

# *A Study on Whether the Green Finance Reform and Innovation Pilot Zone can Promote High Quality Economic Development—Empirical Examination Based on Data from 286 Prefecture-level Cities*

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**Abstract:** Taking the introduction of the green financial reform and innovation pilot zone in 2017 as a quasi-natural experiment, the impact of the green financial reform pilot zone on the high-quality development of the economy is studied. The results demonstrate that the pilot policy has helpful effect to the high-quality development of China. The results at different latitudes demonstrate that the policies have an apparent influence on innovation and greening of the economy, the economic green development, and the economic sharing development, but the impact effect on the economic high efficiency and structural optimization is not significant. Further research shows that there is regional heterogeneity in the high-quality by pilot policy, and the policy impact is more significant in the city samples in the eastern area. This paper provides a good research perspective for understanding the relationship between green finance and high-quality economic development, provides evidence for promoting pilot policy nationwide, and provides value to follow for improving the green financial system and economic high-quality construction.

## 1. Introduction

Green finance, as a fusion of finance and green economy, bears the important task of enhancing economic growth potential and accelerating the economy is moving towards green development [1], and has become a new engine for the development of green economy and the promotion of high-quality economic development. The establishment of pilot zones as a symbol of the landing and implementation of green financial reform, only a few literatures empirically test the measurement of the green financial development level of green financial reform and innovation pilot zones [2], this paper selects the panel data of 286 prefecture-level cities in China from 2013 to 2021 to research on the relationship between China's green financial innovation pilot policy and economic high-quality development.

The possible marginal shining point lies in the following: firstly, as a comprehensive policy, the use of double-difference models can identify the policy net effect and further make up for the shortcomings of the research on single green financial products and related theoretical studies. Second, in view of the difficulty of obtaining data at the city level, current research focus more on provincial level, to study what aspects are linked between green finance and high-quality economic development. But this paper focus on prefecture-level city, trying it find the influence of the pilot policy on high- equality economic development, which has an innovative impact to the research.

## 2. Theoretical Analysis and Research Hypothesis

Based on the five concepts, this paper decomposes economic high-quality development into economic innovation development, economic efficient development, economic structure optimization, economic green development, and economic sharing development. In the high-quality economic development, economic innovation corresponds to the problem of development power, economic efficiency corresponds to the problem of development efficiency, economic coordination corresponds to the problem of development structure, economic green corresponds to the problem of development mode, and economic sharing corresponds to the problem of development equity. This paper will explore the influence of pilot policies on high quality development. This paper focuses on five aspects, and specific impact mechanism is analyzed in Figure 1.

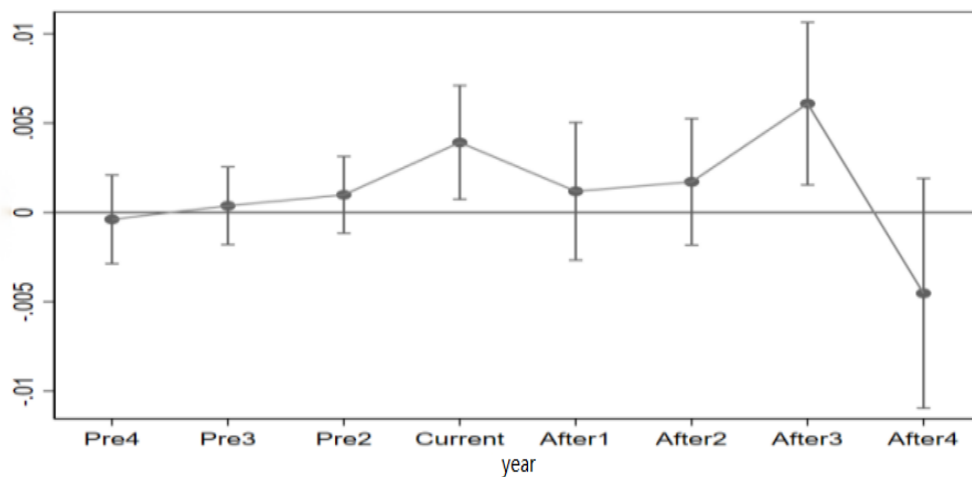


Figure 1: Parallel trend test

### 2.1. Green Finance and Innovative Economic Development

Innovation is the first power to lead development [3]. First, Green technology takes into account energy conservation, emission reduction and sustainable development in a green way, and becomes a continuous driving force for realizing green economic transformation and sustainable development. Secondly, Green finance has green bonds and other financial instruments can reasonably allocate the risk and return, provide different investors risk investment preferences, for science and technology innovation to maximize the collection of financial support. Green finance provides funding channels for the production and research and development of green technologies through risk investment and the provision of financing, thus facilitating the green innovation development Based on this, this paper proposes the following hypotheses.

H1: Pilot policies can promote innovative economic development.

## 2.2. Green Finance and Efficient Economic Development

Reasonable and effective green finance policies not only have a qualitative "structural adjustment" effect on the economy, but also play a quantitative role in "stabilizing growth". Green financial policy as a means of environmental regulation, can be internalized through the cost of polluting enterprises, thus crowding out the survival space of inefficient enterprises, prompting enterprises to improve the efficiency of resource allocation, and directly contribute to economic growth. For green enterprises, the green credit policy will alleviate some of the financing constraints, which means that enterprises can increase their investment in innovation, thus favoring the innovative development of enterprises and improving the competitiveness of the industry [4]. Although, China's green industry has obtained more funds under the tilt of the policy, but the green industry policy started late, the construction of the legal system about green finance is not yet sound, resulting in the waste of resources. Consequently, this paper raises the hypotheses.

H2a: Pilot policies promote efficient economic development.

H2b: Pilot policies inhibit efficient economic development.

## 2.3. Green Finance and Economic Structure Optimization

Structural adjustment is the core of economic transformation. The creation of pilot policy can realize the transformation of polluting industries to green industries and the advanced industrial structure by attracting foreign investment and strengthening environmental regulations at the macro level [5]. Through limiting the expansion of non-green industries, green finance achieves top-down optimization and restructuring of industries, leading to the consolidation of capital, labor, and technology. This, in turn, fosters an enhancement in the overall economic efficiency of society. However, too fast-paced green industry transformation and elimination of backward production capacity will bring huge transformation costs, which will, on the contrary, impede further optimization of the industrial structure towards rationalization, advancement and greening, and will further increase the risks in green industry transformation. Consequently, this paper raises the hypotheses.

H3a: Pilot policies promote structural optimization of the economy.

H3b: Pilot policies inhibit structural optimization of the economy.

## 2.4. Green Finance and the Greening of the Economy

The realization of economic green development should take build an ecological civilization as a goal, take the road of sustainable development of resources, and realize the synergistic optimization of ecology and economy [6]. First, the influence of green finance on the green development of the economy from the view of the main body. Green finance, as an amalgamation of finance and green economy, offers support for environmental enhancement and the advancement of green industries. Additionally, green finance possesses the inherent capability to stabilize the financial economy, thereby facilitating high-quality economic development [7]. The second is the way in which green finance affects the greening of the economy. Green financial policy can promote the green development of the economy through investment supervision and guiding green consumption. Green finance absorbs the savings of enterprises and individuals to form social capital, and in order to protect their own investment income from loss, enterprises and individuals will take note of the whole procedure of investment to make it conform to green standards.

H4: Pilot policies to promote green economic development

## 2.5. Green Finance and Shared Economic Development

The shared development of the economy is the value orientation of the goal of high-quality economic development [8]. Economic development and the protection of environmental resources are the main objectives of the development of green finance, with the purpose of realizing the sustainable development of the economy. The cost-risk sharing effect of green finance can effectively solve the "congestion" problem of green finance in the advanced stage of economic development and help the economy realize high-quality development [9]. Therefore, green financial policies and activities to education, environmental protection and other green industries tilt to make the economic benefits continue to grow, can to a certain extent contribute to the realization of the shared development. However, as China is coupled with the gradual loss of the dividends of factors such as population, resources and the environment, the transformation and optimization of the industrial structure will face difficulties in the near future, and in the long term it will aggravate social injustice as well as deepen the social contradictions [10]. Therefore, the following hypothesis is proposed.

H5a: Pilot policies for Shared economic Development.

H5b: Pilot policies Inhibit Shared economic Development.

Theoretical analysis shows that the level of high-quality economic development consists of the above five dimensions, these five aspects have an integrated impact on the high quality of economic development so the following hypothesis is proposed.

H6a: Pilot policies for high-quality economic development.

H6b: Pilot policies inhibit high-quality economic development.

## 3. Research Design

### 3.1. Modeling

Pilot green finance policies as a policy shock, to aim to test whether the pilot policy can promote high-quality economic development, the commonly used method for assessing the effect of policy implementation in literature studies is the double difference model (Difference-in-Difference). This method involves classifying the research subjects into a treatment group and a control group to discern the net impact of policy implementation, the method compares the time trends before and after policy enactment, as well as the differences in policy implementation between the treatment and control groups. This approach serves to eliminate temporal policy variations and unobservable factors, ultimately revealing the pure effect of policy implementation. The model is structured as follows:

$$quality_{i,t} = \alpha + \beta treat \times post_{i,t} + \gamma control_{i,t} + \theta_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

Where  $quality$  denotes the city's composite index of high-quality economic development in year  $t$ ,  $treat$  denotes the regional dummy variable for the pilot policy, and  $post$  is dummy variable indicating the comparison between the pre- and post-implementation display of the policy.  $control$  is the set of control variables.  $\theta_i$  is the individual fixed effect, the  $\mu_t$  is the year fixed effect, and  $\varepsilon_{i,t}$  is the random disturbance term. The estimated coefficients  $\beta$  measures the difference in the change of economic high-quality development before and after the shock of the pilot policy, reflecting the impact of the green finance field that policy on economic high-quality development after double-checking the score before and after the conducting of the pilot policy and between the pilot and non-pilot regions.

## 3.2. Selection of Variables

### 3.2.1. Explained Variables

High-quality economic development (quality). This paper draws on Yu Bo's (2022) construction method of economic high-quality index system, and divides economic high-quality development into five dimensions by using entropy method. The five dimensions include: economic innovative development, economic efficient development, economic structural advantages, economic green development and economic shared development. At last, this paper synthesizes the above five dimensions into a comprehensive index of high-quality development (Table 1).

Table 1: Evaluation system cfor indicators of high-quality economic development

Level 1 indicators	Secondary indicators	Tertiary indicators	Indicator properties
High-quality economy developmental	Innovative economic development	R&D	forward
		Number of R&D	forward
		Number of inventions licensed	forward
		Number of patents granted	forward
	Efficient economic development	GDP per capita	forward
	Optimization of the economic structure	Urban registered unemployment	negative
		Urban-rural income gap	negative
	Greening of the economy	Domestic waste disposal rate	negative
		Centralized treatment rate of sewage treatment plants	negative
		Comprehensive utilization rate of general industrial solid waste	negative
		Average PM2.5	negative
		Industrial sulfur dioxide emissions	negative
		Industrial wastewater discharge	negative
	Economic shared development	Industrial powder emissions	negative
		Number of beds	forward
		Expenditure on education	forward
Public libraries per 100 inhabitants		forward	
Urban road space per capita		forward	

### 3.2.2. Explanatory Variables

This paper mainly constructs the policy pilot time and the product item of the policy pilot area to measure. Treat represents the regional dummy variable of the green finance reform and innovation pilot zone. If the city is a policy pilot zone, the dummy variable takes 1, otherwise it takes 0. In this paper, dummy variables are set before and after the pilot policy, 1 is taken during the pilot period of green finance policy (after 2017), and 0 is taken during the non-pilot period.

### 3.2.3. Control Variables

Giving that the high quality of the economy is also affected by other factors. Referring to the study of Shi Dai-min and Shi Xiaoyan (2022), this paper controls five economic variables in the model, namely, urbanization rate, government intervention, infrastructure development, human

capital level, and openness to the outside world. In view of space constraints, the variable definitions are not shown and are available to interested readers on request from the authors.

### 3.3. Data Sources

In order to compare the influence of pilot policy on high-quality development, the time limit is four years before and after the promulgation of the 2017 policy, i.e., 2013-2021. The 2013 China Urban Statistical Yearbook counted 286 prefectural-level cities in China, and in order to maintain the consistency of the data, the cities counted in 2013 are taken as the standard, and the cities added in the following years are not added. The primary data sources for this article include the China Urban Statistical Yearbook, statistical yearbooks of various prefectural cities, statistical bulletins on national economic and social development at the prefectural level, as well as reports on financial accounts.

### 3.4. Descriptive Statistics

The explanatory variables in this paper have reverse indicators, which are mainly processed by entropy value method. Firstly, the inverse indicator is taken as the inverse for normalization, secondly, the indicators are standardized to eliminate the scale, and finally the entropy value analysis is used to synthesize the composite index. Given the limited space available, interested readers may request a copy from the author.

## 4. Empirical Analysis

### 4.1. Parallel Trend Test

This paper refers to the practice of Song Hong and Sun Yajie [11] to recognize the degree of sensitivity of the policy to time change by moulding the regression time interval, and examines the effect of the pilot policy on the implementation of high-quality development of the economy in the current period as well as the effect of the policy implementation after the implementation of the policy, and tests the common trend hypothesis. Specifically, the pilot policy implemented in 2017 is taken as the midpoint, and the policy window is moved forward four years as well as backward four years and regression analysis is done to analyze the policy effect of the green financial pilot policy by judging the regression coefficients. As can be seen from Figure 1, the regression coefficient has been fluctuating around the 0-axis before the implementation of the policy in 2017, and the regression coefficient of the pilot policy in the year of implementation is significantly positive, and the coefficient of the three years after the implementation of the policy is also significantly positive, rising year by year, as can be seen from the figure. 2021 is a year when it is more difficult to obtain the data of the prefectural-level cities, so the results of the study will have some deviation. Overall, the positive effect of pilot policy on high-quality is sustainable.

### 4.2. Empirical Results

The results of the benchmark model and the total indicator regression are demonstrated in Table 2. Among them, model (1) (2) demonstrates the total effect of pilot policy on high-quality economic development. Model(1) shows that the estimated coefficient of green financial reform and innovation pilot zones is significantly positive, controlling for individual and time effects, which illustrates that the conducting of the policy significantly promotes the city's economic high-quality development. Model (2) refers to the fact that the estimated coefficient of pilot policy is still

significantly positive after controlling the effects of other factors on high-quality economic development. The regression results from the baseline model and sub-indicators reveal that model (3) confirms the promotional effect of the pilot policy on the innovative development of the economy. Furthermore, even after the introduction of control variables, the green financial pilot policy remains effective in enhancing innovative economic development. This shows that the pilot policy can provide economic growth momentum for economic development, thereby validating hypothesis H1. Model (6) show that the green finance pilot policy can significantly promote the green development of the economy, and the estimated coefficients are still significant at the 1% confidence level after controlling for other variables, so hypothesis H4 is verified. Model (7) explores the influence of policies on the shared development of the economy. The regression results indicate that the policies significantly foster the shared development of the economy, with correlation coefficients remaining significant at the 1% confidence level even after controlling for other variables. Hypothesis H5a is thereby verified.

Table 2: Baseline model and indicator regression results

variant	High-quality development		Innovative development	Efficient development	Jfunction structure optimization	Ggreen Green Development	Sshared development
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
did	0.007*** (0.001)	0.007*** (0.001)	-0.002*** (0.001)	0.001 (0.003)	-0.001 (0.002)	0.000*** (0.000)	0.003*** (0.001)
urban		-0.008 (0.006)	0.007 (0.004)	-0.027 (0.022)	-0.001 (0.010)	-0.008*** (0.003)	0.010** (0.004)
govern		-0.010** (0.004)	-0.005* (0.003)	-0.087*** (0.015)	-0.005 (0.007)	-0.003 (0.002)	0.005* (0.003)
trans		0.000 (0.001)	0.000 (0.000)	0.003 (0.002)	-0.000 (0.001)	0.000 (0.000)	-0.001 (0.000)
hcl		-0.054*** (0.006)	-0.036*** (0.005)	-0.054** (0.022)	0.003 (0.010)	-0.005* (0.003)	-0.035*** (0.004)
open		0.000 (0.001)	-0.000 (0.001)	-0.001 (0.003)	-0.000 (0.001)	0.000 (0.000)	-0.000 (0.001)
_cons	0.413*** (0.001)	0.420*** (0.003)	0.014*** (0.002)	0.300*** (0.012)	0.008 (0.005)	0.092*** (0.001)	0.060*** (0.002)
N	4390	4390	4390	4390	4390	4390	4390
R <sup>2</sup>	0.919	0.923	0.885	0.852	0.204	0.444	0.965

Note: Values in parentheses are t-statistics; \* indicates level of significance: \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## 5. Robustness Tests

### 5.1. Placebo Test

In order to alleviate the influence of other disturbing factors, this paper refers to the method of Cai et al. to carry out a placebo test, specifically randomly selecting some cities from all cities as a fictitious experimental group, and the remaining cities as a dummy control group, and estimating the model (1), and this process is repeated 1,000 times, and the edge of which can be obtained as 500 estimated coefficients of the pilot policy. Figure 2 demonstrates the p-value and kernel density plots of the 500 estimated coefficients of the green financial pilot policy on high-quality economic development, and the kernel density plots of the estimated coefficients are basically normally distributed on both sides of zero. And the regression coefficient of green finance pilot policy on

economic high-quality development in the benchmark regression is 0.007, which lies outside the distribution of estimated coefficients of the placebo test. It can be determined that the promotion effect of the implementation of this pilot policy on the high-quality does not originate from random disturbing factors.

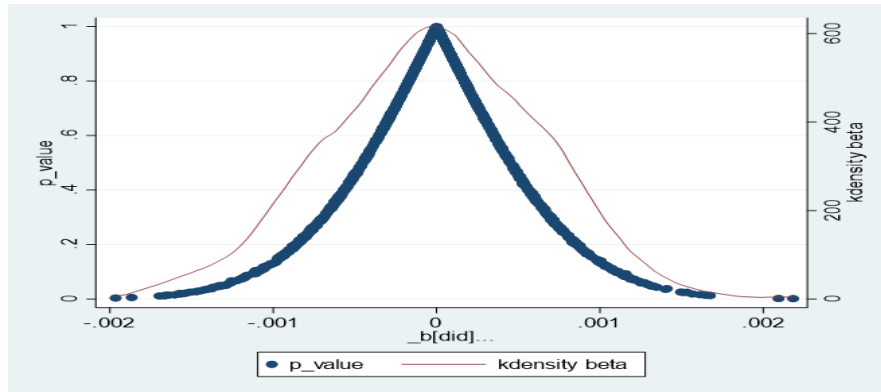


Figure 2: Placebo test results

## 5.2. Replacement of Variable Metrics

In order to further ensure the robustness and reliability of the estimation results, this paper refers to the practice of Zhao Tao [12], the index of economic high-quality development is measured through the application of the principal component analysis method. Through the data organization, it can be seen that the value of KMO is 0.733 greater than 0.6, which indicates that it is suitable for principal component analysis. The specific estimation results obtained by using principal component analysis are shown in Table 2, and the regression results obtained by entropy value method and principal component analysis are consistent, that is, the pilot policy can facilitate the high-quality development of the economy. In view of space limitations, the results are not presented and are available to interested readers on request from the authors.

## 6. Heterogeneity Analysis

Considering the disparities in economic development levels across the eastern, central, and western regions of China, as well as variations in green finance development, human capital, urbanization rate, and government intervention, regional differences in high-quality economic development are expected to arise. After controlling for time and regional effects, the regression coefficient demonstrates that the pilot policy in the eastern region of China have an apparent influence on high-quality economic development at the 1% significance level. Additionally, the pilot zones for green financial reform and innovation in the western region also positively influence high-quality economic development, although the regression coefficient only achieves a 10% significance level. Through comparison, it can be seen that the green financial pilot policy effect is relatively significant in the eastern and western cities, the reason may be that the eastern region has a good financial development environment, the level of green technology development is higher, the ecological and environmental protection governance has achieved certain results, so the pilot policy have formed a number of positive promotional effects. The western region has a lower level of green financial development, so the response to the pilot policy is also more sensitive. From the results, it can be seen that the impact of the green financial reform and innovation pilot zones in the central region on the high-quality development of the economy is not visible, which may be attributed to the following reasons: First, the six provinces in central China have different levels of development, and the degree of integration and coordination of the economy in the region is not



high, which leads to a deepening of the insufficiency and imbalance situation, and further restricts the effect of the green financial reform and innovation pilot zones. Secondly, the prevalence of highly polluting heavy industries in the central region poses significant challenges to industrial transformation and upgrading, ultimately leading to an insignificant impact of the green finance pilot policy. Given the limited space available, interested readers may request a copy from the author.

## 7. Conclusions and Policy Recommendations

The conclusions are as follows:(1) On the whole, the pilot zone for green financial reform and innovation has a positive impact on the high-quality economic development, confirming the effectiveness of the green finance pilot policy; (2) from the sub-indicators, The green finance pilot policy can greatly enhance economic innovation, green development, and shared economic progress; however, its effect on economic efficiency and structural optimization is not particularly significant; (3) There exists regional heterogeneity in the impact of the green finance pilot policy on the high-quality development of the economy, with a more pronounced effect observed in the eastern and western regions. In addition, this paper also carries out a number of robustness tests, indicating that the measurement results have stability and reliability.

The findings presented in this paper carry three key policy implications: first, further increase the ground of policy pilots and actively promote green financial pilot work. The findings of this paper indicate that green financial reform and innovation pilot zones have successfully driven high-quality economic development on an overall level. Looking ahead, there is a need to broaden the scope of these policy pilots, particularly in the eastern and western regions where the policy impact is more pronounced, in order to consistently enhance and refine the green financial system. Second, establish a green financial policy evaluation mechanism to effectively guarantee the sustainability of policy implementation. The green finance pilot policy aims to foster energy conservation, environmental protection, and the advancement of green industries. However, such development should not compromise economic efficiency. The results presented in this paper reveal that the green finance pilot policy does not significantly contribute to efficient economic development and structural optimization. Therefore, it is necessary to establish an assessment mechanism for the implementation of the policy, adopt a phased assessment method for the implementation of the policy in each pilot city, and conduct a comprehensive assessment of the indicators to ensure the sustainability of the implementation of the policy. Thirdly, efforts should be made to continuously enhance the green financial reform and innovation policy system, with the aim of fostering more coordinated and efficient economic development. The findings presented in this paper indicate that green financial pilot policies do not have a significant impact on efficient economic development. This suggests the need to transform the mode of economic development, improving its quality while simultaneously considering Rate of economic growth.It is imperative for the government to bolster support for the transformation of enterprises and associated industries, aiding them in navigating the challenging "pain period" of optimization and upgrading, and ultimately attaining the objective of sustainable economic development.

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