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Influencing Factors of Agricultural Mechanization

-- Based on the Perspective of Soft Input

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Abstract

Based on the panel data of 32 provinces in China from 2010 to 2017, this paper empirically analyzes the impact of agricultural science and technology investment on agricultural mechanization by constructing agricultural science and technology input indicators and using two methods of ordinary panel regression and spatial regression model. The results showed that: scientific and technological innovation significantly promoted agricultural mechanization. At the same time, education investment has also significantly improved the mechanized farming area of agricultural mechanization. The results of spatial econometric analysis further confirmed the stability of the research results. Therefore, the relevant departments should increase the investment in science and technology and education of agricultural industry, pay attention to the training and guidance of agricultural machinery technology, and effectively improve the efficiency of agricultural machinery promotion. At the same time, the state should also increase investment in the innovation of agricultural mechanization equipment.

Keywords

Agricultural Mechanization; Soft Input; Scientific and Technological Innovation.

1. Introduction

Agricultural mechanization can be defined as a process by which human labor along the entire agricultural value chain is replaced by other sources of energy, such as animal power, fossil energy or renewable energy [1]. The mechanization of agriculture is our country agriculture modernization important constituent, is the agriculture modernization foundation. Through the analysis mechanization of agriculture construction present situation, the existence question and the development situation, proposed promotes our country mechanization of agriculture development support policy to suggest, this has the profound practical significance to our country mechanization of agriculture and even the agriculture modernization advancement.

Theodore W. Schultz (1964) wrote at the beginning of "transforming traditional agriculture": no matter how fertile his land is, or how hard he tills, if he only follows his father's farming method, he will never produce more food. And if a farmer can master and use science to tell him about machines, soil, animals and plants, no matter how barren his land is, he can still get a good harvest. He is so efficient that his brothers and neighbors can move into the city and the whole society can still produce enough food [2]. This description vividly depicts the process of Agricultural Mechanization (hereinafter referred to as "agricultural mechanization") as the representative of modern agricultural production factors transforming traditional agriculture, and ultimately providing surplus labor for the development of industrialization and urbanization. It can be seen that the active development of agricultural mechanization is of great strategic significance for promoting the construction of modern agriculture and new socialist countryside, building a well-off society in an all-round way and realizing national modernization. Lu et al. (2009) studied the role of agricultural mechanization in the modernization of asian agriculture: taiwan's experience [3]. Qiao (2017) found that mechanization was a factor affecting China's agriculture. This is especially true for less developed countries [4]. Daum and Birner (2020) pointed out that Across Africa, governments, development practitioners and private companies had rediscovered agricultural mechanization as a top priority [5]. Loon et al. (2020) deemed that there was great untapped potential for farm mechanization to support rural development initiatives in low- and middle-income countries [6].

Domestic and foreign scholars have carried out a wealth of research on agricultural mechanization. Adekunle et al. (2016) studied the socio-economic determinants of agricultural mechanization in Africa based on a research note of cassava cultivation mechanization [7]. Li et al. (2017) analyzed the effects of land lease policy on changes in land use, mechanization and agricultural pollution [8]. Wang et al. (2018) examined the constrains mechanization in Chinese agriculture based on the role of farm size and fragmentation [9]. Aryal et al. (2019) assessed the factors associated with the adoption of small-scale machine types, particularly irrigation pumps, threshers and power tillers (two-wheel tractors) [10]. The academic community also analyzed how to improve the level of agricultural mechanization from the perspectives of farmers' income, land management scale, agricultural labor cost and agricultural machinery purchase subsidy. However, few literatures focus on the impact of soft input on agricultural mechanization and its mechanism, which makes it a new starting point to analyze the agricultural mechanization from the perspective of science and technology investment and education investment.

This paper selects agricultural mechanization management institutions, agricultural mechanization technology extension institutions, agricultural mechanization education, training institutions, agricultural mechanization scientific research institutions and agricultural mechanization investment, including 13 indicators, using the panel data of 32 provinces from 2010 to 2017 to carry out empirical research to analyze the impact of soft input factors on Agricultural Mechanization in China. The structure of the paper is as follows: the second chapter makes a basic statistical analysis. In the third chapter, a benchmark regression model is established to quantitatively analyze the influence of various factors on mechanization. In the fourth chapter, from the perspective of spatial econometrics, the spatial autoregressive model is established to test the stability of the analysis results. The fifth chapter is the summary.

2. Index and Basic Analysis

From the data availability, this paper selects the relevant data of 32 provinces in China from 2010 to 2017. The data is from WIND database. The first level indicators include: agricultural mechanization management institutions, agricultural mechanization technology extension institutions, agricultural mechanization education and training institutions, agricultural mechanization scientific research institutions, and agricultural mechanization investment. Among them, each level index includes the number of institutions at the end of the year, the number of people at the end of the year, and the number of scientific and technological personnel (teachers) at the end of the year. In this paper, the mechanization level is expressed by the area of machine tillage, the area of machine sowing and the area of machine harvesting. In recent years, the degree of mechanization in China has been continuously improved, as shown in Figure 1:

It can be seen from Figure 1 that the area of mechanized farming, machine type and mechanical harvesting increased year by year from 2010 to 2017. Taking 2016 as an example, the comprehensive mechanization level of rice cultivation and harvest in China reached 79.20%, of which the level of mechanized farming reached 99.31%, the level of machine seed reached 44.45%, and the level of machine harvest reached 87.11%. However, the development gap of

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mechanization level in different provinces is still very large and unbalanced. Table 1 shows the average values of each index in each province.

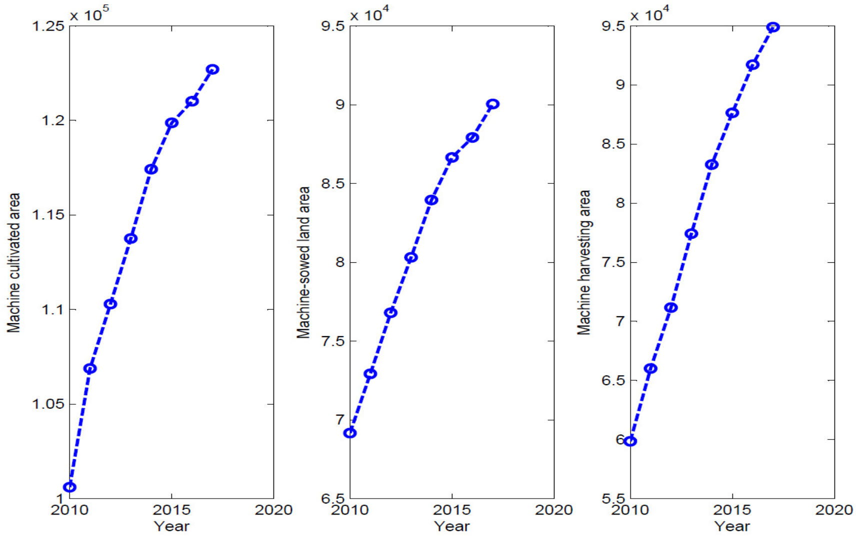

Figure 1. Degree of mechanization

Table 1. Average value of each index in each province from 2010 to 2017

		Beijing	Tianjin	Hebei	Shanxi	Neimeng gu	Liaoning	Jilin	Heilong jiang
Agricultural Mechanization Management Organization	Number of institutions at the end of the year	193.63	156.75	1,815.75	1,342.38	752.13	1,151.50	697.38	682.50
	Number of people at the end of the year	465.13	797.75	4,328.00	4,907.13	2,204.25	3,024.00	5,710.75	3,354.38
	Number of people at the end of the year: scientific and technological personnel	142.13	139.50	1,822.50	2,619.25	1,233.38	1,471.25	4,344.13	2,214.50
Agricultural Mechanization Operation	Machine cultivated area	55.14	360.85	5,415.19	2,642.10	6,219.45	3,780.60	4,828.86	14,241.43
	Machine-sowed land area	137.74	406.50	6,578.39	2,492.73	6,665.58	3,164.25	4,802.48	13,830.28
	Machine harvesting area	108.86	320.39	4,642.41	1,596.97	4,123.90	1,733.69	2,714.90	11,495.82
Agricultural Mechanization Technology Extension Organization	Number of institutions at the end of the year	12.50	10.50	165.75	121.25	92.00	76.00	59.00	83.88
	Number of people at the end of the year	281.88	108.75	1,214.50	947.75	891.75	1,003.25	1,059.75	639.00
	Number of people at the end of the year: scientific and technological personnel	137.88	79.13	712.13	679.88	626.88	666.38	858.00	514.00
Agricultural Mechanization	Number of institutions at	9.13	11.50	118.50	59.88	46.63	50.00	37.50	60.88

Education and Training	the end of the year								
	Number of people at the end of the year	285.25	131.75	821.25	641.00	280.75	782.63	1,169.00	1,232.25
	Number of people at the end of the year: scientific and technological personnel	105.88	66.00	491.13	466.50	201.38	4.63	4.38	8.50
Agricultural Mechanization Research Institutions	Number of institutions at the end of the year	0.00	1.00	1.00	11.00	3.13	158.75	299.13	833.00
	Number of people at the end of the year	0.00	31.38	20.63	267.63	39.25	158.75	299.13	535.75
	Number of people at the end of the year: scientific and technological personnel	0.00	21.88	13.75	209.13	16.25	88.63	229.38	535.75
Agricultural Mechanization Input	Total individual input of farmers	9,426.76	13,395.27	143,878.57	105,517.16	141,673.10	122,907.24	163,939.65	225,734.86
	Total unit and collective investment	3,104.28	1,344.27	1,983.29	991.52	1,590.35	1,096.50	274.69	9,087.96
	Total other investment	36.56	0.00	24.45	8.89	405.85	329.13	377.13	393.68
	Total	45,939.97	49,867.34	427254.95	261,765.97	435,396.63	302,680.66	487,774.90	657,773.12
		Shang hai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shan dong	Henan
Agricultural Mechanization Management Organization	Number of institutions at the end of the year	110.38	1,227.25	1,304.63	1,245.75	1,092.25	1,524.75	1,871.00	1,737.88
	Number of people at the end of the year	276.50	4,540.75	2,756.13	3,662.38	2,392.75	3,594.38	9,237.63	6,336.25
	Number of people at the end of the year: scientific and technological personnel	180.63	2,098.25	2,409.75	2,276.50	901.50	1,682.88	4,697.25	1,895.38
Agricultural Mechanization Operation	Machine cultivated area	353.81	6,042.05	1,432.16	7,369.45	1,017.99	3,724.85	6,200.35	0.00
	Machine-sowed land area	61.59	4,170.16	223.44	4,552.13	102.59	732.23	8,412.86	0.00
	Machine harvesting area	155.50	5,046.03	898.49	6,070.19	357.57	3,013.23	7,217.75	0.00
Agricultural Mechanization Technology Extension Organization	Number of institutions at the end of the year	8.75	89.13	42.25	83.00	10.00	93.88	146.50	161.88
	Number of people at the end of the year	74.38	948.00	204.13	765.50	69.50	353.00	995.63	1,944.38
	Number of people at the	60.25	646.13	165.75	553.50	40.63	220.00	715.13	860.75

	end of the year: scientific and technological personnel								
Agricultural Mechanization Education and Training	Number of institutions at the end of the year	1.25	53.63	37.75	67.88	14.88	47.25	131.50	126.88
	Number of people at the end of the year	2.88	365.38	162.13	810.38	141.75	284.25	1,055.00	1,789.25
	Number of people at the end of the year: scientific and technological personnel	1.75	254.25	101.38	624.00	88.00	139.38	810.50	987.00
Agricultural Mechanization Research Institutions	Number of institutions at the end of the year	1.00	0.25	0.88	2.00	0.00	0.63	4.00	0.25
	Number of people at the end of the year	122.38	1.25	42.88	49.63	0.00	58.75	103.63	0.25
	Number of people at the end of the year: scientific and technological personnel	35.13	1.25	28.88	44.88	0.00	31.88	67.50	0.25
Agricultural Mechanization Input	Total individual input of farmers	8,016.81	168,654.38	60,158.99	207,419.85	54,867.22	96,724.75	221,683.22	222,556.86
	Total unit and collective investment	3,360.41	14,575.95	13,115.94	1,838.85	537.12	819.17	8,672.70	4,224.11
	Total other investment	324.07	222.59	402.50	195.97	9.87	36.25	0.38	70.20
	Total	54,724.29	604,217.07	201,614.95	594,456.64	128,145.91	270,373.16	649,672.91	611,823.84
		Hubei	Hunan	Guangdong	Guangxi	Hainan	Chongqing	Sichuan	Gui zhou
Agricultural Mechanization Management Organization	Number of institutions at the end of the year	943.75	2,050.50	1,104.38	1,216.75	170.38	918.00	3,228.00	1,144.88
	Number of people at the end of the year	3,239.38	8,222.50	3,165.13	3,724.63	442.75	2,241.13	6,852.13	3,148.25
	Number of people at the end of the year: scientific and technological personnel	1,818.63	2,788.38	762.75	2,440.38	153.88	1,231.63	3,381.88	1,533.00
Agricultural Mechanization Operation	Machine cultivated area	5,440.22	5,693.24	3,582.16	4,266.17	503.71	1,980.77	4,024.49	1,534.86
	Machine-sowed land area	1,840.55	907.68	220.39	605.45	6.68	133.42	676.30	59.69
	Machine harvesting area	3,760.25	3,639.15	1,536.03	1,761.82	249.28	340.48	1,763.24	282.08
Agricultural Mechanization Technology	Number of institutions at the end of the	101.13	127.13	108.25	100.75	15.63	38.88	151.75	84.50

Extension Organization	year								
	Number of people at the end of the year	836.25	1,577.88	582.75	972.13	77.00	188.75	747.50	362.63
	Number of people at the end of the year: scientific and technological personnel	597.00	702.88	270.25	644.25	34.63	123.25	495.63	209.63
Agricultural Mechanization Education and Training	Number of institutions at the end of the year	57.63	103.88	55.88	88.38	16.88	20.00	96.25	28.75
	Number of people at the end of the year	798.75	821.13	487.00	1,301.75	110.63	278.00	508.63	657.63
	Number of people at the end of the year: scientific and technological personnel	513.13	491.13	242.25	925.25	64.63	160.50	344.88	422.25
Agricultural Mechanization Research Institutions	Number of institutions at the end of the year	2.25	5.25	3.13	0.38	0.63	3.00	7.50	2.75
	Number of people at the end of the year	96.25	132.25	177.50	4.38	2.50	59.50	229.25	93.00
	Number of people at the end of the year: scientific and technological personnel	76.88	61.25	137.25	1.63	1.25	45.00	149.63	81.83
Agricultural Mechanization Input	Total individual input of farmers	179,769.37	177,375.18	80,966.01	114,695.04	21,286.45	44,561.01	153,707.40	51,146.37
	Total unit and collective investment	4,295.87	4,241.35	6,308.18	807.54	720.19	1,212.45	5,143.57	909.02
	Total other investment	1,372.74	1,193.15	324.28	95.32	10.50	898.89	11,100.53	49.13
	Total	468,288.10	471,225.44	184,092.90	273,535.46	48,853.10	121,526.83	507,427.89	138,695.24
		Yunnan	Xizang	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Bing tuan
Agricultural Mechanization Management Organization	Number of institutions at the end of the year	1,364.13	7.88	919.63	1,166.88	156.63	177.13	836.88	177.38
	Number of people at the end of the year	3,790.00	74.13	2,963.75	3,278.75	497.13	538.50	5,791.38	413.25
	Number of people at the end of the year: scientific and technological personnel	2,657.13	3.50	878.25	854.50	373.13	393.13	4,019.13	284.38
Agricultural Mechanization Operation	Machine cultivated area	2,431.39	144.79	2,717.98	2,390.39	356.46	886.99	4,337.93	1,172.17
	Machine-sowed land	106.66	133.04	1,983.27	1,496.14	293.96	694.46	4,216.03	1,243.90

	area								
	Machine harvesting area	382.27	113.43	1,670.54	945.89	194.69	529.57	2,189.41	920.34
Agricultural Mechanization Technology Extension Organization	Number of institutions at the end of the year	136.00	2.13	102.63	84.63	34.88	22.88	93.13	95.63
	Number of people at the end of the year	871.38	9.75	1,361.63	712.75	262.50	311.75	973.75	217.75
	Number of people at the end of the year: scientific and technological personnel	738.00	5.63	613.00	299.63	232.25	266.88	716.13	195.00
Agricultural Mechanization Education and Training	Number of institutions at the end of the year	120.25	0.00	85.38	80.13	11.25	6.88	82.13	9.25
	Number of people at the end of the year	978.50	0.00	1,275.88	604.50	113.13	58.50	570.25	55.75
	Number of people at the end of the year: scientific and technological personnel	710.75	0.00	777.25	324.13	90.13	53.25	486.88	52.50
Agricultural Mechanization Research Institutions	Number of institutions at the end of the year	2.50	0.00	0.75	2.38	0.00	0.75	0.13	2.00
	Number of people at the end of the year	79.50	0.00	21.00	39.50	0.25	7.50	0.00	30.38
	Number of people at the end of the year: scientific and technological personnel	57.50	0.00	2.25	21.88	0.00	5.25	0.00	29.38
Agricultural Mechanization Input	Total individual input of farmers	88,323.99	15,555.25	87,350.01	60,366.64	11,934.46	28,158.41	144,500.89	53,971.25
	Total unit and collective investment	2,072.05	0.00	4,582.39	321.18	811.47	1,846.45	600.20	4,097.63
	Total other investment	1,280.90	0.00	5.13	102.63	42.50	17.13	165.03	21.38
	Total	220,825.36	53,274.51	237,124.46	187,848.28	33,220.35	74,951.13	410,804.55	134,485.63

It can be seen from table 1 that there are great differences in agricultural mechanization level and investment among different provinces and regions in China. China is a vast country, the weather conditions and geographical conditions vary greatly, some areas of rural labor surplus, some areas of land is very scarce, coupled with the constraints of rural per capita income and other factors, leading to the development of mechanization in different regions have obvious differences.

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3. Benchmark Regression Analyses

3.1. Benchmark Regression Model

The benchmark regression model is set as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \sum_{i=1}^{n} \beta_n X_n + \varphi_i + \omega_t + \varepsilon_{it} \quad (1)$$

where the subscripts i and t represent the province and year, respectively, andY_{it} is a different dependent variable, X_{it} is the core explanatory variable, X_n is the vector of control variables. According to the model setting of previous similar studies, all variables were treated with logarithm. The main parameter β_1 describes the potential causal relationship between the core explanatory variable and the dependent variable. φ_i is time fixed effect, which is used to control the influence of common time shocks such as economic cyclical fluctuations on dependent variables. ω_t is the individual fixed effect, which is used to control the factors that do not change with time at the individual level, and ε_{it} is the random disturbance term.

3.2. Empirical Regression Results

Regression found that innovation has the greatest impact on agricultural mechanization, which may be because when the innovation is improved, the corresponding mechanization level will also be improved, and the cost of mechanized operation will be reduced, so all aspects of agricultural mechanization operation will increase. At the same time, education also has a significant improvement in the mechanized farming area, which is mainly due to the higher level of knowledge required for mechanized operation, the higher the human capital invested in individuals, and the higher the mastery of mechanized operation. The regression Analysis of influencing factors of mechanization are shown in Table 2.

Table 2. Regression Analysis of influencing factors of mechanization

	Mechanized farming area of Agricultural Mechanization	Mechanized planting area of Agricultural Mechanization	Mechanical harvesting area of Agricultural Mechanization
Management institutions	-0.9340^{***}	-2.1830^{***}	-0.9695^{***}
	(0.2074)	(0.0952)	(0.0692)
Promotion people	-0.8336^{**}	-0.6546^{*}	-1.1978^{***}
	(0.2860)	(0.3120)	(0.2605)
Educational institutions people	1.4582^{**}	0.9308^{*}	0.8143^{*}
	(0.4405)	(0.4173)	(0.3783)
RD institutions	164.8239^{***}	231.0265^{***}	72.2505
	(31.9728)	(33.0200)	(52.3827)
Import all	0.0124^{***}	0.0140^{***}	0.0127^{***}
	(0.0013)	(0.0008)	(0.0006)
_cons	222.7297	-79.0151	-1.8e+02
	(118.8830)	(130.6048)	(151.0591)
N	203	203	203
F	1.4e+03	434.7888	647.8901
r2_a	0.7683	0.6985	0.7571

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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The regression found that innovation has the greatest impact on the mechanized farming area of agricultural mechanization, which may be because when the innovation is improved, the corresponding mechanization level will also be improved, and the cost of mechanized operation will be reduced, so the mechanized area of agricultural mechanization operation will increase. At the same time, education also has a significant improvement in the mechanized farming area, which is mainly due to the higher level of knowledge required for mechanized operation, the higher the human capital invested in individuals, and the higher the mastery of mechanized operation.

4. Spatial Econometric Analysis

Agricultural Mechanization often has strong spatial correlation. Therefore, this paper establishes the following spatial econometric model for analysis.

$$IS_{it} = \beta_0 + \lambda \cdot W \cdot IS_{it} + \sum_{i=1}^{n} \beta_n X_{n,i,t} + \gamma \cdot X_n \cdot D + \varepsilon_{it}$$
$$\varepsilon_{it} = \rho \cdot E \cdot \varepsilon_{i,t} + V_{it}$$

It is very important to construct spatial weight matrix for spatial econometric analysis. This paper constructs the following five kinds of matrix to analyze the data. Firstly, based on the geographical distance between cities, we establish the weight matrix W1 of geographical distance. In order to make the results more robust, this paper further constructs the adjacent geographic distance matrix for analysis.

In many empirical studies, Moran's I and Geary's C are commonly used methods, which have appeared in many literatures, especially the former. Moran's I is the first method applied to global clustering test (cliff and ord, 1973). The calculation and test process of these two indexes are described below.

(1) Moran’s I index

Moran's I index is defined as follows:

$$\text{Moran's I} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(Y_i - \bar{Y})(Y_j - \bar{Y})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}}$$

where, $S^2 = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \bar{Y})$, $\bar{Y} = \frac{1}{n}\sum_{i=1}^{n} Y_i$.

Y_i is the observation value of the ith area, and n is the total number of regions. W_{ij} is the binary adjacent space weight matrix, which represents any primary color. The proximity criterion or distance criterion is used to define the mutual proximity of spatial objects. Moran's I index is generally between -1 and 1. If it is greater than 0, it means that the similar characteristic values of adjacent regions tend to cluster. When it is close to 1, it indicates that similar attributes are clustered together (high value and high value, low value and low value); less than 0 indicates negative correlation; when it is close to - 1, it indicates that different attributes are clustered together (high value and low value, low value and high value); if it is close to 0, it means that the attribute is randomly divided Cloth, or there is no spatial autocorrelation.

For Moran's index I, the standardized statistic Z can be used to test whether there is spatial autocorrelation in n regions.

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$$Z = \frac{I - E(I)}{\sqrt{var(I)}}$$

If the Z values of Moran's I's normal statistics are greater than the critical value 1.65 (1.96) of the normal distribution function at the level of 0.05 (0.01), it indicates that the region has obvious positive correlation in spatial analysis.

(2) Geary's C coefficient

The calculation formula of Gear's C coefficient is as follows:

$$C = \frac{(n-1)\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - x_j)^2}{2\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where, C is the Geary coefficient, other variables are the same as Moran's I index.

The value of gear coefficient C is generally between [0,2]. Greater than 1 indicates negative correlation, equal to 1 indicates no correlation, and less than 1 indicates positive correlation.

4.1. Spatial Correlation Test

In order to investigate the spatial spillover effect of industrial structure, we use Moran's I and Geary's C index to measure the global and local spatial correlation. The results of global spatial correlation test showed that Moran's I was greater than 0 and Geary's C was less than 1 under the weight matrix. The test results are shown in Table 3.

In this paper, in the analysis of agricultural mechanization and its influencing factors, the Moran'I index is used to prove there is a positive spatial correlation in Agricultural Mechanization in China, and the selected variables are tested by Geary test, and the fixed effect model is used. Finally, the model estimation results are obtained by using the robust standard error of clustering. The empirical results in Table 3 show that scientific and technological innovation has significantly promoted agricultural mechanization. At the same time, education investment has also significantly improved the mechanized farming area of agricultural mechanization. The spatial autocorrelation coefficient is consistent with moran'i index, which indicates that there is spatial positive correlation in agricultural mechanization. In order to improve the level of Agricultural Mechanization in China, we should not only consider the effect of various factors, but also comprehensively consider the spatial correlation and spatial dependence.

Table 3. Spatial econometric analysis of Agricultural Mechanization

	Mechanized farming area of Agricultural Mechanization		Mechanized planting area of Agricultural Mechanization		Mechanical harvesting area of Agricultural Mechanization	
Year	*Moran`s I*	*Geary`s C*	*Moran`s I*	*Geary`s C*	*Moran`s I*	*Geary`s C*
2010	0.029*	0.889*	0.082***	0.835***	0.017	0.925
2011	0.034**	0.889*	0.087***	0.826***	0.023	0.915
2012	0.032*	0.884*	0.091***	0.823***	0.028*	0.906*
2013	0.024*	0.892*	0.090***	0.825***	0.027*	0.906*
2014	0.020	0.898*	0.087***	0.825***	0.027*	0.897*
2015	0.019	0.902*	0.086***	0.828***	0.029*	0.892*
2016	0.014	0.905*	0.084***	0.827***	0.032*	0.890*
2017	0.009	0.912	0.084***	0.830***	0.034**	0.887*

4.2. Estimation Results of Spatial Autoregressive Model

Through LR and LM tests, the SAR model is finally selected for analysis. The results show that the spatial correlation exists, and the results are consistent with the above results, which is still robust. The test results are shown in Table 4:

Table 4. Stability test of spatial econometric model

	(1)	(2)	(3)	(4)	(5)
	FE	FE	FE	FE	FE
Import all	0.0016***	0.0018***	0.0020***	0.0020***	0.0020***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
RD institutions		86.2949***	75.4379**	75.8735***	77.8366***
		(30.1468)	(29.4523)	(29.4363)	(29.4421)
Educational institutions people			-0.6739***	-0.6560***	-0.6374***
			(0.1538)	(0.1553)	(0.1561)
Promotion people				-0.1281	-0.1018
				(0.1588)	(0.1604)
Management institutions					-0.3167
					(0.3066)
Spatial	0.7318***	0.6936***	0.5633***	0.5545***	0.5501***
rho	(0.0604)	(0.0645)	(0.0770)	(0.0781)	(0.0783)
Variance					
sigma2_e	6.0e+04***	5.8e+04***	5.4e+04***	5.4e+04***	5.4e+04***
	(5.6e+03)	(5.4e+03)	(5.1e+03)	(5.1e+03)	(5.0e+03)
N	232	232	232	232	232

5. Conclusion

Based on the perspective of soft input, this paper studies the impact of human and science and technology investment on agricultural mechanization. It is found that innovation has the greatest impact on agricultural mechanization. At the same time, education also has a significant improvement on the mechanized farming area of agricultural mechanization. Through the study of this paper, the following management implications are put forward:

(1) The government should strengthen the awareness that agricultural technology can promote agricultural development and increase investment capital. For example, the government should increase the fund subsidies for agricultural machinery technology research and development, and increase the investment of private enterprises. The government should actively look for funding channels, expand the source of capital investment and develop more financing methods according to the improvement of agricultural machinery technology research fund system, Provide financial support for R & D.

(2) Industrial development of agricultural machinery technology. According to different climate, geographical environment, market demand and other regional agricultural machinery technology research and development, such as: suitable for planting rice to research and development of machinery technology to improve rice yield, suitable for planting corn to research and development of machinery technology to improve the yield of corn, suitable for planting grass mainly to research and development to improve the quality of pasture machinery technology, and some planting vegetables and Fruit mainly focuses on the research and development of mechanical technology to improve the yield of vegetables and fruits, and develops regional agricultural machinery technology according to the favorable advantages to improve the yield and quality of crops. In addition, the government should strengthen the establishment of agricultural industry chain, realize the popularization and application of

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machinery technology in agricultural production, effectively connect agricultural production with market demand, and promote the development of agricultural mechanization.

(3) Adhere to scientific and technological innovation. In order to speed up the pace of agricultural mechanization development, we need to innovate and change the traditional development mode, such as: promote the industrialization mode of combining Internet and modern agricultural machinery, set up special funds, accurately establish the key research direction of agricultural machinery, develop the machinery and equipment for sowing, fertilization, irrigation and harvesting required by the agricultural planting process, and add laser measurement and intelligent determination The research and development personnel of machinery can cooperate with universities and enterprises and use all the advanced resources of colleges and universities to innovate better mechanical technology; We should integrate the development process of mechanization into the advanced modernization process, learn from the experience of agricultural product planting, soilless cultivation and other technologies, improve the innovation ability, and develop and produce more advanced machinery and equipment.

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