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INFLUENCING FACTORS ANALYSIS OF CORN PRICE FLUCTUATION IN SHAANXI PROVINCE, CHINA

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Abstract

Corn is one of the most important grain crops in China, and also in Shaanxi Province. In order to master the changing law of corn market, realize reasonable regulation and control, and promote the stable development of the market, it is necessary to conduct in-depth research on the influencing factors of corn price fluctuation in Shaanxi Province. Based on the data of Shaanxi Province from 2000 to 2021, in the present study, the main factors affecting the price fluctuation in Shaanxi Province was explored by using factor analysis method. Eight indexes including corn yield, production cost, disaster-affected area, disposable income of rural residents, disposable income of urban residents, corn demand, wheat price index and consumer price were selected as factors affecting corn price fluctuation. Results showed that the disaster area and corn demand were the main factors affecting the corn price fluctuation in Shaanxi Province, and the disposable income of urban and rural residents had little impact on the corn price fluctuation. Governments and industry groups can therefore take preventive measures to limit the impact of major climate events on corn markets and economies. It also assesses the appropriate proportion of corn used for feed and energy production to ensure adequate supply and stable prices.

Introduction

Shaanxi is a major agricultural province in China, and corn is one of its important grain crops. However, in recent years, with changes in market demand and supply, there have been significant fluctuations in the price of corn in Shaanxi Province, which has certain impact on farmers' production and income.

At present, many studies have emerged on the influencing factors of corn price fluctuation. Li *et al*. (2016) used a VAR model to analyze the dynamic relationship between corn price and macroeconomic variables. Zhang and Zhao (2017) conducted an empirical study on the factors affecting corn market price in China, while Wang *et al*. (2019) analyzed the factors influencing the price of corn in China from the perspective of supply and demand. Fan and Tang (2015) investigated the influence mechanism of U.S. corn price on Chinese corn futures market, and Zhang *et al*. (2019) analyzed the factors influencing the price of corn in the United States. Zhou and Chen (2016) conducted an empirical study on the influence factors of corn price in China's futures market, while Liu and Wang (2019) analyzed influencing factors of corn price in China based on ARIMA model. In addition to directly analyzing corn prices, some scholars explored the broader economic implications of agricultural policies and their impact on poverty reduction in Latin America (Delgado *et al.* 1998; Shively, 2001). Huang *et al.* (2002) discussed plant biotechnology in China, while Schlenker and Roberts (2009) examined nonlinear temperature effects indicating severe damages to US corn yields under climate change. Feng *et al*. (2010) investigated linkages among climate change, corn yields, and Mexico-US cross-border migration.

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Several scholars specifically analyzed the impact of China's agricultural support policies on world markets (Chen 2015), as well as the impact of China's grain security policy on world cereal prices (Yu and Wang 2015). Su and Mitchell (2016) conducted research on climate change and maize yield in Iowa, while Zhang *et al.* (2016) studied the determinants of corn price volatility in China. Li *et al.* (2018) investigated the impact of global crude oil price on China's corn price, while Wang and Liu (2019) analyzed the influencing factors of corn price in China using a nonlinear cointegration model. Lyu *et al.* (2020) explored the effect of biofuel policies on the price of corn. Although there are a large number of studies on the corn price fluctuation and its influencing factors, there are few studies on the influencing factors analysis of the corn price fluctuation in Shaanxi Province. Therefore, in the present study, factor analysis method was used to determine the influencing factors of the corn price fluctuation, in order to identify the main factors affecting the corn price fluctuation. This would provide scientific basis for the government to formulate relevant policies and farmers' production.

Materials and Methods

On the supply side, production cost, natural disaster and corn yield are the main factors that affect corn price fluctuation. The production cost is an important part of the price. The production cost of corn includes material and service costs, labor costs and land costs. Keeping other conditions unchanged, the price of corn changes in the same direction as the production cost. Natural disasters have an important effect on corn prices. When natural disasters happen, corn production may be reduced, which will lead to insufficient supply in the market, which will make the price of corn rise. In addition, natural disasters can affect the quality of corn, which in turn affects its value and price. Other things being equal, when an increase in corn production causes a glut of corn, the price of corn will fall. Otherwise, it will lead to higher corn prices.

On the demand side, inflation, resident income level, substitute price and corn demand are the main factors affecting corn price fluctuation. When there is inflation, the currency depreciates, causing the price of corn to rise. With the increase of residents' income level, their demand for food will increase accordingly. As one of the world's main food crops, corn is an indispensable part of People's Daily diet in many countries, so its price is affected by people's income level. Wheat and corn, both major food crops, are substitutes. When wheat prices rise, the supply of corn may decrease because some farmers may switch to wheat. That could lead to higher corn prices because supplies are down. Corn is mainly used for direct consumer consumption, feed consumption and industrial raw material consumption. When the demand for corn increases, the supply on the market may not meet the demand, which may lead to a rise in the price of corn; conversely, it will lead to a decline in the price of corn.

Governments can regulate the corn market through fiscal and monetary policies, agricultural subsidies, tariffs and import and export restrictions. Since the 21st century, government has successively implemented the policies of "temporary purchase and storage" and "market purchase + subsidy" to regulate the stability of the corn market and ensure the national food security.

Due to the availability of data, the present study selected factors affecting corn price fluctuation from two aspects of supply and demand, including corn yield X1, production cost X2, affected area X3, rural residents' disposable income X4, urban residents' disposable income X5, corn demand X6, wheat price index X7, and consumer price index X8. In addition, factor analysis method was used to analyze the index data of Shaanxi Province from 2000 to 2021, in order to find the main factors of corn price fluctuation in Shaanxi Province, China.

Factor analysis is a multivariate statistical method, which starts from the study of internal dependence of index correlation matrix, and classifies some variables with overlapping

information and intricate relationship into a few unrelated comprehensive factors. Factor analysis groups variables according to the magnitude of correlation, so that variables in the same group have high correlation, while variables in different groups have no correlation or low correlation. The basic model of factor analysis is:

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m + \varepsilon_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + \cdots + a_{2m}F_m + \varepsilon_2 \\ \vdots \\ X_n = a_{n1}F_1 + a_{n2}F_2 + \cdots + a_{nm}F_m + \varepsilon_n \end{cases} \quad (1)$$

Among them, $X_i \left(j = 1, 2, \cdots, p \right)$ represents the variable selected for factor analysis. $a_{ij} \left(i = 1, 2, \cdots p, \, j = 1, 2, \cdots m \right)$ represents the element in row *i*, column *j* of the factor load matrix. $F_j \left(j = 1, 2, \cdots, m \right)$ representative common factor. $\varepsilon_i \left(i = 1, 2, \cdots, p \right)$ represents special factor.

Before factor analysis, it is necessary to test whether there is a strong correlation between the selected variables, that is, whether the problem studied is suitable for factor analysis. The commonly used test methods include variable correlation test, KMO and Bartlett test. SPSS software is used for analysis in this paper.

Kaiser-Meyer-Olkin (KMO) test statistic is an index used to compare the simple correlation coefficient and the partial correlation coefficient between variables. The KMO statistic is between 0 and 1. When the sum of squares of the simple correlation coefficients among all variables is much larger than the sum of squares of the partial correlation coefficients, the KMO value is close to 1. The closer the KMO value is to 1, the stronger the correlation between variables is, and the original variables are more suitable for factor analysis. When the sum of squares of the simple correlation coefficients among all variables is close to 0, the KMO value is close to 0. The closer the KMO value is to 0, the weaker the correlation between variables, and the less suitable the original variables are for factor analysis. When the value of KMO is greater than 0.6, it is suitable for factor analysis.

Results and Discussion

As can be seen from Table 1 that the correlation coefficient of X3 and X6 is -0.419, less than 0.5, and the correlation coefficient of other variables was greater than 0.5, indicating that there is a strong correlation between variables. The value of KMO was 0.837 (Table 2), greater than 0.6. The P value corresponding to the Bartlett sphericity test was 0, which is less than the significance level of 0.05, indicating that the null hypothesis should be rejected, that is, there is correlation between variables. Based on the above analysis, the 8 variables selected in the present study have strong correlation and are suitable for factor analysis. The variance contribution rate of factor analysis obtained by SPSS software is shown in Table 3.

Results presented in Table 3 showed that the cumulative variance contribution rate of the first two common factors was 92.971%, greater than 85%, so two common factors should be extracted. The characteristic root of the first common factor was 5.411, and the variance contribution rate was 67.637%, indicating that the first common factor can explain 67.637% of the original variable variation. The characteristic root of the second common factor was 2.027, and the variance contribution rate was 25.334%. This indicates that the second common factor can explain 25.334% of the original variable variation. Two common factors could explain 92.971% of the variation in the original variable. When extracting two common factors, the loss of information of

the original variable was less, which fully indicates that the two common factors have good representation.

Table 1. Variable correlation.

	X1	X2	X3	X4	X5	X6	X7	X8
X1	1	0.885**	-0.566**	0.815**	0.842**	0.875**	0.931**	0.911**
X2	0.885**	1	-.601**	.969**	0.979**	.806**	0.952**	0.987**
X3	-0.566**	-0.601**	1	-.601**	-0.614**	-.419	-0.542**	-0.600**
X4	0.815**	0.969**	-0.601**	1	0.998**	.694**	0.885**	0.972**
X5	0.842**	0.979**	-0.614**	0.998**	1	.730**	0.908**	0.983**
X6	0.875**	0.806**	-0.419	0.694**	0.730**	1	0.909**	0.808**
X7	0.931**	0.952**	-0.542**	0.885**	0.908**	0.909**	1	0.959**
X8	0.911**	0.987**	-0.600**	0.972**	0.983**	0.808**	0.959**	1

**indicates significant at the 0.01 level.

Table 2. KMO and Bartlett tests

KMO test value		0.837
Bartlett test	Approximate chi-square	391.531
	Degree of freedom	28
	significance	0.000

Table 3. Total variance explanation table

Component	Initial eigenvalue			Extract the sum of loads squared			Sum of the squares of rotating loads		
	Total	Percentage of variance	Cumulative (%)	Total	Percentage of variance	Cumulative (%)	total	Percentage of variance	Cumulative (%)
1	6.769	84.614	84.614	6.769	84.614	84.614	5.411	67.637	67.637
2	0.669	8.357	92.971	0.669	8.357	92.971	2.027	25.334	92.971
3	0.412	5.148	98.119						
4	0.100	1.245	99.364						
5	0.032	0.397	99.761						
6	0.015	0.183	99.944						
7	0.004	0.049	99.993						
8	0.001	0.007	100.000						

When extracting two common factors, the rotated component matrix was obtained by using SPSS software. Results presented in Table 4 showed that variables X1, X2, X4, X5, X6, X7 and X8 had a large load on the first common factor, indicating that the first common factor can be used to explain these variables. That is, the first common factor was a composite reflection of corn yield, production cost, rural residents' disposable income, urban residents' disposable income, corn demand, wheat price index, and consumer price index. Variable X3 had a large load on the second common factor, indicating that the second common factor was mainly used to reflect the affected area.

Table 4. Rotational component matrix

	Factor 1	Factor 2
X1	0.884	0.326
X2	.874	0.454
X3	-0.243	-0.930
X4	0.801	0.521
X5	0.822	0.514
X6	0.915	0.103
X7	0.934	0.315
X8	0.883	0.450

By using the eigenvalues of the two common factors, the comprehensive score F of each factor affecting the price of corn in Shaanxi Province can be calculated. The specific calculation formula is:

$$F = 5.411 * F_1 + 2.027 * F_2 \qquad (2)$$

The comprehensive score *F* of various factors affecting the price of corn in Shaanxi Province was calculated by using SPSS software, as shown in Table 5, which showed that X3 is the factor that has the greatest influence on the price fluctuation of corn in Shaanxi Province, followed by X6, and other influencing factors are X7, X1, X8, X2, X5 and X4 in order from the largest to the smallest. This indicates that the disaster area and corn demand are the main factors affecting the corn price fluctuation in Shaanxi Province, and the disposable income of urban residents and rural residents have little impact on the corn price fluctuation. This result is consistent with the research results of Wang and Liu (2019), Yu and Wang (2015) as well as the actual situation of Shaanxi Province, indicating that the indicators selected in this paper and the method used were reasonable. Thus, corn price fluctuations are mainly affected by natural disasters and the demand for corn from other industries. Governments and industry groups can therefore take preventive measures to limit the impact of major climate events on corn markets and economies. It also assesses the appropriate proportion of corn used for feed and energy production to ensure adequate supply and stable prices.

Table 5. Component score coefficient matrix

	F1	F2	F
X1	0.213	-0.106	1.371
X2	0.137	0.053	0.963
X3	0.413	-0.976	2.143
X4	0.066	0.174	0.563
X5	0.080	0.154	0.645
X6	0.352	-0.389	2.122
X7	0.242	-0.147	1.540
X8	0.143	0.043	0.997

This study selected eight indicators: corn yield, production cost, disaster area, disposable income of rural residents, disposable income of urban residents, corn demand, wheat price index and consumer price. By using the method of factor analysis, the influencing factors of maize price fluctuation in Shaanxi Province were explored. Results showed that the disaster area and corn demand were the main factors affecting the corn price fluctuation in Shaanxi Province, and the disposable income of urban and rural residents had little impact on the corn price fluctuation.

Therefore, in order to reduce the fluctuation of corn prices, government can take timely measures to reduce the area of corn affected by natural disasters. At the same time, government can use market intervention to ensure the stability of corn demand.

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References

Chen J 2015. The impacts of China's agricultural support policies on world markets. China Agricul. Econo. Revi. **7**(1): 37-50.

Delgado MS, Hopkins J and Kelly VA 1998. Agricultural policies and their impact on poverty reduction: Lessons from Latin America. Agricul. Econo. **19**(1-2): 5-16.

Fan Y and Tang Y 2015. Research on the influence mechanism of U.S. corn price on Chinese corn futures market. J. Financial Res. **11**: 59-68.

Feng S, Krueger AB and Oppenheimer M 2010. Linkages among climate change, crop yields and Mexico-US cross-border migration. Proceedings of the Nat. Acad. Sci. **107**(32): 14257-14262.

Huang J, Wang H, Pray CE and Rozelle S 2002. Plant biotechnol. China. Sci. **295**(5555): 674-676.

Li C, Zeng Y and Xiao H 2016. Modeling dynamic relationship between corn price and macroeconomic variables: An empirical analysis based on VAR model. J. Indus. Engin. Engin. Manag., **30**(4): 585-591.

Li Y, Li Q and Li K 2018. Impact of global crude oil price on China's corn price. J. Cleaner Product. **185**: 812-820.

Liu J and Wang S 2019. Analysis of influencing factors of corn price in China based on ARIMA model. J. Agricul. Sci. Tech. **21**(4): 109-116.

Lyu Y, Wang Y and Xia J 2020. Effect of biofuel policies on the price of corn: Evidence from the United States. Renewable Energy **153**: 1141-1148.

Schlenker W, Roberts MJ 2009. Nonlinear temperature effects indicate severe damages to US crop yields under climate change. Proceed. Nat. Acad. Sci. **106**(37): 15594-15598.

Shively GE 2001. Agricultural policies, price changes, and poverty in Honduras. Agricul. Econ. **25**(2-3): 303-314.

Su L and Mitchell PD 2016. Climate change and maize yield in Iowa. Agricul. Forest Meteorol. **223**: 37-45.

Wang X, Wang J and Yang J 2019. Analysis on factors influencing the price of corn in China from the perspective of supply and demand. J. Food Sci. Tech. **36**(10): 17-22.

Wang L and Liu X 2019. Analysis on the influencing factors of corn price in China: Based on the nonlinear cointegration model. J. Agribusi. Develop. Emerg. Econo. **9**(5): 559-573.

Yu H and Wang J 2015. The impact of China's grain security policy on world cereal prices. China Agricul. Econo. Revi. **7**(3): 429-443.

Zhang J, Wang L and Wu D 2016. Determinants of corn price volatility in China. J. Agribusi. Develop. Emerg. Econ, **6**(2): 130-146.

Zhang L and Zhao N 2017. Empirical study on the factors affecting corn market price in China. J. Econ. Sustain. Develop. **8**(12): 47-57.

Zhang J, Sun X, Wu D 2019. Analysis of factors influencing the price of corn in the United States. J. Agricul. Resour. Econ. **40**(6): 41-55.

Zhou W and Chen Y 2016. Empirical study on the influence factors of corn price in China's futures market. Mathem. Modelling. Natural Phenom. **11**(2): 39-48.

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