness check, Column (1) of Table 3 replaces the dependent variable with an alternative measure, and the coefficient of DFI remains significantly positive (0.0006, p<0.01). Column (2) incorporates province-year interaction fixed effects, yielding a DFI coefficient of 0.0001 (p<0.01), which consistently supports the baseline finding.

4.2.2. Sub-dimensional analysis

The aggregate growth index of China's DFI only reflects the overall development trend under the comprehensive influence of sub-dimensions, but fails to capture the diversified development trend across different dimensions. The research on the development of DFI should not only pay attention to its overall level, but also pay attention to the evolution of its sub-dimensions. Only by

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differentiated analysis of these sub-dimensions can we better understand its economic and social impact and potential, so as to provide strong support and effective guidance for leveraging DFI to promote HQED.

The sub-dimensions of DFI are included in turn as explanatory variables. The regression results in Table 3 show that the coefficients of coverage breadth (DCB) and depth of use (DUD) are both 0.0001 and significant at the 1 % level. The breadth of coverage is account penetration, and the depth of use is payment, monetary fund and credit services; both of them positively affect urban HQED, and contribute more to higher penetration or more advanced use.

In summary, both coverage breadth and depth of use have a positive effect on urban HQED, and their contributions to improving HQED level are relatively comparable.

4.3. Endogeneity test

In order to reduce the possible endogenous bias associated with DFI, this study uses IV two-stage least squares (2SLS) estimation method, using Internet penetration as a tool variable. This is represented by the logarithm of the number of Internet broadband users per 100 people based on the resident population (ln_IBU). There are two bases for the selection of the instrument. First of all, Internet penetration is the basic infrastructure of digital finance. Studies have shown that there is a significant positive correlation between Internet development and DFI [13]. Second, Internet penetration is mainly determined by external telecommunications policies rather than local economic performance. As a general technology, it affects the economy through multiple channels, making it less likely to affect quality-oriented development through DFI alone [14].

The results of endogenous test are shown in Table 3. The first-stage regression confirmed that ln _ IBU was significantly correlated with DFI. The second stage regression shows that the DFI coefficient is 0.0108, which is significant at the level of 1 %, indicating that after controlling endogeneity, the significant positive consequences of DFI on HQED persist over time.

Table 3. Robustness tests

	(1) Replace the Explained Variable	(2) Province-Year Interaction	(3) Year Clustering	(4) Coverage Breadth	(5) Usage Depth	(6) First Stage Regression	(7) Second Stage Regression
ln_QUA						0.0002***	
						(0.000)	
ln_DFI	0.0006***	0.0001***	0.0002***				0.0108***
	(0.0001)	(0.0000)	(0.0000)				(0.002)
DCB				0.0001***			
				(0.0000)			
DUD					0.0001***		
					(0.0001)		
Controls	YES	YES	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	3434	3650	3650	3650	3650	3650	2789
adj.R-sq	0.934	0.728	0.981	0.981	0.981		

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4.4. Mechanism testing

Building on the above analysis, Digital Financial Inclusion (DFI) advances urban HQED through three pathways: technological innovation, industrial structure improvement, and entrepreneurial activity stimulation. This study measures technological innovation by patent applications/grants [15] and industrial structure by the tertiary industry share in regional GDP; industrial upgrading, measured as weighted value-added shares across primary, secondary, and tertiary sectors (primary industry share × 1 + secondary industry share × 2 + tertiary industry share × 3) [16]; and the ratio of the number of registered enterprises to the permanent resident population to measure the level of entrepreneurial activity [17].

Following the approach of Jiang [18] and based on a two-way fixed effects model, this study constructs a mediation effect model for empirical testing. The econometric model is specified as follows:

$$M_{i,t} = \beta_0 + \beta_1 DFI_{i,t} + \theta X_{i,t} + \mu_t + \gamma_i + \varepsilon_{i,t} \tag{2}$$

Where Mi, t represents the mediating variable for city i in year t; The number of patent applications and grants, the industrial structure level, the industrial upgrading index, and the entrepreneurial activity level are sequentially substituted into Mi, t. Regression was conducted with DFI development level as the core independent variable to examine how DFI affects these mediating variables.

The DFI estimation coefficients of patent application and authorization are 0.0316 and 0.0197, respectively, as shown in Table 4 (1) and (2); both were statistically significant at the 1 % level. This shows that DFI has significantly promoted the development of technological innovation. According to Column (3) and Column (4), the estimated coefficients of DFI on the level of industrial structure and the overall industrial upgrading index are 0.0005 and 0.0014, respectively. The former is significant at the 5 % level, and the latter is significant at the 1 % level. This shows that DFI has significantly improved the industrial structure, and its positive effect on the overall industrial upgrading is greater than the impact on the level of industrial structure. As shown in Column (5), the coefficient of DFI on entrepreneurial activity is estimated to be 1.1534, which is significant at the 5 % level. This shows that DFI also significantly promotes entrepreneurial activity.

In summary, while promoting the development of urban technological innovation, DFI has stimulated entrepreneurial vitality, improved industrial structure, and is conducive to industrial upgrading. Through these channels, HQED is positively promoted, thus confirming the hypothesis H_2-H_4.

Table 4. Mechanism analysis

	(1) Patent Applications (10k)	(2) Patent Grants (10k)	(3) Industrial Structure Level	(4) Overall Industrial Upgrading	(5) Entrepreneurial Activity
DFI	0.0316***	0.0197***	0.0005**	0.0014***	1.1534**
	(0.0073)	(0.0060)	(0.0002)	(0.0003)	(0.4549)
Controls	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES

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Table 4. (continued)

Year FE	YES	YES	YES	YES	YES
Observations	3650	3650	3640	3640	3640
adj.R-sq	0.839	0.783	0.877	0.753	0.319

4.5. Heterogeneity analysis

The relationship between digital economy and regional economic development is characterized by tightness and complexity, which is increasingly significant in the context of accelerating globalization and rapid advances in information technology. Due to the continuous imbalance of regional economic development in China, the contribution of DFI may also be significantly different in cities with different levels of economic development.

4.5.1. Urban economic development level

In order to examine the background differences in the level of economic development, cities are divided into high per capita GDP and low per capita GDP groups. The regression shows that the DFI coefficient of the high GDP group is 0.0003, and the DFI coefficient of the low GDP group is 0.0001, which is significant at the statistical level of 1 %. The interaction between high GDP dummy variable and DFI is positive and significant, which confirms that the promotion effect is stronger in more developed cities. This is because regions with higher per capita GDP have superior digital infrastructure, higher financial literacy, and an industrial structure that is compatible with the DFI financing mechanism.

4.5.2. Urbanization levels across regions

The urban samples are divided into two subsets: high urbanization rate and low urbanization rate. The DFI coefficient of the high urbanization group is 0.0002, and the DFI coefficient of the low urbanization group is 0.0001, both of which are significant at the level of 1 %, and the interaction term with the high urbanization dummy variable is positive and significant, indicating that the impact of DFI is magnified in cities with higher urbanization levels. This pattern is particularly evident in large economic corridors; for example, the Yangtze River Economic Belt has played its spatial advantages, but it also faces the constraints of weak factor support capabilities [19]. More urbanized areas benefit from demand-side advantages such as population agglomeration and higher acceptance of digital finance, as well as supply-side advantages such as complete digital infrastructure, developed financial system and superior regulatory environment.

4.5.3. Regions

The DFI coefficients of the eastern, central and western regions were 0.3185, 0.3555 and 0.3420, respectively, which were all significant at the 1% level. The promotion effect is most obvious in the central region, followed by the western region, and the eastern region is relatively the least significant. This change is attributed to diminishing marginal returns and gap-filling contributions: the eastern region already has a well-developed traditional financial system and a high DFI penetration rate, while the central and western regions start from a lower baseline, and DFIs can directly provide financial services to underserved populations, resulting in a strong gap-filling

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contribution [20]. Furthermore, the positive influence of DFI is more conspicuous in underdeveloped regions through channels like entrepreneurial endeavors.

Table 5. Heterogeneity analysis

	(1) Full Sample	(2) Eastern	(3) Central	(4) Western	(5) Higher Per Capita GDP	(6) Lower Per Capita GDP	(7) High Urbanization Rate	(8) Low Urbanization Rate
DFI	0.3347***	0.3185***	0.3555***	0.3420***	0.0003***	0.0001***	0.0002***	0.0001***
	(0.0236)	(0.0405)	(0.0130)	(0.0126)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3333	1223	1181	929	1824	1826	1765	1764

5. Conclusions and policy recommendations

Using panel data from 282 Chinese cities over 2011-2023 and two-way fixed effects and mediation models, this study finds that DFI significantly drives HQED via technological innovation, industrial structure optimization, and entrepreneurial activity, with coverage breadth and usage depth having similar marginal contributions. This promoting effect is stronger in cities with higher per capita GDP and urbanization rate. In terms of regions, this effect shows a clear pattern: the central region is the strongest, the western region is the second, and the eastern region is relatively moderate. Subsequent policy recommendations are derived from these findings. First, strengthen the DFI system by balancing breadth and depth. Through mobile platforms and physical points, the service network is extended to underserved areas to ensure universal access. Financial institutions are urged to use big data and artificial intelligence to design tailored credit products for SMEs and entrepreneurs. Second, promote digitization and promote industrial transformation and entrepreneurship. Develop a regulatory framework, use regulatory technology to strengthen supervision, strengthen the credit system through public data sharing, and improve consumer protection through financial literacy programs, while ensuring digital inclusion. Third, use the differentiated role of DFI to implement targeted policies. For high-income cities, we should guide the development of digital finance to high value-added industrial chain, technology frontier and green field. For less developed regions, increase investment in digital infrastructure, develop products suitable for local industries, and enable capital and technology flows to strengthen regional coordination.

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