

# Research on Chinese Agricultural Products Based on Supply and Demand

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**Abstract.** Based on the data of agricultural prices and economic development in China in recent years as well as the previous research of economists, this paper will analyze the rules of fluctuation in agricultural prices in China and its possible influencing factors from the perspective of supply and demand. Due to the rapid development of productivity and the constant change of demand structure, the price of agricultural products in China has been increasing rapidly. However, in this process, the supply and demand imbalance also occurs from time to time, resulting in a large price fluctuation. This paper will also analyze some of China's agricultural policies and their positive effects. Macro policies can stabilize agricultural prices to some extent, but their effect is limited. Therefore, appropriate macro-control is needed to fundamentally guide production and trade process from both sides of supply and demand, so as to stabilize the price of agricultural products and market expectations.

**Keywords:** Imbalance, periodicity, trend, structural change, effectiveness of policies.

## 1. Introduction

China has the largest population in the world, and it is one of the largest agricultural countries, with hundreds of millions of farm workers to produce the agricultural products. For such a populous developing country, maintaining the prices of agricultural products stable and the balance between supply and demand are of great significance for social stability and economic development. There are many factors affecting the price of agricultural products, some of which can be explained by the classical economic models that have been discovered now, while for others many random variables and policy changes are needed to be taken into consideration to find the rules and predict the future changes.

From a macro perspective, the trend of China's agricultural prices is positively correlated with the trend of international agricultural prices. This is related to China's accession to the WTO and further integration into the international market. The influence of the international market on the supply, demand and price fluctuations of China's agricultural products market is significantly increasing. The complexity and diversification of the factors affecting the price of agricultural products makes the changes in the international market to be easily transmitted to China, resulting in the changeover of the domestic agricultural product market. Scholars have pointed that from the end of the 20th century to the early 21st century, the fluctuation of international agricultural products prices has experienced six stages, including decline and low hovering, steady rise, decline, oscillatory rise, rapid rise, slight decline and rapid decline, with different characteristics in each stage [1].

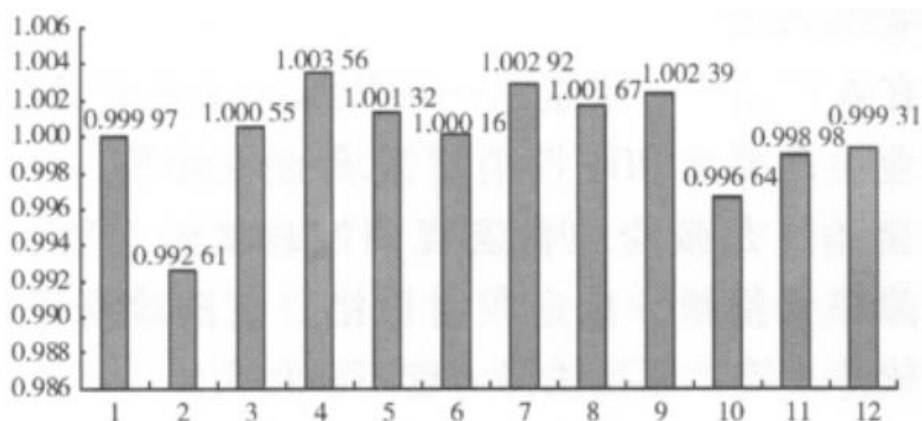
From a micro perspective, many factors within China affect the price of agricultural products. The production of agricultural products is a process of natural reproduction as well as economic reproduction, which is affected by both natural risk and market risk [2]. The way agricultural products are produced determines that they are highly affected by changes in the natural environment. From the perspective of the market, China has a large yield and reserve of rice, wheat and other bulk grain crops, and the government's regulation and are relatively strict. Therefore, there are basically no conditions for speculation. For garlic, mung beans and other agricultural products with concentrated producing areas, strong seasonality, easy storage and small market capacity, they are easy to become the object of speculation by excess liquidity, which will lead to the market prices of these agricultural products fluctuating in a short period of time [2]. Due to the conditions of small-scale agricultural

production and management, with not well-organized farmers, the production behavior is easy to converge. Also, the production cycle of most crops is relatively long, and the yield has certain fluctuations between years. From the above two aspects, and under the action of "cobweb model", the price fluctuates greatly and frequently.

In combination with the past data and the actual supply and demand of agricultural products in China, the self-regulation ability of the market is limited [3]. Therefore, the supply and demand analysis should take both economic principles and the possible "butterfly effect", mostly in the process of production and trade, into consideration. Although there are many factors affecting the change of agricultural economy and agricultural prices from macro and micro perspectives, they are inseparable from the two basic elements of the agricultural economy: supply and demand. Therefore, this paper will mainly focus on the supply and demand of agricultural products, and from a macro perspective to analyze the possible impact of policy on the price.

## 2. Supply

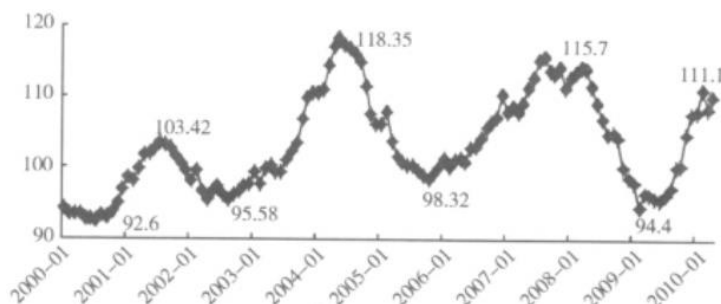
The first concern is the seasonality of agricultural production, which is a basic element of agriculture. Although China's climate varies greatly from region to region, the Chinese people have mastered the production cycle of many agricultural products and the relationship between climate change and yield from practice and empirical analysis for thousands of years. With the development of modern science, many scientists have explained the rationality of traditional farming habits from the theoretical point of view. As shown in Figure 1, the monthly differences of agricultural products in China are not large and do not show significant "seasonal" characteristics. Season index varies only 0.00095 [2]. The season index of February is much lower than that of the other 11 months, mainly because the traditional Chinese festival Spring Festival is in February for most of the occasions. Accordingly, a large number of protective policies led to the decrease of season index around the Spring Festival. Therefore, it could be said that the change of macro policies plays a significant role in China's agricultural development and the change of agricultural prices. The impact of policies will be analyzed in more detail in the following content of this paper. Although the price fluctuation of agricultural products in China is not significant from the perspective of season, it still shows significant periodicity and trend characteristics if it is taken as the unit of year.



**Figure 1.** Monthly season index of agricultural price fluctuation in China (2000-2009 average) [2]

In terms of periodicity, China's agricultural prices fluctuate significantly. From year to year, prices rise and fall by a large margin. For different agricultural products and different regions, there also exists the phenomenon that the prices of agricultural products rise or fall sharply. The main reason for the periodicity is that under the conditions of small-scale agricultural production and selling, the farmers are not well organized and collaborated and also the production behavior is easy to converge [2]. Therefore, the fluctuation of some commodities with long production cycles (such as the agricultural products) described by the cobweb model could be more prominent when it comes to China.

Figure 2 and 3 show the trend index of agricultural prices in China in the past two decades. As mentioned above, farmers are highly sensitive to prices and are prone to overreact to local market changes, resulting in local overproduction or underproduction. Also, because of the weak risk bearing ability leads to follow the trend of planting, breeding to avoid regret, which further leads to local supply and demand imbalance. In China, some economists have even pointed out that letting the market itself to control the supply of an agricultural product will lead to its price further away from its equilibrium point, or there is a spontaneous tendency to fluctuate [4].

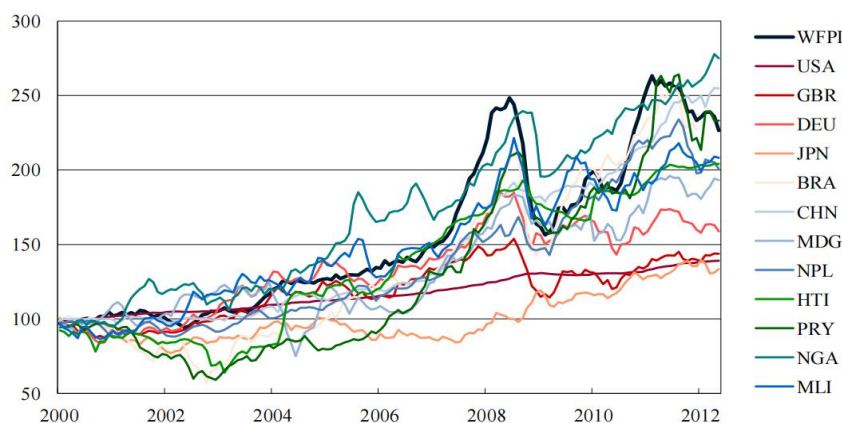


**Figure 2.** Agricultural price trend index of China from 2000 to 2010 [2]



**Figure 3.** Agricultural price trend index of China from 2010 to 2020 (source: BRICdata)

Although the price of agricultural products in China fluctuates greatly under the action of cobweb model, it still shows an overall upward trend. This is the characteristic of trend that mentioned above. Figure 4 shows the growth of agricultural prices in the world's major countries from 2000 to 2012. It is worth noting that the starting value of agricultural prices in 2000 is set to 100 for all countries, so that the curves in Figure 4 represent the relative growth rate of agricultural prices in each country. Looking at the curve for China, it is not hard to find that the increase of agricultural prices in China over the 12 years was large, second only to Nigeria among the countries in the figure. Therefore, the price of agricultural products in China shows a very obvious upward trend.



**Figure 4.** Food price index development (2000=100, nominal in US dollar terms) [5]

The rapid increase of China's agricultural prices is mainly due to the increase of agricultural input costs from the supply side. According to the cost-push theory, the price increase of agricultural

production factors will promote the price increase of agricultural products. The increasing price of agricultural products will lead to the reconfiguration of agricultural inputs, agricultural output in the premise of unchanged. In this process, if this reconfiguration is unable to fully balance the cost increase due to its price increase, the increase of agricultural input costs, will inevitably lead to rising prices [6].

As shown in Table 1, from 2003 to 2009, the unit prices of various production factors of agricultural products in China kept increasing, which also confirmed the overall upward trend of agricultural prices in China. In terms of growth, labor cost has the largest increase and the fastest growth rate. It could be argued that increasing labor costs are the main driving force of increasing agricultural prices in China. China is a typical developing country. In developing countries, labor costs in the production and processing of agricultural products accounted for a relatively small proportion than in developed countries [5]. Therefore, the price of agricultural products in developed countries is relatively stable, while the price of agricultural products in developing countries will increase with the increase of labor cost.

**Table 1.** Prices of major input factors for rice, wheat and maize production (2003-2009) [6]

Year	Seed (yuan/kg)	Fertilizer (yuan/kg)	Labor (yuan/day)	Land cost (yuan/hm <sup>2</sup> )
2003	2.61	2.87	18.80	790.95
2004	3.16	3.73	22.51	811.05
2005	3.85	4.16	25.84	930.30
2006	4.07	4.14	30.26	1023.75
2007	4.25	4.19	35.59	1224.60
2008	4.72	5.57	46.36	1494.30
2009	5.09	5.41	53.69	1719.30
Increase of 2009 compared to 2003 (%)	95.02	88.50	185.59	117.37

However, some scholars point out that the rationality of labor cost valuation is questionable [6]. Because most of China's agricultural production is small-scale manual production in the unit of family, the degree of mechanization is very low. The cost of labor cannot be calculated by simply using the average price of labor. In spite of this, the increase in labor costs has contributed to the increase in agricultural prices to some extent. Combined with the increase in the price of input factors, the increasing price of agricultural products is the recent trend. From the overall point of view, China's agricultural prices have obvious periodicity and trend. At the same time, there are many local factors will lead to local supply changes, resulting in local supply and demand imbalance.

As mentioned above, mechanization and automation of agricultural production and processing in China are not high. This may lead to uneven quality of agricultural products, which may lead to imbalance between supply and demand of the same product in the same region at the same time. In addition, the speed of market information dissemination is limited, the channels for farmers to obtain information are relatively restricted, and there is a lack of scientific guidance. Therefore, it is easy to see the phenomenon that the agricultural products are difficult to sell, which leads to the imbalance of local supply and demand and the fluctuation of agricultural prices. If the market is left to its own device, these partial imbalances may emerge from time to time. Meanwhile, the policies and macro-control may effectively alleviate the situation of partial supply imbalance and stabilize people's expectations of agricultural prices.

### 3. Demand

The first thing that needed to be taken into consideration is that the change of consumers' food demand structure and preference will lead to the change of demand structure of agricultural products, and then affect the price of agricultural products. In general, it is believed that economic development will bring about the increase of people's income, and the increase of people's income is the driving force for the transformation of food consumption structure. Bennett's law is often applied to reveal changes in the food consumption structure, which indicates that with the increase of people's income

level, the proportion of people's caloric needs from animal-derived food tends to increase [7]. Since the end of the 20th century, China's economy has grown rapidly, with its GDP growing at an average annual rate of more than 10 percent. Incomes have also increased sharply -- especially for urban residents. As a result, many of the "luxuries" are gradually transformed into "necessities", such as meat, eggs, seafood and so on.

As can be seen from Table 2 (source: China Agricultural Sector Development Report), from the perspective of food demand, the way for Chinese people to obtain calories has gradually changed from grains to animal-derived food, which can provide a great number of proteins and fat. From a relatively small-time scale, although the proportion of calories in grain food decreases, people's demand for grain does not decrease significantly, and also the demand of grains for feeding makes agricultural production pressure increase.

**Table 2.** Percentage of energy provided by different kind of nutrients for Chinese citizens

Year	Total/kcal	Carbohydrates/%	Protein/%	Fat/%
1930	2533.0	79.4	12	8.6
1982	2491.3	70.8	10.8	18.4
2002	2250.5	58.6	11.8	29.6
2020	2248.0	50.6	14.7	34.7

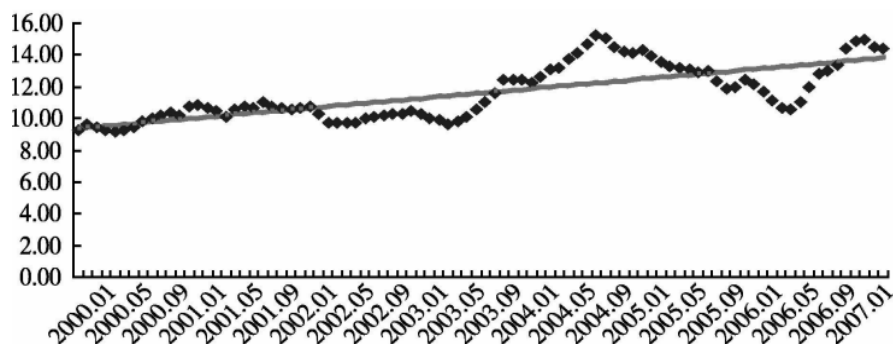
As shown in Table 3, despite a slight decrease in the proportion of grain demand for food, the amount of feeding grains has increased significantly, leading to increasing total demand for grain. From the perspective of biology, this phenomenon is also consistent with Lindeman Efficiency, because most of the energy transferred from grains to animals is lost. Therefore, an increase in the demand for animal-derived food leads to a larger increase in the demand for grains as a production factor, even though the demand for grains as food decreases slightly. As mentioned above, according to the cost-push theory, the price increase of agricultural production factors will promote the price increase of agricultural products [6]. Here feeding grains can be regarded as a factor of production in the agricultural production process. This also explains from another perspective why the price of agricultural products, including grains in China has shown an increasing trend in recent years, namely the trend mentioned above.

**Table 3.** Change of demand for grain in China, city and country (1995-2009) [8]

Year	Grain for eating (city) g/day	Grain for feeding (city) g/day	Grain for eating proportion (city)	Grain for eating (country) g/day	Grain for feeding (country) g/day	Grain for eating proportion (country)
1995	366.32	502.09	42.18	701.64	217.66	76.32
1996	360.11	511.79	41.30	701.92	242.51	74.32
1997	339.54	520.39	39.48	686.85	263.28	72.29
1998	338.26	522.47	39.30	681.92	278.58	71.00
1999	333.76	556.49	37.49	678.08	284.40	70.45
2000	329.61	583.94	36.08	685.48	315.61	68.47
2001	321.08	551.59	36.79	653.70	328.80	66.53
2002	324.71	645.84	33.46	647.95	351.83	64.81
2003	327.77	696.57	32.00	609.32	352.67	63.34
2004	327.57	645.90	33.65	598.08	341.75	63.64
2005	325.95	706.00	31.59	572.33	396.93	59.05
2006	325.95	706.85	31.56	563.29	417.11	57.46
2007	329.25	691.26	32.26	546.58	386.61	58.57
2008	--	--	--	545.48	377.58	59.09
2009	374.55	641.28	35.15	518.52	402.48	56.30

From the above analysis, it can be seen that the demand for agricultural products is gradually increasing, and the growth is relatively stable, with few fluctuations. However, as mentioned in the supply part, the supply of agricultural products fluctuates and does not match the demand well, under

the action of the cobweb model. From the perspective of the commodity property, there are very few substitutes for different kinds of agricultural products, whether for food or other purposes. Therefore, once the imbalance between supply and demand occurs, the price will rise rapidly or the products will be difficult to sell. The most typical example of this phenomenon is pork, which is produced by domesticated pigs. As shown in Figure 5, the changes in pork prices are consistent with the previous conclusions of trend and periodicity. The gray line is the trend line obtained by the least square method [9].



**Figure 5.** Average pork price in China (unit: yuan) [9]

To sum up, from the perspective of demand side, the structural change is very significant. People's consumption focus gradually shifts from grains to fresh vegetables, fruits, meat and eggs [8]. And the transition has been steady, with no dramatic fluctuation. As for the future demand changes, some scholars draw on Japan and South Korea, two East Asian countries similar to China, to predict the changes in China's agricultural product demand structure. Based on the demand data of Japan and South Korea in recent years, it can be predicted that as for food, China's demand for grain per capita will further decrease, the demand for vegetables and fruits will remain stable after certain further increase, and the demand for meat and eggs will still increase rapidly and substantially [10].

#### 4. Policy Effect

Since the supply and demand rules of agricultural products can be discovered and applied to predict the future trend, why targeted policies are needed to adjust them? First of all, this macro analysis is aimed at a very large scope of China's agricultural market. The overall trend can be predicted, but it does not mean that the price of each region, for each product, can be predicted in the process of production and trade. Secondly, there are many random variables in economic activities, such as international trade barriers, natural disasters, changes in residents' demand and so on. These random variables are not completely predictable, like the turbulence in fluid dynamics. At the same time, leaving the power to allocate resources by the free market without control and protection is likely to lead to imbalance between supply and demand, and the interests of domestic producers and consumers may suffer. Therefore, in recent years, many economists in China have been exploring the ways of developing China's agricultural economy and how to adjust policies to adapt to the changes in real economic situations, based on classical economic models and the experience of China's agricultural economic development.

In fact, in contrast to many western countries, China's previous agricultural policies were relatively protective and planned because the People's Republic of China had a relatively weak economic foundation when it was founded. Without policy protection, there may be imbalance between supply and demand in the agricultural product market. On the contrary, excessive reliance on policy guidance and planning will also lead to an extreme of the market and eventually lead to imbalance between supply and demand. So, it could be argued that the role of policy is to keep the balance between the invisible hand and the visible hand. In recent years, the most important agricultural policy change in China has been the abolition of the Agricultural Tax. Agricultural Tax is a tax levied by the country on all groups and individuals engaged in agricultural production and with agricultural income [11]. It

has a history of more than 2,600 years in China. Since January 1st, 2006, China has completely abolished the Agricultural Tax. This means that the economic burden on farmers will be reduced and their income will be raised. It also shows that the market will further play a decisive role in the development of China's agricultural economy [11].

From the point of view of agricultural prices, the abolition of agricultural tax reduces the cost of agricultural production. The reduction of production cost will further affect the prices of agricultural products and alleviate the trend of continuous increase of agricultural prices to a certain extent. At the same time, higher incomes for agricultural producers will boost domestic demand, further strengthening the vitality of the Chinese economy. In the above analysis of supply and demand, it is mentioned that the agricultural price has certain periodicity due to unstable factors in the process of production. Prices may fluctuate a lot, or move spontaneously away from the equilibrium point, if there is no policy to intervene [4]. Therefore, some policies have been introduced to buffer against changes in price, like a buffer that chemically keeps the acidity of a solution from deviating too much from neutral.

China implements a temporary purchase and storage policy for important agricultural products such as corn, rapeseed and soybeans, and supports enterprises to participate in the purchase and storage [2]. This policy is named Temporary Purchase and Storage Policy of Agricultural Products. The policy uses national financial funds to buy and store agricultural products as a "buffer" in case of natural disasters, changes in international trade and so on. If the prices of agricultural products increase too much, the stored agricultural products will be released appropriately to satisfy market demand. Similarly, if the prices of agricultural products decrease too much, or if the producers of agricultural products have difficulties in selling, the national funds and some enterprises will buy these agricultural products in large quantities.

As mentioned in the introduction part, a big amount of people in China are both producers and consumers of agricultural products, so in order to protect the interests of the people, the interests of agricultural producers should be taken seriously. Therefore, China also has a policy of setting minimum prices for agricultural purchases, which is named Minimum Purchase Price Policy of Agricultural Products. This means that when the market price is lower than the minimum purchase price, national financial funds and enterprises must buy the producer's agricultural products with the minimum purchase price [12]. From a macro perspective, this policy reflects the assistance of other industries (the secondary and tertiary industries) to agriculture (the primary industry). The policy also stabilized the expectations of consumers and producers for agricultural prices, and further prevented excessive fluctuations in agricultural prices. In addition to these policies, China has also introduced many direct subsidies for agricultural products. Through direct economic subsidies to farmers to ensure the continuity and stability of the supply side, so as to further stabilize the price of agricultural products [2]. However, some scholars point out that only relying on the national purchase and storage as well as economical support is not enough to maintain the long-term stability of agricultural prices and maximize the role of the market. It just cures the symptoms, not the diseases, like a "temporary medical relief". Therefore, it is necessary to give scientific theoretical guidance from three aspects of supply, demand and risk control [4]. To some extent, the author of this paper also supports this view. To stabilize the prices of agricultural products fundamentally, both sides of supply and demand should be taken into consideration and policies are to guide people towards a rational direction.

From the perspective of supply and risk control, theoretical guidance combined with subsidy policies are aimed at guiding agricultural producer to reasonably predict the market and not overreact to market changes, so as to blindly expand the scale of planting or breeding. As a consequence, the supply would keep close to the equilibrium, or say match the demand well and would not fluctuate greatly. The perspective of demand is mostly related to marketing and processing of agricultural products. Adjust consumer expectations to prevent unexpected changes in demand. Also, through industrial processing, the commodity forms of agricultural products are more diversified.

To sum up, the role of policy is not only as a "buffer" to stabilize agricultural prices from a macro perspective, but more importantly to guide supply and demand from the origin. So that the people

who follow these policies will produce rationally, trade rationally, and consume rationally. It also gives better play to the role of markets.

## 5. Conclusion

This paper takes China as an example to analyze the rules of China's agricultural prices from the perspectives of supply and demand. China's agricultural prices have significant periodicity and increasing trend. Although season is an important factor affecting agricultural development, data show that season has no significant impact on agricultural prices. The periodicity of agricultural prices is mainly due to the effect of cobweb model and other factors. The increasing trend is the result of the development of China's overall economy, including agricultural economy. There is also a structural shift in Chinese demand for agricultural products. Increased demand for animal-derived food has led to increased production of agricultural products and higher costs have further pushed up agricultural prices.

Although the law of supply and demand can be discovered and used to predict the future direction of agricultural prices, the market itself may still suffer from supply and demand imbalance under the action of many random variables. China's agricultural policy has prevented many possible crises from a macro perspective and well prepared for future crises. However, too much, too strict policy is not conducive to the role of the market. This paper argues that the role of policy is not only to treat symptoms, but more importantly to treat diseases, that is, to provide scientific guidance from both ends of supply and demand, to guide producers and consumers to follow the laws of supply and demand. Macro policies can achieve the expected positive effects in some aspects, but there are more complex influencing factors in real economy. This paper only analyzes a few typical aspects with the example of China. Moreover, this analysis is not systematic and does not find a universal law. In the future, it is positive to continue searching and summarizing the rules according to the changes of real economic situations, to further draw the laws that is not only targeted at the real developing situation of a certain country like China, but also economically universal and can be applied by future economists.

## References

- [1] Fu, X., Niu, B. The characteristics, laws and trends of international agricultural product price fluctuation [J]. *Chinese Rural Economy*, 2009 (5): 87 - 96.
- [2] Yang, G., Li, S. The influence factor and development trend of agricultural product price fluctuation [J]. *Agricultural Outlook*, 2011, 7 (2): 24 - 27.
- [3] Chen, F., Fan, Q., Gao T. Agricultural policies, Food production and Food production adjustment Ability [J]. *Economic Research Journal*, 2010 (11): 101 – 114.
- [4] Lu, X., Zhang, J. Analysis of citrus production and price fluctuation based on cobweb model theory [J]. *Rural Economy*, 2010 (8): 60 - 62.
- [5] Bekkers, E., Brockmeier, M. Food and agricultural price volatility on the world market and its transmission to domestic markets.
- [6] Li, G. Analysis of China's agricultural price rise since 2003[J]. *Chinese Rural Economy*, 2011 (2): 11 - 21.
- [7] Barnett, Richard C., Bessler, David A., Thompson, Robert L. The Money Supply and Nominal Agricultural Prices [J]. *American Journal of Agricultural Economics*, 1983 (65).
- [8] Zhong, F., Xiang, J. The impact of urbanization on grain demand: An analysis from the perspective of caloric consumption [J]. *Journal of Agrotechnical Economics*, 2012 (1): 4 - 10.
- [9] Li, B., He, Q. Analysis on Short-Term Fluctuations of Pork Price and Its Reasons in China [J]. *Issues in Agricultural Economy*, 2007 (10): 18 - 21.
- [10] Yang, J., Cheng, S., Yang B., et al. Changing Trends of Food Consumption Structure in Japan and Korea and Their Implications for China's Future Food Demands [J]. *China Soft Science*, 2013 (1): 24 - 31.

- [11] Ma, G. Research on the Problems of "Three Agricultural" and related agricultural taxation in the post-agricultural Tax Era [M]. Shanghai University of Finance and Economics Press, Shanghai, China, 2007.
- [12] He, W. The current situation, problem and countermeasure of minimum grain purchase price policy in China [J]. Macroeconomics, 2010 (10): 32 - 43.