A Study of the Factors Influencing Futures in the Agricultural Industry Based on Multiple Linear Regression Models——Take Corn Futures Prices as An Example

Xinyu Li[1,*]

[1] Fuyuan British American School, Shenzhen, Guangdong,518000, China

Abstract. With the development of the COVID-19 and the intensification of global warming, agricultural production is highly volatile and the global food crisis may further intensify. According to the recent studies in China and the United States, the research on the influencing factors of agricultural products is crucial. In this paper, when analyzing the influencing factors of agricultural products industry based on multiple linear regression model, the corn industry is taken as an example. The independent variables China CPI, U.S. CPI, China-U.S. exchange rate, S&P 500 index and export agricultural price index are selected, and the dependent variables are China corn futures price Y1 and U.S. corn futures price Y2, and the data all started from August 2021 to end in July 2022. Spss software is used to get the final corresponding results. A comparison of the factors influencing corn futures prices in China and the U.S. shows that corn futures prices fluctuate due to studied factors and that corn dominates agricultural futures in both countries. Moreover, as living standards improve, the demand for corn changes in different directions in these two countries, but both countries will experience less investment in agricultural futures.

1 INTRODUCTION

According to the Global Report on Food Crises released by the Food and Agriculture Organization of the UN (FAO), 193 million people in 53 countries/territories experience a food crisis or deterioration of food insecurity in 2021, a record high of nearly 40 million more than in 2020. Forty-two countries or territories and nearly 180 million people are expected to face a food crisis or worse in 2022, due to climate change, the COVID-19 pandemic and the rising cost of food and fuel. Current agricultural development has the following problems:

1.There are thousands of pesticides being produced and used in the world, and about 80% of the pesticides used go directly into the environment. The World Health Organization has conducted statistics on pesticide use in 19 countries, and the statistics show that approximately 500,000 acute poisonings from pesticides occur globally each year, and approximately 40,000 people die from pesticide poisoning.

2.The Global Forest Resources Assessment Remote Sensing Survey released by the FAO which shows that the average annual area of deforestation from 2010 to 2018 has decreased by approximately 29% and a reduction of over 50% in the net area of forest loss. The report states that agricultural expansion, including grazing and cropland expansion, caused nearly 90% of global deforestation between 2000 and 2018. Among these, cropland expansion was the most significant cause of deforestation, which accounts for 86 million hectares globally.

3.Agricultural intensification will require increased amounts of energy inputs. Irrigation, mechanisation, transports, processing and conservation will all require increased energy intensity and energy reliability. Countries will all face a double challenge of meeting these energy requirements without undue and irreversible impacts on the environment. Technological advances in the use of renewable energy sources such as solar, wind, biomass and hydro energy are creating opportunities for more sustainable energy systems. Crop, pasture and forestry residues and other forms of biomass are likely to make a substantial contribution, and the agricultural sector will become the main energy producing sector. Scientific and technological support in these areas is now urgently needed to accelerate the widespread application of these technologies.

There are also many positive aspects of current agricultural development, among which the collection and analysis of big data could not only increase the productivity of individual farms, but also halt the global food crisis. For example, in order to minimize the side effects of pesticide use on the ecosystem, big data offers the opportunity to use pesticides intelligently and precisely, helping farmers to easily decide when and where to use which pesticide, and this monitoring helps food producers to avoid overuse of chemicals. In addition, the best way to meet the growing demand for food without taking up more land and resources is to

* Corresponding author: 1755617461@qq.com

make more efficient use of the farmland already available to increase yields. Big data provides farmers with information about weather, rainfall, soil moisture and other factors that affect crop yields. Using all this data, growers are able to make accurate and reliable decisions that will ultimately increase yields on their farms. On the other hand, hybrid rice has been promoted on a cumulative total of 4 billion acres since 1976, yielding an additional 400 million tonnes of grain. The highest annual average yield in China in 1958 was only around 400 kg per acre, whereas hybrid rice planted today yields around 800 kg to 1,000 kg per acre. The annual increase in rice production alone can feed 70 million people, achieving an overall balance between food supply and demand in China and alleviating the contradiction between rapid population growth and decreasing arable land area.

2 LITERATURE REVIEW

2.1 Technological breakthroughs in agriculture

Konstantinos G et al. (2018) stated that the emergence of machine learning (ML) along with big data technologies and high performance computing has created new opportunities to unravel, quantify, and understand data-intensive processes in agricultural operating environments. ML is defined as the scientific field that empowers machines to learn without being strictly programmed. Year by year, ML applies in more and more scientific fields including, for example, biochemistry, medicine, meteorology, economic sciences and climatology [1]. In the area of new materials for two-series hybrid rice, a new material has been developed for a long spike and neck double-low cultivation es sterile line, which has the advantages of low starting temperature and no neck wrapping. The successful implementation of this project means that the amount of gibberellin will be significantly reduced in seed production, resulting in a certain degree of reduction in production costs, which can be more than 100 yuan per mu [2]. Guo (2016) proposed that agricultural Internet of Things and information technology represented by intelligent equipment technology, are gradually integrated into the whole process of agricultural production and operation, and agricultural forms and processes have undergone profound changes [3]. The effective integration of ICT technologies, represented by the Internet, with various segments of the agricultural industry has transformed traditional agricultural production and business models, creating new production models, technology application models, and industry patterns. Based on technology diffusion theory and information asymmetry theory, and other methods such as descriptive analysis and econometric analysis, Han studied the organization model and operation mechanism of "Internet+" agriculture [4].

2.2 Research on the problems of agriculture

Zhuang (2016) proposed that until now, the development of agricultural science and technology in China still has the following problems: low level of agricultural science and technology, difficulty in transforming agricultural science and technology achievements, and ineffective promotion of technological achievements after transformation [5]. In terms of finance, objectively restricted by the development stage of China's market economy development stage, the focus of the financial industry has long been in the active areas of market economy such as industry and commerce, and the level of financial development in urban areas is far better than that in rural areas. The uncertainty of agricultural production, the non-openness of the agricultural market, and the lag of supporting public resources in rural areas have led to the fact that China's rural finance has generally been in the development stage of policy-based finance for a long time, lacking a sustainable market-based financial system. These objective circumstances have seriously affected the overall development and prosperity of the rural economy [6]. China's agricultural pollution sources are scattered, influenced by natural factors, they are extensive, complex, random and difficult to monitor, and any single control means is hard to achieve the desired control effect [7]. Zhu (2014) stated that with the accelerated pace of agricultural modernization and urbanization, China produces a large amount of straw and livestock manure every year, and the production is growing linearly. A large amount of straw is burned and the livestock manure containing harmful substances is disposed of or washed into water, causing serious environmental pollution and endangering the health of humans and animals. Since straw and livestock manure are rich in nutrients and are valuable and renewable biomass resources, the resource utilization of agricultural waste is an important element in the control of agricultural non-point source pollution, conservation of biomass resources and sustainable development [8].

2.3 Introduction to the research methods

Liu (2014) used principal component analysis as well as multiple linear regression equations to quantitatively study irrigation water utilization efficiency for the current situation of irrigation water use in typical fields of rice in Inner Mongolia, selected factors with a greater degree of influence through influence factors identification, and established prediction model equations, which were checked and calibrated to meet prediction criteria. The model output was combined with the results of the main influencing factors to analyze the water saving potential and provide theoretical support for the future water saving projects in irrigation areas [9]. Gao (2018) constructed a multiple linear regression model, a weighted multiple linear regression model, a multiple linear regression model based on principal component analysis, and a stepwise regression model when studying the influencing factors of total grain production in China from 1997 to 2010. These four

models were also used to fit the influencing factors for 2011-2015, respectively, and the fitted values of grain yield obtained were compared with the actual output value according to the fitting accuracy formula to find and rank the fitting accuracy of each model[10]. In studying the risk factors in the production and marketing of Xinjiang's special agricultural products, Shang (2019) used the sample data of consumers' willingness to purchase a certain agricultural product to analyze the binary logistic regression model and concluded that consumers' monthly income, product quality, marketing of the product and consumers' geographical distribution have a more obvious effect on consumers' willingness to purchase a certain agricultural product, while consumers' gender, age, educational level and occupation are not significant in influencing demand [11]. Mohamad and Said (2011) chosed a linear programming model in their study of farmland allocation and solved for selected vegetable crops using LINDO. The results showed that there are good returns even in short planning horizon and if properly implemented will increase farm income and provide beneficial contribution to the farming societies [12].

3 RESEARCH METHODS

3.1 Time Series Analysis

Time Series (Time Series) is also known as dynamic series, which refers to a sequence formed by arranging the same statistical values in the order of their occurrence in time. Time series data is fundamentally a dynamic data that reflects one or more cause-free trends that change over time. By exploring the laws of change of the data, the overall fluctuation of the statistical time series, the future situation of the series is predicted based on the historical data obtained. The key to time series forecasting methods is to be able to process and analyze the random data to mine certain laws and use such laws to forecast and estimate the future [13]. Time series development stage is mainly two periods, the initial period is before the Second World War, financial and economic forecasting as the focus area; followed by the mid-war stage to the 21st century as a rapid development stage, the application areas are also more extensive such as meteorology and hydrology, space and aviation, electronic computers, mechanical vibration and modern automation. Specifically, meteorological data, sales data, electrical load data, stock prices and stock trading volumes in financial markets, military science, space science, GPS location data, facial image acquisition for identification, biomedical ECG measurement data such as fingerprint recognition, etc. [14].

3.2 Multivariable linear regression model

Regression analysis uses a model that describes the relationship between the dependent and independent variables in a simplified mathematical form. In many cases, the contribution of a single independent variable is not sufficient to explain the dependent variable y alone. If this is the case, multivariate linear regression can be performed to investigate the effect of multiple variables on the dependent variable. In a multivariable linear regression model, the dependent variable is described as a linear function of the independent variables Xi, as follows:

$$Y = a + b1 \times X1 + b2 \times X2 + ... + bn \times Xn.$$

The model allows to calculate the regression coefficient bi for each independent variable Xi [15]. In stock price forecasting, since stock prices exhibit a certain linear relationship, a regression analysis followed by a factor analysis, yielding the price factor and the turnover factor, and a multiple linear regression with these two factors as independent variables and the closing price of the next day as dependent variable is performed to forecast the opening price of the next day [16].

4 ANALYSIS OF THE CURRENT SITUATION OF AGRICULTURE

4.1 The comparison between agriculture now and before

4.1.1 Breakthroughs in agricultural technology

To achieve higher efficiency and lower energy costs, drones and robotics are gradually replacing traditional agricultural machinery. A leading agricultural technology company in China has released an agricultural unmanned vehicle with a highly flexible modular expansion design that can switch functions between different scenarios such as crop spraying, spreading, mowing and transportation, replacing fuel farming machines to meet farmers' different farming needs. The unmanned agricultural vehicle is powered by electricity. It is also equipped with a high-precision navigation and autopilot system, which automatically plans the operation route according to the terrain and reduces energy consumption. According to the company's social responsibility report, its unmanned farming equipment has helped farmers save nearly 280 million liters of fossil fuel since 2007.

To reduce inputs of agricultural chemicals, an agri-tech company has launched a smart platform that uses satellite data to help farmers decide how much and how to apply fertilizer. The platform uses satellites to divide farmland into zones and monitor the condition of crops within those zones. With the help of cloud computing and image analysis technology, the platform can suggest to farmers the dosage of fertilizer or spraying pesticides in different zones.

4.1.2 Problems arising

Due to frequent human modifications, the level of carbon dioxide concentration in the atmosphere has been increasing in recent years. The global average carbon dioxide concentration in 1820 was 280 ppm, while the current level has reached an all-time high of 415 ppm.

The global average temperature continues to climb due to the large amount of greenhouse gas emissions.

Climate change has led to an increase in natural disasters and rising economic losses. About 17% of global greenhouse gas emissions are directly caused by agriculture, forestry activities and land use change. At the same time, agricultural activities indirectly contribute to GHG emissions in three ways: deforestation, soil erosion and degradation, habitat and biodiversity loss.

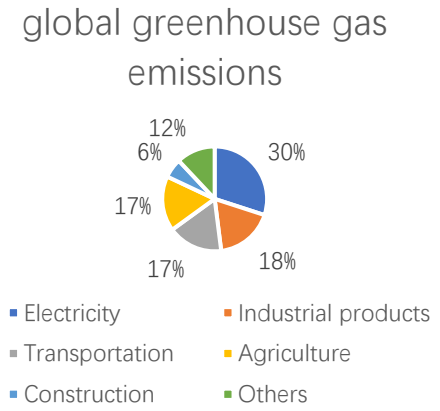

Figure 1. Total global greenhouse gas emissions in 2019

4.2 Future Agricultural Development

4.2.1 New breakthroughs in technology in the future

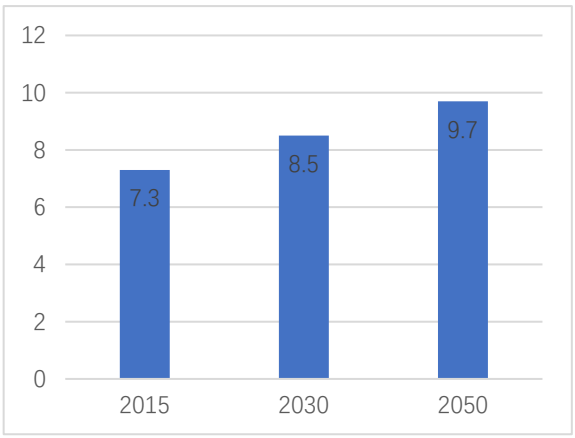

Figure 2. Total world population in billions

According to forecasts, the global population will increase by more than 30% by 2050, with a total population of 9.7 billion. The rapid growth of population will put enormous pressure on the world's food and resource supply. Intelligent food production technologies can significantly increase yields and thus ease the pressure on food supply. For example, intelligent seed soaking technology, laser grader, unmanned rice transplanter and unmanned harvester, etc. Environmental modification can expand the area of arable land and thus ease the pressure of resource supply. For instance, if the problems of cold climate and thin air in highland areas are solved by new technology, and mechanized farming in highland areas is achieved, the problem of land shortage in traditional grain-producing areas can be solved.

4.2.2 Solutions to the generated problems

To protect forests and stop deforestation, researchers can develop new forest mapping tool. When large areas of forest are destroyed, an warning will be sent to the conservator. Digital technology can be applied to biodiversity conservation as an important tool for digital monitoring systems of endangered animal habitats, helping to maintain ecological balance. To promote carbon peaking in agriculture and fulfill carbon neutrality, the development of agricultural gas sensing technology can accurately measure the greenhouse gases generated by agricultural activities, and foster the transformation of green and low-carbon development in agriculture.

5 ANALYSIS OF INFLUENCING FACTORS

5.1 The impact of policies on agriculture

China is a socialist market economy, and the market plays a decisive role in resource allocation under the macro-control of the government. Both efficiency and equality are considered in the allocation of resources. The basic objectives of China's agricultural policy are:

1. To establish a socialist agricultural market economy;
2. To increase the effective supply of agricultural products;
3. To raise the income level of farmers.

Some of China's agricultural products had a situation where supply exceeded demand, and then the prices of agricultural products began to fall. In order to safeguard the interests of farmers, the government implemented a policy of purchasing surplus agricultural products from farmers at a minimum price. The Chinese government abolished many restrictions on agricultural imports, broke the monopoly of state-owned enterprises in agricultural imports, abolished the import license system, and reduced the agricultural import tariffs, etc. In terms of agricultural exports, it abolished agricultural export subsidies and abolished the export license system, etc. In terms of subsidy policies, direct subsidies for grain cultivation, seeds, and the purchase of large agricultural machinery have been introduced since 2004 to raise farmers' income. In terms of financial support, interest-free loans are provided for agricultural development projects. Moreover, agricultural cooperatives play an important role in promoting agricultural development. As a bridge, the government can obtain more comprehensive and real information about the farmers with less input, and it can promote the smooth implementation of government policies through the help of professional cooperatives. At the same time, agricultural cooperatives have rich professional knowledge and practical experience in agricultural industry, and they understand

both the wishes of their members and the development status of the country. The participation of professional cooperatives in government decision-making not only helps to avoid some decision-making mistakes, but also can promote the implementation of government decisions.

The United States is a capitalist market economy, where the primary goal of both manufacturers and individuals is to pursue their own interests. There is less government intervention, and macro-control measures favoring fiscal and monetary policies. More attention is paid to efficiency in resource allocation. The goal of U.S. agricultural policy is to promote efficient economic growth and preserve the income of farmers. Previously, farmers were not only able to obtain considerable agricultural output through employing cheaper labor, but also received high government subsidies every year. The high subsidies in the United States were met with countervailing lawsuits in global market and opposition from domestic tax payers. The long-standing policy of target price subsidies and price difference subsidies for agricultural products was eliminated in 1996, and subsidies in aspects of price and income were discontinued after 2002. These policies have helped ensure a smooth transition of U.S. agriculture into a market economy. In addition, The U.S. government feels a responsibility obligation to participate in crop insurance in order to help farmers cope with the risks they face in agricultural production and to improve their income levels. However, because high protected prices drive consumers to bear unreasonable burdens, the government has implemented agricultural policy reformation to gradually reduce subsidies for agricultural insurance.

5.2 The impact of CPI on agriculture

Consumer price index (CPI) is an important macroeconomic indicator reflecting the changes in the price level of consumer goods and services related to the life of residents. As an important component of prices, changes in agricultural prices are not only influenced by national price adjustment policies, but also increasingly by domestic and international market factors. Changes in the prices of major bulk agricultural products (e.g. rice, corn) will cause the CPI to fluctuate to a certain extent, and accordingly, the CPI, in the process of rising or falling, will also, in turn, cause the expected agricultural products' prices changes in the market. When the CPI rises, if wages remain unchanged or rise less than the CPI, real wages will fall thus leading to lower purchasing power. Rice, as a normal good, decreases in demand when real income decreases. However, as a necessity, the income elasticity of demand (YED) for rice is small ($0<YED<1$), so demand does not change significantly when real income changes. On the supply side, a rise in CPI leads to an increase in the cost of agricultural production because the prices of machinery, animal power, and labor needed to produce rice are higher. As a result, the supply of rice decreases. Overall, both demand and supply of rice may fall when CPI rises, and the change in rice prices cannot be accurately judged because the extent of both declines is unknown.

5.3 The impact of interest rate on agriculture

The interest rate is the ratio of the amount of interest to the amount of borrowed funds (principal) for a certain period of time. Interest rate is the main factor that determines the cost of capital of an enterprise, as well as the decisive factor for financing and investment. The study of the financial situation must consider the current situation of interest rates and their trends. For speculators in the futures market, interest on margin is the main cost of their transactions. Therefore, changes in interest rates will directly affect the decisions of agricultural futures speculators. If interest rates increase, transaction will costs rise, and then speculators will face higher risk, they might reduce their speculative trading in agricultural futures, resulting in a decrease in trading volume. For agricultural producers, higher interest rates will lead to higher investment costs in agricultural production, so they may stop expanding or invest less in developing new technologies, and thus production will not be expanded. From a macro point of view, a prolonged period of high interest rates may result in deflation and a gradual fall in agricultural prices. However, the price elasticity of agricultural products is small, so this only affects agriculture slightly.

5.4 The impact of exchange rate on agriculture

The exchange rate is the ratio of exchange between two currencies and in other word, the value of one country's currency against another. When the exchange rate increases, on the export side, the export price of agricultural products increases and becomes less competitive in the global market, which may lead to a decrease in total exports and an increase in the inventory of domestic agricultural products. Thus, price of agricultural products may decrease. On the import side, the import price of agricultural products is relatively lower, and more manufacturers may choose to import agricultural products in pursuit of lower cost, resulting in lower demand for domestic agricultural products, which will decrease the prices. For domestic agricultural producers, the higher exchange rate makes farmers richer with increased purchasing power, then farmers can use less RMB to buy advanced technology, machinery, and equipment from abroad, thus increasing the division of labor in agricultural production and improving production efficiency, therefore, the supply of agricultural products increases and the prices may decrease.

6 DATA COLLECTION AND ANALYSIS

6.1 Data collection

Because both China and the U.S. are large producers and demanders of corn, and corn occupies a relatively

important position in the overall agricultural futures, so corn is selected as the research object for comparative analysis in this paper. The independent variables chosen are the corresponding CPI of China and the U.S., the exchange rate between China and the U.S., the S&P 500 index and the U.S. export agricultural price index, and the dependent variables are the Chinese corn futures price Y1 and the U.S. corn futures price Y2. The data are from August 2021 to July 2022. The Chinese CPI data are from the Chinese government website, the U.S. CPI historical data are from the U.S. Bureau of Labor Statistics - Department of Labor, the U.S.-China exchange rate data are from Baidu Stock Market Access, the S&P 500 index is from Investing, and the U.S. export agricultural price index is from the United States government website, and the corn futures prices of China and the United States are from Tonghuashun Finance.

Table 1. Data collection

Time	China prices	U.S. prices	China CPI	U.S. CPI	CNYUSD	S&P 500 index	U.S. export index
7/22	2670	618.5	2.7	0	6.7442	4146.75	-3
6/22	2780	750	2.5	1.3	6.6986	3827.25	-0.1
5/22	2935	753	2.1	1	6.672	4107	2
4/22	3044	818.25	2.1	0.3	6.6085	4127.5	1.2
3/22	2917	747.5	1.5	1.2	6.3398	4539.25	4.5
2/22	2892	697	0.9	0.8	6.3089	4327.25	2.9
1/22	2767	624.75	0.9	0.6	6.3614	4492.5	3
12/21	2671	592.5	1.5	0.6	6.3561	4758.5	0.7
11/21	2668	568	2.3	0.7	6.3645	4537.5	1.1
10/21	2680	569	1.5	0.9	6.4056	4690.25	1.1
9/21	2565	537.5	0.7	0.4	6.4448	4343.75	-1.5
8/21	2517	533	0.8	0.3	6.4605	4534.5	0.9

6.2 Data analysis

Table 2. The spss results of corn futures prices of China

Influencing factors	**BETA**
CPI%	0.415
CNYUSD	-0.820
S&P 500 index	-0.850

Table 3. The spss results of corn futures prices of the U.S.

Influencing factors	BETA
CPI%	-0.069
U.S. export agricultural price index	0.688
S&P 500 index	-0.842

When considering the relationship between CPI and corn prices, corn is regarded as a commodity. The normalized coefficient of Chinese CPI is positive, which accounts for the positive relationship between CPI and corn prices in China. The increase of CPI is most probably resulted from increasing money supply, so a rise in CPI tends to represent a rise in the overall price level, and thus a rise in corn prices. From the supply side, as the CPI rises, farmers may choose to produce other more profitable agricultural products, which leads to a decrease in the supply of corn and thus an increase in prices. Moreover, because corn remains one of the main consumer goods in China, changes in the CPI have a significant impact on its price, and the value of the beta coefficient of the Chinese CPI is large. For the U.S., the normalized coefficient of CPI is negative, which explains the inverse relationship between the U.S. CPI and the U.S. corn price. Because of the developed economy and the advantage of minting taxes, national income increases at a faster rate when the CPI rises. Corn is more often treated as inferior good in the U.S., so demand for corn decreases when income increases, and thus prices decrease. Moreover, corn is not a major consumer good in the U.S., and the price of corn is only an almost negligible fraction of national income, so changes in the CPI have little effect on its price, and the value of the beta coefficient of the CPI is small.

Corn is considered as a futures product when considering the relationship of the U.S.-China exchange rate, the S&P 500, and the Agricultural Export Price Index with corn prices. The relationships between the S&P 500 and corn futures prices in the U.S. and China are similar, both are inversely correlated with a negative beta coefficient, which validates the efficient market hypothesis to some extent. The S&P 500 index is often used as a proxy for the entire U.S. stock market. An increase in the S&P 500 index indicates a positive trend in the U.S. stock market, so people are more willing to invest their money in other products at that time. Because corn futures are a low-risk and thus low-return investment, changes in the stock market have little impact on the returns from investing in corn futures. Conversely, investing in other products may result in greater returns. So when the S&P 500 rises, investment in corn futures decreases and corn futures prices decrease.

In terms of international trade, for China, the RMB exchange rate is negatively correlated with corn prices. When the RMB appreciates, the price of exported corn increases and the export advantage decreases. Since corn export volume tends to be very large, foreign importers are sensitive to corn price changes, and higher prices lead to lower demand for corn imports and thus considerably lower prices. For the domestic market, the appreciation of the RMB causes more people to take money out of the futures market as they prefer to hold the currency or deposit money in banks, which leads to lower corn futures prices. At the same time, a rise in the exchange rate will lead to less inflation and domestic prices will stabilize accordingly, so the price of corn as a commodity will also decrease. Therefore, the beta coefficient of the exchange rate between the US and

China is negative and has a large value. For the U.S., the beta coefficient of the Agricultural Export Price Index is positive and large, which indicates that the agricultural export price index and corn futures prices are positively correlated and corn futures have a high impact as a percentage of the overall agricultural futures. So when U.S. agricultural exports are positive, corn futures can be purchased more to gain higher returns.

7 CONCLUSION

A comparison of the factors influencing corn futures prices in China and the U.S. shows that corn futures prices fluctuate due to studied factors and that corn dominates agricultural futures in both countries. Moreover, as living standards improve, the demand for corn changes in different directions in these two countries, but both countries will experience less investment in agricultural futures. In the future, as one of the largest economies in the world, price levels in China and the United States will rise and people will have a higher standard of living, which will reduce demand for traditional agricultural products like corn, and futures prices will also be affected. In order to ensure the stability of the capital market and to guarantee the basic standard of living of farmers, it is necessary to produce high-quality agricultural products in the future, as well as to stabilize the prices of agricultural products and the prices of agricultural futures. For the governments, in order to give full play to the role of agricultural futures market in promoting agricultural economic development, they should increase the varieties of trading agricultural futures and expand the scale of futures market trading. Developing small varieties favored by investors to attract investors to enter the market and participate in trading, and activating the grain futures market. Moreover, through the e-commerce trading platform, the price forecasting and risk prevention functions of the futures market should be fully utilized to attenuate the drastic fluctuations of grain production and prices, and provide reference for agricultural policies such as protective prices and subsidies formulated by the government.

References

1. Liakos,Konstantinos G., Patrizia Busato, Dimitrios Moshou, Simon Pearson, and Dionysis Bochtis. 2018. "Machine Learning in Agriculture: A Review" Sensors 18, no. 8: 2674. https://doi.org/10.3390/s18082674
2. Huang Sihai. Research on technical support system of agricultural science and technology park [D]. Hunan Agricultural University,2018.
3. Guo Leifeng. Research on key technologies of big data for agricultural field[D]. China Academy of Agricultural Sciences,2016.
4. Han X. Research on "Internet+" agricultural organization model and operation mechanism[D]. China Agricultural University,2017.
5. Zhuang Xuehua. Research on bottlenecks and countermeasures of transformation of agricultural science and technology achievements[D]. Hunan Agricultural University,2016.
6. Xu Dandan. Research on the sustainable development of rural finance in China [D]. Jilin University, 2013.
7. Wei Xin. Research on the control of agricultural surface pollution in China[D]. Northwest Agriculture and Forestry University of Science and Technology, 2014.
8. Zhu Jianchun. Study on the resource utilization of agricultural waste in Shaanxi [D]. Northwest Agriculture and Forestry University of Science and Technology, 2014.
9. Liu YJ. Analysis of factors influencing irrigation water utilization efficiency based on principal component analysis and multiple linear regression analysis [D]. Inner Mongolia Agricultural University, 2014.
10. Gao Lulu. Analysis of factors influencing grain yield based on multiple linear regression[D]. Chongqing Normal University,2018.
11. Shang Yuxin. Research on the construction of regional brand of Xinjiang special agricultural products[D]. Shandong University,2019.
12. Nordin, H. M., & Fatimah, S. (2011). A mathematical programming approach to crop mix problem. African Journal of Agricultural Research, 6(1), 191-197.
13. Yang H-M, Pan C-S, Bai W. A review of time series forecasting methods[J]. Computer Science, 2019, 46(01): 21-28.
14. Jia MZ. Research and application of time-series analysis methods based on machine learning[D]. Xi'an University of Science and Technology, 2020.
15. Dtsch Arztebl Int. 2010 Nov; 107(44): 776–782.doi: 10.3238/arztebl.2010.0776
16. Li Jun. Multiple linear regression method based on factor analysis and its application in stock price prediction [D]. Nanjing University,2014.