A study on the total agricultural output value and its influencing factors in all provinces of China

Xiaoyu Li[1, a], Jiahui Li[2, b]

[1]School of economics, Shanxi University of Finance and Economics, Taiyuan 030006, China

[2]School of Business Administration, Shanxi University of Finance and Economics, Taiyuan 030006, China

[a]1458779899@qq.com, [b]1332484647@qq.com

Keywords: total value of farm output, empirical analysis, multiple linear regression, Eviews, influencing factor

Abstract: Agriculture plays an important role in China's economic development. The development of social production begins with agriculture. Only on the basis of agricultural development can industry emerge and develop, and then the development of the tertiary industry. It can be seen that agriculture is the foundation of national economy. Only by strengthening the agricultural foundation and ensuring the supply of agricultural products, can we smoothly promote the rapid development of China's industry and cities; only by strengthening the agricultural infrastructure and making the agricultural development, farmers rich and rural stability, can we maintain the long-term stability and sustainable development of the whole society. In this paper, the relationship between the total agricultural output value and the effective irrigation area, the total power of agricultural machinery, and the application of agricultural chemical fertilizer was studied. After selecting the indicators, we use Eviews software to carry out regression test analysis on the data, and then use the methods of multicollinearity analysis, heteroscedasticity test and autocorrelation test to carry out the research. Finally, according to the conclusion, we put forward the corresponding methods and suggestions for the problems existing in the relationship.

1. Introduction

According to the relevant theoretical analysis, using the econometric method, taking the total output value of agriculture (y) as the explanatory variable, the effective irrigation area (x1), the total power of agricultural machinery (x2), and the net amount of agricultural fertilizer application (x3) as the explanatory variables, a econometric model is set up for this purpose, and three methods of multicollinearity test, heteroscedasticity test and autocorrelation test are used to study the effectiveness The influence of irrigation area, total power of agricultural machinery and application of agricultural chemical fertilizer on the total output value of agriculture. After checking and analyzing the established model, the factors that do not have significant influence are removed, and the model is rebuilt, and the conclusions and suggestions are drawn through analysis.

2. Data collection

Table 1 Total local agricultural output value and main factors impact data for each region in 2017

area	total value of farm output,Y	effective irrigation area,X1	farm machinery production,X2	agricultural fertilizer application yield, X3
Beijing Municipality	154.48	186.05	137.35	10.53
Tianjin Municipality	238.02	546.92	308.87	21.78
Hebei Province	3441.37	11102.81	4447.98	335.49
Shanxi Province	969.52	3351.65	1460.28	118.55
Nei Monggol	1418.31	3805.11	3086.9	229.35
Liaoning Province	2068.6	2813.86	1520.31	152.09
Jilin Province	1400.38	3152.54	1790.87	231.24
Heilongjiang Province	2911.86	5442.29	5530.84	255.31
Shanghai Municipality	162.04	119.01	188.21	9.92
Jiangsu Province	3722.1	4825.49	3952.5	319.99
Zhejiang Province	1434.71	2360.73	1432.15	87.52
Anhui Province	2174.61	6580.99	4400.34	338.69
Fujian Province	1618.59	1384.13	1061.65	123.8
Jiangxi Province	1326.9	2260.82	2027.67	143.58
Shandong Province	4929.85	13353.02	4964.43	463.5
Henan Province	4610.71	11710.08	5210.64	716.09
Hubei Province	2780.37	4468.12	2899.15	333.87
Hunan province	3043.52	5894.06	3113.32	246.54
Guangdong province	2793.76	2696.79	1771.26	256.46
Guangxi province	2146.37	3803.18	1618.79	259.86
Hainan province	613.87	511.59	263.99	51.14
Chongqing province	1033.68	1299.73	687.19	97.72
Sichuan province	3335.51	4404.55	2735.09	249.83
Guizhou province	1772.59	2575.15	1065.43	103.69
Yunnan province	1841.46	3333.04	1757.71	231.87
Tibet Autonomous Region	68.05	619.69	247.8	6.03
Shaanxi Province	1910.71	2667.27	1236.77	231.95
Gansu Province	1252.51	2684.95	1306.72	97.92
Qinghai Province	145	453.87	196.99	10.13
the Ningxia Hui Autonomous Region	310.99	831.26	506.53	40.09
Xinjiang Uygur Autonomous Region	2005.38	2489.32	4944.92	248.09

3. Modelling

According to the relevant theoretical analysis, using the method of econometrics, taking the total output value of agriculture (y) as the explanatory variable, the effective irrigation area (x1), the total power of agricultural machinery (x2), and the net amount of agricultural fertilizer application (x3) as explanatory variables, the following econometric model is set up: $Yi=\beta0+\beta1X1i+\beta2X2i+\beta3X3i+\mu i$. In the formula, Yi is the total agricultural output value of the ith Province, x1i is the effective irrigation area of the ith Province, x2i is the total power of agricultural machinery of the ith Province, x3i is the net amount of agricultural fertilizer application in the ith Province, and μ I is the random error term of the model. Through the independent variable coefficients β 1, β 2 and β 3, we can judge the linear relationship between the total agricultural output value and the effective irrigation area, the total power of agricultural machinery and the net yield of agricultural fertilizer application. If $\beta 1 > 0$, the total agricultural output value is positively correlated with the effective irrigation area. If $\beta 1 < 0$, the total agricultural output value is negatively correlated with the effective irrigation area. If $\beta 1 = 0$, the total agricultural output value is not correlated with the effective irrigation area. In the random disturbance term, the μi in the stochastic disturbance term represents the combined influence of many factors on Y but not included in the model. For y, x1, X2, X3 and other data, the OLS method is used to estimate model parameters. From the regression results, it can be seen that the t-test value of explanatory variable X2 is 1.160815, which fails to pass the test at the significant level of $\alpha = 0.1$, so explanatory variable x2 has no significant impact on y, which should be excluded in the model setting.The new model is $Yi=\beta0+\beta1X1i++\beta3X3i+\mu i$

4. Interpretation of result

4.1 Multicollinearity test

The correlation coefficient of X1 and X3 is 0.87721, which is greater than 0.8. It is doubted that there is serious multicollinearity between explanatory variables, so the test is carried out again. Using the method of variance expansion factor for auxiliary regression, the values of the determinable coefficient R^2 and the variance expansion factor Vif are shown in Table 2.

Table 2 Values of the decision coefficient R^2 and variance expansion factor VIF

Explained variable	Decision coefficient R^2	Variance expansion factor VIF
X1	0.769498	4.338357
X3	0.769498	4.338357

Since the determinable coefficient of auxiliary regression is not high, according to experience, when the variance expansion factor Vif ≥10, it usually indicates that there is a serious multicollinearity problem between the explanatory variable and other explanatory variables. In the table, the variance expansion factor Vif is below 5, indicating that there is no serious multicollinearity problem.

4.2 Autocorrelation Inspection and Amendment

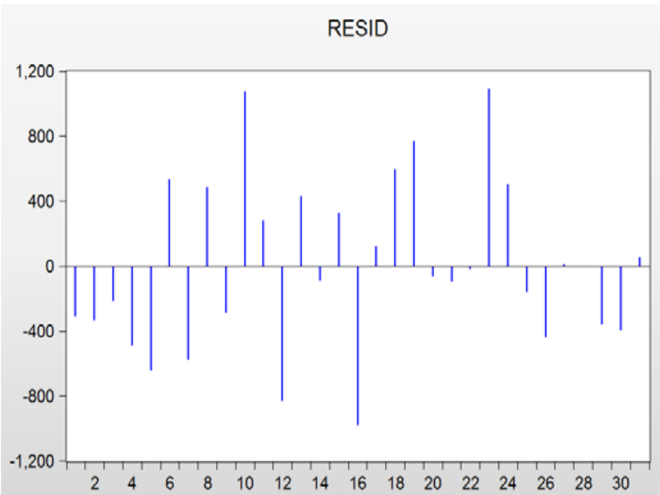

Figure 1 Graphic test method

It can be seen from the graph test that the variation of residual is not continuous positive and continuous negative, but mostly one positive and one negative, indicating that there may be no autocorrelation in residual terms. Because of the rough graph analysis, BG test is used for autocorrelation test.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.053324	Prob. F(2,26)	0.9482
Obs*R-squared	0.126639	Prob. Chi-Square(2)	0.9386

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 06/01/19 Time: 15:34
Sample: 1 31
Included observations: 31
Presampl e missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	-0.001095	0.063638	-0.017203	0.9864
X3	0.031061	1.371874	0.022642	0.9821
C	-1.830604	161.4544	-0.011338	0.9910
RESID(-1)	-0.057390	0.196089	-0.292673	0.7721
RESID(-2)	-0.032101	0.200853	-0.159824	0.8743

Figure 2 LM test results after correction of heteroscedasticity

It can be seen from the figure2 that the nR2 value is 0.126639 and the p value is 0.9386, indicating the original assumption: H0:: ρ 1 = …… ρ n = 0, the correct probability is as high as 93%, so there is no autocorrelation.

4.3 Heteroscedasticity test and correction

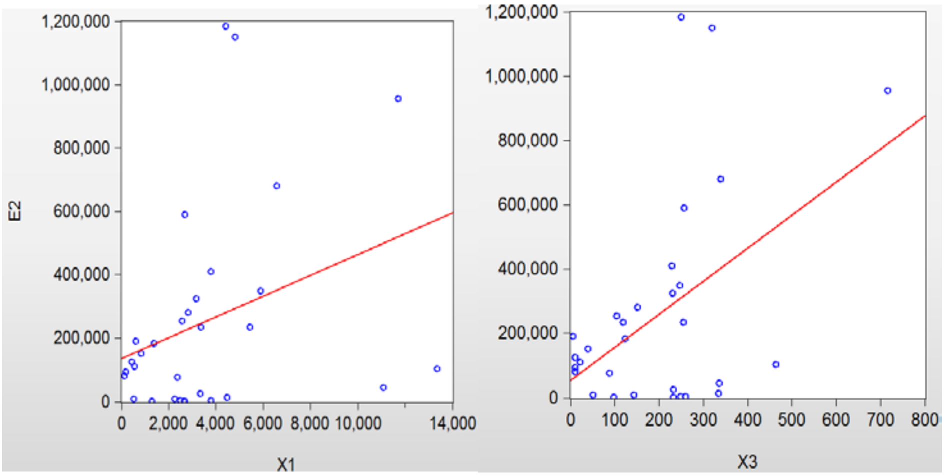

Figure 3 scatter plot of E2 with XI (i =1,3)

It can be seen from the residual diagram that the residual E2 increases with the increase of Xi, indicating that there may be Heteroscedasticity in μi, but because the judgment of Heteroscedasticity in graphic analysis is relatively rough, it is difficult to determine whether there is heteroscedasticity only by graphic judgment, so whether there is heteroscedasticity should be further tested. According to the residual diagram, the model can be simply judged as the increasing heteroscedasticity, so the GQ test is used for preliminary judgment. Sorting the variable values, constructing the sub sample interval, and establishing the regression model. N = 31, delete the middle 7 observations, the remaining two sample intervals, 1-12 and 20-31. The regression results were obtained by OLS. ∑e21i=3466891 ∑e22i=932856.3 F=∑e21i/∑e22i=3.7164255631. At α=0.05, the degrees of freedom of denominator molecules are all 8, F =3.616140939> F0.05(8,8)=3.44, so reject the original hypothesis, indicating that the model does have heteroscedasticity.

However, because there are many conditions in GQ test, the value of TR2 is 12.75925, and its p value is 0.0257, which indicates that there is heteroscedasticity in the model at the level of α=0.05. The heteroscedasticity was corrected. In WLS estimation, it is found that the effect of 1/X1*X3 weight is good by estimation test. Then the weighted least square method is used to estimate the parameters of the model, and the regression results are used to test whether there is heteroscedasticity for the weighted regression results.

F-statistic	2.240975	Prob. F(6,24)	0.0738
Obs*R-squared	11.13131	Prob. Chi-Square(6)	0.0844
Scaled explained SS	8.169256	Prob. Chi-Square(6)	0.2260

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 06/01/19 Time: 15:44
Sample: 1 31
Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	43457.08	263360.6	0.165010	0.8703
WGT^2	-42627.91	273535.7	-0.155840	0.8775
X1^2*WGT^2	-0.043144	0.027192	-1.586610	0.1257
X1*WGT^2	37.40793	251.9216	0.148490	0.8832
X1*X3*WGT^2	1.687448	1.571205	1.073983	0.2935
X3^2*WGT^2	-16.86003	19.50716	-0.864300	0.3960
X3*WGT^2	1223.649	4281.836	0.285777	0.7775

R-squared	0.359075	Mean dependent var	251654.5
Adjusted R-squared	0.198843	S.D. dependent var	343132.3
S.E. of regression	307128.7	Akaike info criterion	28.30360

Figure 4 Revised results

According to the revised results, the value of nR2 is 11.13131, its p value is 0.0844, and there is no heteroscedasticity after correction at the level of α=0.1, and the revised F test is significant.

$$\hat{Y}=445.9589+0.130798\ X1+4.970116\ X3$$

$$(163.0900)(1.860489)(3.556231)$$

$$T=(0.0107)\quad (0.0733)\quad (0.0014)$$

$$R2=0.819227\qquad 2=0.806315\qquad F=63.44531$$

From the above, at a given significant level of α=0.1, the explanatory variables X1 and X3 have significant effects on the explained variables Y, so the model is set correctly.

4.4 Model analysis

1. Economic significance test: the model estimation results show that, at the level of α = 0.1, assuming that other variables remain unchanged, For every 1,000 hectares of effectively irrigated area, the average gross agricultural output value will increase by $13,079.8 million ; the total power of agricultural machinery has no significant impact on the total agricultural output value; When the net amount of fertilizer applied in agriculture increases by 10,000 tons, the average gross agricultural output value will increase by 497.0116 billion yuan. This is consistent with theoretical analysis and empirical judgment.

2. Goodness of fit: the determinable coefficient R2=0.819227, and the modified determinable coefficient R2=0.806315, indicating that the model fits the sample well.

3. F test: for H0:: β 1 = β 2 = β 3 = 0, a significant level α = 0.01 is given, and the p value is 0.0000<0.01. The original hypothesis H0 should be rejected, which shows that the regression equation is significant, that is, the combination of variables such as effective irrigation area and net amount of agricultural fertilizer application has a significant impact on the total agricultural output value.

4. T test: for H0:: β 1 = β 2 = β 3 = 0, a significant level α = 0.1 is given, and P values are 0.0733 and 0.0014 respectively. It can be seen that when other explanatory variables remain unchanged, the

effective irrigation area and the net amount of agricultural fertilizer application have a significant impact on the total agricultural output value of the explained variables.

5. Conclusions and Perspectives

Through theoretical and multi-level empirical analysis, the factors of effective irrigation area and chemical fertilizer application have a significant positive impact on agricultural GDP, while the total power of agricultural machinery has no significant impact on agricultural GDP. From the results of the model, we can see that the application of chemical fertilizer has a great impact on the total output value of agriculture, and the application of chemical fertilizer can indeed significantly increase the total output value in a short period of time. Although the impact of the total power of agricultural machinery on the total output value of agriculture is not very significant, this is because China has not yet fully realized machinery automation and science and technology agriculture, so it is like "the total power of agricultural machinery" Such explanatory variables have no significant effect on the total agricultural output value. This shows that the level of agricultural productivity in China is still backward. As far as labor tools are concerned, most of the rural areas in China use primitive hand tools, and most of them are planted and harvested by manpower. At present, China's agriculture relies on increasing the number of agricultural employees, chemical fertilizer and agricultural infrastructure to enhance the total agricultural output value.

6. Propose

The use of chemical fertilizer can increase soil fertility, increase crop nutrition, and have a direct impact on improving grain output and agricultural output value. However, the use of chemical fertilizer will also make soil and water eutrophication, resulting in environmental pollution, and its use has a significant trend of diminishing marginal utility. But it is obviously impossible for agricultural output value to rely too much on chemical fertilizer input. Therefore, it is necessary to reasonably control the use of chemical fertilizer, improve the use efficiency, and reduce the environmental side effects of the use of agricultural input factors.

Agricultural Mechanization: Mechanized large-scale production is a sign of the progress of modern agriculture, reflecting the development of agricultural infrastructure. However, its impact on the total output value of agriculture is not great, so the attention of the state to develop agriculture should not be too much on the development of agricultural mechanization.

China should strive to build a scientific and sustainable development of agriculture by applying modern science and technology, the means of production provided by modern industry and scientific management methods, coordinating the development of agriculture with other industries, developing diversified modern agriculture. In the long run, we should increase the impact and contribution of financial input on agricultural output, and gradually reduce the contribution of rural labor to improve the organic composition of agriculture.

We will increase efforts to protect rural land use and increase resources and reduce expenditure. Strictly control the non-agricultural use of cultivated land, take measures to prevent the damage and waste of cultivated land caused by natural disasters; pay attention to the adverse impact of the use of chemical fertilizer on farmland; actively encourage and encourage the reclamation of wasteland, and constantly expand the effective use area of cultivated land.

References

[1] Fenglin Li. empirical analysis based on the influencing factors of agricultural production in China [J]. Inner Mongolia Science and Technology, 2006.

[2] Lei Yuan. Research on Influencing Factors of Agricultural Gross Output Value in China -- An Empirical Analysis Based on 31 Provinces and Cities in China [J] Journal of Shandong Agricultural University (Social Sciences Edition), 2013.

[3] Guoyuan Niu, Xiaojun Zhao, Dengbo Yu. On Mechanization in Agricultural Economic Development in Ningxia [J] Research on Market Economy, 2001.

[4] Zhibo Sun. Study on the Relationship between Rural Financial Development and Rural Economic Growth in Jiangxi Province [D] Master thesis of East China Jiaotong University, 2012.

[5] Xiaojing Fu. Analysis of Influencing Factors of Foreign Investment in Shandong Province [J] Economic Forum, 2016.