Has digital financial inclusion improved the quality of China's green economy?

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Abstract:

This paper constructs China's green economy development quality rating index system from two dimensions: green economy development efficiency and green economy development level, measures China's provincial green economy development quality index from 2011 to 2020 using the coupled coordination degree method and empirically demonstrates the impact of digital inclusive finance on green economy development quality using a panel fixed effects model. The findings suggest that digital inclusive finance hinders the quality of green economy development in China, and the conclusions still hold after using instrumental variables to deal with endogeneity; moreover, digital inclusive finance promotes the level of green economy development while hindering green economy efficiency. Regional and structural heterogeneity in the quality of digital inclusive finance for green economy development and its variables across dimensions exist.

Keywords: digital inclusive finance; green economy; development quality; enhancement

1 Introduction

"As China's economy enters a new stage of development in the 14th Five-Year Plan period, improving the quality of green economic growth has become the key to implementing the new development concept and promoting high-quality growth in the new era[1]. As a typical model of deepening global financial practices, digital inclusive finance reveals an essential direction for the future development of fintech[2]. The digital era is accompanied by the shift of China's economy to the stage of high-quality development. The impact of digital inclusive finance, as a new economic form that integrates digital technology and financial inclusion, on the quality of China's green economic development should not be underestimated. Therefore, this paper explores whether digital inclusive finance enhances the quality of green economy development in China from the multidimensional target attributes of green economy development. What are the heterogeneous characteristics of the effects?

Existing studies have found that the development of inclusive finance can promote economic growth, arguing that financial inclusion is a feature of financial product and a process of increasing the quantity, quality, and efficiency of financial intermediation services[3]-[4]. Financial inclusion reduces the likelihood of involuntary financial exclusion of economic individuals. However,, financial inclusion positively affects GDP per capita growth in the sample countries only if it is supported by policies with good rule of law, corruption control, and political stability[5]-[6].

Digital Inclusive Finance integrates digital technology and inclusive finance across borders, revealing the future direction of inclusive finance. As a solution to expand financial inclusion, digital finance can provide digital financial products and services to involuntarily financially excluded people with the help of digital media such as cell phones and help most Indonesian SMEs obtain financing support such as operation and investment[7]. Ahmad M (2021) et al. selected the digital inclusive finance index compiled by Peking University from 2011-2018 to construct provincial panel data and examined the impact of digital inclusive finance and human capital on China's economic growth using a panel fixed effects regression model, which found that digital inclusive finance and human capital have a positive effect on China's economic growth and that all three aspects of digital financial coverage breadth, usage depth and digitalization of inclusive finance have a positive impact on economic growth[8].

There have been studies on inclusive finance and digital inclusive finance and their economic growth effects. Still, there are few studies on the impact of digital inclusive finance on the quality of green economy development. This paper focuses on the impact of digital inclusive finance on the quality of green economy development based on the previous research results.

2 Theoretical analysis and research hypothesis

The quality of green economic development is a quality-benefit economic category integrating the concept of sustainable development, which is the critical path to

realizing the high-quality development of China's green economy. Considering that the process of interaction and game between green economy development level and efficiency is the organic unity of the coordinated development of green economy in terms of quantity and quality, which can genuinely and objectively reflect the quality of green economy development. Therefore, this paper will argue the impact of digital inclusive finance on green economy development from two dimensions: green economy efficiency and green economy development level.

On the one hand, the development of digital inclusive finance will induce consumers to use electronic communication devices excessively, generating a large amount of electronic waste and wasting resources; moreover, the promotion and popularization of digital inclusive finance requires a large amount of physical infrastructure and strong support from cloud technology, which will inevitably require the consumption of a large amount of energy reserves. If the energy used is not environmentally friendly and clean enough, it will damage the environment. In addition, the credit support of digital inclusive finance will also induce short-sighted investors to use funds for highly polluting industries, which will aggravate environmental pollution. For this reason, this paper argues that the development of digital inclusive finance negatively affects green economic efficiency.

On the other hand, digital inclusive finance can alleviate the credit constraints of SMEs, support the development of green economic development, effectively help SMEs to efficiently manage capital disposal and business operations, and help promote the development of green industries and environmental enterprises at the same time, the development of digital inclusive finance provides preferential credit interest rate support for ecological enterprises in the region, which strongly supports environmental enterprises to better achieve economic efficiency and environmental protection The development of digital inclusive finance also provides preferential credit rates for ecological protection enterprises in the region, which strongly supports environmental protection enterprises to better achieve economic efficiency and environmental protection. In addition, the development of digital inclusive finance can also save the operational and risk costs of financial institutions in the region, and the digital convenience provides more accurate credit risk assessment, reduces the waste of paper media, and actively promotes the development of green economy. For this reason, this paper argues that the development of digital inclusive finance improves the development of the green economy.

In summary, on the one hand, digital financial inclusion negatively affects the green economy; on the other hand, digital financial inclusion positively affects the level of green economy development. Given that the quality of green economy development encompasses both the efficiency and the level of green economy development, one of the two cannot be neglected. Therefore, the impact of digital inclusive finance on the quality of green economy development must be verified empirically.

Based on the theoretical analysis, the research hypotheses 1-3 of this paper are proposed:

Hypothesis 1: There is a negative effect of digital inclusive finance on the efficiency of the green economy.

Hypothesis 2: There is a positive effect of digital inclusive finance on the level of green economic development

Hypothesis 3 (a): There is a positive effect of digital inclusive finance on the development quality of green economy development.

Hypothesis 3(b): There is a negative effect of digital inclusive finance on the quality of green economic development development.

3 Research design

3.1 Model Setting

Based on the previous theoretical analysis, to verify the impact of digital inclusive finance on the quality of China's green economy development, the benchmark regression model (1) is set in this paper:

$$ln(\mathrm{QGE}_{it}) = \alpha_0 + \alpha_1 ln(DIF_{it}) + \sum_{j=1}^{k} \lambda_j X_t + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where ln(QGE) denotes the logarithmic value of the green economy development quality index in i Province in t-th year. ln(DIF) means the logarithmic value of digital financial inclusion development in i Province in t-th year. X denotes a set of control variables introduced in the model (1) above, γ and μ denote individual fixed and time-fixed effects, respectively, ε denotes random disturbance terms.

To further verify the impact of digital inclusive finance on the efficiency of green economy development and the level of green economy development, models (2) and (3) are expressly set up for verification.

$$ln(GTFP_{it}) = \alpha_0 + \alpha_1 ln(DIF_{it}) + \sum_{j=1}^{k} \lambda_j X + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

$$ln(GE_{it}) = \alpha_0 + \alpha_1 ln(DIF_{it}) + \sum_{j=1}^{k} \lambda_j X + \mu_i + \gamma_t + \varepsilon_{it} \quad (3)$$

Where ln(GTFP) and ln(GE) denote respectively the logarithmic value of the green economy efficiency and the green economic development level in i Province in t-th year.

3.2 Variable selection

3.2.1 Explained variables

The China Green Economy Development Quality Index (QGE) measures the quality of China's green economy development from two dimensions: green economy efficiency (GTFP) and green economy development level (GE). It uses a coupled coordination model to scientifically measure China's green economy development quality index. Specifically, considering that both green economy development efficiency and green economy level can reflect the quality of green economy development unilaterally to a certain extent, but the perspectives of the two are different, among which the green economy efficiency from the input-output perspective and the green economy development level measured by the comprehensive index reflects the organic unity of the quantitative and qualitative coordinated development of green economy, which can portray the quality of green economy development scientifically. Therefore, this paper adopts the coupled coordination degree model to measure the dynamic correlation between the efficiency and level of green economy development in China's provinces and regions to characterize the quality of China's green economy development.

First, the coupled coordination degree model measures the quality index of China's green economic development. The specific calculation method is described below. The coupling degree (C) and the coupling coordination degree model (D) are calculated. Among them, the coupling degree model of green economy development level and efficiency is shown in equation (4):

$$C = 2 \times \frac{\sqrt{GFTP \times GE}}{\left(GFTP \times GE\right)} \tag{4}$$

In equation (4), C represents the coupling degree between the level of green economic development and efficiency, and the value range is [0,1]; the larger the value of C indicates, the stronger the interaction between the level of green economic development and efficiency.

To effectively avoid the pseudo-evaluation results caused by the simultaneous outliers of green economy development level and efficiency, the coupling coordination degree D needs to be calculated based on the coupling degree C to accurately characterize the interactive coordination relationship between green economy development level and efficiency at different development levels. Therefore, the coupling coordination degree model is shown in (5):

$$D = \sqrt{C \times T}\,; T = \alpha \times GTFP + \beta \times GE \tag{5}$$

In Eq. (5), D is the coupling coordination degree of the green economic development index and green total factor productivity, and the value range is [0,1], which reflects the green economic development quality level QGE. T is the comprehensive evaluation index, where and are the pending coefficients of green economic development index and green total factor productivity, respectively. In this paper, the level of green economic development and development efficiency are two essential dimensions of green economic development quality, both are equally important and cannot be deviated from one another, so the values of α and β are set to 0.5.

Second, the level of green economy development (GE) is measured. The green economy is an economic development model based on sustainable development, featuring low carbon, high efficiency, and social inclusion, and is committed to improving human welfare and social equity while significantly reducing environmental risks and ecological disasters. Based on the essence of the green economy in the new era, this paper focuses on the vivid practice of China's green economy development. It scientifically evaluates the level of China's green economy development in four evaluation dimensions: innovation drive, economic efficiency, low-carbon environment protection, and social development. Economic efficiency refers to the efficiency of single factors, such as capital, labor, energy, and land, and is the key to green economic development; low-carbon environmental protection includes carbon and pollutant emissions, green coverage, environmental management intensity, and ecological protection enterprise registration density, and is an essential way for sustainable development of green economy. Social development includes industry and employment structure, urban-rural income gap, people's welfare and leisure benefits, digital and educational equity, and cultural sharing, which are the values of green economic development.

In addition, considering that the level of green economic development has the attribute characteristics of hidden variables, it is necessary to use the corresponding measurable explicit influence factors to jointly measure; at the same time, taking into account the availability of existing statistical index data, the green economic development level evaluation index system is constructed, as shown in Table 1. The entropy weight method is used to determine the weight coefficients of each green economic development level index, which are all listed in Table 1.

Third, measuring the efficiency of green economic development (GTFP). As socialism with Chinese characteristics enters a new era, improving green economic efficiency is the key to transforming China's economic growth mode and achieving high-quality development of the green economy. Specifically, green economic efficiency is based on the accurate measurement of economic efficiency of traditional factors of production (e.g., labor, capital, energy) and further introduces non-

desired outputs of economic activities (e.g., environmental pollution, carbon emissions, haze pollution, income disparity) into the measurement framework, which can scientifically reflect the degree of coordination between economy and environment within a particular region. Therefore, green economic efficiency is a comprehensive economic efficiency after weighing the costs of resources and the environment, and also a vital dimension reflecting the quality of green economic development in the new era.

The green economic efficiency is measured by the non-radial, non-angle SBM-DEA model proposed by Tone (2001), and the specific indicators are shown in Table 1. Among the environmental pollution indexes in Table 1, the entropy weight method determines the three hands of industrial wastewater emission, industrial sulfur dioxide emission, and industrial solid waste generation in each region. The corresponding weights are obtained as 0.323, 0.474 and 0.203, respectively, and then the index synthesis method measures the environmental pollution index.

Table 1 China's Green Economy Development Quality Evaluation Index System

Level 1 Indicators	Secondary indicators	Basic indicators (Attribute)	Specific indicator measurement formula	Weight
Green Economic Development Level Indicators	Innovation Driven	R&D investment intensity (+)	R&D expenditure/GDP	0.0229
		Technology market share (+)	Technology Market Turnover/GDP	0.0091
		Patent share per capita (+)	Three kinds of domestic patents granted/total population	0.0121
	Economic efficiency	Capital efficiency (+)	GDP/Fixed Asset Investment	0.0441
		Labor efficiency (+)	GDP/number of employees	0.0201
		Energy efficiency (+)	GDP/total energy consumption	0.0199
		Land efficiency (+)	Total food production/total arable land area	0.0111
	Low Carbon Environmental Protection	Carbon Emission (-)	Emissions/GDP	0.1088
		Pollutant Emissions (-)	Waste water, waste gas, and solid waste/GDP	0.1187
		Green coverage of built-up area (+)	Green coverage rate of built-up areas	0.0813
		Environmental management intensity (+)	Total investment in environmental management/GDP	0.1244
		Environmental protection enterprise registration density (+)	Number of registered environmental protection enterprises/total registered enterprises	0.0269
	Social Development	Industrial structure (+)	Share of output value of different industries in GDP multiplied by the corresponding weights	0.0535
		Employment structure (+)	Share of employment in different industries in total employment	0.0587
		Urban-rural income gap (-)	Thiel Index	0.0897
		People's well-being (+)	The average value of [basic pension insurance + unemployment insurance + basic medical insurance coverage	0.1131
		Digital equity (+)	Internet penetration rate	0.0480
		Education Equity (+)	Investment in education by province/GDP of the province	0.0234
		Cultural sharing (+)	Investment in cultural undertakings by province/GDP of the province	0.0143

Green Economy Development Efficiency Indicators	Inputs	Labor input	Employment by province for the year	
		Capital Inputs	Capital input in constant 2010 prices calculated by the perpetual inventory method	
		Energy input	Total energy consumption after standard coal	
	Expected output	Real GDP	Real GDP in constant 2010 prices	
	Non-desired outputs	Carbon Emissions	CO2 emissions	
		Haze Pollution	PM2.5 emissions	
		Environmental Pollution Index	Industrial wastewater emissions, industrial sulfur dioxide emissions, and solid waste generation combined weighted	

Note: "+ (-)" in the "attribute" column indicates the measurement method of the base index, which is a positive (negative) indicator; the larger (smaller), the better.

3.2.2 Core explanatory variables

The Digital Inclusive Finance Development DIF is measured using the Digital Inclusive Finance Index calculated by the China Digital Finance Research Center of Peking University in the corresponding year.

3.2.3 Control variables

The level of economic development (lnpgdp) is measured by the logarithm of GDP per capita in each province; government intervention (gov) is measured by the share of government expenditure in GDP; urbanization rate (urban) is measured by the ratio of urban population to rural population; regional education level (edu) is characterized by the average number of years of education in the region, measured by the formula of middle years of education = [(elementary school number of people * 6 + number of people in junior high school * 9 + number of people in high school and secondary school * 12 + number of people in college and above * 16) / population under six years old].

3.3 Data sources and descriptive statistical analysis

This paper selects panel data for China and 30 provinces from 2011-2020, excluding the Tibet Autonomous Region and Hong Kong, Macao, and Taiwan. The data on CO2 emissions are obtained from the CEADS database; the data on registered environmental protection enterprises are obtained from the national industrial and commercial enterprise registration microdata; the data on the degree of government attention to environmental protection are obtained from the China Knowledge Network newspaper database; the data on PM2.5 emissions are obtained from Washington University's Atmospheric Composition The rest of the data are obtained from the China Statistical Yearbook, provincial statistical yearbooks, national economic and social development bulletins, and wind databases. The results of descriptive statistics of specific variables are shown in Table 2.

Table 2 Descriptive statistics of variables

Variable	N	Mean	p50	SD	Min	Max
ln(QGE)	300	-2.590	-2.704	0.545	-3.620	-1.555
ln(GE)	300	-0.451	-0.448	0.106	-0.740	-0.168
ln(GTFP)	300	-0.753	-0.810	0.466	-1.739	0
ln(DIF)	300	5.219	5.412	0.668	2.909	6.068
*ln*pgdp	300	4.684	4.644	0.182	4.215	5.111
urban	300	0.572	0.550	0.122	0.350	0.896
edu	300	0.145	0.131	0.0440	0.0850	0.296
gov	300	9.210	9.139	0.899	6.766	12.50

3.4 Initial Experience Judgment

To observe more intuitively the linear relationship between digital inclusive finance on green economy development quality index, green economy efficiency, and green economy development level, this paper makes

a preliminary portrayal of the above three groups of quantitative relationships with the help of scatter fit plots, as shown in Figure 3. it is not difficult to find that the hypotheses proposed in this paper are initially confirmed. The specific quantitative relationships are subject to further empirical analysis in later papers.

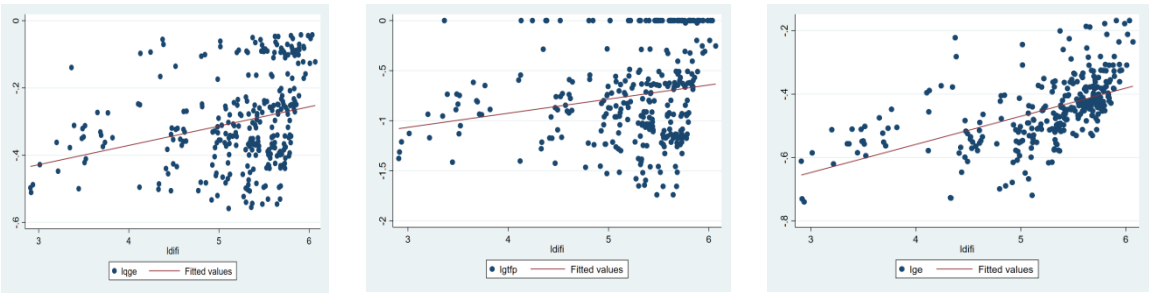

Figure 1 Fitting scatter trend of each explanatory variable for the impact of digital financial inclusion

4 Analysis of empirical results

4.1 Basic regression results

The econometric theory of short-panel model selection and testing is combined to ensure the scientific validity of the model regression results.[1], Focus on cross-sectional correlation, heteroskedasticity, and autocorrelation in short panel models with possible error terms[2], The final model was determined to be a panel two-way fixed effects model. Table 3 reports the regression results of the fixed effects of equations (1)-(3). From model (1)-model (3), it can be found that the impact of digital inclusive finance on the quality of green economic development and green economic development efficiency are both significantly negative at the 1% significance level, and hypotheses 1-2 are verified; the effects of digital inclusive finance on the level of green economic development are positive at the 1% significance level, and hypothesis 3(b) is verified. The coefficients of other control variables in the model are positive except for the coefficient of economic development level in the model (3), which is damaging and conforms to the theoretical expectation.

1 For the PLS and FE models: Because the short panel data is a balanced panel and time effects are considered, the value of the test for the presence of cross-sectional correlation statistic is 4.06, which is greater than the critical value of 0.5198 at the 1% significance level, rejecting the original hypothesis that the model does not have cross-sectional correlation; the p-value of the F-statistic for the model selection is 0 under the premise of dealing with cross-sectional correlation, so the FE model is chosen. For the PLS and RE models, the p-value of the model selection statistic is 0, the original hypothesis is rejected, and the FE is selected. For the FE and RE models, the Hausman test statistic is 28.39 under the premise of considering cross-sectional correlation, and the corresponding p-value is 0, and the FE is selected.

2 The statistic for testing the heteroskedasticity of the model is 18516.89, which corresponds to a p-value of 0. Therefore, there is heteroskedasticity in the model; the F-statistic for testing autocorrelation in the model is 27.848, which corresponds to a p-value of 0.0000.

Table 3 Baseline regression results

	model(1)	model(2)	model(3)
ln(DIF)	-0.228***	-0.287***	0.059***
	(0.063)	(0.062)	(0.017)
ln pgdp	1.719*	1.764*	-0.045
	(0.909)	(0.875)	(0.072)
edu	0.017	0.009	0.008
	(0.022)	(0.018)	(0.007)
urban	2.837**	2.093*	0.744***
	(1.012)	(0.931)	(0.199)

gov	0.134	0.086	0.048
	(0.522)	(0.515)	(0.070)
Time Effect	YES	YES	YES
Individual effects	YES	YES	YES
N	300	300	300
R^2	0.546	0.4835	0.8839

Note: Driscoll-Kraay standard errors in parentheses, *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. r2 is the within-group goodness-of-fit. The regression results omit the constant term, as below.

4.2 Endogeneity issues

Considering that the impact of digital inclusion finance on green economy development is a relatively macro-level issue, it is crucial to effectively identify the endogeneity problems existing in the model and strip out the one-way impact of digital inclusion finance on the quality of green economy development article empirical evidence. To this end, three possible endogeneity problems in the model regressions will be discussed individually.

First, the problem of reverse causality: For equation (1), there is a risk that the improvement of the quality of green economic development will reverse the use of digital inclusive finance, so there is a particular risk of reverse causality in the regression results. However, since the dependent variable in this paper results from the comprehensive measurement of provincial indicators, and the digital inclusive finance is based on the index measured by Ant Financial Services data, the two are from different data sources, and the possibility of reverse causality is reduced.

Second, the measurement error problem: the digital inclusive finance index uses a combination of subjective and objective weighting to determine the weights in the measurement process, which fits the development of digital inclusive finance in reality and has high robustness. In addition, the index measured in this paper is compared with the results calculated by other scholars, and the general trend is found to be consistent, which further ensures the reliability of the index measurement results. Accordingly, the measurement error can be negligible.

Third, the omitted variable problem: Considering that there may be factors in equation (1) that affect both digital inclusive finance and the quality of green economy development, such as capacity, preference, future expectations, and a series of unobservable factors, which may lead to bias in the model regression coefficients. To further avoid the endogeneity problem arising from the above situation, this paper draws on Yi Xing-key and Zhou Li (2018) to construct a "Bartik instrument" (the product of the lagged first-order digital inclusive finance index and the first-order difference of the digital inclusive finance index) for instrumental variables regression. The results of the under-identification test (LM statistic corresponding to a p-value of 0) and the weak instrumental variables test (Wald F-statistic of 525.187) indicate that the above instrumental variables are valid. The two-stage least squares method was used to perform the regression test. The specific regression results are shown in Table 4. The coefficients of the regression results in the first stage are significantly not equal to 0. The reliability of the regression of this paper's model is further illustrated by the fact that digital financial inclusion development inhibits the quality of green economy development from the second-stage regression results.

Table 4 Regression results of instrumental variables

	Stage 1 (Dependent variable*ln(DIF)*)	Stage 2 (Dependent variable*ln(QGE)*)
ln(DIF)		-0.3896*** (0.0169)
Tool Variables (L.DIF*D.DIF)	-0.0866*** (0.0140)	
Control variables	YES	YES
Time Effect	YES	YES
Individual effects	YES	YES

N	570	570
R^2	0.9473	0.5096

4.3 Heterogeneity analysis

4.3.1 Regional heterogeneity

To further investigate whether there is regional heterogeneity in the effects of digital inclusive finance on the green economy development quality index, green economy efficiency, and green economy development level index, this paper further divides the sample into three subsamples: East, Central, and West, for regression. The details are shown in Table 5. According to the regression results, the dependent variables of model (1)-(3) in Table 7 are the green economic development quality index, and the green economic development quality index of digital inclusive finance is negative at 5% and 10% significance levels in the eastern and central regions, respectively, but insignificant in the western region, which indicates that the current development of digital inclusive finance inhibits the green economic development quality in the east and central regions of China, but the impact on the western part is not significant; Table 7 model (4)-(6) dependent variable is green economic efficiency, digital inclusive finance on the green economic efficiency of the eastern and central regions are negative at 1% and 5% significance levels, respectively, but for the western part in is not significant, indicating that digital inclusive finance only has a negative impact on the green economic efficiency of the eastern and central areas, and the effect is greater in the eastern region; its impact on the western region is not The effect on the western region is not significant. Table 7 Model (7)-(9) The dependent variable is the green economic development level index, and digital inclusive finance has a positive effect on the green economic development level index in the eastern and western regions at 1% and 5% significance levels, respectively, while it is not significant for the central region, indicating that the development of digital inclusive finance has improved the green economic development level in the eastern and western regions.

Table 5 Regression results of regional heterogeneity

	ln(QGE)			*ln(GTFP)*			*ln(GE)*		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	East	Mid	West	East	Mid	West	East	Mid	West
ln(DIF)	-0.06**	-0.06*	-0.04	-0.30***	-0.26**	-0.22	0.07***	0.02	0.05**
	(0.02)	(0.03)	(0.04)	(0.08)	(0.10)	(0.16)	(0.01)	(0.02)	(0.02)
lpgdp	0.66**	0.43*	-0.07	2.61**	2.00**	-0.05	0.02	-0.26	-0.22**
	(0.25)	(0.21)	(0.32)	(0.97)	(0.80)	(1.26)	(0.08)	(0.19)	(0.10)
edu	0.00	0.03**	0.02	-0.01	0.13**	0.06	0.02	0.01	0.00
	(0.02)	(0.01)	(0.02)	(0.07)	(0.04)	(0.07)	(0.02)	(0.01)	(0.00)
urban	0.23	1.11**	1.08*	0.68	3.71**	2.89	0.26	0.72***	1.45***
	(0.37)	(0.42)	(0.59)	(1.17)	(1.61)	(2.45)	(0.41)	(0.17)	(0.29)
gov	0.50*	-0.16	-0.33	1.81*	-1.14	-0.81	0.20	0.48***	-0.52**
	(0.23)	(0.22)	(0.54)	(0.87)	(0.91)	(2.19)	(0.12)	(0.13)	(0.18)
N	110	80	110	110	80	110	110	80	110
R^2	0.57	0.50	0.67	0.56	0.41	0.58	0.85	0.93	0.94

4.3.2 Structural heterogeneity

Combined with the empirical results of the benchmark regression, this paper further investigates the structural heterogeneity of digital financial inclusion on the quality of green economy development, green economy efficiency, and green economy development level under different urbanization levels and divides the urbanization rate into two subsamples of high and low based on the mean value for regression. The specific results are shown in Table 6. From the division of urbanization rate, the inhibitory effect of digital inclusive finance on the quality of green economic development and green economics efficiency is more potent in regions with high urbanization

levels; in addition, there is a significant pull effect of digital inclusive economy on the level of green economic development in regions with low urbanization level.

Table 6 Regression results of structural heterogeneity under different urbanization levels

	ln(QGE)		*ln(GTFP)*		*ln(GE)*	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
ln(DIF)	-0.364*	-0.065**	-1.472*	-0.336***	0.018	0.075***
	(0.184)	(0.021)	(0.738)	(0.096)	(0.031)	(0.013)
lpgdp	0.022	0.581***	0.312	2.204***	-0.226**	0.119
	(0.452)	(0.042)	(1.772)	(0.137)	(0.085)	(0.093)
edu	0.036	-0.005	0.120	-0.024	0.024**	0.006
	(0.029)	(0.005)	(0.115)	(0.020)	(0.008)	(0.009)
urban	1.218	0.462***	4.348	1.016**	0.525**	0.833***
	(0.817)	(0.087)	(3.178)	(0.375)	(0.218)	(0.222)
gov	-0.471	0.169	-1.828	0.665	-0.057	0.012
	(0.429)	(0.183)	(1.656)	(0.685)	(0.102)	(0.141)
N	121	179	121	179	121	179
R^2	0.492	0.665	0.478	0.576	0.884	0.907

5 Research findings and insights

Using balanced panel data from 30 provinces in China from 2011 to 2020, this paper empirically tests the panel fixed effects model to obtain the following results: digital inclusive finance hinders the quality of green economy development in China, and the conclusion still holds after using instrumental variables to deal with endogeneity, and digital inclusive finance promotes the level of green economy development while hindering green economy efficiency. There is regional and structural heterogeneity of digital inclusive finance on the quality of green economy development and its dimensional variables.

Specifically, first, in terms of regional heterogeneity, the development of digital inclusive finance inhibits the quality of green economic growth in the east and central regions of China, but the effect on the western regions is not significant; digital inclusive finance only harms the green economic efficiency in the eastern and central regions, and the effect is greater in the eastern region; the development of digital inclusive finance improves the green economic development level in the eastern and western regions; and the effect on the central The development of digital inclusive finance has improved the green economy development level in the eastern and western regions, while the effect on the green economy development level in the central region is not significant. Second, in terms of structural heterogeneity, the inhibitory effect of digital inclusive finance on the quality of green economic development and green economics efficiency is stronger in regions with high urbanization levels; in addition, there is a significant pull effect of digital inclusive economy on the level of green economic development in regions with lower urbanization levels.

According to the findings of this paper, the following insights are drawn: First, with the cross-fertilization of technology and finance, the boundaries of financial services are increasingly blurred, and the characteristics of digital financial risks are constantly amplified, the government needs to further strengthen the professionalism, unity and penetration of financial regulation, actively explore and promote the sandbox mechanism of digital financial regulation, balance financial risks and innovation, and effectively stimulate digital inclusive finance to boost the high-quality green economy development. Second, it is necessary to activate the positive effect of digital inclusive finance on the efficiency of the green economy, and pay great attention to the regional and structural heterogeneity characteristics of digital inclusive finance on the quality of green economic development.

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