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The impact of fintech innovation on green growth in China: Mediating effect of green finance

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ABSTRACT

Although green growth has become the economic development strategy of many countries in the world, and studies have analyzed the influencing factors of green growth from multiple angles, there are few literatures devoted to the impact of fintech and green finance on green growth. From the perspective of fintech development, this paper tries to construct a comprehensive index to evaluate the green growth of regional economy based on the in-depth analysis of the influence mechanism of green finance on green growth. At the same time, China's provincial panel data from 2011 to 2018 are selected to test the impact of fintech innovation and green finance on green growth, and its mechanism. It turns out that fintech and green finance significantly promotes green economic growth. At the same time, the impact of fintech and green finance on green growth has obvious regional heterogeneity, that is, the impact in eastern China is significantly stronger than that in central and western China. Further research shows that fintech innovation mainly promotes green economic growth through green credit and green investment. Therefore, fintech innovation can promote green economic growth by improving the development level of green finance, which has great reference significance for most countries.

1. Introduction

Looking back, China's rapid economic growth has long been achieved at the cost of environmental pollution. The extensive economic growth mode, which is mainly in exchange for short-term economic benefits, is characterized by high input, high consumption and high pollution. Although China is the world's largest and fastest developing emerging economy, its economic growth is accompanied by serious environmental pollution, and this economic growth mode is no longer sustainable. It is necessary to fundamentally change the economic growth mode and take the road of green growth. In view of this, how to eliminate the "black footprint" in the process of rapid economic growth and achieve green growth is an important issue that is widely concerned by China and most countries in the world (Capasso et al., 2019; Liu et al., 2019; Vargas-Hernandez, 2020; Sun et al., 2020).

Although green growth is a new concept, its emergence has aroused wide attention of scholars and produced different definitions. The concept of green Growth was first proposed by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2005 to explore the opportunity of introducing a new low-carbon sustainable development model for rapidly developing Asian countries (ESCAP, 2005). The concept is similar to sustainable development as accepted in many developed countries. However, many developing countries have long considered environmental protection costly and feared that sustainable development might inhibit their economic growth (Brundtland, 1987). Different from sustainable development, green growth is a way to promote economic growth and development by seeking long-term balance between environmental hazards and economic growth (Popp et al., 2011). Other scholars proposed and discussed two definitions of green growth, weak growth and strong growth (Stoknes and Rockström, 2018). While these definitions differ, they all agree that green growth is environmentally sustainable growth. Since then, green growth as a path of economic development has been widely supported and recognized in global policy studies (Sterner and Damon, 2011). According to the research of OECD, green growth refers to a fact that whether economic growth becomes greener and natural resources are used more efficiently (OECD, 2009).

FinTech is a huge achievement of economic development and scientific and technological progress. According to the Financial Stability Board (FSB), fintech refers to financial innovation brought about by technology that creates new business models, applications, processes or products that have a significant impact on financial markets, financial

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institutions or the way financial services are enhanced (FSB, 2016). Some scholars also believe that participants, added value, rules, strategies and vision are the five dimensions that change the fintech market (Hung and Luo, 2016). Fintech is also a broader extension of the financial ecosystem (Gomber et al., 2017; Anagnostopoulos, 2018), which includes innovations in payment systems (including cryptocurrencies), credit markets (including P2P lending) and insurance, with blockchain-assisted smart contracts also playing an important role (Thakor, 2020).

A series of existing studies mainly focus on the connotation and indicator system construction of green growth, the impact of technological innovation and fintech on economic growth, and the impact of technological innovation on green economic growth (Guo et al., 2017; Zhang et al., 2020; Yang et al., 2021a). At present, the level of technological innovation in China is constantly improving (Wu et al., 2020b). As a technological innovation, fintech will affect the production and operation of enterprises by changing financing conditions through the provision of financial services and so on, thus it is bound to have an impact on the environment and economy (Ahmed and Huo, 2020; Cao et al., 2021; Cao et al., 2021). However, there is little literature on the impact of fintech innovation on green growth. Under the background that green growth has become an important development goal of all countries in the world and the rapid integration of finance and science and technology, it is very necessary and meaningful to study the influence mechanism of fintech innovation on green growth and put forward corresponding policy enlightenment. Therefore, from the perspective of fintech development, based on in-depth analysis of the impact mechanism of fintech innovation on green growth, this paper tries to build an index system to evaluate the green growth of regional economy, and uses dynamic factor analysis method to reduce dimension and solve the weight of the index system, and finally gets the green growth index. At the same time, China's provincial panel data from 2011 to 2018 were selected to test the impact of fintech innovation on green growth and its mechanism.

The innovation of this paper mainly includes the following aspects: (1) Novel perspective of topic selection. A series of existing studies mainly focus on the impact of financial innovation on economic growth, or the impact of financial development on green growth, and few studies on the impact of fintech innovation on green growth. (2) This paper proposes the influence mechanism and path of fintech innovation on green growth. This paper proposes the mechanism and path of fintech innovation influencing green growth. The study finds that green credit and green investment are two main paths of fintech innovation influencing green growth, namely, fintech innovation promotes green finance development through green credit and green investment, thus promoting green growth. (3) Building a green growth index. Based on a large number of existing studies and combined with the reality of China, this paper constructed a three-level index system of green growth, and used dynamic factor analysis method to reduce dimension and solve the weight of the index system to calculate the green growth index, so as to evaluate the level of China's green growth. (4) This paper carries out multi-level empirical tests to make up for the deficiencies of existing studies. This paper not only tests the correlation between fintech innovation and green growth, but also further tests the heterogeneity and impact mechanism. In order to better reveal the regional heterogeneity and impact mechanism of fintech innovation on green growth.

The rest of the paper is as follows: In the second part, the theoretical mechanism and research hypothesis are proposed based on the review of relevant literature and the analysis of the mechanism of fintech influencing green growth. The third part constructs the green growth index; The fourth part is research design, including data source, variable selection and econometric model construction. The fifth part examines the impact, heterogeneity and mechanism of fintech on green growth. The sixth part summarizes the research conclusion and draws the corresponding enlightenment.

2. Theoretical mechanism and research hypothesis

Obviously, there are many factors affecting green growth, both subjective and objective. Some studies have found that, in order to pursue performance, some local governments provide a large amount of financial support to some enterprises with high energy consumption and high pollution and drive economic growth through investment (Lin and Zhu, 2019; Wu et al., 2020a, 2020b; Wang et al., 2020b, 2020a). In the implementation of green growth strategy, there is also a situation of inconsistent tightness in each year, which affects the sustainability of green growth (Wang et al., 2020b). Since China's financial institutions are dominated by commercial banks (Zhao et al., 2019), most commercial banks are controlled to some extent by the government (García-Herrero et al., 2009; Song et al., 2011b, 2011a), which indirectly promotes political competition among local governments. In addition, state-owned financial institutions represented by state-owned banks provide relatively loose credit to state-owned enterprises and real estate enterprises (Wu and Xu, 2020a, 2020b). At the same time, the development of the financial system increases the credit capacity and willingness of households and enterprises, which may promote household consumption of energy-intensive goods (Cai et al., 2019). Therefore, the development of financial institutions may indirectly increase resource consumption and pollution emissions, thus affecting green growth. As most of China's State-Owned enterprises are traditional heavy industries highly dependent on natural resources, these enterprises have low technological innovation level, high energy consumption and serious pollution (Song et al., 2011b, 2011a; Hao et al., 2020). Therefore, for enterprises highly dependent on natural resources, product prices will cause economic fluctuations with the sharp fluctuations of resource prices (Rongwei and Xiaoying, 2020; Cheng et al., 2020), thus affecting green growth. In addition, strategic interaction of regional environmental regulations is a typical feature of Local government behavior in China, which can affect local green productivity growth through porter effect and pollution shelter effect (Xin Peng, 2020), and under a certain degree of strictness, environmental policies and environment-related technologies have a positive impact on green growth (Wang et al., 2019; Ulucak, 2020). Other studies have found that economic development has a positive impact on green growth, but trade opening is not conducive to green growth. Energy consumption has a negative impact on green growth, while renewable energy consumption has a significant promotion effect on green growth (Tawiah et al., 2021). It can be seen that the factors affecting green growth include not only technological innovation, financial factors, enterprises' own factors, but also political factors. Therefore, the factors affecting green growth are multifaceted.

2.1. The influence of technological innovation on green economic growth

For a long time, technological innovation has been regarded as an important factor affecting environmental pollution and economic growth (Guo et al., 2017; Zhang et al., 2020; Sun et al., 2020; Yang et al., 2021c, 2021d; Cheng et al., 2021). Moreover, technological innovation and spillover provide developing countries with good opportunities for economic growth (Seck, 2012; Tientao et al., 2016; Ilkay et al., 2021). However, technological innovation is a double-edged sword to environmental pollution and economic growth (Yang et al., 2021b). On the one hand, technological innovation will have a positive effect on green economic growth (Wang et al., 2021; Nosheen et al., 2021). Technological innovation can reduce product costs by improving production efficiency of enterprises, thus driving consumer demand and stimulating economic growth (Zeng et al., 2014). Technological progress can break the resource curse and achieve sustainable growth of green economy (Tian and Liu, 2019). Technological progress has enriched the diversity of production input factors, thus promoting green economic growth (Koren and Tenreyro, 2013). On the other hand, due to the rebound effect, technological innovation will increase the total demand for natural resources, thus aggravating environmental pollution and damaging green economic growth (Herring and Roy, 2007; Zhang et al., 2020). It can be seen that technological innovation has an objective impact on green economic growth.

2.2. Fintech's impact on green growth

In essence, fintech is the result of the organic integration of finance and technology, as well as a kind of technological progress and innovation. The process of fintech's impact on the economy is mainly reflected in promoting green growth. Therefore, the impact of fintech on green growth is unique. According to the financial accelerator theory of Bernanke and Gertler (1989), when an enterprise is positively or negatively affected in the economy, its net worth will rise or fall, and the credit market will magnify its impact on the economy and ecological environment. Technological innovation and progress can improve the efficiency of enterprises in obtaining information in the credit market (Greenwood and Jovanovic, 1990), enabling the financial sector to screen borrower information more effectively, thus reducing economic fluctuations caused by financial friction caused by information asymmetry (Dynan et al., 2006). Some scholars believe that technological progress can break the resource curse, improve environmental quality and achieve sustainable economic growth (Tian and Liu, 2019). Financial development and technological innovation are important factors affecting economic growth (Ahmed and Huo, 2020), and there is a close relationship between resource consumption, environmental pollution and economic growth (Anser et al., 2020; Muhammad et al., 2021). China's green growth shows a trend of fluctuations year by year, and financial development and technological innovation are the accelerators of this phenomenon, thus exacerbating the fluctuations of green growth (Ahmed and Huo, 2020; Cao et al., 2021). Some studies have also shown that although the expansion of the scale of financial institutions and the increase of the size of the stock market will cause significant fluctuations in green growth, the interaction between financial development and technological innovation can significantly reduce the volatility of green growth (Cao et al., 2021). The study finds that green finance comprehensively promotes high-quality economic development through its positive impact on ecological environment, economic efficiency and economic structure (Yang et al., 2021c, 2021d). Therefore, financial technology innovation mainly relies on big data, artificial intelligence, cloud computing, blockchain and other technologies. Financial science and technology innovation promotes green growth by improving green credit capacity and increasing green investment, accelerating the development of green finance, and then increasing financial support, optimizing industrial structure, improving resource allocation efficiency, reducing financial friction and improving the ecological environment. Based on this, this paper puts forward the following hypothesis:

H1: Fintech innovation plays a significant role in promoting green growth.

China is a vast country, and there are great differences in economic development and fintech level, so different regions have different levels of fintech innovation and green growth. The regional heterogeneity of green growth is obvious, which is mainly reflected in that the level of green growth in eastern China is higher than that in central and western China. Some scholars have done preliminary research on this. Studies show that there are significant spatial differences among cities in China in terms of resource input, social and economic benefits, and environmental indices affecting green growth (Ma et al., 2019). The research finds that although the scale of R&D investment is not conducive to the growth of green economy in the short term, it has a positive impact on the growth of green economy, and the scale of R&D investment has a positive impact on the growth of green economy in the long term, but it is negative in the eastern and western regions at the present stage (Song et al., 2019). Foreign direct investment (FDI) has a pollution paradise effect on green growth in eastern and central China, and a pollution halo effect on green growth in western China (Qiu et al., 2021). Some scholars discussed the relative role of green technology innovation in promoting the development of green finance in central and western China and its impact on economic growth in central and western China. The results show that the impact of green technology innovation on green growth is significantly different in the east and the central and western regions (Hsu et al., 2021). Empirical studies based on Chinese provincial data suggest that China's pursuit of green growth will result in a loss of 7% to 8% of GDP. However, the eastern region will hardly be affected by strict carbon control policies, while the central and western regions will be greatly affected (Song et al., 2020). Other studies show that public expenditure on human resources and green energy technology R & D promotes the development of green economy through labor and technology-oriented production activities, but the effect is different in different countries (Zhang et al., 2021a, 2021b). Therefore, the impact of financial science and technology innovation on green growth has obvious regional heterogeneity. Based on this, this paper puts forward the following hypothesis:

H2: The impact of fintech innovation on green growth has obvious regional heterogeneity.

2.3. Influence mechanism

An empirical analysis of the coupling and coordinative development of China's green finance and economic growth (Yin and Xu, 2022). As one of the main forms of green finance, green credit will affect the growth of green economy. Studies show that green credit policies can stimulate green innovation of polluting enterprises by implementing credit constraints, thus realizing green transformation of emerging economies (Hu et al., 2021). Under the constraint of green credit policy, pollution of manufacturing industry can be reduced and sustainable economic development can be realized (Nabeeh et al., 2021; Zhang et al., 2021a, 2021b). Green credit policies can promote green growth by improving financial performance and core competitiveness of banks and encouraging commercial banks to lend to green enterprises (Zhang et al., 2021a, 2021b; Luo et al., 2021). The research finds that the green credit regulatory policy has an obvious promoting effect on the growth of green total factor productivity (GTFP), which is greater than the input-output total factor productivity (TFP) (Zhang, 2021). From the perspective of environmental constraints, green credit, credit scale, environmental regulation, technological progress and industrial structure play an important role in promoting energy efficient utilization. Therefore, green credit has a positive impact on the efficient utilization of energy (Song et al., 2021). It is found that both price type and quantity type green credit have obvious effects on output, environment, health and utility welfare, which is conducive to the green upgrading of industrial structure and achieve a win-win situation between output and environment (Liu and He, 2021). From the perspective of total loan amount, green credit policy enables green enterprises to obtain more credit resources than polluting enterprises. This policy basically achieves the original intention of directing credit resources to green enterprises, and also realizes pareto improvement of financial resource allocation, thus promoting green growth (Zhou et al., 2021a, 2021b). However, some studies have shown that green credit policy has a significant negative impact on R&D intensity and total factor productivity (TFP) of listed companies. Green credit reduces bank credit but increases trade credit, while reducing the allocation efficiency of bank credit in energy-intensive industries (Wen et al., 2021). It can be seen that fintech provides technical support for green credit, achieves optimal allocation of credit resources, improves the allocation efficiency of funds, and thus promotes green growth. Therefore, we propose the following hypothesis:

H3: Fintech innovation exerts a positive impact on green growth by increasing green credit. That is, the positive transmission mechanism of "fintech innovation → increasing green credit → promoting green growth" exists steadily.

The influence mechanism of fintech innovation on green growth is also reflected in that fintech innovation promotes green economic growth by promoting the level of green investment. Some scholars tested the spatial characteristics of green investment and spillover effects of environmental regulation and protection, pollution prevention and control, and environmental public governance by constructing spatial econometric models. The results show that economic and environmental factors play a greater role than political factors (Du et al., 2019). It is found that green investment will reduce carbon emission level in both short and long term, thus promoting green growth (Li et al., 2021; Shen et al., 2021a, 2021b). Green investment can help reduce related environmental violations and promote environmental performance, thus enhancing the impact of green investment on enterprise long-term performance (Chen and Ma, 2021). Other scholars studied the impact of public environmental concern (PEC) on enterprises' green investment from the perspective of CEO replacement. It is found that heavy polluting enterprises will relieve pressure by increasing green investment, thus promoting green growth (Gu et al., 2021). Therefore, this paper further analyzes the impact mechanism of fintech innovation on green growth from the perspective of green finance from the dimension of green investment. Therefore, the following hypotheses are proposed in this paper:

H4: Fintech innovation has a positive impact on green growth by increasing the level of green investment. That is, the positive transmission mechanism of "fintech innovation → increasing green investment → promoting green growth" exists steadily.

3. Construction of green growth index

Green growth index is the key to monitor and evaluate the running status of green growth mode. Since the definition of green growth has different connotations, scholars have different methods to construct green growth index. However, most of the early literatures on green growth and sustainable development only measured a single indicator, and could not make a comprehensive assessment of green growth (Fehr et al., 2004; Huge et al., 2010; Ou, 2012). Later, some scholars used multiple indicators to construct the green growth index. For example, 12 indicators were selected from production, consumption and environment to construct the green growth evaluation system (Kim et al., 2014). Some study constructs a comprehensive index system of green economy, and uses entropy weighted TOPSIS method to evaluate the green economic growth from 2000 to 2017 in China (Lin and Zhou, 2021). However, these indexes do not fully reflect China's reality. In order to facilitate the empirical study of the impact of financial science and technology innovation on green growth, this paper starts from the connotation of green growth, selects a number of indicators, constructs a three-level index system to measure the green growth level of 31 provinces in China, uses the dynamic factor analysis method to reduce the dimension of the index system, and then solves the weight. Thus, the green growth index of each province is calculated.

3.1. Selection of green growth indicators

The term "green growth" has transcended the narrow connotations of a mechanical combination of "green" and "growth". It represents human efforts to "promote economic growth and development by balancing environmental hazards with long-term economic growth" (OECD, 2009). Green growth is a growth mode that pursues economic growth and development while preventing environmental degradation, loss of biodiversity and unsustainable use of natural resources. While emphasizing the coordinated development of the economy and environment, it also emphasizes improving social welfare, improving human health, increasing employment and solving related resource allocation problems by changing consumption and production patterns (Zhang and Li, 2016).

Based on the above green growth index construction method and related research. Since green growth follows the "three pillars" of sustainable development, the complementarity of economic, social and environmental dimensions is emphasized (Nielsen et al., 2014). This paper draws on the research of Kim et al. (2014), Peng (2020), Cao et al. (2021), Tawiah et al. (2021), this paper constructs the green growth index from four aspects of economic development, urban construction, resources and environment, and financial support of China's provinces and regions, aiming to construct a more comprehensive green growth index that can reflect China's actual situation.

The index contains the above four secondary indicators, and under 13 tertiary indicators. As for the selection of indicators of economic development dimension, since the premise of green growth is economic development, the core connotation of green growth is economic growth (GDP growth) with significant environmental protection (Jacobs, 2012). Three indicators are mainly selected to measure the per capita GDP, the proportion of tertiary industry in GDP and the proportion of R&D expenditure of industrial enterprises above designated size in GDP. As for the selection of indicators of the dimension of urban construction, since urban construction is the greening construction capacity of people's lives, three indicators are mainly selected to measure the urban per capita green area of parks, the greening coverage rate of built-up areas, and the harmless treatment rate of household garbage. As for the selection of indicators of resource and environment dimensions, since green growth requires the fundamental improvement of environmental and resource saving technologies (Hong et al., 2013), and green economic growth is based on resource conservation and environmental protection, five indicators, namely total water consumption, total energy consumption, sulfur dioxide emissions, total wastewater discharge and chemical oxygen demand emissions, are mainly selected for measurement. As for the index selection of financial support dimension, since financial support reflects the local government's emphasis on green growth, the proportion of total investment in environmental pollution control in GDP and the proportion of investment in industrial pollution control in industrial added value are mainly selected for

Table 1
Indicator system of green growth.

Primary index	Secondary index	Tertiary indicators	Symbol	Unit
Green growth index	Economic development	Per capita GDP	X1	Yuan
		tertiary industry in GDP	X2	%
		Proportion of R & D expenditure of Industrial Enterprises above Designated Size in GDP	X3	%
	Urban construction	Greening coverage rate of built-up area	X4	%
		Harmless treatment rate of domestic waste	X5	%
		Urban per capita park green space area	X6	Square meters
	Resource environment	Total water consumption	X7	hundred million cubic meters
		Total energy consumption	X8	10,000 ton standard coal
		Sulfur dioxide emissions	X9	ton
		Total wastewater discharge	X10	10,000 tons
		COD emissions	X11	10,000 tons
	Financial support	Proportion of total investment in environmental pollution control in GDP	X12	%
		Proportion of industrial pollution control investment in industrial added value	X13	%

measurement. The specific index system is shown in Table 1. To sum up, the impact mechanism of fintech innovation on green growth (See Fig. 1.)

3.2. Solution of green growth index

After constructing the three-level indicator system of green growth index, this paper tries to further solve the weight by reducing the dimension of 13 three-level indicators, so as to reflect the regional green growth level more objectively. Considering that the selected data is the panel data of 31 inter provincial regions, this paper attempts to use the dynamic factor analysis method to reduce the dimension of 13 indicators. Different from traditional factor analysis, Federici and Mazzitelli, 2005pointed out that dynamic factor analysis is aimed at panel data, and its basic idea is to transform "dynamic data" into "static data". In other words, the dynamic factor analysis method is to calculate the average value of panel data in the dimension of time, integrate the panel data into "static data", and then extract common factors using principal component method from correlation matrix or covariance matrix, so as to achieve the purpose of dimensionality reduction. Therefore, this paper calculates the correlation matrix of panel data for each year, and then calculates the average of the correlation matrix in the time dimension. Finally, starting from the average correlation matrix, the principal component method is used to extract the common factor. The specific principles are as follows:

Assuming that

$$X(I,J,T) = \{X_{ijt}\}\ i = 1,2,\dots,I; j = 1,2,\dots,J; t = 1,2,\dots,T.$$

where: i represents different subjects; j represents different indicators; t different times.

Firstly, the correlation matrix S of $X(I,J,T)$ is decomposed into three independent correlation matrices:

$$S = S(I)^* + S(IT) + S(T)^* \tag{1}$$

In formula (1), $S(I)^*$ is the static structure matrix of the subject, representing the intertemporal correlation matrix of each subject, reflecting the relative structural differences of each subject independent of the time dimension; S(IT)is the dynamic difference matrix of a single subject, representing the correlation matrix of individual and time interaction, reflecting the dynamic difference caused by the change of the overall average level of all subjects and the change of a single subject. $S(T)^*$ is the average dynamic change matrix, representing the correlation matrix of each period, reflecting the dynamic difference in time dimension that eliminates individual influence.

$$S = (S(I)^* + S(IT)) + S(T)^* = S(T) + S(T)^* \tag{2}$$

Eq. (2) is a simplification of Eq. (1), in which: $S(T)$ refers to the average correlation matrix of different periods generated by principal component analysis, and $S(T)^*$ represents the variation of different periods generated by a linear regression model. Federici and Mazzitelli (2005) pointed out that $S(T)$, as an average correlation matrix, meant that panel data was averaged to the cross-section dimension, and PCA was used to solve it. $S(T)^*$ represents the change trend in time, which is solved by linear regression model. In order to achieve the purpose of dimensionality reduction, this paper will focus on the solution and analysis of $S(T)$. After solving $S(T)$, the principal components will be extracted from the correlation matrix.

$$S(T) = \frac{1}{T}\sum_{t=1}^{T} S(t) \tag{3}$$

Before using dynamic factor analysis to solve the index weight, this paper first standardized the data set of green growth indicator system from 2011 to 2018 to eliminate the influence of dimension. Secondly, dynamic factor analysis was carried out in this paper by using R language. Four common factors were extracted, and the cumulative variance contribution rate reached 76%, which indicated that the interpretation degree of the four common factors to the original data reached the expected level. The specific results are shown in Table 2. The extraction results of common factors are shown in Fig. 2.

In addition, as can be seen from the extraction results of common factors in Fig. 2, the extraction results of common factors by dynamic factor analysis in R language are consistent with the assumption of the green growth indicator system originally constructed in this paper, which indicates that the dimensionality reduction results by dynamic factor analysis are in line with expectations. Starting from the indicators extracted from the common factors, the four common factors represent

Table 2
Dynamic factor analysis results.

	RC1	RC2	RC3	RC4
SS loadings	4.01	2.07	1.93	1.85
Proportion Var	0.31	0.16	0.15	0.14
Cumulative Var	0.31	0.47	0.62	0.76

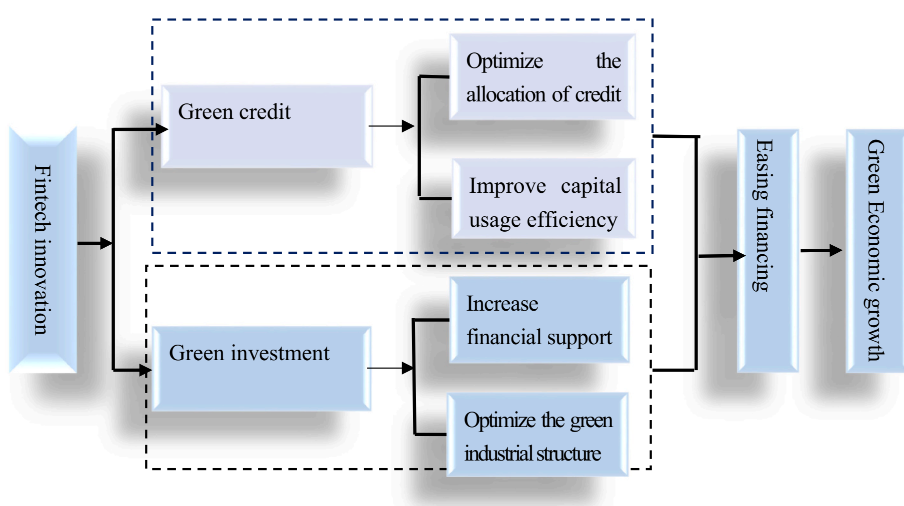

Fig. 1. The impact mechanism of fintech innovation on green growth. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

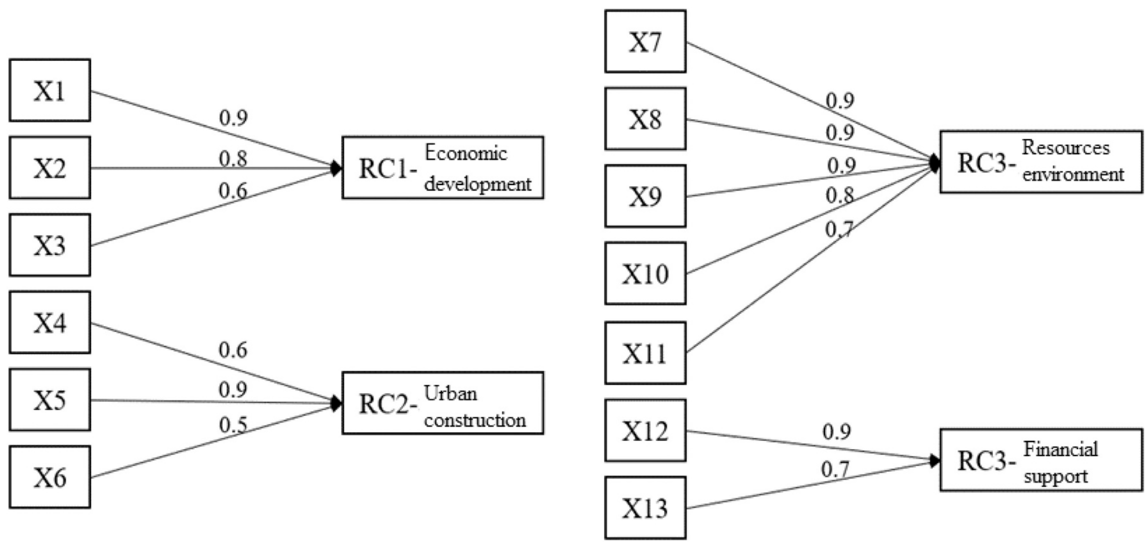

Fig. 2. Common factor extraction results.

the meanings of economic development, urban construction, resources environment and financial support respectively. Finally, this paper uses the principal component score coefficient to solve the score of the four principal components, and then calculates the comprehensive score according to the variance contribution rate of each principal component, and finally obtains the green growth index. The calculation formula is shown in Formula (4), where represents the comprehensive score, and $RC1$, $RC2$, $RC3$ and $RC4$ represent four common factors. Therefore, the calculation result of green growth index is shown in Fig. 3.

$$Y = RC1^{*}0.31 + RC2^{*}0.16 + RC3^{*}0.15 + RC4^{*}0.14 \quad (4)$$

4. Study design

4.1. Data source and description

In order to unify the caliber of each indicator and make the data comparable, the data of each indicator mainly come from Wind database, Peking University Digital Financial Inclusion Index (DFI), China Statistical Yearbook and China Environmental Statistics Yearbook. At the same time, this paper also constructs the green growth index. In order to study the impact of fintech on green growth, the indicators related to fintech and green growth in 31 inter-provincial regions in China from 2011 to 2018 are selected from multiple dimensions.

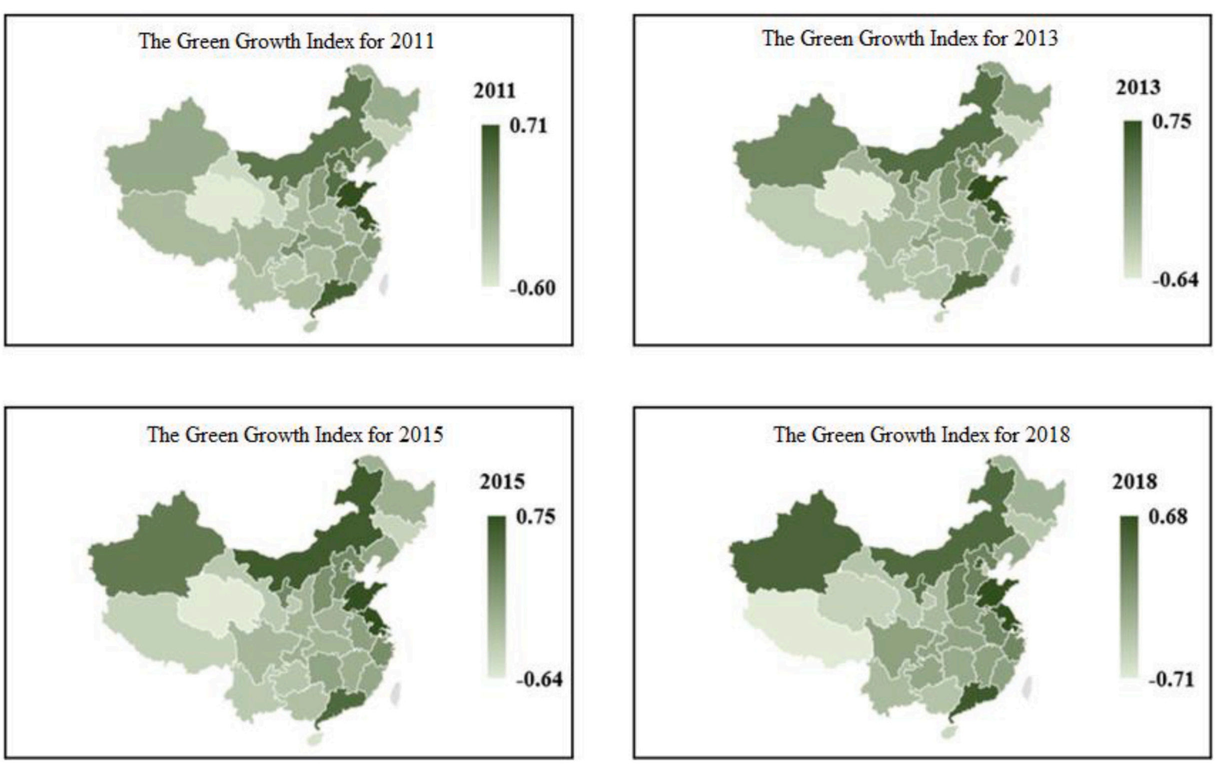

Fig. 3. Regional green growth index of each province. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

4.2. Variable selection

Explained variable: Green growth ($Green\_growth_{it}$), which is replaced by the green growth index calculated in this paper to measure the green growth level of China's 31 inter-provincial regions.

Explanatory variable: fintech innovation level ($Fintech_{it}$), which is replaced by the fintech innovation development level of China's 31 inter-provincial regions. This paper selects the authoritative China Digital Financial Inclusion Index (DFI), which can reflect the progress of digital financial inclusion and further reflect the development level of fintech in China's 31 inter-provincial regions. There are three secondary indicators under the Digital Financial Inclusion Index. First, $Fintech\_breadth_{it}$ represents the coverage of digital financial inclusion, mainly reflecting the coverage of fintech innovation. Second, $Fintech\_depth_{it}$ represents the depth of application of digital inclusive finance, which mainly reflects the application of fintech innovation in credit, investment, insurance and payment. Third, $Fintech\_digital_{it}$ represents the degree of digitalization of inclusive finance, which mainly reflects the characteristics of mobile, affordable, credit and facilitation of fintech innovation. At the same time, 33 third-level indexes are set under the second-level indexes.

The control variables are: $Capital_{it}$ is the proportion of scientific research and technical personnel in the total population, $Labor_{it}$ is the registered urban unemployment rate, and $Education_{it}$ is the proportion of the number of students in regular institutions of higher learning in the total population. The proportion of scientific and technical personnel in the total population indirectly reflects the technology input of a region, which indirectly affects the green growth level of the region. Therefore, this paper expects the sign of this variable to be positive. The higher the registered urban unemployment rate is, the lower the labor input of the region is, which is not conducive to the improvement of the regional green growth level. Therefore, the sign of this variable is expected to be negative in this paper. The proportion of the number of students in ordinary institutions of higher learning to the total population reflects the level of education in the region. The higher the level of education is, the more high-end technical talents will be, which is a steady driving force for the improvement of green growth level. Therefore, this paper expects the sign of this variable to be positive.

Intermediate variable: Based on the above analysis of the influence mechanism of fintech innovation level on green growth, this paper selects $Green\_credit_{it}$ green credit and $Green\_invest_{it}$ green investment level as intermediate variables from the perspective of green finance to test the influence mechanism of fintech innovation on green growth. The index variables in this paper are summarized in Table 3.

Table 3
Variable definitions.

Variable types	Variable name	Variable symbol	Variable selection
Explained variable	Green growth index	$Green\_growth_{it}$	Green growth composite index
Explanatory variables	Financial science and technology innovation level	$Fintech_{it}$	Digital inclusive financial index
Control variables	Labor input	$Labor_{it}$	the registered urban unemployment rate
	Technical input	$Capital_{it}$	Proportion of scientific research and technical personnel in the total population
	Education level	$Education_{it}$	Proportion of students in ordinary colleges and universities in the total population
Instrumental variable	Internet development level	$Internet_{it}$	Investment in fixed assets of information transmission, computer services and software industry
Robustness test	Coverage breadth	$Fintech\_breadth_{it}$	Coverage of digital Inclusive Finance
	Use depth	$Fintech\_depth_{it}$	Depth of digital Inclusive Finance
	Degree of digitization	$Fintech\_digital_{it}$	Digital Inclusive Finance
Mechanism test	Green credit	$Green\_credit_{it}$	Green credit balance (100 million yuan)
Mechanism test	Green investment	$Green\_invest_{it}$	Local financial expenditure on environmental protection / total local financial expenditure

4.3. Econometric model

In this paper, the panel regression model is used to study the impact of financial science and technology innovation on green growth. In the model, the green growth index $Green\_growth_{it}$ is the explanatory variable, the level of financial science and technology innovation $Fintech_{it}$ is the explanatory variable, and the technology input $Capital_{it}$, labor input and education level $Education_{it}$are the control variables.

The panel regression in this paper adopts three different estimation strategies of mixed regression, fixed effect and random effect respectively. First, the estimation strategy is judged. The panel regression F test results show that the p value is less than 0.05, which rejects the null hypothesis, indicating that the fixed effect model is superior to the mixed regression model. Secondly, the panel regression BP test results show that the random effect is better than the mixed regression model. Finally, the hausmann test results show that, rejecting the null hypothesis, the fixed effect model is superior to the random effect model. To sum up, this paper constructs a fixed effect model to analyze the impact of fintech innovation on green growth. The benchmark regression model is shown in Formula (5). In the model, i represents 31 inter-provincial regions in China, t represents year, and ε represents random disturbance term. Benchmark regression will be used to test hypothesis:

H1: fintech innovation has a significant contribution to green growth.

$$Green\_growth_{it} = \alpha_0 + \beta_1 Fintech_{it} + \beta_1 Technology_{it} + \beta_1 Labor_{it} + \beta_1 Education_{it} + \varepsilon_{it} \quad (5)$$

In addition, in order to further analyze the impact of financial science and technology innovation on green growth, this paper will test the regional heterogeneity of financial science and technology innovation on green growth, and analyze whether there are differences in the promotion degree of financial science and technology innovation on green growth in the East, central and West Regions. Heterogeneity test will be used to test hypothesis H2: the impact of financial science and technology innovation on green growth has regional heterogeneity.

Finally, through the mechanism test, this paper fully describes the impact mechanism of financial science and technology innovation on green growth. The recursive eqs. (6), (7) and (8) are set to analyze whether the transmission mechanism of intermediary variables exists, so as to more clearly describe the impact path of financial science and technology innovation on green growth. The test of intermediate variables will be used to test hypothesis H3 and H4 that fintech innovation has a positive impact on green growth through increasing green credit and green investment.

$$Green\_growth_{it} = \alpha_0 + \beta_1 Fintech_{it} + \sum \beta CV + \varepsilon_{it} \quad (6)$$

$$Mediators_{it} = \alpha_0 + \beta_2 Fintech_{it} + \sum \beta CV + \varepsilon_{it} \quad (7)$$

$$Green\_growth_{it} = \alpha_0 + \beta_3 Fintech_{it} + \beta_4 Mediators_{it} + \sum \beta CV + \varepsilon_{it} \quad (8)$$

5. Test results and analysis

5.1. Descriptive statistics

The descriptive statistical results of variables are shown in Table 4. From the mean value, it can be seen that during 2011–2018, the green growth index of the explained variable and the financial science and technology innovation level of the explanatory variable showed an obvious upward trend, so the three-dimensional indicators of digital inclusive financial coverage, depth of use and digitization that constitute the financial innovation level showed the same development trend as the financial science and technology innovation level. This reflects the increased level of green growth and fintech innovation in 31 Chinese provinces during the 2011–2018 period. From the perspective of maximum and minimum values, the gap between the green growth index of the explained variable and the fintech innovation of the explained variable, as well as between the maximum and minimum values of the three dimensions is relatively large. This shows that the green growth level and fintech innovation level of China's 31 provinces are unbalanced, and there are great differences among regions.

5.2. Benchmark regression

Firstly, the panel data of 31 provinces in China are used for benchmark regression, and the regression results are shown in Table 5. Following the approach of stepwise regression, this paper first only controls the fixed effect, and does not add relevant control variables. The test results are shown in Column (1). It is found that the regression coefficient of fintech innovation level is significantly positive, indicating that the fintech innovation level has a significant promoting effect on green growth Second, the test results after successively introducing relevant control variables are shown in Column (2). It is found that the fintech innovation level of explanatory variable passes the significance test of 5% confidence level, and the positive effect of fintech innovation level on green growth still unchanged as can be seen from the fitting results, the improvement of 1% fintech innovation level will bring about 0.0737% green growth. The test results are shown in Column (3). All the above test results show that fintech innovation has a significant impact on green growth.

Table 4
Descriptive statistics.

Variable	Year	Min	Max	Mean	Standard error
	2011	−0.6005	0.7144	−0.0400	0.0551
Green_growth$_{it}$	2015	−0.6397	0.7521	−0.1000	0.0641
	2018	−0.7062	0.6807	−0.0700	0.0653
Fintech$_{it}$	2011	16.2200	80.1900	40.00419	3.2879
	2015	186.3800	278.1100	220.0084	4.0525
	2018	263.1239	377.7337	300.2082	5.2605
Technology$_{it}$	2011	0.0022	0.0291	0.0051	0.0009
	2015	0.0024	0.0316	0.0061	0.0009
	2018	0.0024	0.0385	0.0057	0.0011
	2011	0.0047	0.0185	0.0117	0.0006
Labor$_{it}$	2015	0.0042	0.0197	0.0113	0.0007
	2018	0.0042	0.0199	0.0107	0.0008
	2011	0.0174	0.0545	0.0339	0.0013
Education$_{it}$	2015	0.0194	0.0538	0.0342	0.0012
	2018	0.0214	0.046963	0.0340	0.0010
	2011	77.8480	4952.172	1611.085	1268.539
Green_credit$_{it}$	2015	158.1234	6658.74	2151.126	1610.955
	2018	322.8702	9858.69	2925.092	2255.499
	2011	0.0132	0.0499	0.0289	0.0096
Green_invest$_{it}$	2015	0.0169	0.0576	0.0307	0.0101
	2018	0.01496	0.0561	0.0313	0.0097
	2011	1.9600	98.8500	34.2781	27.2297
Fintech_breadth$_{it}$	2015	139.87	268.39	191.1113	28.8401
	2018	249.8197	353.86	281.9223	26.6400
	2011	6.7600	93.5200	46.9326	21.7480
Fintech_depth$_{it}$	2015	125.25	259.81	173.6632	33.6784
	2018	225.2748	400.3972	287.4968	44.1420
	2011	7.5800	93.4200	46.3194	19.3775
Fintech_digital$_{it}$	2015	373.77	453.66	399.6403	21.6580
	2018	349.7658	440.2605	383.7016	21.2866

Due to space constraints, descriptive statistics for only some years are presented in Table 3.

Table 5
Benchmark regression.

Variable	(1)	(2)	(3)
	Green_growth$_{it}$	*Green_growth*$_{it}$	*Green_growth*$_{it}$
Fintech$_{it}$	0.094**	0.076**	0.0737**
	(2.60)	(2.13)	(2.11)
Technology$_{it}$	11.612**	12.831**	11.770**
	(2.25)	(2.55)	(2.37)
Labor$_{it}$		−17.860***	−19.048***
		(−3.68)	(−3.98)
Education$_{it}$			8.424***
			(2.91)
α_{it}	−0.063	0.1313	−0.1366
	(−2.04)	(2.16)	(−1.25)
R^2	0.1030	0.1499	0.1393
obs	248	248	248

***, **, * respectively indicate passing the test at the significance level of 1%, 5% and 10%. (the same below).

5.3. Endogenous test

The above analysis shows that technological innovation will have an impact on green growth, but some studies also show that the setting of economic growth target also has a significant inhibitory effect on green technological innovation (Shen et al., 2021a, 2021b). Similarly, green growth will also have an impact on fintech innovation. When the level of green economic growth increases, fintech innovation will be paid attention to and the level of fintech innovation will be improved. Therefore, there may be endogenous problems between fintech innovation and green growth. In other words, there may be a reverse causality relationship between the financial technology innovation level *Fintech*$_{it}$ of the explanatory variable and the green growth level *Green_growth*$_{it}$ of the explained variable. Therefore, in order to alleviate the potential endogeneity problems in the econometric model, this paper adopts two methods of replacement explanatory variables and system GMM respectively.

In this paper, the explanatory variables of the lagging period are introduced to replace the explanatory variables of the current period. Since the innovation level of fintech lagging behind the first phase will affect the green growth level of the current economic period, and the green growth level of the current economic period cannot adversely affect the innovation level of the last phase of fintech, this eliminates the influence of the current phase to a certain extent, thus alleviating the problem of endogeneity. The regression results of the lagging term method are shown in Table 6 (1). The results show that the fintech

Table 6
Endogeneity test

Variable	*Green_growth*$_{it}$ (1)	*Green_growth*$_{it}$ (2)
L. Fintech$_{it}$	0.067*	0.461***
	(1.88)	(4.71)
Technology$_{it}$	12.101**	−28.981***
	(2.24)	(−3.72)
Labor$_{it}$	−19.354***	10.341
	(−3.16)	(0.93)
Education$_{it}$	13.365***	1.016
	(4.27)	(0.22)
α_{it}	−0.313***	0.018
	(−2.67)	(0.09)
R^2	0.154	
obs	248	248
Weak instrumental variable checking		Pass

innovation level of the lagging term still has a significant promoting effect on green economic growth, and the test results are basically consistent with the baseline regression.

In order to further solve the influence of endogeneity, this paper adopts instrumental variable method to alleviate endogeneity through two-stage least-squares 2SLS regression. Information transmission, computer service and software industry fixed asset investment completion $Internet_{it}$ were selected as the instrumental variable of fintech innovation level. As an instrumental variable, the following four conditions must be met: (1) Highly correlated with the random explanatory variable replaced. (2) Is not correlated with the random error term. (3) It is not correlated with other explanatory variables in the model. (4) When multiple tool variables need to be introduced into the same model, there is no correlation between these tool variables. The tool variable chosen in this paper meets the condition of being a tool variable. The instrumental variables selected in this paper not only reflect the hardware facilities of fintech innovation level, but also are highly correlated with fintech innovation level. At the same time, it will not have a direct impact on the growth of the green economy, so it is appropriate to choose $Internet_{it}$ as the tool variable. The regression results are shown in column (2) of Table 5, and the test results are still consistent with the baseline regression.

5.4. Robustness test

The digital financial inclusion Index is composed of three dimensions, $Fintech\_breadth_{it}$, $Fintech\_digital_{it}$ and $Fintech\_depth_{it}$. Therefore, in the robustness test, this paper replaces the explanatory variable fintech innovation level in the benchmark regression with these three indicators in turn. The results of robustness test are shown in Table 7. The test results showed that all dimension index variables passed the significance test. This shows that the impact of fintech innovation on green growth is stable.

5.5. Heterogeneity test

In order to further study the impact of fintech innovation on green growth, this part will focus on analyzing the regional heterogeneity of the impact of fintech innovation on green growth. According to “China Statistical Yearbook”, 31 provinces of China are divided into three regions: eastern, central and western, and tested respectively according to the established model.

The regional heterogeneity test results are shown in Table 8. The financial science and technology innovation level in the East has passed the significance test of 5% confidence level. According to the fitting results, the improvement of 1% financial science and technology innovation level has led to an increase of 0.129% of the regional green growth level, which is higher than the national average level. The fintech innovation level in the panel regression of central and western regions did not pass the significance test, so it was not listed in the table. Based on the above results, it can be concluded that the impact of fintech innovation on green growth has obvious regional heterogeneity, that is, hypothesis H2 is valid.

Table 7
Robustness test.

Variable	$Green\_growth_{it}$	$Green\_growth_{it}$	$Green\_growth_{it}$
$Fintech\_breadth_{it}$	0.135***		
	(3.05)		
$Fintech\_digital_{it}$		0.018*	
		(1.68)	
$Fintech\_depth_{it}$			0.029*
			(1.78)
$Technology_{it}$	13.891**	8.86*	−0.675
	(2.56)	(1.86)	(−0.18)
$Labor_{it}$	−17.443***	−16.044***	−12.778***
	(−3.21)	(−3.32)	(−3.66)
$Education_{it}$	12.844***	7.500***	5.370*
	(4.04)	(2.70)	(2.51)
α_{it}	−0.323***	−0.121	−0.053
	(−2.70)	(−1.14)	(−0.66)
R^2	0.1909	0.1192	0.1011
obs	248	248	248

Table 8
Test of domain heterogeneity.

Variable	Eastern part
$Fintech_{it}$	0.129**
	(2.31)
$Technology_{it}$	9.206
	(1.46)
$Labor_{it}$	−28.835**
	(−2.45)
$Education_{it}$	6.666
	(0.67)
α_{it}	0.0783
	(0.22)
R^2	0.2215
obs	88

The essential reason of regional heterogeneity lies in the difference of economic level among the three regions. The eastern region has significant geographical advantages and resource endowment, early start of economic development, and high level of fintech innovation. Moreover, the Beijing-Tianjin-Hebei Region, Yangtze River Delta, Guangdong-Hong Kong-Macao and other urban agglomerations provide material foundation and technical support for regional development, and its fintech innovation and development level and green growth are ahead of other regions. In this context, fintech innovations can be more quickly transformed into a driving force for green economic growth. However, the economic development level of central and western regions is low, and the local government’s support for fintech innovation and green growth is insufficient, which leads to the problems of insufficient impetus, low innovation efficiency and long cycle of fintech innovation, and the promotion effect of fintech innovation on green growth is not significant.

5.6. Mechanism test

In order to further test the impact mechanism of financial science and technology innovation on green growth, this paper selects green credit and green investment as the intermediary variables of the development level of green finance. In terms of green credit, green credit balance ($Green\_credit_{it}$) is selected as an intermediary variable to reflect the financing level of enterprises through bank loan channels. In terms of green investment ($Green\_invest_{it}$), by referring to the measurement analysis of the development degree of green finance in China by Zeng et al. (2014), local fiscal environmental protection expenditure/total local fiscal expenditure is selected as an intermediary variable to measure the financing level of enterprises through other channels except bank loans. The choice of these two mediators takes into account the correlation with green growth and fintech innovation. In order to fully characterize the transmission mechanism between the two, this paper constructed the following recursive eq. (9)–(13) to test the mediating mechanism of relevant variables and further test the influence mechanism of fintech innovation on green growth. In the mechanism test, if the mediation effect exists, the following conditions should be met: First, β_1 is statistically significant, otherwise the mediating effect is not significant; Second, when β_2 and β_4 are both significant, if β_3 is significant and the impact of fintech innovation on green growth becomes insignificant, there will be a partial intermediary effect. Third, when β_2 and β_4 are both significant, if β_3 is not significant, it indicates that there is a complete mediation effect.

$$Green\_growth_{it} = \alpha_0 + \beta_1 Fintech_{it} + \sum \beta CV + \varepsilon_{it} \quad (9)$$

$$Green\_credit_{it} = \alpha_0 + \beta_2 Fintech_{it} + \sum \beta CV + \varepsilon_{it} \tag{10}$$

$$Green\_invest_{it} = \alpha_0 + \beta_2 Fintech_{it} + \sum \beta CV + \varepsilon_{it} \tag{11}$$

$$Green\_growth_{it} = \alpha_0 + \beta_3 Fintech_{it} + \beta_4 Green\_credit_{it} + \sum \beta CV + \varepsilon_{it} \tag{12}$$

$$Green\_growth_{it} = \alpha_0 + \beta_3 Fintech_{it} + \beta_4 Green\_invest_{it} + \sum \beta CV + \varepsilon_{it} \tag{13}$$

First, this paper examines the mechanism path of green credit (*$Green\_credit_{it}$*) as a mediator variable. According to the year-end balance of green credit of 21 major commercial banks disclosed by China Banking Regulatory Commission, the balance of green credit is calculated by multiplying the year-end balance of green credit of 21 major commercial banks by the proportion of the balance of loans of inter-provincial and regional financial institutions in the balance of loans of national financial institutions. The test results are shown in Table 9. Calculate the balance of green credit. The mechanism test results of green credit are shown in Table 8. The test results showed that , β_1 passed the significance test, and β_2 , β_3 and $\beta_4$were also significant. This suggests a partial mediating effect. The test results confirm the robust existence of the transmission mechanism of "fintech innovation promotes green growth through increasing green credit", so hypothesis H3 is established. This shows that fintech innovation can improve the ability of commercial banks to identify high-quality enterprises, so as to make the contribution of green credit more accurate and put funds into enterprises with real demand for green capital. At the same time, the increase of green credit will help increase financial support, optimize the industrial structure through improving the efficiency of capital allocation, and then promote green growth.

Secondly, this paper tests the mechanism path of green investment (*$Green\_invest_{it}$*) as an intermediary variable, and the test results are shown in Table 10. The results showed that β_1 passed the test of significance, β_2、 β_3 and $\beta_4$were significant. This suggests a partial mediating effect. The test results confirm that the positive transmission mechanism of "fintech innovation promotes green growth through increasing green investment" is robust, so hypothesis H4 is established. This shows that fintech innovation can reduce financing constraints, promote green investment and promote green growth by broadening financing channels, improving financing environment and reducing financing costs for enterprises. Therefore, fintech will increase financial support and optimize green industrial structure through green investment, and ultimately promote green economic growth.

6. Conclusion and enlightenment

In this paper, the influence mechanism of fintech innovation level on green growth is analyzed, and the green growth index that accords with China's reality is tentatively constructed. By using the panel data of 31 provinces in China, a panel regression econometric model is established to test the influence of fintech innovation on green growth. The results show that:(1) the impact of fintech innovation on green growth is mainly reflected in that fintech innovation promotes the development of green finance through green credit, green investment and other mechanisms, thus promoting green growth. (2) The level of financial science and technology innovation can significantly promote green economic growth. The green growth of economy is inseparable from the drive of scientific and technological innovation, and green growth cannot be based on low efficiency. The high-efficiency development pursued by green growth needs the drive of financial scientific and technological innovation. (3) The impact of fintech innovation on green growth has obvious regional heterogeneity. Heterogeneity test results show that the impact of fintech innovation on green growth in the eastern region is significantly stronger than that in the central and western regions, which is mainly caused by the differences in economic development levels among the three regions. (4) Fintech innovation can promote green economic growth by improving green credit and green investment. The mechanism test results show that fintech innovation can significantly improve the balance of green credit and green investment. Therefore, fintech innovation can promote green economic growth while promoting green finance by increasing green credit and green investment.

To this end, it is necessary for eastern, central and western China to step up support for green growth, focus on the systematism, integrity and synergy of fintech development, and further promote green growth and coordinated development across China's provinces and regions. It is urgent to actively promote the implementation of fintech innovation achievements and dredge the transmission mechanism of fintech innovation to promote green growth. However, it is still necessary to strengthen the supervision of fintech innovation to prevent the adverse impact of fintech risks while continuously strengthening the development of fintech innovation.

The shortcomings of this paper are as follows: First, when measuring the level of fintech innovation, the sample range is short because it only contains data of 8 years, and there are certain limitations in the selection of green growth indicators. Second, when testing the impact of green finance on green growth, this paper only selects two dimensions of green credit and green investment for the mechanism test. In the future, with the rapid development of green finance, the mutual relationship and influence mechanism between fintech innovation and green growth can be studied from more dimensions

Table 9
Green credit mechanism test.

Variable	(1)	(2)	(3)
	$Green\_growth_{it}$	*$Green\_credit_{it}$*	*$Green\_growth_{it}$*
$Fintech_{it}$	0.0737**	0.0010***	0.0631*
	(2.11)	(16.46)	(1.80)
$Green\_credit_{it}$			0.00026**
			(2.08)
$Technology_{it}$	11.770**	14.497**	16.205***
	(2.37)	(4.18)	(3.00)
$Labor_{it}$	−19.048***	−4.586	−21.829***
	(−3.98)	(−1.20)	(−4.42)
$Education_{it}$	8.424***	−0.288	8.479***
	(2.91)	(−0.16)	(2.94)
α_{it}	−0.1366	−0.008	−0.139
	(−1.25)	(−0.11)	(−1.28)
R^2	0.1393	0.1624	0.1565
obs	248	248	248

Table 10
Test of green investment mechanism.

Variable	(1)	(2)	(3)
	$Green\_growth_{it}$	*$Green\_invest_{it}$*	*$Green\_growth_{it}$*
$Fintech_{it}$	0.0737**	0.005**	0.070**
	(2.11)	(2.53)	(2.00)
$Green\_invest_{it}$			1.040*
			(1.71)
$Technology_{it}$	11.770**	1.432***	11.369**
	(2.37)	(4.41)	(2.30)
$Labor_{it}$	−19.048***	0.076	−20.051***
	(−3.98)	(0.24)	(−4.17)
$Education_{it}$	8.424***	−0.031	8.614***
	(2.91)	(−0.61)	(2.97)
α_{it}	−0.1366	0.021***	−0.160
	(−1.25)	(4.90)	(−1.45)
R^2	0.1393	0.156	0.151
obs	248	248	248

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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