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Pathways to Sustainable Economic Growth: Empirical Evidence from the Development of Digital Inclusive Finance in China

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Abstract: This study explores the digitalization of inclusive finance and the sustainable improvement of economic strength in China. The survey data is employed from the digitalization of inclusive finance index developed by Peking University and the China Household Finance Survey (CHFS) database 2011-2023 to analyze the impacts of the digitalization of inclusive finance on provincial and national improvement of economic strength. Specifically, it reveals that the regional and national economic grows as well as the inclusive nature of finance. The sustainability of the improved economic level in China is influenced by the deviations of financial digitalization inclusion from the long-term balance and short-term changes. In summary, the bivariate long-run relationship suggests that adopting the inclusive nature of finance measures will be beneficial to the improvement of China's economic strength.

Keywords: Financial digitalization, the inclusive nature of finance, the improved economic level, cointegration, China.

1. Introduction

The inclusive nature of finance means that all levels of society have access to quality financial product services, which include transactions, savings, credit, insurance, etc. Inclusive finance aims to address the imbalances and inadequacies in economic and social development [1]. It provides financial insights and support to achieve common prosperity for all individuals. By offering financial product services to customers who are typically underserved by traditional finance, inclusive finance has effectively promoted financial product services [2]. Similarly, Ouma[3] suggests that the inclusive nature of finance can bolster credit access and savings capabilities among the poor, thereby enhancing their economic level and living standards. The World Bank states that financial stability is "the availability to individuals and businesses of useful and affordable financial products and services that meet their needs - transactions, savings, credit, insurance, etc. - in a responsible and sustainable manner." In China, the inclusive nature of finance and financial digitalization have become critical drivers of improvement of economic strength over the past few decades. Government has adopted a series of policies and reforms to expand access to financial product services, especially in underserved rural and low-income areas. Chinese government has actively promoted the inclusive nature of finance through various initiatives, including the expansion of financial digitalization services [4].

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Research underscores that the adoption of financial digitalization in China has facilitated a more inclusive economic environment, supporting the improved economic level and reducing disparities [5]. What's more, application of artificial intelligence and big data in finance has enhanced risk management and efficiency, contributing to overall economic stability and development [6]. Thus, China's embrace of financial digitalization represents a significant step toward creating a more inclusive and dynamic economy.

Recently, the scale of the inclusive nature of finance and financial digitalization in China has expanded significantly due to technological advances, market growth, and government promotion [7]. Financial digitalization, exemplified by the proliferation of mobile payment platforms like Alipay and WeChat Pay, has greatly expanded the scope of urban and rural financial product services. This expansion has enabled small businesses and individuals, particularly in underserved regions, to participate more fully in the economy by providing them with easier access to credit, savings, and investment opportunities [7, 8]. In general, financial digitalization is becoming more and more important for the improvement of economic strength. Supporting inclusive finance has become a powerful driving force for economic recovery and inclusive growth[8]. Most scholars agree that inclusive finance can improve regional financial service system, broaden investment and financing channels, ease the financing constraints of corporate entities, and promote regional industrial development[9]. At the same time, with the help of powerful network platforms and mobile terminals, financial digitalization services such as online credit, digital payments, and digital currencies have inherent green attributes and can replace high-carbon energy such as coal [2]. At the micro level the inclusive nature of finance enhances access to credit, savings, and investment opportunities, which in turn stimulates the improved economic level and reduces poverty [7]. The World Bank highlights that inclusive financial systems can boost economic resilience by enabling individuals and small businesses to better manage risks and seize opportunities for growth [10]. Furthermore, research indicates that the inclusive nature of finance supports the achievement of broader sustainability goals by promoting entrepreneurship and facilitating equitable resource distribution, often leading to improved family welfare and community development [7]. Additionally, inclusive financial practices support environmental sustainability by financing green technologies and sustainable business practices [11]. Overall, ensuring widespread access to financial product services is not just helpful for individual advancement but a critical component of a more stable and equitable economy.

This study does the following work. Firstly, it reveals long-term dynamic relation between financial digitalization inclusion and sustainable improvement of economic strength in China from a theoretical perspective. At the same time, compared with the studies of Yang and Zhang [4] and Yang et al. [7], it explores the mechanism path of financial digitalization promoting the improved economic level of institutions and governance, which is a useful supplement to existing studies. Secondly, the panel VAR method and cointegration analysis are used to analyze the relation between financial digitalization inclusion and the improved economic level in various provinces, thereby providing a more effective empirical evaluation of this relation and emphasizing that improvement of economic strength and the inclusive nature of finance are mutually influential and unbalanced in different regions. Thirdly, the dynamic vector error correction model (VECM) is used to examine long-term cointegration relation, attempting to reveal the intricate relation between the inclusive nature of finance development and provincial the improved economic level and the long-term sustainability of per capita GDP. Finally, by creating a financial digitalization inclusion variable, it makes a theoretical contribution to the study of the inclusive nature of finance index using relevant financial digitalization indicators.

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2. Literature Review and Hypothesis

The academic community generally agrees that financial digitalization inclusion has a catalytic effect on improved economic level [12]. Ratnawati [6] analyzed panel data from 34 provinces in Indonesia from 2015 to 2019 and studied the inclusive nature of finance, national economy increase, and the national economic system stability. However, results show that the inclusive nature of finance has a negative impact on national economy increase but can enhance the stability of the national economic system. They pointed out that this is because of the diversity of population, economic conditions, and geographical conditions in Indonesian provinces. Therefore, it is imperative to analyze the relation between the inclusive nature of finance and improvement of economic strength in various provinces in China. Zehri [5] studied panel data from 61 countries from 2010 to 2021 by developing a generalized liquidity method. Results show that the penetration of financial digitalization services is positive for the improved economic level. In addition, the impact of governance and institutions on the relation between financial digitalization inclusion and the improved economic level in sub-Saharan Africa from 2014 to 2020 is studied [11]. By adopting VAR technology and taking the financial digitalization conclusion index, gross domestic product (GDP) and per capita GDP growth rate as the main variables, the study concluded that regional characteristics and spatial governance quality have a significant impact on the relation between financial digitalization inclusion and economic sustainability.

The findings clearly indicate that financial digitalization inclusion has a potential catalytic effect on sustainable the improved economic level. Accordingly, the following hypothesis are proposed:

H1: The development of financial digitalization inclusion promotes the improved economic level in China.

China's rapid economic level is due to the increase in financial participation and the effective flow of capital, making it a leading global economic power. Li et al. [13] studied the impact of digitalization of inclusive finance on household consumption based on panel data from CHFS and the Digitalization of inclusive finance Index developed by Peking University. Results show that digitalization of inclusive finance promotes household consumption. In addition, Yang and Zhang [4] studied the digitalization of inclusive finance and the steady and sustained growth of China's small business company based on data from listed companies on China's New Third Board Market from 2011 to 2018 and the Digitalization of inclusive finance Index of Peking University. Results show that the development of digitalization of inclusive finance helps promote the steady and sustained growth of small business company, which promotes the steady and sustained growth of small business company. The research results suggest that we should promote digitalization of inclusive finance and reshape the ecological structure of the financial industry to provide sound financial support for the steady and sustained growth of my country's small business company. Thus, this study further hypothesizes that

H2: There is a long run dynamic relation between the development of financial digitalization inclusion and sustainable the improved economic level in China.

If long-term cointegration is detected, developments in financial digitalization inclusion can be expected to mirror regional the improved economic level. Ratnawati et al [6] studied the relation between the inclusive nature of finance, national economy increase and the national economic system stability in Indonesia. Results show that the inclusive nature of finance will promote the stability of the country's financial system but will have a negative impact on national economy increase. Zehri et al [5] studied the potential impact of decent work and the inclusive nature of finance on the improved economic level based on diverse data from 26 low-income, 20 middle-income and 15 high-income countries. Contrary to Ratnawati et al. [6], their findings emphasize that favorable conditions for decent work and increased opportunities for financial digitalization services contribute positively to

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the improved economic level. Furthermore, the impact of governance and institutions on the relation between financial digitalization inclusion and the improved economic level in Sub-Saharan Africa (SSA) between 2014 and 2020 is studied [11]. Therefore, the positive impact of institutional quality and governance on the financial digitalization inclusion-the improved economic level relation in SSA is confirmed. In summary, it is hypothesized that the improved economic level is affected by the development of the inclusive nature of finance in each province, while regional the improved economic level also affects the development of the inclusive nature of finance in China. Therefore, the relation between financial digitalization inclusion and the improved economic level is affected by long-term equilibrium changes and short-term dynamic changes.

3. Data and Methodology

3.1. Data Introduction

The data comes from 31 provincial panel data in China from 2011 to 2023. Among them, GDP and per capita GDP data come from the National Bureau of Statistics. China's inclusive finance digitalization data comes from the Financial Digitalization Research Center of Peking University. In addition, the relevant research also uses the "Inclusive Finance Digitalization Index". Specifically, 33 indicators are selected from the three dimensions of digitalization degree, usage depth, and coverage breadth to construct an inclusive finance digitalization index system. The index covers three levels: province, city, and county, with a time span of 2011 to 2023, and is subdivided from different dimensions based on total volume and coverage, usage depth, and digital support services, payment, insurance, monetary funds, credit reporting, investment, credit and other business classification indicators [14]. We also use per capita GDP to measure the improved economic level, and use logarithmic form to eliminate the improved economic level differences caused by different population sizes. Both GDP and per capita GDP are expressed in logarithmic form.

3.2. Variables

Provincial panel data is used from 2011 to 2023 in China for quantitative empirical analysis. First, a panel VAR model is constructed to test whether the development of financial digital inclusion can promote the improvement of economic levels at the regional or national level, or whether there is a bivariate causal relationship. Financial digitalization is considered a good way to improve financial inclusion[15] and can significantly reduce users' transaction costs. CHFS is a national sampling survey project conducted by the China Household Finance Survey and Research Center, which aims to collect household finance-related information at the micro level. This study uses three dimensions to proxy the financial inclusion index, namely, coverage breadth, usage depth, and digitalization level. The inclusive nature of finance index is constructed for 2011 to 2019, and we use exponential smoothing to predict other years to 2023.

3.2.1. Summary Statistics of Financial digitalization Inclusion Index by Province

It presents the descriptive summary of the inclusive nature of finance index by provinces during 2011-2023 in Table 1. The total number of observations is 403. The inclusive nature of finance index ranges from 16.22 to 636.497 with a positive skewness of 0.125 and a kurtosis of 2.32. On average, the mean the inclusive nature of finance index is 274.82, and the median is 137.31, which implies that the potential outliers pay an important role in calculating the inclusive nature of finance index for each province. The statistics suggests that the development of the inclusive nature of finance exists imbalance among various regions. The coefficients of variation of most of the inclusive nature of

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finance index by provinces are around 0.5, implying that the unit return of potential risk are similar across each region.

Table 1: Descriptive statistics of the inclusive nature of finance index by provinces 2011-2023

ID	Province	Mean	Median	S.D.	Min	Max	CV	Skewness	Kurtosis
1	Beijing	345.38	329.94	160.59	79.41	621.01	0.46	0.13	2.11
2	Tianjin	294.91	284.03	140.65	60.58	533.96	0.48	0.09	2.10
3	Hebei	256.70	258.17	133.05	32.42	476.48	0.52	0.02	2.06
4	Shanxi	259.52	259.95	132.24	33.41	477.97	0.51	-0.01	2.10
5	InnerMongolia	253.20	258.50	124.73	28.89	457.61	0.49	-0.11	2.24
6	Liaoning	270.90	267.18	131.27	43.29	490.27	0.48	-0.01	2.18
7	Jilin	252.33	254.76	130.03	24.51	465.21	0.52	-0.06	2.15
8	Heilongjiang	253.32	256.78	127.31	33.58	462.94	0.50	-0.05	2.14
9	Shanghai	352.20	336.65	165.72	80.19	636.50	0.47	0.14	2.09
10	Jiangsu	308.29	297.69	150.33	62.08	562.84	0.49	0.10	2.06
11	Zhejiang	333.34	318.05	156.58	77.39	602.32	0.47	0.15	2.08
12	Anhui	275.15	271.60	143.19	33.07	511.97	0.52	0.02	2.07
13	Fujian	308.78	299.28	150.44	61.76	563.55	0.49	0.10	2.06
14	Jiangxi	268.22	267.17	140.18	29.74	499.16	0.52	0.00	2.08
15	Shandong	276.01	272.06	139.21	38.55	507.42	0.50	0.01	2.11
16	Henan	265.88	266.92	141.88	28.40	498.37	0.53	0.00	2.04
17	Hubei	290.46	285.28	149.28	39.82	538.34	0.51	0.03	2.07
18	Hunan	261.23	261.12	134.21	32.68	483.29	0.51	0.01	2.09
19	Guangdong	307.26	296.17	147.65	69.48	559.30	0.48	0.14	2.04
20	Guangxi	262.47	261.94	136.39	33.89	487.40	0.52	0.01	2.06
21	Hainan	282.67	275.64	143.33	45.56	521.90	0.51	0.05	2.05
22	Chongqing	277.27	276.31	138.75	41.89	508.10	0.50	0.01	2.11
23	Sichuan	269.58	267.80	135.95	40.16	495.91	0.50	0.03	2.08
24	Guizhou	247.35	251.46	135.16	18.47	466.61	0.55	-0.03	2.04
25	Yunan	257.70	256.27	136.63	24.91	481.57	0.53	-0.02	2.08
26	Tibet	242.40	245.57	136.06	16.22	462.26	0.56	-0.02	1.99
27	Shaanxi	270.80	266.85	137.02	40.96	498.69	0.51	0.03	2.08
28	Gansu	241.71	243.78	127.81	18.84	449.61	0.53	-0.07	2.13
29	Qinghai	235.50	240.20	128.95	18.33	443.37	0.55	-0.07	2.06
30	Ningxia	250.97	255.59	127.17	31.31	459.89	0.51	-0.05	2.13
31	Xinjiang	247.98	248.69	128.52	20.34	458.07	0.52	-0.07	2.18

Notes: The total number is 403 from 2011 to 2023.

3.3. Methodology and Model Specification

3.3.1. VAR Model

VAR model is used to predict interrelated time series systems and analyze the dynamic impact of random disturbances on these variable systems [16]. The following VAR model is proposed to study the relation between financial digitalization inclusion and sustainable the improved economic level.

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$$y_t = \Phi_1 y_{t-1} + \cdots + \Phi y_{t-p} + HX_t + \varepsilon_t, \quad t = 1,2,3 \ldots . T \tag{1}$$

Among them,

$$y_i = \begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix}, t = 0, 1, \ldots, T, \varepsilon_t = \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{kt} \end{pmatrix}$$

$$\Phi_i = \begin{pmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1k} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2k} \\ \vdots & \vdots & & \vdots \\ \gamma_{k1} & \gamma_{k2} & \cdots & \gamma_{kk} \end{pmatrix}, and\ i = 1, 2, \ldots, p$$

Where y_t represents a k-dimensional vector of endogenous variables; p signifies the lag order, and T indicates the sample size. The $k \times k$ dimensional matrices $\Phi_1, \Phi_2 \ldots, \Phi p$ is the matrix of coefficients to be estimated. Lastly, ε_t is a k-dimensional vector of disturbances following normal distribution.

3.3.2. Unit Root Test

It is recommended that most time series should be tested for unit roots before modeling [17], otherwise, serious spurious regression problems will be involved. In order to test the existence of unit roots, the Dicky-Fuller enhanced model is used [18]. Specifically, the tested sequence $\{yt\}$ is as follows:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{q} \delta_i \Delta y_{t-i} + \epsilon_t \tag{2}$$

where Δy_t is the first difference of the $\{y_t\}$ sequence. q is the optimal lags selected by SIC criteria. ϵ_t is a white noise process. The null hypothesis is H0: γ=0. In empirical research, a drift term or a time trend is generally selected, and level tests and first-order difference tests are performed on each series.

3.3.3. Vector Error Correction Model

The VECM estimation consists of a system of equations that capture any imbalanced errors that may affect the system. Since the error correction representation requires the two variables to be cointegrated at the CI (1,1) order, the error correction term can eliminate this imbalance and guide the system variables back to balance. The estimated equation is Equation (3).

$$\Delta y_t = \alpha_i + \gamma_y (x_{t-1} - \beta * y_{t-1}) + \sum_{i=1}^{p} \alpha_{i+1}(i) \Delta y_{t-i} + \sum_{i=1}^{p} \alpha_{i+2}(i) \Delta x_{t-i} + \varepsilon_{yt}$$

$$\Delta x_t = \varphi_i + \gamma_x (x_{t-1} - \beta * y_{t-1}) + \sum_{i=1}^{p} \varphi_{i+1}(i) \Delta y_{t-i} + \sum_{i=1}^{p} \varphi_{i+2}(i) \Delta x_{t-i} + \varepsilon_{xt}$$

where Δ is the lag operator. x_t denotes the the inclusive nature of finance index series, y_t denotes the GDP or GDP per capital time series. The y_t series are in natural logarithmic form. γ_x and γ_y are the speed of adjustment parameters, while β is the estimated coefficient from the long-term equilibrium between the inclusive nature of finance index. The improved economic level. ε_{yt} and ε_{xt} are white noise disturbance terms.

4. Empirical Results

First, a unit root statistical test is performed. When performing the Augmented Dickey-Fuller (ADF) test on the level, the null hypothesis of non-stationarity cannot be rejected. When the p-value is greater than 5%, they are not stationary on the level. However, all the inclusive nature of finance indices are

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statistically significant at the 5% level, indicating that the inclusive nature of finance index is stationary in the first difference. In summary, the results show that all series are non-stationary in levels but stationary in first differences, indicating that they obey I (1) processes. Further, it applies the Johanson Cointegration Rank Test and reports the results as follows.

4.1. Johanson Cointegration Rank Test

The results of the unrestricted Johanson cointegration rank test of the trace statistics and maximum eigenvalue test between the inclusive nature of finance index and GDP of each province are shown in Table 2. At the 5% level, except for Shanxi, Heilongjiang, Hunan and Chongqing, there is at least one cointegration equation between the inclusive nature of finance index and GDP in all other provinces. At the 5% significance level, there is at least one cointegration equation between the inclusive nature of finance index and GDP in most provinces. In addition, both the trace statistic and the maximum eigenvalue test support the cointegration test of the inclusive nature of finance index and GDP. In sum, there is a cointegration relation between the inclusive nature of finance index and provincial GDP, indicating a long-term relation between the inclusive nature of finance index and provincial GDP.

Table 2: Johanson Cointegration Test (unrestricted) between the inclusive nature of finance index and GDP by provinces

		Max rank	LL	Eigenvalue	Trace statistic	5% critical value
1	Beijing	0	-23.7745	.	7.9009*	15.41
		≤1	-19.9437	0.50168	0.2392	3.76
2	Tianjin	0	-20.2993	.	7.6919*	15.41
		≤1	-17.0814	0.44293	1.2562	3.76
3	Hebei	0	-15.4403	.	9.5903*	15.41
		≤1	-10.7144	0.57653	0.1384	3.76
4	Shanxi	0	-27.0536	.	18.2236	15.41
		≤1	-18.356	0.79431	0.8284*	3.76
5	InnerMongolia	0	-23.2568	.	14.7018*	15.41
		≤1	-16.3119	0.71711	0.812	3.76
6	Liaoning	0	-18.7719	.	10.4636*	15.41
		≤1	-13.7147	0.60128	0.3492	3.76
7	Jilin	0	-17.7641	.	14.7366*	15.41
		≤1	-12.3092	0.62909	3.8268	3.76
8	Heilongjiang	0	-17.3162	.	15.4361	15.41
		≤1	-9.67468	0.75077	0.1530*	3.76
9	Shanghai	0	-23.4379	.	5.0782*	15.41
		≤1	-21.2061	0.33354	0.6147	3.76
10	Jiangsu	0	-19.816	.	6.3211*	15.41
		≤1	-16.6567	0.43696	0.0027	3.76
11	Zhejiang	0	-20.6428	.	4.3731*	15.41
		≤1	-18.8925	0.27257	0.8726	3.76
12	Anhui	0	-17.8632	.	4.4589*	15.41
		≤1	-15.6463	0.33174	0.025	3.76
13	Fujian	0	-23.5862	.	4.4425*	15.41
		≤1	-21.4639	0.32014	0.1979	3.76
14	Jiangxi	0	-18.3938	.	6.0505*	15.41

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Table 2: (continued).

		≤1	-16.6002	0.27828	2.4633	3.76
15	Shandong	0	-17.3588	.	6.8844*	15.41
		≤1	-14.006	0.45644	0.1787	3.76
16	Henan	0	-18.9834	.	5.7170*	15.41
		≤1	-16.1252	0.40529	0.0005	3.76
17	Hubei	0	-26.1525	.	4.8039*	15.41
		≤1	-23.9634	0.32835	0.4257	3.76
18	Hunan	0	-16.654	.	23.5818	15.41
		≤1	-4.87317	0.88258	0.0203*	3.76
19	Guangdong	0	-19.2286	.	7.2831*	15.41
		≤1	-15.8142	0.46248	0.4545	3.76
20	Guangxi	0	-16.6018	.	6.2700*	15.41
		≤1	-13.7905	0.40018	0.6476	3.76
21	Hainan	0	-18.8702	.	4.5564*	15.41
		≤1	-16.6327	0.33424	0.0813	3.76
22	Chongqing	0	-20.21	.	15.9459	15.41
		≤1	-12.2463	0.76495	0.0184*	3.76
23	Sichuan	0	-19.7299	.	2.2839*	15.41
		≤1	-18.6043	0.18507	0.0327	3.76
24	Guizhou	0	-12.0257	.	13.0362*	15.41
		≤1	-5.98803	0.66638	0.9609	3.76
25	Yunan	0	-17.2244	.	3.5235*	15.41
		≤1	-15.4662	0.27362	0.007	3.76
26	Tibet	0	-14.7186	.	4.9551*	15.41
		≤1	-12.2441	0.36231	0.0061	3.76
27	Shaanxi	0	-20.4463	.	6.3328*	15.41
		≤1	-18.0789	0.34977	1.598	3.76
28	Gansu	0	-17.2944	.	18.5111	15.41
		≤1	-8.13604	0.81084	0.1943*	3.76
29	Qinghai	0	-19.8758	.	5.6998*	15.41
		≤1	-17.2789	0.37635	0.5059	3.76
30	Ningxia	0	-22.4655	.	9.1704*	15.41
		≤1	-17.8919	0.56463	0.0232	3.76
31	Xinjiang	0	-27.2234	.	11.8093*	15.41
		≤1	-21.3196	0.65816	0.0016	3.76

Notes: Lags interval (in first differences) is from 1 to 4. * denotes rejection of the hypothesis at 10% significance level.

4.2. Unit Root Test and Johanson Cointegration Rank Test between National Level The inclusive nature of finance Index and National GDP

Further, we conduct the Unit Root Test and Johanson Cointegration Rank Test between national level the inclusive nature of finance index and GDP in China. Similar to the previous diagnostic test steps, the ADF test and Philips-Perron test are performed on the two series. In Table 3, the ADF test fails to reject the null hypothesis at the level, but rejects the null hypothesis of the first-order difference at a confidence interval of 5% or higher. The PP results seem to confirm the ADF test. Therefore, the

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country-level the inclusive nature of finance index and GDP time series are both stationary at the first-order difference, but non-stationary at the level, indicating that they follow I (1) process.

Table 3: Unit Root Test for national level the inclusive nature of finance index and GDP

	ADF Test					PP test		
	level		1st diff			Level	1st diff	
FI	-0.333	(o)	-3.795	(o)	***	-0.339	-3.188	**
GDP	-1.382	(1)	-3.146	(1)	**	-2.389	-3.769	***
GDPPC	-1.026	(1)	-3.622	(1)	**	-1.81	-4.346	***
Critical Value								
1%		-3.750						
5%		-3.000						
10%		-2.630						

Notes: The null hypothesis of the ADF test is that the series has a unit root. The null hypothesis of the Phillips-Perron (PP) test is that the series is stationary. The ADF lag length is automatically selected based on the SIC criterion. In the tests, the constant and the linear trend are selected as exogenous variables. The lags of the ADF and the bandwidth of the PP are in parentheses. *** and ** denotes significance at 1% and 5% respectively.

Table 4: Johanson Cointegration Test between national level the inclusive nature of finance index and GDP

Max rank	Parms	LL	Eigenvalue	Trace statistic	5% critical value
0	6	-18.666	.	3.565**	15.410
≤1	9	-16.995	0.262	0.222	3.760

Notes: Total number of observations is 11. Lags interval (in first differences) is from 1 to 2. Trend is constant. ** denotes rejection of the hypothesis at 5% significance level.

The results of the unrestricted Johansen cointegration rank test between the national the inclusive nature of finance index and GDP are shown in Table 4. For equal-weighted series, under the assumption that there is no cointegration equation (r=0), both the trace statistic and the maximum eigenvalue statistic are greater than the critical value, indicating that the null hypothesis is rejected at the 5% level. However, under the assumption of at most 1 cointegrating equation ($r \leq 1$), both rank tests fail to reject the null hypothesis at the 5% level, indicating support for long-term cointegration. It seems that for the value-weighted series national the inclusive nature of finance index and GDP, both the trace statistics and the maximum eigenvalue statistics indicate that there is a cointegration equation which is significant at the 5% level. Therefore, both formulated national level the inclusive nature of finance indices and GDP have long run cointegrated relations.

4.3. Vector Error Correction Estimations

The variance decomposition mainly analyzes the impact of each generalized shock on the variance change of the endogenous variable. The variance decomposition results are shown in Table 5. It reports the VECM estimation between the national level financial inclusion index and GDP. The change of the national level financial inclusion index is decomposed into random components (represented by εyt and εxt) and the previous period's deviation from long-term balance (expressed as x_{t-1} -β* y_{t-1}) The cointegrating vector are -0.001 and 0.001 respectively. αx and αy measure the speed of adjustment. The adjustment coefficient for the inclusive nature of finance index is 0.052, while the speed of adjustment for GDP is 0.001. Clearly, the inclusive nature of finance index is slightly more responsive to deviations from the long-term equilibrium in the previous period.

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However, these two coefficients are relatively small and cannot strongly explain their speed of adjustment to the national average GDP.

Table 5: Vector error-correction model estimation between national level the inclusive nature of finance index and national average GDP

Equation	Parms	RMSE	R-square		Chi2	P>chi2
D_FI	4	14.4124	0.9124		72.86797	0
D_LNGDP	4	0.030182	0.9121		72.64294	0
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
D_FI						
_ce1-L1.	-0.001	0.001	-0.760	0.450	-0.003	0.001
FI_LD.	0.052	0.343	0.150	0.880	-0.621	0.724
LNGDP_LD.	77.159	171.040	0.450	0.652	-258.074	412.391
Constant	0.001	46.316	0.000	1.000	-90.776	90.778
D_LNGDP						
_ce1_L1.	0.001	0.000	1.270	0.203	0.001	0.001
FI_LD.	0.001	0.001	0.030	0.976	-0.001	0.001
LNGDP_LD.	-0.292	0.358	-0.810	0.416	-0.994	0.411
Constant	0.201	0.097	2.070	0.038	0.011	0.391
Cointegrating Equation						
Equation		Parms		chi2		P>chi2
_ce1		1		2.602882		0.1067

5. Conclusion

The importance of inclusive finance to the improvement of regional economic strength and national sustainable development has been verified. Based on the survey data of CHFS and the inclusive finance digitalization index developed by Peking University, the unit root test and cointegration method are used to analyze the impact of inclusive finance digitalization on the improvement of provincial and national economic strength. Specifically, the study found that the development of financial inclusion has promoted the improvement of regional and national economic levels, while the sustainability of China's economic level improvement is affected by the deviation of financial digitalization inclusiveness from long-term equilibrium and short-term dynamics. In addition, the study also shows that in most provinces and regions, there is a long-term cointegration relationship between the improvement of regional economic strength and financial inclusion. The existence of this long-term relationship between two variables means that taking financial inclusion measures will be conducive to the improvement of China's economic strength.

This research highlights that broadening the inclusive nature of finance is crucial for improvement of economic strength, as it empowers marginalized communities by providing them with tools for savings, credit, and insurance. These services enable better investment in education and health,

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fostering entrepreneurship and business growth. Studies have shown that when financial systems are inclusive, they contribute to economic stability and growth by boosting consumer spending and reducing income inequality. Additionally, inclusive financial systems can enhance economic resilience by diversifying financial access across different segments of society, which is important for sustainable development. Thus, enhancing the inclusive nature of finance not only promotes individual well-being but also drives broader economic progress and equity.

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