

Land Transfer and Agricultural Modernization: Internal Mechanism and Empirical Testing

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Abstract: Agricultural modernization is the long-term goal of China's agricultural development and an important part of achieving Chinese path to modernization. Land transfer, as the direction of agricultural system reform, should play an important role in achieving agricultural modernization. Based on the provincial Panel data from 2011 to 2020, this paper theoretically and empirically analyzes and verifies the impact of land transfer on agricultural modernization. The results indicate that land transfer has a significant impact on the development of agricultural modernization in China, and the conclusion still holds after considering robustness tests such as replacing the dependent variable, tail reduction treatment, and lag treatment. Heterogeneity analysis indicates that land transfer has spatial heterogeneity in the development of agricultural modernization in China, with significant effects on the modernization of agriculture in the eastern and central regions, but not in the western regions. This paper provides new Empirical evidence for the related research of land circulation and agricultural modernization, and also provides relevant policies for accelerating land circulation to promote agricultural modernization.

Keywords: Land transfer, Agricultural modernization, Scale operation, Heterogeneity.

1. Introduction

The 20th National Congress of the Communist Party of China stressed that the central task of the CPC is to unite and lead the people of all ethnic groups in building a strong socialist modernization country in an all-round way, achieve the second century goal, and comprehensively promote the great rejuvenation of the Chinese nation with Chinese path to modernization. The No. 1 central document of the Central Committee of the CPC in 2023 pointed out that the most arduous and arduous task of building a socialist modern country in an all-round way is still in the countryside. The weak link is agricultural modernization. Without agricultural modernization, national modernization is incomplete, incomplete, and unstable. It can be seen that agricultural modernization is an important task of building China into a modern power and an important component of achieving Chinese path to modernization.

As a carrier of rural revitalization, land is an important resource and fundamental way for agricultural development, rural construction, and farmers' income increase. The "Household responsibility system" implemented in the early 1980s liberated Agricultural productivity through enthusiasm, but also made China return to the small-scale peasant economy with the agricultural collectivization production mode of "Learn from Dazhai in agriculture". With the continuous advancement of urbanization in China, rural labor has begun to leave rural areas and flow to urban development. With this, problems such as rural aging and hollowing out have led to inefficient use and waste of land resources. In the current situation of agricultural development, the contradiction between the production mode of small-scale farmers and productivity has formed, which to some extent hinders the large-scale and mechanized management of land. Moderate scale management of land is a policy advocacy for achieving agricultural modernization, and the implementation of land transfer policies lays the foundation for moderate scale management of land. The State Council's Opinion on

Guiding the Orderly Transfer of Rural Land Management Rights to Develop Moderate Scale Operation in Agriculture points out that land transfer and moderate scale operation are the necessary paths for the development of modern agriculture. The No. 1 central document of the Central Committee also proposed to guide the orderly circulation of land management rights and develop the appropriate scale operation of agriculture. Land transfer is an important part of the current rural land system reform, which involves the national economy and people's livelihood. Through the transfer of rural land, it can promote the growth of farmers' income, improve agricultural production efficiency, liberate rural labor, and coordinate the development of industries. The development of agriculture, rural areas, and farmers is undoubtedly related to the promotion of agricultural modernization. Therefore, exploring the internal relationship between land transfer and agricultural modernization construction not only has positive significance for the construction of agricultural modernization, but also provides theoretical support for land transfer.

2. Literature Review

The specific concept of agricultural modernization was first proposed by American economist Schultz (1987). Schultz believed that agricultural labor productivity was a key indicator to measure the level of agricultural modernization, and the way out for traditional agriculture was to transform it into modern agriculture.

In China, Premier Zhou Enlai first proposed agricultural modernization in 1954 and classified it as one of the "four modernizations". In 1961, Premier Zhou further interpreted the connotation of agricultural modernization as mechanization, water conservancy, fertilizer, and electrification. Enter the new era, the development of agriculture in China not only focuses on agricultural productivity, but also focuses on the construction of goals such as food security, ecological protection, and sustainable

development. As a result, the connotation of agricultural modernization has become more extensive. Zhong Xiaoping and Yu Xiaohua (2023) believe that there is not only one path to agricultural modernization. There are significant differences in the historical, cultural, social, economic, and resource endowments of countries around the world, and they should be based on their own national conditions and explore agricultural modernization paths that are in line with their own reality. Chen Yanjun and Liu Xuejuan (2021) pointed out the general characteristics of agricultural modernization with Chinese characteristics: the synchronization of four modernizations is the condition for the realization of agricultural modernization with Chinese characteristics, and the new development concept is the guiding ideology of agricultural modernization with Chinese characteristics, and put forward the theory of transforming traditional agriculture, the theory of Structural stage theory of agricultural development, and the theory of induced technological innovation. Yang Hua et al. (2020) constructed an evaluation system for agricultural modernization from four dimensions: industrial structure, factor input, quality efficiency, and sustainable development. Jiang Song et al. (2015) used principal component analysis to calculate the level of agricultural modernization in the western region and delved into the regional differences in the evolution speed of agricultural modernization in the western region.

Land transfer refers to the separation of ownership and management rights, allowing farmers with land contracting rights to transfer and lease land through various forms. Regarding the research on land transfer, Zhang Wenxuan et al. (2022) analyzed the current situation and influencing factors of land transfer in China, and pointed out the role of land ownership confirmation in promoting land transfer. Hu Xia and Liu Xiaojun (2021) found in their analysis of small farmers in Japan that after 40 years of land ownership and management rights transfer, Japan has achieved certain results in scaling up its agriculture. Zeng Long et al. (2022) pointed out through empirical analysis that with the deepening of land transfer, large-scale land management promotes the development of rural industrial integration. Li Yujia (2022) pointed out that there are four modes of land transfer: rental mode, equity participation mode, cooperation mode, and leaseback mode. He analyzed the current situation of land transfer and believed that land transfer effectively improves the utilization rate of rural land, promotes the diversified development of farmers' income structure, promotes the rapid development of agricultural technology, and promotes the optimization and adjustment of agricultural industrial structure. Dong Lixia (2022) believes that land transfer can increase agricultural operating income, promote industrial adjustment, improve ecological environment, increase agricultural scale returns, and effectively assist in the development of rural economic modernization. Delangelman et al. (2022) analyzed that land transfer has four effects on non agricultural employment: improving agricultural labor productivity, promoting the integration of three industries, weakening land root awareness, and reducing the threshold effect of non agricultural employment for farmers.

On the research of land circulation on agricultural modernization, Hong Yinxing (2019), based on Marxist theory, pointed out that the level of land capital accumulation directly affects the level of agricultural modernization. The current Household responsibility system does not meet the requirements of agricultural modernization in the new era,

and the first problem to be solved is land circulation. A scholar (2010) proposed that land transfer and large-scale management are essentially two aspects of the same problem. Only by implementing land transfer can we achieve relative concentration of land and expand the scale of agricultural management. Therefore, land transfer is the prerequisite and foundation of agricultural modernization. Yang Guangliang (2022) pointed out that the small scale of agricultural land management hinders the establishment of China's modern agricultural production system. Chen Yiyuan (2023) believes that agricultural scale is not equivalent to agricultural modernization, and does not consider the employment problem of farmers after land transfer. Such agricultural modernization lacks a foundation. Liu Yi studied the meaning and background of rural land transfer, and elaborated on the significance of land transfer for agricultural modernization in China from multiple dimensions such as economy, technology, and system. Zhao Ning (2022) analyzed the market mechanism of land transfer from the supply and demand side of the market, and inferred the impact mechanism of land transfer on rural economy under the logic of "land transfer out party - land transfer in party". Wang Yunchang and Mu Lan (2022) analyzed and verified that land transfer can promote the process of agricultural modernization through the Mesomeric effect, taking agricultural scale operation and rural human capital level as intermediary variables.

There have been certain achievements in the research on land transfer and agricultural modernization in the theoretical community, but most of them focus on a single aspect, such as the improvement of production efficiency and the impact of farmers' income, neglecting the overall impact of land transfer on the development of agriculture, rural areas, and farmers. There is a relatively lack of theoretical literature systematically explaining the impact of land transfer on the development of agricultural modernization, and empirical research needs to be supplemented. This article is based on data from 30 provinces in China from 2011 to 2020, and verifies the impact of land transfer on agricultural modernization through theoretical analysis and empirical testing, providing certain theoretical support for the promotion of land transfer.

3. Basic Theory and Mechanism of Action

3.1. The connotation of agricultural modernization

Agricultural modernization refers to the process of utilizing modern scientific technology and management methods to improve agricultural production efficiency and quality, and promote sustainable agricultural development. It involves various aspects of agricultural production, rural economy, and farmers' lives, aiming to achieve scale, intensification, specialization, and automation of agriculture, in order to adapt to social and economic development and the continuous growth of people's demand for high-quality agricultural products.

The development goal of Chinese agricultural modernization based on China's characteristics and national conditions is to improve the level of Agricultural productivity, improve the quality of agricultural products, increase farmers' income, improve rural social conditions, strengthen rural infrastructure construction, and achieve sustainable agricultural development. The achievement of the above

goals requires advanced scientific technology and management methods.

Firstly, agricultural modernization relies on the support of science and technology. By introducing new agricultural machinery and advanced agricultural production technologies, agricultural production efficiency and labor productivity can be improved. For example, the promotion of Precision agriculture technology and intelligent agricultural system can realize precision fertilization, irrigation and Pest control, reduce resource waste and improve crop yield.

Secondly, agricultural modernization requires strengthening the construction of agricultural infrastructure. This includes improving infrastructure such as farmland water conservancy facilities, road transportation networks, power supply, and rural communication, and improving the convenience of rural logistics and information exchange. Good infrastructure can reduce the transportation cost of agricultural products, promote the circulation of agricultural products in the market, and increase farmers' income.

3.2. Connotation of land transfer

Land transfer refers to the process in which rural collective land, under certain conditions, is transferred by the land user to others with or without compensation, in order to achieve optimal allocation of land resources and maximize economic benefits. The connotation of land transfer lies in the transfer of property rights of rural land. The essence of land transfer lies in the transfer of land management rights, which means that the owner or user of the land transfers the land management rights to others. The reform of the Household responsibility system at the beginning of the reform and opening up in China constituted a phenomenon that rural land in China belonged to collective ownership and land use rights belonged to farmers. Land transfer allows farmers to transfer their land use rights to other farmers, agricultural enterprises, or investors without changing their collective ownership, in order to achieve a change in land use rights.

3.3. The impact of land transfer on agricultural modernization

Land transfer can achieve the intensification and scale of agricultural production. Through socialized mass production, that is, the organization and collaboration of the entire society, advanced productivity and scientific technology are utilized to carry out large-scale agricultural production activities to promote agricultural modernization. Scale production improves agricultural production efficiency, reduces production costs, and maximizes economic benefits by integrating various technical means and resources such as varieties and machinery. In the past, there was a phenomenon of human capital waste in the operation of small-scale peasant economies, often resulting in a mismatch of labor force and affecting agricultural production efficiency due to the small amount of land cultivated by households. Through land transfer, it is possible to rematch agricultural labor force with arable land area, liberate some agricultural labor force from flowing to the secondary and tertiary industries to engage in non agricultural production activities, and achieve a dual increase in agricultural production efficiency and household income.

Land transfer can improve the automation and informatization level of agricultural production, in order to achieve agricultural modernization. With the continuous renewal and development of Mechanised agriculture

equipment, scale operation provides a technical prerequisite for agricultural modernization. Under scale operation, advanced information technology can be used to monitor, analyze and optimize management in the process of agricultural production, so that land can be used by farmers, cooperatives or other economic organizations with mechanical farming conditions. Improving the level of agricultural production and management will significantly improve the process of Mechanised agriculture. On the basis of small-scale peasant economy with family production, it is difficult for individual farmers to have sufficient funds to purchase agricultural machinery to improve agricultural production efficiency. Even if farmers are able to purchase socialized agricultural machinery services, the narrow household size and fragmented distribution of arable land also limit the use of agricultural machinery. It can be said that the purchase cost of agricultural machinery and the distribution of fragmented farmland hinder the advancement of mechanization.

Land transfer can bring various economic and social benefits. Scale operation can attract more capital and technology to enter the agricultural field, invest more resources in scientific management and technological innovation. At the same time, scale management can promote the improvement of farmers' abilities and qualities in terms of large-scale planting, organizational level, and market mechanism construction. Due to their own bottlenecks, the use of advanced technology in small-scale agricultural production methods often lags behind, leading to a disadvantage for small-scale farmers in the market competition mechanism. Through land transfer, the land Means of production will be concentrated by cooperatives, agricultural means of production operation management companies and other institutions to engage in production. These organizations have the advantage of quick access to scientific and technological information, and can timely introduce advanced technology into agricultural production, thus promoting the mechanized, intelligent and digital development of agriculture.

In summary, the following hypothesis is proposed: land transfer has a significant impact on agricultural modernization.

4. Research Design

4.1. Data source

This paper selects Panel data of 30 provinces (excluding Tibet) in China from 2011 to 2020 as the research object, with 300 observations in total. All data comes from the China Statistical Yearbook, China Rural Statistical Yearbook, China Business Management Statistical Yearbook, China Rural Policy and Reform Statistical Yearbook, etc. from 2011 to 2020. Some missing data are supplemented by Linear interpolation.

4.2. Variable selection

Explanatory variable: Agricultural modernization. At present, there are various methods for measuring agricultural modernization. Based on previous scholars' research, this article constructs an agricultural modernization indicator system from four dimensions: agricultural input, agricultural output, rural development level, and rural ecological environment. The entropy method is used to calculate the agricultural modernization index. The specific indicators are

as follows:

Table 1. Indicator System for Agricultural Modernization

Goal layer	Criterion layer	Index layer	Index attribute	Entropy weight
Agricultural modernization	Agricultural input	Arable land per capita	+	0.16099
		Effective irrigation rate	+	0.10096
		Mechanical power per unit cultivated area	+	0.08686
		People employed in the primary industry	-	0.3403
	Agricultural output	Land productivity	+	0.13414
		Per capita grain output	+	0.1186
		Labor productivity	+	0.07334
	Rural development level	Rural Engel coefficient	-	0.02338
		Urbanization ratio	+	0.05158
		Per capita disposable income of farmers	+	0.07571
	Rural ecological environment	Forest coverage rate	+	0.08792
		Fertilizer load degree	-	0.02369
		Carbon emission	-	0.02881

The entropy method used in this article is an objective weighting method that determines the weight of various indicators based on their observed values, providing a basis for comprehensive evaluation of multiple indicators. Compared to subjective weighting, entropy method has higher credibility and accuracy. The specific steps are as follows:

The first step is to standardize the data using the range transformation method to eliminate the impact of dimensionality. Indicators are divided into positive indicators and negative indicators. The standardization formula for positive indicators is:

$$X^*_{ij} = \frac{X_{ij} - \min X_{ij}}{\max X_{ij} - \min X_{ij}} \quad (1)$$

The standardization formula for negative indicators is:

$$X^*_{ij} = \frac{\max X_{ij} - X_{ij}}{\max X_{ij} - \min X_{ij}} \quad (2)$$

Among them, X_{ij} refers to the original data of the j th evaluation index of the i th province, X^*_{ij} refers to the standardized data of the j th index of the i th province, and, $\max X_{ij}$, $\min X_{ij}$ are the maximum and minimum values of the index respectively.

Step 2: Calculate the proportion P_{ij} of each evaluation

object under each indicator, using the formula:

$$P_{ij} = \frac{X^*_{ij}}{\sum_{i=1}^n X^*_{ij}} \quad (i = 1, 2, \dots, n; j = 1, 2, \dots, m) \quad (3)$$

Step 3, calculate the entropy value E_j of each indicator, with the formula:

$$E_j = -\frac{1}{\ln n} \sum_{i=1}^n P_{ij} \ln P_{ij} \quad (4)$$

When $P_{ij}=0$, set $P_{ij} \ln P_{ij}=0$.

Step 4, calculate the weight W_j of the indicator, using the formula:

$$W_j = \frac{1 - E_j}{\sum_{j=1}^m (1 - E_j)} \quad (5)$$

Finally, calculate the comprehensive score of each evaluation object, which is a positive indicator. The calculation formula is:

$$S_j = \sum_{j=1}^m W_j P_{ij} \quad (6)$$

Due to space limitations, only the level of agricultural modernization in 2011, 2015, and 2020 is shown here. The evaluation results are shown in the table below:

Table 2. Agricultural Modernization Level of Various Provinces in China

Province	2011	2015	2020	Province	2011	2015	2020
Beijing	0.378	0.362	0.481	Henan	0.217	0.273	0.350
Tianjin	0.320	0.345	0.434	Hubei	0.209	0.285	0.364
Hebei	0.276	0.315	0.380	Hunan	0.269	0.327	0.459
Shanxi	0.193	0.242	0.266	Guangdong	0.291	0.340	0.425
Inner Mongolia	0.267	0.319	0.423	Guangxi	0.207	0.264	0.366
Liaoning	0.262	0.301	0.325	Hainan	0.259	0.321	0.455
Jilin	0.278	0.326	0.388	Chongqing	0.212	0.259	0.351
Heilongjiang	0.344	0.417	0.544	Sichuan	0.179	0.229	0.324
Shanghai	0.340	0.351	0.409	Guizhou	0.144	0.204	0.309
Jiangsu	0.279	0.356	0.444	Yunnan	0.164	0.214	0.274
Zhejiang	0.369	0.424	0.595	Shaanxi	0.209	0.247	0.321
Anhui	0.220	0.283	0.375	Gansu	0.141	0.178	0.221
Fujian	0.337	0.406	0.593	Qinghai	0.194	0.217	0.297
Jiangxi	0.316	0.334	0.422	Ningxia	0.221	0.267	0.331
Shandong	0.249	0.306	0.377	Xinjiang	0.222	0.276	0.316

According to the calculation results, it can be seen that the level of agricultural modernization development in various provinces of China (excluding Tibet) is basically showing a steady growth trend. From a time perspective, the level of agricultural modernization in each province has increased to a certain extent between 2011 and 2020. From a spatial perspective, there is a significant regional heterogeneity in the development level of agricultural modernization in China. The level and growth rate of agricultural modernization in the eastern region are better than those in the central and western regions.

Core explanatory variable: land transfer. This article uses the household contracted farmland transfer area to represent it. Among them, the transfer area of household contracted farmland includes transfer area, exchange area, rental area, equity area, and other forms of transfer area.

Control variable: the level of industrial structure, which is

measured by the ratio of the added value of the Secondary sector of the economy and Tertiary sector of the economy;

For foreign trade, this indicator is measured by the total import and export volume of each province;

Rural electricity consumption, represented by the electricity consumption of rural areas in each province;

The level of human capital is represented by the average number of years of education in rural areas;

The level of fiscal support for agriculture is represented by the ratio of agricultural expenditure amount to fiscal expenditure in government finance.

4.3. Descriptive statistics

The descriptive statistics of variables are shown in the table below. The maximum value of the agricultural modernization index is 0.5949, with a mean of 0.3090, indicating that China's agricultural modernization is still in the development stage and there is a large room for improvement.

Table 3. Descriptive Statistical Analysis

Variable	Symbol	Obs	Mean	Std. Dev.	Min	Max
Agricultural modernization	AM	300	0.3090	0.0806	0.1414	0.5949
Land transfer	LC	300	1.45e+07	1.37e+07	164548	6.90e+07
Industrial structure	IS	300	1.2187	0.6960	0.5180	5.2968
Foreign trade	FT	300	425.6325	573.4673	1.3334	2622.8120
Rural electricity consumption	RE	300	294.7178	425.5895	4.07	2011
Human capital	HM	300	7.6934	0.8418	3.8189	9.8009
Fiscal support for agriculture	FS	300	11.4545	3.2840	4.1097	20.3840

4.4. Model construction

This article examines the impact of land transfer on agricultural modernization, and therefore sets a benchmark model as follows:

$$\ln AM_{it} = \alpha_1 + \alpha_2 \ln LC_{it} + \alpha_3 \ln X_{it} + \varepsilon_{it} \quad (7)$$

Where, AM_{it} represents agricultural modernization, LC_{it} represents land transfer indicators, and X_{it} represents control variables, ε_{it} is a random perturbation term, i represents province, and t represents time. In order to avoid pseudo regression, reduce homoscedasticity and heteroscedasticity and nonlinearity caused by various variables and improve data stability, all variables are logarithmized in this paper.

5. Empirical Analysis

5.1. Basic regression

This article uses OLS, individual fixed effects model, and bidirectional fixed effects model for regression, and the regression results are shown in the following figure. Among them, column (1) represents OLS regression, column (2) represents individual fixed effect model, and column (3) represents bidirectional fixed effect model. All three regressions are significant at a level of no less than 5% and have positive correlation coefficients, indicating that land

transfer has a significant promoting effect on the development of agricultural modernization. Land circulation can reduce production costs, improve the efficiency of the use of production factors, reduce environmental pollution and resource waste caused by the excessive use of various resources under the situation of small-scale farmers' production, solve the problem that agricultural modernization is restricted by small-scale farmers' Relations of production, and promote the development of agriculture from traditional agriculture to modern agriculture.

5.2. Robustness testing

In order to ensure the effectiveness and reliability of the above research and analysis on the impact of land circulation on the development of agricultural modernization, the following methods are used for robustness testing: (1) regression is conducted by replacing the level of agricultural modernization with the agricultural green Total factor productivity measured by the SBM model; (2) Shrink the tail of all variables at the level of 1% to reduce the impact of Outlier on the regression results; (3) Considering that the role of land transfer requires a certain period of time and may have a certain lag effect, this article conducts a lag treatment on the variables of land transfer.

From the table below, it can be seen that the coefficients of the explanatory variables in the table are all positive and have passed the significance test. The main conclusion is consistent with the above, indicating that the conclusion of land transfer promoting agricultural modernization is credible.

Table 4. Results of Basic Regression Analysis

Variable	Column (1)	Column (2)	Column (3)
LC	0.040*** (0.014)	0.113*** (0.020)	0.046** (0.019)
IS	0.228*** (0.033)	0.263*** (0.030)	-0.055* (0.033)
FT	0.062*** (0.013)	0.138*** (0.019)	0.055*** (0.015)
RE	-0.007 (0.017)	0.091*** (0.023)	0.059* (0.017)
HM	-0.135 (0.094)	0.023 (0.036)	0.005 (0.026)
FS	-0.078 (0.052)	-0.212*** (0.046)	-0.107*** (0.035)
Cons	-1.680*** (0.267)	-3.697*** (0.346)	-2.416*** (0.333)
Province	No	Yes	Yes
Time	No	No	Yes
N	300	300	300
R ²	0.4185	0.7933	0.8936

Note: ***, **, * means passing the significance test of 1%, 5%, 10% respectively. The value in () represents standard error, the same below.

Table 5. Results of robustness testing

Variable	Column (1)	Column (2)	Column (3)
LC	0.109*** (0.041)	0.037* (0.019)	0.047** (0.019)
IS	-0.045 (0.069)	-0.045 (0.032)	-0.066* (0.034)
FT	-0.050 (0.032)	0.054*** (0.016)	0.056*** (0.015)
RE	-0.139*** (0.036)	0.057*** (0.017)	0.071*** (0.018)
HM	-0.045 (0.055)	-0.002 (0.029)	0.011 (0.026)
FS	-0.176** (0.074)	-0.101*** (0.035)	-0.091*** (0.034)
Province	Yes	Yes	Yes
Time	Yes	Yes	Yes
Cons	-1.614 (0.697)	-2.266*** (0.331)	-2.501*** (0.337)
N	300	300	300
R ²	0.8246	0.8936	0.8963

5.3. Heterogeneity analysis

Given the varying development levels of land transfer and agricultural modernization in 30 provinces of China, there are also differences in the impact of land transfer on the development of agricultural modernization in China. The regression results based on the full sample in the previous text may overlook the spatiotemporal heterogeneity of the impact of land transfer on agricultural modernization under the conditions of development level and resource endowment in each province. Based on this, 30 provinces in China are divided into three regions: East, Central, and West, and regression analysis is conducted to examine the heterogeneity of the impact of land transfer on agricultural modernization.

From the comparative analysis in Table 6, it can be seen that the impact of land transfer in the eastern region on the development of agricultural modernization has passed the significance test. The land transfer in the central region has a significant effect on the development of agricultural

modernization, but it is lower than that in the eastern region. The effect of land transfer in the western region on the development of agricultural modernization has not passed the significance test. The possible reason is that the overall economic level of the eastern region is relatively high, with advanced production technology, and new business entities such as enterprise capital and agricultural technology companies have a better development environment in the eastern region. Land transfer has a significant impact on agricultural modernization, while the central region, due to the relative lack of these advantages, has a lower impact on agricultural modernization than the eastern region. However, the capital, technology, labor and other factors in the western region are far inferior to those in the central and western regions, and the area suitable for agricultural cultivation in the western region is relatively small, the environment is fragile, and the degree of land transfer is also low. Under the influence of various factors, land transfer is difficult to have a significant impact on agricultural modernization.

Table 6. Results of Heterogeneity Analysis

Variable	East	Central	West
LC	0.099*** (0.032)	0.084** (0.046)	0.033 (0.039)
IS	-0.127* (0.074)	-0.016 (0.084)	-0.053 (0.058)
FT	0.045 (0.044)	0.044** (0.018)	0.061 (0.029)
RE	0.062*** (0.020)	0.159* (0.095)	0.240 (0.063)
HM	0.015 (0.048)	-0.062 (0.042)	-0.036 (0.042)
FS	-0.221*** (0.055)	-0.114* (0.060)	-0.231 (0.080)
Province	Yes	Yes	Yes
Time	Yes	Yes	Yes
Cons	-2.887*** (0.656)	-0.505 (0.689)	-2.673*** (0.607)
R ²	0.8905	0.9379	0.9443

6. Conclusions and Suggestions

6.1. Conclusions

This paper takes the Panel data of 30 provinces in China (outside Tibet) from 2011 to 2020 as samples, theoretically analyzes the role of land circulation on agricultural modernization, and uses the fixed effect model to empirically study the impact of land circulation on agricultural modernization. The main conclusions are as follows: Land transfer has a significant impact on the development of agricultural modernization in China; Land transfer has spatiotemporal heterogeneity in promoting agricultural modernization. From a regional perspective, it has a significant impact on the eastern and central regions of China, but not on the western regions of China.

6.2. Suggestions

Based on the above empirical results, this article proposes the following policy recommendations: (1) Accelerate the process of rural property rights confirmation, establish a sound land transfer market, improve the land transfer system, and enhance the convenience and transparency of land transfer. (2) Provide land transfer subsidies and financial support, establish land transfer subsidies and incentive mechanisms, provide financial support and loan facilities for farmers and enterprises participating in land transfer, reduce transfer costs, and actively promote land transfer. (3) Optimize the rural land system, improve the rural land property rights system, and give farmers more autonomy and security in land transfer. At the same time, pay attention to protecting the rights and interests of farmers, and prevent problems such as resource loss, worsening poverty, and changing the agricultural use of land during the land transfer process. Only by enabling farmers to achieve tangible benefits in land transfer can we achieve a shift in China's farmers' attitude towards land transfer from hesitation to participation, in order to promote the modernization of agriculture. (4) Cultivate new entities and improve the quality of moderately sized business entities. All parties should create a favorable development environment for moderate scale business entities. Relevant institutions and governments should provide professional technical training and promotion services as much as possible, accelerate the cultivation of new professional farmers, and achieve breakthroughs in the development of agricultural modernization.

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