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Research on the Influencing Factors of Green Finance on Agricultural Green Development

-- A Case Study of Green Finance Reform and Innovation Pilot Zone in Zhejiang Province

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Abstract

In 2019, the Ministry of Agriculture and Agricultural Bank of China issued the Notice on the Implementation of the Five Actions for Green Agricultural Development, which proposed to accelerate the results of the five actions through the integration and innovation of a variety of financial instruments. This project takes Zhejiang Province, one of the five provincial green finance reform and innovation pilot areas in China, as the research object, and uses the agricultural and green finance data of Zhejiang Province from 2006 to 2021 to deeply explore the influencing factors and mechanism of green finance on agricultural green development. Firstly, this paper uses eviews software to establish a regression model, and then tests and corrects the multicollinearity, heteroscedasticity and autocorrelation of the model through statistical test, partial correlation coefficient test, BG test and stepwise regression. Finally, the optimal model to reflect the correlation between agricultural green development and green finance is obtained. This is of great practical significance for realizing the green and sustainable development of China and improving the problems of agriculture, rural areas and farmers.

Keywords

Green Finance; Agriculture Green Development Influencing Factors; Stepwise Regression Method; Green Finance Reform and Innovation Experimental Zone.

1. Introduction

Since the reform and opening up, with the rapid development of China's economy, environmental problems have become more and more serious. At the same time, with the continuous progress of agriculture, "ecological" and "sustainable development" have gradually become the goal that people pursue. China has continuously introduced relevant policies to make strategic arrangements for the green development of agriculture. The continuous improvement of policies has effectively promoted the utilization rate of agricultural resources in China.

China has made a positive layout for the development of green finance. In January 2021, Liu Guiping, deputy governor of the People's Bank of China, pointed out that vigorously developing green finance is an inherent requirement to promote the construction of ecological civilization, and an important measure to achieve green and low-carbon development and the "30·60 goal". By guiding the flow of capital, green finance promotes the transformation of industries to the direction of resource conservation, technology development and ecological and environmental protection. As a booster for the current green agricultural development, green finance provides long-term impetus for the sustainable development of agriculture. In June 2017, to further promote the development of green finance, China set up green finance reform and innovation

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pilot zones in five provinces. Starting from Zhejiang Province, one of the pilot areas of green finance reform and innovation, this paper uses multiple regression and stepwise regression analysis methods to explore the influencing factors of green finance on agricultural green development, and then expounds relevant suggestions for green finance to help agricultural green development in the future.

2. Literature Review

The literature related to the research content of this paper mainly includes the policy effect of green finance reform and innovation experimental zone, the calculation of agricultural green development index and the construction of evaluation system.

Zuo et al. (2021) demonstrated that green finance can effectively promote the construction of livable rural environment and help rural revitalization by studying the mechanism of green and low-carbon finance on rural revitalization. Based on the analysis and comparison of green financial products, Zhang Junwei, Fei Jianxiang and Xu Yongchen (2020) concluded that the effect of green finance is affected by the planting scale and varieties of crops.

The related research on the construction of agricultural green development index has been quite mature in China. Zhang et al. (2018) took product safety as an important dimension, introduced it into the construction process of agricultural green development index, and applied it to specific counties for in-depth research. Some scholars have also constructed an evaluation system for agricultural green development indicators in accordance with local development conditions according to different regions. In general, although the construction of agricultural green development index system is highly subjective, the relevant research has been sufficient.

To sum up, scholars at home and abroad have carried out various studies on green finance and green agricultural development, but most of them expounded the relationship between them from a macro perspective, and few verified the relationship between them from a micro perspective through empirical analysis. Therefore, based on the existing research, this paper continues to study the specific path of green finance's role in regional agricultural development from the micro perspective. Starting from the agricultural and green finance data of Zhejiang Province from 2006 to 2021, this paper comprehensively uses diversified analysis methods to study the influencing factors and effects of green finance's role in agricultural green development. At the same time, feasible suggestions are put forward.

3. Analysis of Influencing Factors

Investment in environmental pollution control: In the current society, environmental pollution problems are becoming more and more serious. In the field of agriculture, environmental pollution will affect the growth and development and yield of crops, produce a series of diseases, and bring many adverse effects to agricultural development. Therefore, the increase of investment in environmental pollution control is conducive to alleviating the problem of agricultural environmental pollution control, improving the quality of crops and promoting the green development of agriculture. Therefore, this paper selects investment in environmental pollution control in Zhejiang Province as explanatory variable X1.

Fiscal expenditure on energy conservation and environmental protection: financial support for agriculture can improve agricultural production conditions and resource use efficiency, which plays a positive role in promoting green economic growth that cannot be ignored. Therefore, the part of fiscal expenditure on environmental protection used in agriculture can improve the agricultural production environment, improve the quality and efficiency of agricultural production, generate income effect and multiplier effect, and contribute to the green development of agriculture. Therefore, this paper selects the fiscal expenditure on energy conservation and environmental protection in Zhejiang Province as the explanatory variable X2.

Agricultural insurance premium income: Agricultural insurance can help farmers disperse risks and make up for losses, which is of great significance for agricultural green development. In 2018, Zhejiang Zhengfa [2006] No. 17 document "Notice of Zhejiang Provincial People's Government on carrying out policy-based agricultural Insurance Pilot Work" mentioned that we should vigorously expand the scale of agricultural insurance, further improve the level of agricultural insurance protection, and gradually optimize agricultural insurance services. The development of agricultural insurance provides a certain security guarantee for the green development of agriculture, and contributes to the green and prosperous development of agriculture to a certain extent. Therefore, there is a positive correlation between agricultural insurance premium income and agricultural green development. This paper selects agricultural insurance premium income in Zhejiang Province as explanatory variable X3.

Balance of agriculture-related loans: In recent years, the Central People's Bank of China has used monetary policy tools such as re-lending for agriculture to encourage financial institutions to continuously increase agriculture-related loans, which has promoted the development of rural inclusive finance, largely alleviated the lack of funds in agriculture, rural areas and farmers, and effectively supported the development of agricultural economy and the revitalization of rural industries. Therefore, under the background of rural revitalization, agriculture-related loans will provide a certain financial basis for rural agricultural development, and the increase of agriculture-related loans can drive the green development of agriculture. There is a positive correlation between the two. Therefore, this paper selects the agriculture-related loans balance in Zhejiang Province as the explanatory variable X4.

4. Variable Selection and Data Sources

4.1. Selection of Explanatory Variables and Explained Variables

Y -- Comprehensive index of green agriculture development in Zhejiang Province.

X1 -- Investment in environmental pollution control in Zhejiang Province / 100 million yuan.

X2 -- Fiscal expenditure on energy conservation and environmental protection in Zhejiang Province / 100 million yuan.

X3 - Premium income of agricultural insurance in Zhejiang Province / 100 million yuan.

X4 - Balance of agriculture-related loans in Zhejiang Province / 100 million yuan.

4.1.1. Explained Variable

Green agricultural development is an essential link in building a resource-saving and environment-friendly society. Based on the interpretation of agricultural green development, referring to the research ideas of Zhang Naiming, Wei Qi and other scholars, this paper constructs the evaluation index system of agricultural green development level from the four dimensions of resource conservation, environmental friendness, economic income increase and product safety. The specific indicators are shown in the table 1.

Referring to the method of Zhang Naiming et al. (2018) in the Construction and Application of Agricultural Green Development Evaluation Index System, this paper uses the analytic hierarchy process (AHP) to determine the weight of each index and calculate the agricultural green development index. Therefore, according to the importance of resource conservation, environmental friendliness, economic income increase and product safety, the weights are given to 25%, 55%, 10% and 10% respectively. Considering that the three indicators are not significantly different in importance, they are given the same weight. Finally, the

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comprehensive index Y of agricultural green development in Zhejiang Province from 2006 to 2021 was calculated, and the calculation results are shown in Table 2.

Table 1. Evaluation index system of agricultural green development level1

First-level indicators	Secondary indicators	Tertiary indicators	Units
Level of green agricultural development	Conservation of resources	Agricultural output value per unit of cultivated land area	RMB '000 / ha
		Water consumption per unit of agricultural output value	Ton/ten thousand yuan
	Environmentally friendly	Forest cover	%
		Decrease rate of fertilizer application intensity	%
		Rate of decrease in intensity of pesticide application	%
		Intensity of ammonia nitrogen emissions from agriculture	G/m3
		Growth rate of agricultural GDP per capita	%
	Increasing economic income	Agricultural cost profit growth rate	%
		Land output rate growth rate	%
	Product safety	Green business certification growth rate	%

4.1.2. Explanatory Variables

Common green financial products include green credit, green investment, green insurance, green bonds, etc. This paper selects three indicators of green credit, green investment and green insurance as the proxy variables of green finance, which are respectively represented as the investment in environmental protection and pollution control in Zhejiang Province X1, the fiscal expenditure for energy conservation and environmental protection in Zhejiang Province X2, the premium income of agricultural insurance in Zhejiang Province X3, and the balance of agriculture-related loans in Zhejiang province X4.

4.2. Data Sources and Collection

The data related to agricultural green development used in this paper are from Zhejiang Statistical Yearbook (2006-2021), and the data of green finance indicators are from China Finance Yearbook, China Insurance Yearbook and Zhejiang Statistical Yearbook of Natural Resources and Environment (2006-2021), etc. This paper uses the moving average method to fill in the missing values. The following table shows the relevant data of green finance and agricultural green development in Zhejiang Province from 2006 to 2021:

Table 2. Data related to green finance and agricultural green development 2in Zhejiang Province from 2006 to 2021

Time	Green Agricultural Development Composite index Y	Investment in environmental pollution control X1/ 100 million yuan	Government expenditure on energy conservation and environmental protection is x2/100 million yuan	Premium income from agricultural insurance is x3/100 million yuan	The balance of agriculture-related loans is X4/ 100 million yuan
2006	0.49	140.3	20.32	0.1091	7576.05
2007	0.45	177.4	30.69	0.6984	9566.475
2008	0.46	519.7	43.06	1.5758	11556.9
2009	0.48	198	55.42	1.7672	14125.17
2010	0.53	333.7	82.07	1.7128	17851.39
2011	0.53	238.7	93.33	2.3351	21177.82
2012	0.60	375.4	77.7	4.0827	25011
2013	0.59	390.4	98.14	5.2459	28371.93
2014	0.60	474.2	120.65	6.17455	28911
2015	0.61	520.7	167.89	7.1032	30382.83
2016	0.63	650.6	161.4	7.3278	30079.08
2017	0.63	528.8	190.15	7.5524	32572.94
2018	0.63	527.9	194.75	8.8195	35576
2019	0.64	572.9	269.55	9.9616	40234
2020	0.65	832.9	220.59	11.8545	4689
2021	0.66	822.4	203.78	12.7642	47400

Note: The data are from Zhejiang Statistical Yearbook, China Finance Yearbook, China Insurance Yearbook and Zhejiang Statistical Yearbook of Natural Resources and Environment, etc. Due to the inconsistency of measurement units in the original data, this paper uses the normalized transformation method to process the data in a dimensionless way.

5. Model Establishment and Testing

5.1. Correlation Chart and Trend Chart Analysis

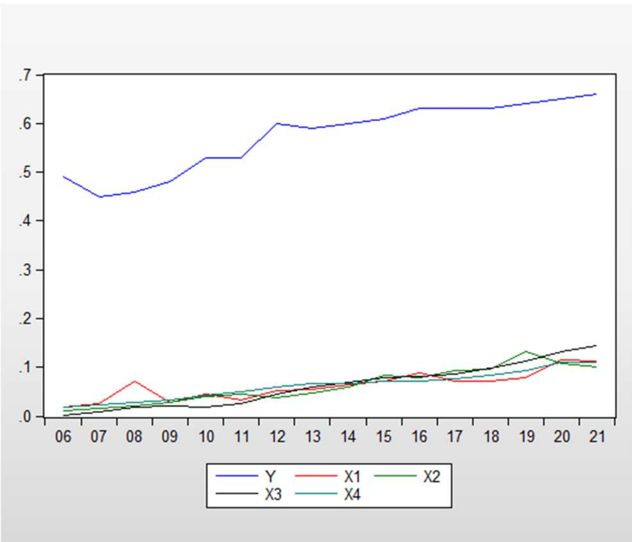

Figure 1. Trend diagram of explanatory variables and explained variables1

It can be seen from the trend chart that each explanatory variable changes in the same direction as the explained variable, and with the increase of the variable, the gap expands slightly and basically remains unchanged. Therefore, there may be a certain correlation between each explanatory variable and the explained variable.

5.2. Regression Model Analysis

5.2.1. Model Establishment

The relevant data of green agriculture development in Zhejiang Province from 2006 to 2021 were used as samples, and the comprehensive level of green agriculture development in Zhejiang province was used as the explained variable Y. Based on the analysis of the above correlation diagram and trend diagram, the following multiple nonlinear regression model (double log model) is preliminarily established:

$$ln\,Y = \beta_0 + \beta_1\,ln\,X_1 + \beta_2\,ln\,X_2 + \beta_3\,ln\,X_3 + \beta_4\,ln\,X_4 + \mu$$

Where, is a constant term, indicating the comprehensive level of agricultural green development in Zhejiang Province without any influencing factors, and is a random disturbance term.$\beta_0\mu$.

5.2.2. Model Estimation

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 12/20/22 Time: 00:26
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.335080	0.106603	3.143235	0.0094
LOG(X1)	0.032832	0.036618	0.896608	0.3891
LOG(X2)	0.003812	0.053320	0.071498	0.9443
LOG(X3)	-0.079748	0.028109	-2.837107	0.0162
LOG(X4)	0.361880	0.078540	4.607592	0.0008

R-squared	0.943984	Mean dependent var	-0.563399
Adjusted R-squared	0.923614	S.D. dependent var	0.131168
S.E. of regression	0.036252	Akaike info criterion	-3.546329
Sum squared resid	0.014456	Schwarz criterion	-3.304895
Log likelihood	33.37063	Hannan-Quinn criter.	-3.533966
F-statistic	46.34307	Durbin-Watson stat	1.197465
Prob(F-statistic)	0.000001		

Figure 2. Model estimation results2

$$ln\,\hat{Y}_i = 0.3351 + 0.0328\,ln\,X_1 + 0.0038\,ln\,X_2 - 0.0797\,ln\,X_3 + 0.3619\,ln\,X_4$$

(0.1066) (0.0366) (0.0533) (0.0281) (0.0785)

t= (3.1432) (0.8966) (0.0715) (-2.8371) (4.6076)

R^2=0.9440 $\overline{R}^2$ = 0.9236 F = 46.3431 $\hat{\sigma}$ = 0.0363 DW=1.1975

5.2.3. Model Testing

(1) Economic test

The calculation results of the model show that the investment in environmental protection and pollution control X1, the fiscal expenditure for energy conservation and environmental protection X2, the premium income of agricultural insurance X3, the balance of agriculture-related loans X4 and the comprehensive level of green agricultural development are double-log relations, and the parameters and are elasticities. $ln\,X_1\,ln\,X_2\,ln\,X_3\,ln\,X_4\,\beta_1, \beta_2, \beta_3\beta_4$ That is, assuming that other explanatory variables remain unchanged, every 1% increase in investment in environmental protection and pollution control, the comprehensive level of green agricultural development Y will increase by % on average; 0.0328 Assuming that other explanatory variables remain unchanged, every 1% increase in fiscal expenditure on energy conservation and environmental protection X2, the comprehensive level of green agricultural development Y will increase by % on average; 0.0038 Assuming that other explanatory variables remain unchanged, every 1% increase in agricultural insurance premium income X3 will reduce the comprehensive level of green agricultural development Y by % on average. 0.0797Assuming that other explanatory variables remain unchanged, every 1% increase in agriculture-related loan balance X4 will increase the comprehensive level of green agricultural development Y by % on average. 0.3619Except for the signs of the regression coefficients which violate the theoretical setting, the signs of the other regression coefficients are consistent with the theoretical setting.β_3.

(2) Statistical inference test

Goodness of fit: R^2=0.9440 is close to 1, indicating that the model has a high goodness of fit, that is, 94.3984% of the variation of explained variable Y of comprehensive development level of green agriculture can be explained by investment in environmental protection and pollution control X1, financial expenditure for energy conservation and environmental protection X2, agricultural insurance premium income X3, agriculture-related loan balance X4 (or the model).

F test: F= 46.34313.49, and the accompanying probability prob(f) is close to 0, rejecting the null hypothesis, indicating that at least one of the regression coefficients and is significantly different from 0, $> F_\alpha(k-1, n-k) = \beta_1, \beta_2, \beta_3\beta_4$ This indicates that at least one of the explanatory variables in environmental protection and pollution control investment X1, energy conservation and environmental protection fiscal expenditure X2, agricultural insurance premium income X3, and agriculture-related loan balance X4 has a significant impact on the comprehensive level of green agricultural development.

t test: The absolute values of regression coefficient t statistics of explanatory variables agricultural insurance premium income X3 and agriculture-related loan balance X4 are 2.8371 and 4.6076 respectively, which are greater than the critical value 2.2010, and their corresponding prob(t) values are 0.0162 and 0.0008 respectively, which are also significantly less than α=0.05, rejecting the null hypothesis. β_3The regression coefficient and significance are not 0, indicating that the impact of agricultural insurance premium income X3 and agriculture-related loan balance X4 on the comprehensive level of green agricultural development is significant respectively. β_4In addition, the absolute value of the t statistic of the constant term is also greater than the critical value, which passes the t test.

However, the absolute values of regression coefficient t statistics of investment in environmental protection and pollution control X1 and fiscal expenditure on energy conservation and environmental protection X2 are 0.8966 and 0.0715 respectively, which are less than the critical value 2.2010, and their corresponding prob(t) values are 0.3891 and 0.9443 respectively, which are also significantly greater than α=0.05. The corresponding Prob (t) values are 0.3891 and 0.9443, respectively, which are significantly greater than α = 0.05, indicating that the impact of environmental pollution control investment X1 and energy conservation and environmental protection expenditure X2 on the comprehensive level of green agricultural development Y is not significant.

(3) Econometric test 1: multicollinearity test

① Simple correlation coefficient method

Correlation coefficient test is carried out in Eviews software, and the correlation coefficient matrix is obtained as follows:

Correlation

	LOG(Y)	LOG(X1)	LOG(X2)	LOG(X3)	LOG(X4)
LOG(Y)	1.000000	0.794460	0.909538	0.845405	0.948897
LOG(X1)	0.794460	1.000000	0.842583	0.877361	0.850838
LOG(X2)	0.909538	0.842583	1.000000	0.945314	0.970563
LOG(X3)	0.845405	0.877361	0.945314	1.000000	0.953810
LOG(X4)	0.948897	0.850838	0.970563	0.953810	1.000000

Figure 3. Correlation coefficient matrix3

It can be seen from the figure that there is a high degree of linear correlation among the explanatory variables, and the minimum value is 0.842583>0.8, indicating that the model has serious multicollinearity.

② Auxiliary regression model method

When there are more than two explanatory variables and there is a complex correlation between the variables, the auxiliary regression model between the explanatory variables can be established to test the multicollinearity.

Dependent Variable: LOG(X1)
Method: Least Squares
Date: 12/28/22 Time: 21:40
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.471531	0.725123	-2.029354	0.0652
LOG(X2)	0.032991	0.420229	0.078506	0.9387
LOG(X3)	0.306595	0.203150	1.509204	0.1571
LOG(X4)	0.114503	0.618273	0.185198	0.8562

R-squared	0.772052	Mean dependent var	-2.892028
Adjusted R-squared	0.715065	S.D. dependent var	0.535390
S.E. of regression	0.285787	Akaike info criterion	0.545180
Sum squared resid	0.980093	Schwarz criterion	0.738327
Log likelihood	-0.361442	Hannan-Quinn criter.	0.555071
F-statistic	13.54789	Durbin-Watson stat	2.629011
Prob(F-statistic)	0.000369		

Dependent Variable: LOG(X2)
Method: Least Squares
Date: 12/28/22 Time: 21:58
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.450826	0.562290	0.801768	0.4383
LOG(X1)	0.015560	0.198203	0.078506	0.9387
LOG(X3)	0.125998	0.147773	0.852648	0.4105
LOG(X4)	1.032462	0.303280	3.404321	0.0052

R-squared	0.946269	Mean dependent var	-2.995180
Adjusted R-squared	0.932836	S.D. dependent var	0.757331
S.E. of regression	0.196270	Akaike info criterion	-0.206331
Sum squared resid	0.462264	Schwarz criterion	-0.013183
Log likelihood	5.650644	Hannan-Quinn criter.	-0.196440
F-statistic	70.44439	Durbin-Watson stat	1.144818
Prob(F-statistic)	0.000000		

Dependent Variable: LOG(X3)
Method: Least Squares
Date: 12/28/22 Time: 22:01
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.892349	0.708128	4.084498	0.0015
LOG(X1)	0.520323	0.344767	1.509204	0.1571
LOG(X2)	0.453367	0.531716	0.852648	0.4105
LOG(X4)	1.123168	0.738556	1.520761	0.1542

R-squared	0.929706	Mean dependent var	-3.227734
Adjusted R-squared	0.912132	S.D. dependent var	1.255978
S.E. of regression	0.372303	Akaike info criterion	1.074103
Sum squared resid	1.663319	Schwarz criterion	1.267250
Log likelihood	-4.592825	Hannan-Quinn criter.	1.083994
F-statistic	52.90361	Durbin-Watson stat	1.493212
Prob(F-statistic)	0.000000		

Dependent Variable: LOG(X4)
Method: Least Squares
Date: 12/28/22 Time: 22:02
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.938574	0.283046	-3.315970	0.0062
LOG(X1)	0.024891	0.134400	0.185198	0.8562
LOG(X2)	0.475850	0.139778	3.404321	0.0052
LOG(X3)	0.143865	0.094601	1.520761	0.1542

R-squared	0.954524	Mean dependent var	-2.900172
Adjusted R-squared	0.943155	S.D. dependent var	0.558866
S.E. of regression	0.133245	Akaike info criterion	-0.980929
Sum squared resid	0.213052	Schwarz criterion	-0.787782
Log likelihood	11.84743	Hannan-Quinn criter.	-0.971039
F-statistic	83.95892	Durbin-Watson stat	0.900871
Prob(F-statistic)	0.000000		

Figure 4. The auxiliary regression model of each explanatory variable4

The results of the above auxiliary regression models are listed in the following table:

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Table 3. Results of the auxiliary regression model

Auxiliary regression model	R^2	F-statistic	The adjoint probability of F
ln(x1)=f(ln(x2) ln(x3) ln(x4))	0.772052	13.54789	0.000369
ln(x2)=f(ln(x1) ln(x3) ln(x4))	0.946269	70.44439	0.000000
ln(x3)=f(ln(x1) ln(x2) ln(x4))	0.929706	52.90361	0.000000
ln(x4)=f(ln(x1) ln(x2) ln(x3))	0.954524	83.95892	0.000000

The adjoint probability of the F statistics of each of the above regression equations is close to zero, and the F statistics are very significant. It can be considered that the original equation has serious multicollinearity.

(4) Correction of multicollinearity

① Stepwise regression method

Establish a univariate regression model: As can be seen from the above correlation coefficient matrix, the correlation coefficient between the log lnx4 of the explanatory variable X4 and the log lny of the explained variable y of the comprehensive level of agricultural green development is the largest and strongest. Therefore, the regression model of the agriculture-related loan balance lnx4 lny= a+blnx4+ is established as the most basic model. ε The remaining variables are introduced into the model one by one to obtain the results:

Table 4. Results of stepwise regression model

Model	Lnx1	Lnx2	Lnx3	Lnx4	R^2	$\bar{R}^2$
lny=f(lnx4)				0.222710 (11.25029) ***	0.900405	0.893291
lny=f(lnx4, lnx1)	0.011445 (0.281284)			0.232039 (5.952827) ***	0.901007	0.885778
lny=f(lnx4, lnx2)		0.034116 (0.548240)		0.267580 (3.173163) ***	0.902656	0.887679
lny=f(lnx4, lnx3)			0.069042 (2.919613) **	0.370705 (6.975386) ***	0.939847	0.930593
lny=f(lnx4, lnx3,lnx1)	0.032892 (0.938191)		0.079268 (3.032620) **	0.365816 (6.819198) ***	0.943958	0.929947
lny=f(lnx4, lnx3,lnx2)		0.004895 (0.092595)	0.069682 (2.726412) **	0.365640 (4.700672) ***	0.939890	0.924863
lny=f(lnx4, lnx3,lnx1, lnx2)	0.032832 (0.896608)	0.003812 (0.071498)	0.079748 (2.837107) **	0.361880 (4.607592) ***	0.943984	0.923614

Note: *** indicates significance at the 0.01 level, and ** indicates significance at the 0.05 level.

Therefore, after the above step-by-step test process, the selected model is lny=f(lnx4,lnx3).

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$$ln\,\hat{Y}_i = 0.2889 - 0.0690\,ln\,X_3 + 0.3707\,ln\,X_4$$
$$(0.0849)\quad(0.0236)\quad(0.0531)$$
$$t = (3.4009)\quad(-2.9196)\quad(6.9754)$$
$$R^2=0.9398\quad \overline{R}^2=0.9306\quad F=101.5582\quad \hat{\sigma}=0.0346\quad DW=1.3850$$

② Statistical inference test

Goodness of fit: R^2 =0.9398 is close to 1, indicating that the model has a high goodness of fit, that is, 93.9847% of the variation of explained variable Y of comprehensive development level of green agriculture can be explained by agricultural insurance premium income X3 and agriculture-related loan balance X4 (or the model).

F test: F= 101.55824.54, and the associated probability prob(f) is close to 0, which rejects the null hypothesis, indicating that at least one of the regression coefficients is significantly different from 0, indicating that at least one of the explanatory variables in the agricultural insurance premium income X3 and agriculture-related loan balance X4 has a significant impact on the comprehensive level of green agricultural development.> $F_\alpha(k-1, n-k)=$.

Student's t-test: The absolute values of regression coefficient t statistics of explanatory variables agricultural insurance premium income X3 and agriculture-related loan balance X4 are 2.9196 and 6.9754 respectively, which are greater than the critical value of 2.1604, and their corresponding prob(t) values are 0.0119 and 0.0000 respectively, which are also significantly less than α=0.05, rejecting the null hypothesis. It shows that agricultural insurance premium income X3 and agriculture-related loan balance X4 have significant impacts on the comprehensive level of green agricultural development respectively. In addition, the absolute value of the t-statistic of the constant term is also greater than the critical value, which passes the t test.

In conclusion, the adjusted model is improved to 0.9398, which is close to 1, indicating that the model has a good goodness of fit to the sample data. $\overline{R}^2$The F-statistic value is 101.5582, and its adjoint probability is 0.000000, which is close to 0, indicating that x3 and x4 have a significant impact on the explained variables, and the overall linear relationship of the model is significant. The absolute values of t statistics of the model were all greater than 2.1604, and the corresponding adjoint probabilities were all less than 0.05, and the t test passed.

(5) Autocorrelation test -- B-G test

In eviews software, the results of lag period 1 and lag period 2 are obtained as follows:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.937633	Prob. F(1,12)	0.3520
Obs*R-squared	1.159573	Prob. Chi-Square(1)	0.2816

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 12/29/22 Time: 23:12
Sample: 2006 2021
Included observations: 16
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007054	0.085453	0.082553	0.9356
LOG(X4)	0.006087	0.053642	0.113477	0.9115
LOG(X3)	-0.003158	0.023928	-0.131990	0.8972
RESID(-1)	0.277249	0.286321	0.968315	0.3520

R-squared	0.072473	Mean dependent var	-1.59E-16
Adjusted R-squared	-0.159408	S.D. dependent var	0.032170
S.E. of regression	0.034640	Akaike info criterion	-3.675313
Sum squared resid	0.014399	Schwarz criterion	-3.482166
Log likelihood	33.40251	Hannan-Quinn criter.	-3.665423
F-statistic	0.312544	Durbin-Watson stat	2.056383
Prob(F-statistic)	0.816024		

Figure 5. B-G test results (lag period is 1)

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As can be seen from the above table, nR^2 = 1.159573< χ^2_α(1)=3.841, prob(nR)= 0.2816 is greater than the given significance level α =0.05, and the corresponding concomitant probability of the t-statistic of the regression coefficient is 0.3520 is greater than 0.05, which fails the significance test, indicating that the model does not have first-order autocorrelation.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.808723	Prob. F(2,11)	0.4702
Obs*R-squared	2.051059	Prob. Chi-Square(2)	0.3586

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 12/29/22 Time: 23:17
Sample: 2006 2021
Included observations: 16
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008747	0.086554	0.101054	0.9213
LOG(X4)	0.010229	0.054543	0.187549	0.8546
LOG(X3)	-0.006049	0.024474	-0.247175	0.8093
RESID(-1)	0.229054	0.295574	0.774947	0.4547
RESID(-2)	0.268350	0.320050	0.838461	0.4196

R-squared	0.128191	Mean dependent var	-1.59E-16
Adjusted R-squared	-0.188830	S.D. dependent var	0.032170
S.E. of regression	0.035076	Akaike info criterion	-3.612265
Sum squared resid	0.013534	Schwarz criterion	-3.370831
Log likelihood	33.89812	Hannan-Quinn criter.	-3.599901
F-statistic	0.404361	Durbin-Watson stat	1.753839
Prob(F-statistic)	0.801779		

Figure 6. B-G test results (lag period is 2)6

As can be seen from the above table, nR^2 = 2.051059< χ^2_α(2)=5.991, prob(nR2)= 0.3586 is greater than the given significance level =0.05, and at the significance level 0.05, the corresponding p values of t statistics of regression coefficients of, are greater than 0.05, which fails the significance test. It shows that there is no second-order autocorrelation at the significance level of 0.05.

(6) Heteroscedasticity test -- White test

Heteroskedasticity Test: White

F-statistic	0.168281	Prob. F(2,13)	0.8469
Obs*R-squared	0.403776	Prob. Chi-Square(2)	0.8172
Scaled explained SS	0.184710	Prob. Chi-Square(2)	0.9118

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/29/22 Time: 20:01
Sample: 2006 2021
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001685	0.001279	1.317375	0.2105
LOG(X4)^2	-0.000123	0.000232	-0.530650	0.6046
LOG(X3)^2	3.01E-05	7.70E-05	0.391599	0.7017

R-squared	0.025236	Mean dependent var	0.000970
Adjusted R-squared	-0.124728	S.D. dependent var	0.001180
S.E. of regression	0.001251	Akaike info criterion	-10.36224
Sum squared resid	2.03E-05	Schwarz criterion	-10.21738
Log likelihood	85.89795	Hannan-Quinn criter.	-10.35483
F-statistic	0.168281	Durbin-Watson stat	1.985446
Prob(F-statistic)	0.846928		

Figure 7. White test results

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nR2=0.403776 $< \chi_{\alpha}^{2}(p) = \chi_{0.05}^{2}(2) = 5.99$,the prob(nR2) concomitant probability is 0.8172, which is greater than the given significance level =0.05, so the null hypothesis is accepted, and there is no heteroscedasticity in the regression model.

(7) Final model

Through the above tests, the final model is determined as follows:

$$ln\,\hat{Y}_i = 0.2889 - 0.0690\,ln\,X_3 + 0.3707\,ln\,X_4$$

$$(0.0849)\quad (0.0236)\qquad (0.0531)$$

$$t = (3.4009)\quad (-2.9196)\qquad (6.9754)$$

$$R^2=0.9398 \quad \bar{R}^2 = 0.9306 \quad F= 101.5582 \quad \hat{\sigma} =0.0346 \quad DW=1.3850$$

The model shows that assuming that other explanatory variables remain unchanged, when the premium income of agricultural insurance X3 increases by 1%, the comprehensive level of green agricultural development Y will decrease by % on average; 0.0690Assuming that other explanatory variables remain unchanged, every 1% increase in agriculture-related loan balance X4 will increase the comprehensive level of green agricultural development Y by % on average.0.3707.

6. Conclusion and suggestions

The green development of agriculture cannot be separated from the support of green finance. The popularization and promotion of green finance also needs green agriculture projects as the carrier. Using the relevant data of Zhejiang province from 2006 to 2021, this paper empirically analyzes the effects of green insurance, green credit and green investment on agricultural green development, and draws the following conclusions: overall, green finance has a positive role in promoting agricultural green development. Among them, green credit has significantly improved the level of agricultural green development by increasing agriculture-related loans, while green insurance has decreased the level of agricultural green development by affecting the premium income of agricultural insurance. This may be caused by the imperfect development of green insurance and the low penetration rate of green investment in rural agriculture.

We should improve and unify the standards for green agricultural development. To be specific, China's green agricultural development standard system has made many provisions on the safety of agricultural products consumption and the use of pesticides, but the requirements on source pollution prevention and control standards and pollutant reduction standards still cannot meet the current agricultural resources and environmental protection standards. Therefore, China must accelerate the improvement of the agricultural green development standard system, guide and standardize the transformation of agriculture to the green direction, and establish a unified standard for finance to help the green development of agriculture.

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