

Team Control Number

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Summary

Pork is one of the important livestock products in China and one of the main sources of animal food for urban and rural residents in China. The income from raising pigs is one of the important incomes of Chinese residents and plays a vital role in the development of China's economy. The supply and demand in the pork market is unstable, and the price of pork is fluctuating due to factors such as supply and demand.

In recent years, China's hog industry has developed rapidly, but at the same time pork prices fluctuate frequently, excessive price fluctuations affect the stability of pig production, and directly affect people's living standards. Therefore, it is urgent to study the fluctuation cycle curve of pork prices and analyze the causes of pork price fluctuations. This will help you to understand the price fluctuation law of pork market and provide theoretical guidance for various market participants to take effective measures to reduce the risk of price fluctuations. The healthy development of the industry and the improvement of people's living standards are of great significance.

In the process of modeling, in order to calculate the factors that have the greatest impact on the established pork price model. We used the multiple regression method to analyze the pork price model from the five aspects of the price of piglets, the price of corn, the price of the producer, the price of pork substitutes and the sudden outbreak. And the function expression between the influence factors is derived. Tests show that the resulting expression can effectively determine the impact of various factors on pork prices.

The research program established according to such a model can well judge whether the research object has a certain probability relationship, and can judge the statistical calculation of pork price by various factors in the society. Grasping the impact factors of the research objects, assigning and calculating them, and transforming the intangible and fuzzy problems into quantitative computing models, making the problem solving more direct and objective. In addition, the model can perform static analysis and dynamic analysis on the research object to determine the effect of sustainable development.

In addition, for the price of piglets, the price of corn, the expected price of producers, the price of pork substitutes, and the sudden epidemic situation, the model can be used to judge the price of pork for the research object, and the weight of the impact factor. Determine the main impact factors that affect the event, and then

improve and adjust the main impact factors to achieve the best results.

Key word: multiple regression analysis; HP filtering; pig production; price fluctuation; impact factor

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1. Introduction

1.1 Background

According to data released by the National Bureau of Statistics of China, in August, China's livestock meat prices rose by 30.9%, of which pork prices rose by 46.7%, an increase of 19.7 percentage points over the previous month. Affected by this, the price of beef, lamb, chicken and duck rose 2% to 5.9%. The increase continued and expanded.

At the same time, African swine fever continues to ravage the world, and international pork prices are also rising rapidly. European Union (EU) pork prices, which represent international indicators, have now risen by 20%.

After entering 2019, the African swine fever epidemic has spread to countries such as Vietnam, and eight countries and regions in East Asia have experienced epidemics. In the first half of 2019 alone, more than 5,800 African swine fever epidemics have occurred in the world. Vietnam has had more than 3,000 epidemics in the first six months of this year. China has also culled over one million pigs due to African swine fever. Affected by this, the global pork supply is sluggish.

The spread of the African swine fever has a major impact on global pig production capacity. China has suffered from the epidemic as the world's largest pig producer and consumer, and has also hit global pig production capacity. In the medium to long term, global pork prices will continue to rise.

Therefore, it is urgent to study the fluctuation cycle curve of pork prices and analyze the fluctuation of pork prices.

1.2 Work

Part I: Analysis of the main influencing factors of pork price fluctuation

A. Analyze the common influencing factors of pork price fluctuations by using data in the past years.

B. Are the recent fluctuations in pork prices highly correlated with the common fluctuations in pork prices? If not, what are the main influencing factors?

Part II: Research on the fallback of the pork price

A. Pork farming usually has a certain periodicity. When the price of pork is high, can you propose a reasonable farming plan? (Note that you should not only take into account the region where pig farming is impossible and the reasonable use of remote area for pig farming so as to realize the fallback of pork price in a short term.)

B. Under the premise that pork farming cannot be completed in a short time, can you propose a reasonable procurement plan from other countries that can guarantee the relative stability of domestic pork prices?

Part III: Research on Optimal Supply and Storage Strategy of Pork

A. When the demand for pork in different regions is relatively stable (using the data

on the website <https://zhujia.zhuwang.cc/>), can you propose the optimal farming plan for different time zones in different regions? (Note that long-distance transportation of pigs and pork is not recommended.)

B. To effectively respond to the peak demand for pork in a certain area, can you propose an effective storage strategy for pork to ensure the stability of pork prices?

2. Problem analysis

2.1 Data analysis

2.1.1 Theoretical Analysis of Influencing Factors of Pork Price Fluctuation

Analysis of the factors of price fluctuation from the perspective of supply.

1. Feed price

In the process of pig breeding in China, which is based on the form of free-range breeding, when the farming owners make the farming decision, they mainly make decisions based on their own income. Therefore, when analyzing the price of pork in China, it is necessary to consider the cost of breeding. The impact on prices. Feed is the most important investment in pig breeding. Since 2011, the proportion of feed costs for pigs of different scales has been rising. In 2014, the proportion of feed costs for large, medium and small-scale pig breeding reached 63.09%, 67.43% and 68.60% respectively. Feed costs constitute a major part of the cost of pig farming. therefore. Fluctuations in feed prices will directly affect the cost of raising pigs, which will have an impact on pork prices.

2. Piglet price

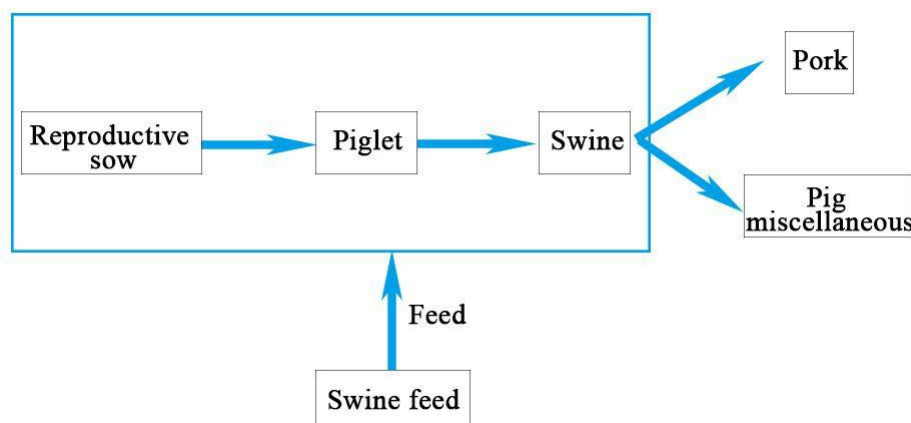


Fig. 1 Pig farming cycle

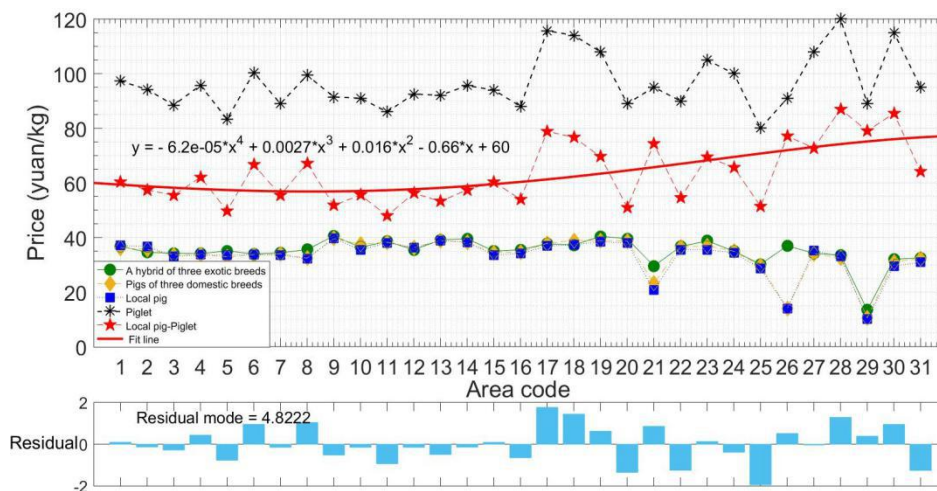


Fig. 2 Pork price – piglet relationship curve (taking the case of pork and pork as an example, where the code 1-31 represents 31 provinces, namely: Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin Province , Heilongjiang Province, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou , Yunnan Province, Tibet, Shaanxi Province, Gansu Province, Qinghai Province, Ningxia, Xinjiang)

From the pig breeding cycle of Figure 1, piglet prices directly affect the price of live pigs; and because the price of pigs is highly correlated with the price of pigs and dogs, the impact of piglet prices on pig prices can be roughly equated with the price of pigs and dogs. After calculation, we can conclude that the correlation coefficient between the price of live pigs and the price of piglets is 0.866, which indicates that the piglet price has a strong correlation with the price of pigs. It can also be said that the price of piglets is almost synchronous with the price fluctuation of pigs. .

If we look at the breeding cycle, the effect of piglet prices on the price of pork should have a certain delay, and the reason why it is shown here is that the two are highly correlated because the price of piglets and the price of pork are both the price of pork products. Linkage.

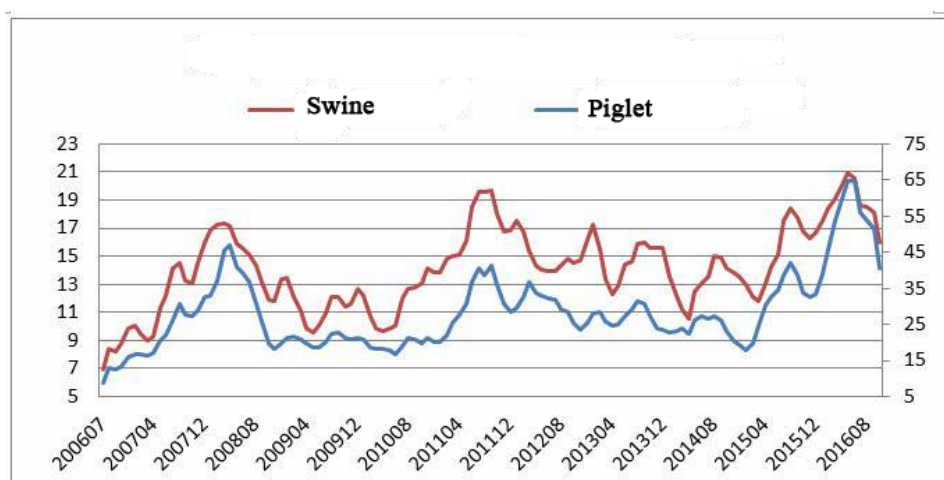


Fig. 3 Comparison of live pig prices and piglet prices

3. Pig growth cycle

As one of the important animal husbandry production targets in China, pig

production requires a certain amount of time for growth and development. Usually, it takes 4-6 months for a pig to grow from breeding to maturity. Throughout the production cycle. The occupation and consumption of labor and capital in pig production are very large. Under normal circumstances, only when the pigs are matured, the farmers can get profit from the end of the production cycle, and the pigs and dogs as a fresh food, storage. The cost is large, and the average farmer has no conditions for long-term storage. Therefore, when the pigs are mature, the farmers must sell the products to the market. Otherwise, the breeding will only increase the cost and reduce the income, even at the loss of breeding. At this time, if the market if there is oversupply of pork in the market, it will lead to further price decline. On the contrary, if the supply of pork in the market is in short supply, it can alleviate the possibility of further price increases. Therefore, the production cycle of pigs limits the production decisions of farmers to a certain extent, and also affects the price of pork through the influence of pork supply on the market.

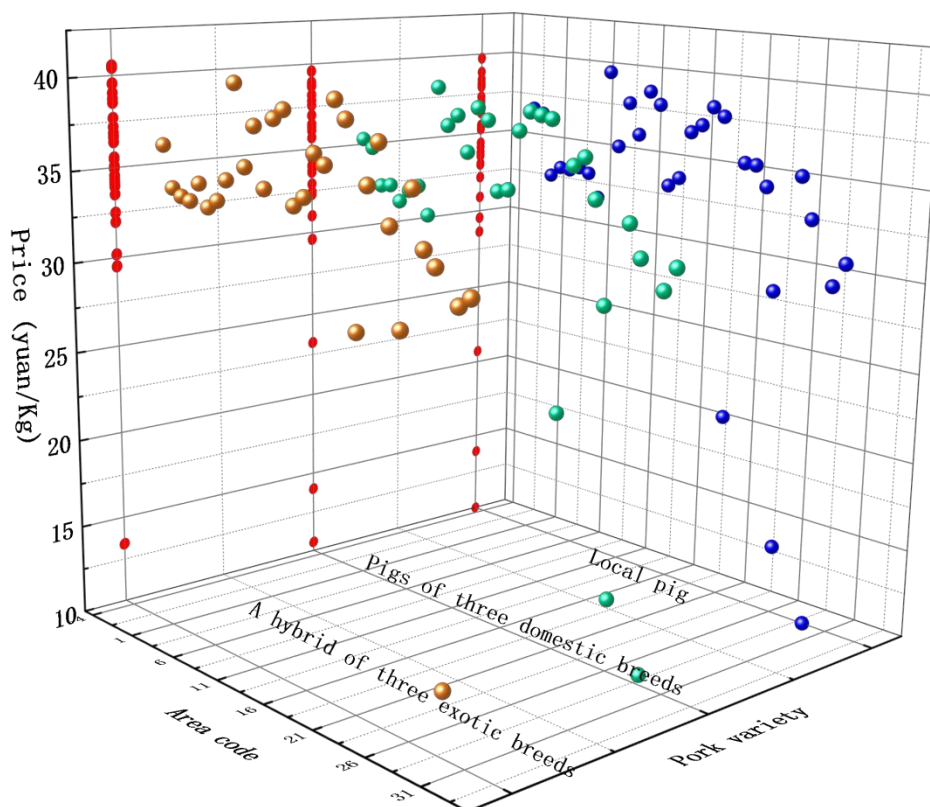


Fig. 4 Distribution of ternary, internal ternary and soil pigs across the country

4. Producer expectations

Our pig breeding has always been based on the free-range of farmers, and this method of free-range has also brought a lot of blindness and conformity. At the same time, the pig industry is still an industry with low entry and exit thresholds. It is easy for farmers to decide whether to farm or not to raise pigs, which has aggravated the blindness and conformity of farming to some extent.

Since pigs must be reared for a certain period of time before they can be marketed, the farmers who decide to engage in pig farming can only predict the price of pigs in the future according to the price of pork at that time. During this time, the

price of pork on the market is It has been in a situation of constant volatility, that is to say, the producer's expected price has a certain lag, and the lag time is generally the production cycle of the pig. This kind of lag brings a certain blindness to the farmers. When the price of pork in the market is high and the income from raising pigs is good, many farmers are blindly optimistic about the price of pork, so they are rushing into the pig industry and expanding. Production has led to a sudden surge in the scale of pig breeding, which has hidden dangers for the oversupply of the market in the future. When the price of pork in the market is low or down, the production enthusiasm of the farmers has been affected, and the consideration of their own interests has been reduced. The amount of stock, even at the expense of slaughtering sows, makes the price of pork on the market more volatile.

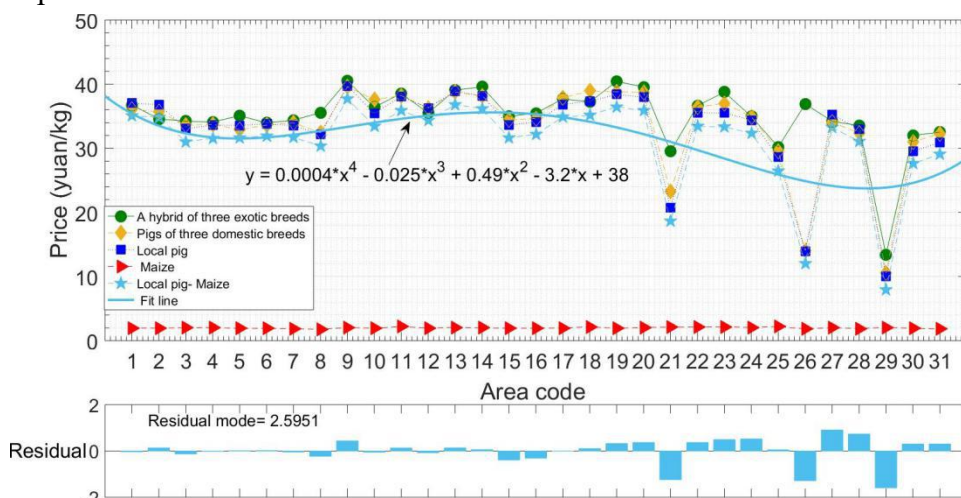


Fig. 5 Pork price-maize relationship curve (taking the internal pork as an example)

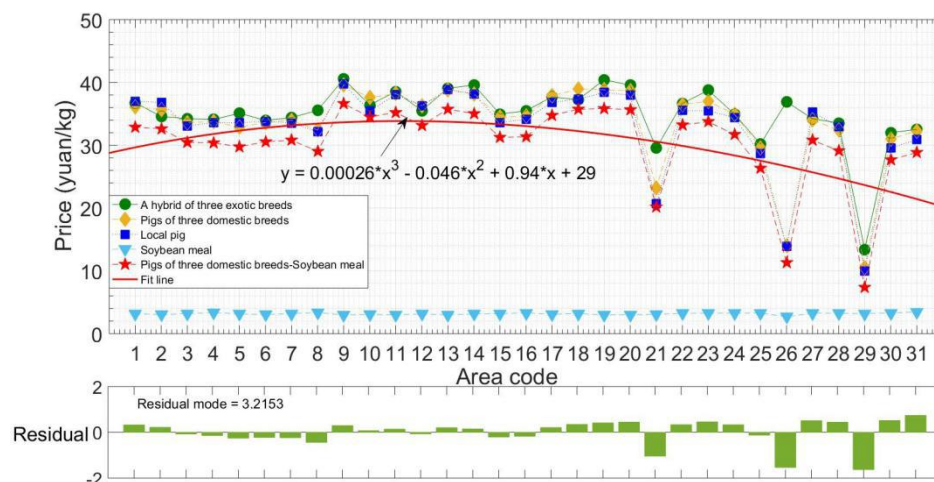


Fig. 6 Pork price - soybean meal relationship curve (take ternary pork as an example)

5. Other

The transfer of rural labor to cities and towns has accelerated. The new generation of peasants have generally received a certain degree of education, and their ideas are relatively new. Compared with their fathers, many of them are more willing to work and live in big cities than to stay in rural areas. In the aquaculture industry, it is considered that the benefit of raising pigs is low, which results in the reduction of free-range households. At the same time, large-scale pig raising has not been followed

up in a timely manner, which has also affected the pig breeding in China to a certain extent, which in turn has an impact on pork prices.

Analysis of the factors of price fluctuation from the perspective of demand.

1. Resident income

According to economic principles, if pork is a normal product, then the demand elasticity of pork is greater than zero, that is, when the income of residents increases, consumers will increase the consumption of pork. The increase in income will increase the consumption of pork by residents, thus driving up the price of pork.

2. Alternative price

With the improvement of people's living standards, people's diet structure is more and more diversified. At the same time, due to the increasing awareness of food safety and health care, some consumers are more inclined to purchase other animal foods. The proportion of cattle, sheep, chicken, eggs and dairy products in daily food consumption is increasing, and the substitution effect on pork is also increasingly prominent. Therefore, the fluctuation of the price of substitutes also affects the consumption of pork and further influences. The fluctuation of pork prices.

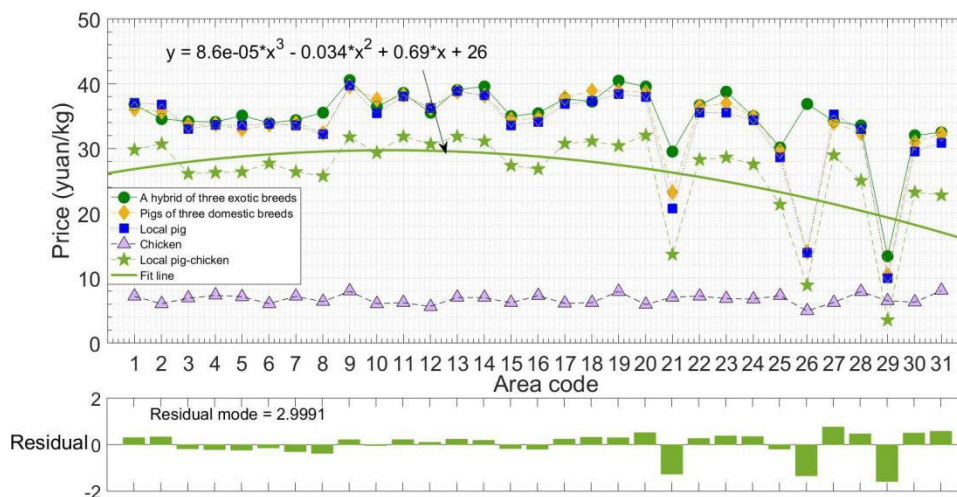


Fig.7 Pork price - chicken relationship curve (taking the example of pork and pork)

3. Traditional holiday holidays

Traditional holiday holidays have a great impact on the consumption behavior of Chinese residents. Taking pork consumption as an example, before the Spring Festival holiday, Chinese residents have the characteristics of purchasing new-year goods, smoked bacon and sausages. The consumption of pork during this period is the peak season, and after the Spring Festival holiday, the demand for pork is cyclical. decline. This change in pig supply shows cyclical and seasonal characteristics to a certain extent, making the price fluctuations of live pigs also show certain periodic and seasonal characteristics.

4. Consider other factors (Blight) .

Epidemics have always been a huge risk for farmers. In terms of supply, once a major epidemic spreads, the stock of pigs will drop sharply, and the supply of pork will decrease, further affecting the market price of pork. At the same time, for the

demand, due to the large-scale spread of the disease, consumers' consideration of their own health will inevitably reduce the consumption of pork, and instead consume other alternative foods such as beef, lamb, aquatic products, etc. Therefore, the market demand for pork is reduced, which in turn affects the market price of pork. It can be seen that the epidemic does not play a role in supply or demand unilaterally, but has a certain influence on the changes in supply and demand, thus affecting the price of pork.

2.2 Analysis of question one

2.2.1 Reasonable farming strategy in the case of high pork prices.

The first is to carry out standardized large-scale farming and avoid market risks. Under the conditions of a market economy, there will be economies of scale to produce benefits, and there will be markets if there is standardization. Large-scale standardized farming is conducive to popularizing advanced science and technology, improving farmers' farming level, and will actively promote the reduction of breeding costs, prevention of animal diseases, prevention and control of breeding pollution, improvement of animal product quality and safety, and increase of economic benefits. Therefore, the implementation of large-scale standardized farming can not only ensure the supply of commodity pigs, but also prevent the price from rising and falling, and enhance the ability to resist market risks.

The second is to develop cooperative economic organizations to avoid market risks. Due to restrictions on capital and technology, small-scale farmers are unable to carry out large-scale large-scale farming. However, many farmers can jointly form an agricultural economic cooperation organization to form an organic whole and survive and develop together in the form of cooperatives. The breeding level of the farmers effectively reduces the transaction costs with the market, realizes the sharing of benefits and risks, effectively changes the situation of asymmetric information with the market participants, and promotes the healthy and rapid development of the pig breeding industry.

The third is to participate in market docking and improve the efficiency of farming. Breeding enterprises can open pork sales direct stores, breed themselves, sell themselves, reduce the circulation of the pork market, and firmly control the farming profits and sales profits in their own hands, thus ensuring corporate profits and effectively avoiding market risks. At the same time, it directly cooperates with supermarkets and schools, adopts the form of agricultural super-docking and agricultural school docking, and connects the small production of thousands of households with the ever-changing big market, and builds an integrated chain of production and sales under the conditions of market economy to realize merchants, farmers, A win-win situation for consumers.

The fourth is to actively strive for project support and promote the sustainable development of the industry. Farmers should actively participate in the construction of various national aquaculture projects, such as participating in the national live pig reserve project, the free mandatory immunization program for major animal diseases,

the standardized construction project for pigs, and the vegetable basket project. While contributing to the national economy, it can also raise the level of farm construction, reduce the cost of infrastructure investment, and promote the improvement of farming efficiency. At the same time, conditional aquaculture companies can apply for registered trademarks for their products, increase their visibility, establish their own brands, expand the influence of their brands, enhance their market competitiveness, and gain more space for the development of enterprises.

When researching live pigs, we often ignore imported pig products from abroad. On the one hand, China imports less, and imported pig products only account for about 2.6% of the total supply. On the other hand, imported raw pig products are mainly frozen meat and pork chop. There is no direct competition with fresh meat sold domestically. In addition, the aquaculture industry has always had a limitation on the sales radius. On the one hand, the transportation of feed ingredients has a certain advantage over the transportation of fresh foods. On the other hand, there are inspections and quarantines for transnational and inter-regional fresh goods transportation. Relatively strict requirements. Despite this, we believe that with the gradual increase in domestic feed costs, the gap between domestic and international aquaculture costs has increased. Under this circumstance, understanding the situation and trend of import of raw pig products is of great significance for the domestic pig market research.

2.2.2 The future trend of pork product imports

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Since October 2017, the monthly import volume of pork in China has been rising month by month. In February 2018, the month-on-month ratio dropped significantly. In March, it rose again. The import of pork in the month was 136,000 tons, an increase of 9.6% year-on-year and an increase of 89.6%. At the same time, the average price of pork imports rose slightly in the fourth quarter of 2017. This year, the monthly average price of imports was 1.19 yuan per kilogram, down 5% year-on-year and 0.3% month-on-month. The current market is at a price. Near the bottom of the pig cycle, domestic pig prices are low and supply is sufficient, and import demand is

weak. In the short-term, domestic pork supply is sufficient and import demand is weakening. In recent years, with the increase of pig production capacity in China, the amount of live pigs has gradually increased. In 2017, the number of pigs in China increased by 0.5%, pork production increased by 0.8%; January 2018 In February, the slaughter volume of designated pig slaughtering enterprises increased by 20.5% year-on-year, with the year-on-year growth rate rising to 37.2% in February. At the same time, pork consumption has shown a downturn. In 2017, domestic pork consumption decreased by 10% year-on-year. Pork supply capacity increased while consumption declined and import demand weakened.

Since 2018, under the pressure of sufficient supply, the price of China's hog market has fallen sharply: in the first quarter of 2018, the price of pigs in China fell by 4.5 yuan per kilogram from the beginning of the year, a drop of 30.5%; the price of white meat fell by 6.6 yuan per kilogram from the beginning of the year. The decline was 31.5%. At the same time, the price of China's pork import market is relatively low, and the price advantage of imported pork is weakened. However, as the market gradually recovers from the pig cycle, the price of imported pig products will increase with the increase in pork prices in the future. The trend of rising. In addition, with the rise of soybean meal prices in trade friction and the boosting of corn prices after treatment, the feed cost of domestic pig breeding may face a certain degree of elevation in the future, although the current imported pig products are less and do not directly produce fresh meat. Competition, but in the case of future cost increases, the import of raw pig products may become an important indicator of the rise in pig prices and an important variable to stabilize prices.

2.3 Analysis of question two

2.3.1 Analysis of optimal breeding plan

In recent years, frequent animal epidemics, rising breeding costs and other factors have increased the instability of pig supply, causing sharp fluctuations in pork prices. It has become an important topic discussed by many domestic scholars to improve pig production efficiency, guarantee pig market supply and stabilize pig market price through the development of scale breeding. In 2007, the opinions on promoting the development of pig production and stabilizing market supply issued by the State Council clearly put forward the policy requirements of supporting the standardized scale pig breeding. Subsequently, the large-scale pig breeding in various regions of China developed rapidly. However, when the demand for pork in different regions is relatively stable, whether the larger the scale of pig breeding in different regions of China, the higher the efficiency? Few domestic scholars analyze which scale of pig breeding is most efficient in different regions. As the pig development is the result of adapting to the characteristics of natural conditions, it is also restricted by science and technology, society, economy, location and other factors. The rationality, scientificity and appropriateness of scale determine the economy of scale production

to a large extent. It is of great practical significance to scientifically guide and arrange the scale development of pig production in this area. Therefore, this article according to the national agricultural cost-benefit data collection could be divided into free-range pig breeding scale, small, medium and large scale, using DEA method to our country 29 provinces (municipalities) four scale pig production efficiency measure, and to develop large-scale pig production provinces (municipalities) the best breeding plan related Suggestions are given.

1. Analysis methods and indicators selection

The efficiency of pig production refers to the extent to which the input elements are fully utilized and the maximum possible output is produced under the conditions of established inputs and technologies. The methods of measuring efficiency mainly include parametric methods and non-parametric methods. Data envelopment analysis is a commonly used non-parametric method. When measuring the production efficiency of pigs, this paper selects the VAS-based DEA model and decomposes the production efficiency into pure technical efficiency and scale efficiency. Pure technical efficiency refers to the level of operation and management technology of a production point relative to other technologies. The scale efficiency reflects the degree of economies of scale of a production point compared with its effective point. The values of production efficiency, pure technical efficiency and scale efficiency are between 0 and 1. The larger the value, the higher the efficiency.

2. Analysis of measurement results

Using DEAP2.0 software, it is estimated that the production efficiency of four kinds of pig production methods in 29 provinces, such as free-range, small-scale, medium-scale and large-scale, is extremely decomposed. At the same time, 29 provinces (cities) are divided into three regions: eastern, central and western regions. Calculate production efficiency, pure technical efficiency and scale efficiency under four production modes in the three regions. According to Figure 1, the production efficiency of the four pig production methods is basically the same, with a significant increase in 2005 and 2008. In 2005, the production efficiency of free-range was highest during 2002-2005, indicating that the free-range production method was most suitable when the technical level and labor cost were generally low at the time. In 2006-2009, large-scale production mode has the highest production efficiency. The other three scales of production efficiency are medium-sized, small-scale, and free-range in order of high to low. The reason may be technological advancement and labor cost increase.

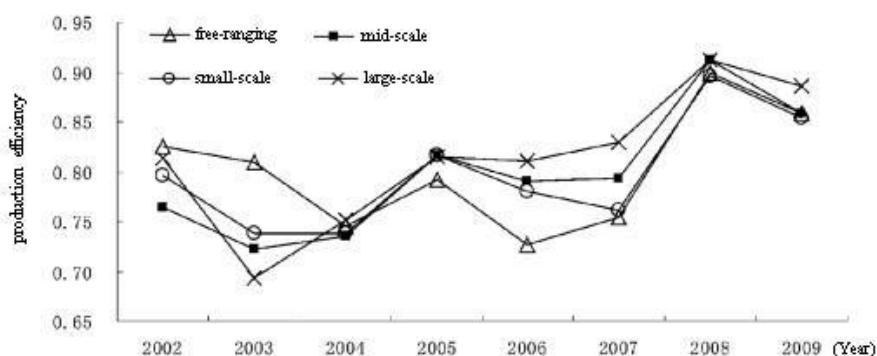


Fig. 8 Changes in production efficiency of four pig production methods in China from 2002 to 2009

(一) Production efficiency and decomposition of four pig production methods in the eastern, central and western regions

The increase in production efficiency between 2002 and 2009 was mainly due to the adjustment of the factor input scale (see Figure 9). In 2002-2005, large-scale farming in the eastern and central regions was better than the other three in terms of absorption and efficient use of aquaculture technology, but the scale efficiency of the other three scales was higher than that of large-scale, indicating that in addition to the effective use of technology, Adjusting the scale of factor input is an important measure to improve the efficiency of large-scale aquaculture production in the eastern and central regions. The production efficiency of the four production methods in the western region is higher than that in the east and the west, which is more difficult to introduce into the mountainous areas, external diseases, and rich in feed resources such as corn and potato. For the western region, free-range and large-scale farming have obvious advantages. Compared with 2002-2005, the production efficiency of four pig production models in the three regions increased to some extent during 2006-2009, but the speed of pure technical efficiency improvement was slower than the scale efficiency (especially in the western region), indicating the past During a period of time, the state promoted the specialization and scale of pig breeding, but the corresponding supporting farming technology promotion was slightly lagging behind. In the short term, specialized and large-scale farming supporting technologies will be the key promotion contents of China's agricultural technology sector.

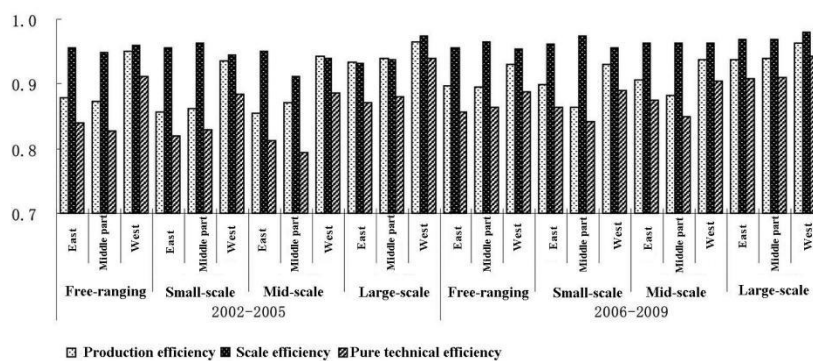


Fig. 9 Production efficiency and decomposition of four pig breeding models in three major regions of China from 2002 to 2009

(二) Analysis of the optimal scale of pig production in each province

The provinces with the largest scale and the largest scale are Shanghai, Fujian, Guangdong, Henan, Hunan, Chongqing and Xinjiang. Among them, Shanghai, Fujian, and Guangdong have the largest scale and optimal scale of large-scale production, and the largest scale and optimal scale of Hunan, Chongqing, and Xinjiang are small. Shanghai, Fujian, Hunan, and Chongqing have the largest production scale and the optimal production efficiency of 1, so maintaining the status quo is the best pig breeding development strategy in these provinces. The pure technical efficiency and scale efficiency of the largest scale and optimal scale of Henan and Xinjiang are 0.96, 0.97, and 0.98, 0.98, respectively, indicating that these two provinces need to improve

the effectiveness of breeding technology regeneration and diffusion, and adjust the scale of factor input. Improve its economies of scale. The pure technical efficiency of the largest scale and the optimal scale of Guangdong Province is 1, the scale efficiency is 0.96, and the scale returns are increasing, which indicates that Guangdong Province has done a good job in the expansion and effective application of aquaculture technology, but the scale of factor input is insufficient. . In the long run, Guangdong Province needs to continue to increase the scale of investment in production factors for pigs to increase its economies of scale.

2.4 Pork price fluctuation policy regulation recommendations

The formation of pork prices is the result of the market mechanism. It is a long-term development trend to form prices and allocate resources through market regulation. In the absence of market regulation, the government's modest adjustment intervention is necessary. The price impact of supply and demand is mainly from supply, and the first important aspect of our regulation is production regulation. The second important aspect is to promote the improvement of the pork market system by introducing targeted market supervision and regulatory measures. The third major aspect is to improve the effectiveness of policy regulation, change passive regulation into active regulation, and control must be intervened at the right time, with appropriate strength and appropriate means. Next, we will mainly propose policy recommendations from the three aspects of the above analysis.

1. Predicting the annual total demand for pork in advance

Change the status quo of insufficient information in China's pork market. The state and relevant institutions should publish the national and provincial pork demand forecast data at the beginning of each year through research and analysis. Our aquaculture producers can determine their own production plans based on this forecast, so that farmers can produce aquaculture. Provide more information to improve the production stability of farmers.

2. Encourage the development of standardized scale breeding

The consumption demand of China's pork future market may reach 70 million tons. Standardized scale breeding can start with scientific feeding and refined feeding, that is, using industrial standard production mode to develop pig breeding industry. The main aspect that the government should do is to support a large number of leading enterprises and encourage them to raise the level and extent of large-scale farming. Under the overall planning and support of the country, with the support of science and technology, we will concentrate on developing a number of leading enterprises in pork industrialization, and form a number of dominant pork producing areas, so that they will become the stable force and leading force in China's pork industry.

3. By strengthening the promotion of improved pig breeds

Establish a scientific and effective breeding system for improved pigs and accelerate the market share of high-quality elites. In terms of cultivation, we must pay attention to the combination of introduction and improvement of varieties, and the combination

of “introduction, breeding, reproduction and promotion” will bring about good quality and resistance as soon as possible. The quality of pigs with strong disease and high production performance is increased, and the production capacity of pork is improved. The government should support the establishment of improved farms based on the number of live pigs and the number of pigs, and use government tenders and business operations to accelerate the improvement of varieties and improve the quality of the pig market and pork.

3. Symbol and Assumptions

3.1 Symbol Description

Symbol	Explain
α	Constant term
p_s	Pig price
p_z	Piglet price
p_y	Corn price
p_e	Producer's expectations
p_i	Pork substitute price
p_1	Alternative beef price
p_2	Alternative lamb price
p_3	Alternative chicken price
p_4	Alternative egg price
p_5	Alternative price of grass carp
p_6	Alternative price of squid
p_7	Alternative price of squid

p_s	Alternative price of octopus
y_c	Per capita disposable income of urban residents
β_ε	Pending parameter
ε	Sudden epidemic
μ	Random disturbance

3.2 Fundamental assumptions

1. There is a linear relationship between the assumption that various factors affect the fluctuation of pork prices.
2. It is assumed that pigs grow naturally during the rearing period and there are no special disasters.
3. Assuming that factors other than the given impact factors are not considered, there is no necessary connection between each factor and they are independent of each other.
4. Assume that the impact factor reference standard value is selected according to the standards set by the United Nations, and the impact factor is the equivalence factor, which is only used for model one. In the process of selecting the optimal value of the impact factor, the influence factors other than the numerical value are ignored.
5. It is assumed that the weight of the evaluation index is independent of the size of the index, and the comprehensive evaluation model is established by using the independent weights in the comprehensive evaluation.

4. Model

4.1 Model establishment

Through the above analysis, the main influencing factors of hog price fluctuations are expressed in a model. A multivariate regression model is established, in which quantifiable factors are directly applied to the model, and non-quantitative factors are fitted to the model in the form of random perturbation terms. The specific expressions are:

$$p_s = \alpha + \beta_z p_z + \beta_y p_y + \beta_e p_e + \sum_{i=1}^8 \beta_i p_i + \beta_c y_c + \beta_\varepsilon \varepsilon + u \quad (1)$$

Where ε represents the epidemic situation, when $\varepsilon=0$ means no epidemic situation, $\varepsilon=1$ means affected by the epidemic situation; u is a random disturbance term. Table 1 shows the direction of impact of various factors.

Table 1 variables in the model and expected direction of influence

Influencing factor	variable name	Expected direction of influence
Piglet price	p_z	+
Corn price	p_y	+
Producer's expected price	p_e	-
Pork substitute price	p_i	+
epidemic	ε	-

The monthly and seasonal data in economic statistics contain seasonal variation factors, and its appearance easily obscures or confuses other objective changes in economic development. Therefore, when performing metrological analysis, it is necessary to eliminate the effects of seasonal fluctuations. This study used the seasonal adjustment method of the X12 time series in Eviews 5.1 software, and used the widely used addition model to perform "seasonal adjustment" on the above monthly data.

4.2 Solving the model

Before performing regression analysis, it is necessary to test the stationarity of each variable to avoid "pseudo-regression" caused by non-stationary data fitting model. The stationary test of the seasonally adjusted time series shows that the original data sequence of each month is a non-stationary time series, and the test results of the first-order difference sequence reject the unit root hypothesis, indicating that they are all 1st order single Sequence, thus establishing a regression equation. On this basis, this study used Eviews 5.1 software to perform regression analysis on the data, and obtained the influence degree of each influencing factor. The estimated results are as follows:

$$p_s = -1.849 + 0.380p_z + 1.190p_y - 0.215p_e + 0.552p_3\varepsilon + \mu \quad R^2 = 0.990, \quad DW = .559, \quad F = 2587.690$$

The regression results show that the DW value is too low, indicating that sequence auto-correlation is likely to exist in the regression, so the above empirical model needs to be revised.

5. Test the Models

5.1 Improvement of the empirical model and analysis of the results

5.1.1 Improvement of the empirical model.

The existence of the correlation of the regression model disturbance term sequence will lead to distortion of the model estimation results. Therefore, the

structure of the disturbance term sequence must be properly described to eliminate the adverse effects of sequence correlation on the model estimation results. This study uses the commonly used 1st order AR(1) model to eliminate the adverse effects of the perturbation term sequence correlation on the estimation results. The improvement of the empirical model is:

$$p_s = \alpha + \beta_z p_z + \beta_y p_y + \beta_e p_e + \sum_{i=1}^8 \beta_i p_i + \beta_c y_c + \beta_\varepsilon \varepsilon + u_t \quad (2)$$

Where $t=1, 2, 3 \dots T$, u_t are the perturbation terms of the regression equation (2), and $\beta_z, \beta_y, \beta_e, \beta_i, \beta_c$, and β_ε are coefficients of the regression model. Through the elimination of the correlation of the perturbation term series by the first-order auto-regressive AR(1) model, new regression results are obtained as follows:

$$p_s = -1.232 + 0.370 p_z + 2.6970 p_y - 0.193 p_e + 0.302 p_3 - 0.113 \varepsilon + \mu_t$$

$$R^2 = 0.909, \quad DW = 1.863, \quad F = 3978.140$$

The results show that the fitting degree is good. The regression equation is highly significant through the auto-correlation test. At the same time, the accompanying probability of the F test is 0.000, which reflects the high linearity between the variables.

5.1.2 Analysis of regression results

① From the regression results obtained above, the factors affecting the price fluctuation of live pigs include five aspects, namely p_z (piglet price), p_y (corn price), p_e (producer expectation), p_3 (chicken price) and ε . (epidemic) (virtual variable). Other explanatory variables either pass the P-value test of the F statistic or do not conform to the t-test, and there is a high correlation between them, which leads to multiple collinearity problems, so they are all eliminated.

② After the income reaches a certain level, the reason why the price of pigs is not sensitive y_c (the monthly income per capita of urban residents in China) does not enter the regression equation may be that with the development of the economy and the increase of the income of Chinese residents, the proportion of food consumption expenditure to income is decreasing. Small, so it is not sensitive to the price of live pigs. Furthermore, according to Engel's law, after the income level reaches a certain level, the increase in income does not make a clear change in the food consumption of residents.

③ Corn prices have the greatest impact on hog prices, followed by piglet prices. From the perspective of each explanatory variable, the magnitude of the absolute value of the coefficient explains the extent to which the explanatory variable affects the explanatory variable. Among them, the coefficient of explanatory corn price is the largest, which is 2.697, indicating that the price of corn has the highest impact on the price of live pigs. The second is the impact of piglet prices on hog prices, which is 0.370, indicating that pig production costs have a significant impact on hog prices.

④ Producers expect prices to have a negative impact on hog prices. The producer's expected price coefficient is -0.193, which is in line with the expected impact. One of the most likely reasons is that when farmers expect future pig prices to rise or pigs are profitable, most farmers are asymmetrical because of information. Taking the

replenishment or increasing the replenishment measures will result in the slaughter of piglets after fattening in the future, and the oversupply will cause the price of live pigs to fall.

⑤ The impact of pork substitute prices on hog prices is mainly due to chicken prices. The price of pork substitutes has a certain degree of impact on the price of live pigs. The impact of the price of substitutes on the price of live pigs mainly comes from the price of chicken. The coefficient of variation is 0.302, indicating that the price of chicken has a positive impact on the price of live pigs, which is in line with the expected impact. At the same time, it may also indicate that people's alternatives to pork are more likely to consume chicken when the price of live pigs rises sharply.

⑥ The epidemic will have a negative impact on hog prices. The coefficient of the virtual variable epidemic is -0.113, which is in line with the expected impact direction, indicating that the epidemic has a reverse effect on the price of live pigs. It also shows that the main impact of the epidemic is on the level of consumer demand. When the pig epidemic is serious, it will cause consumers. Panic, even if there is less pork supply at this time, consumers' demand for pork will be greatly reduced, and farmers have to sell pigs at a reduced price in order to recover the cost of pig production. The impact of the outbreak caused the reduction of pig production, which led to the reduction of pork supply, which was not reflected here.

According to the results of this empirical model, it can be seen that the influence factors of supply and demand affect the price of live pigs together, but the explanatory variables of supply in the model are more than the demand side, indicating that the cause of fluctuations in live pig prices mainly comes from In terms of supply, it also shows that the elasticity of demand for hog prices is less than supply elasticity.

5.1.3 Analysis of pork price research this year

Bring the relevant data of this year to the regression equation, you can get the normal price this year, and then compare the normal price with the actual price. As shown in the figure, it can be seen that the normal price and the actual price are not much different before May this year. However, the actual price has increased all the way in the last few months, and the difference from the normal price is getting bigger and bigger, indicating that the pork price growth this year is unreasonable.

Using this year's data re-fitting to get new coefficients, the regression results for this year are as follows:

$$p_s = 2.735 + 0.113p_z + 1.136p_y - 0.105p_e + 0.218p_3 + 9.8\varepsilon + \mu_t$$

It can be seen from the results that the impact of pork this year mainly comes from the epidemic situation (ε), which is the impact of African swine fever. The coefficient of variation is 9.8. The contrast coefficient found that pork price fluctuations this year have little correlation with pork price fluctuations in previous years.

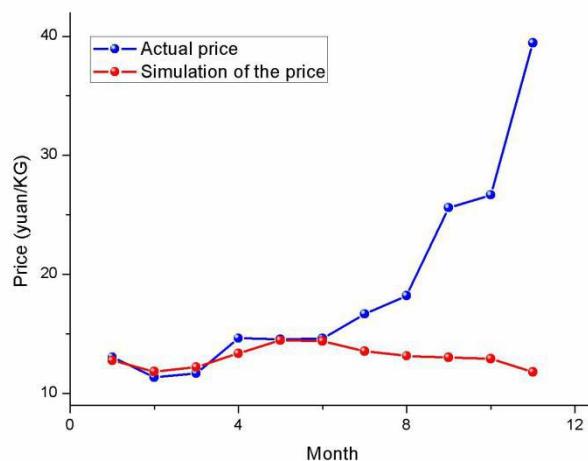


Fig.10 Actual price and model price comparison chart

6. Sensitivity Analysis

The idea of the model we built solves the problem of pork price fluctuation and the prediction of its trend from a macro perspective. In order to realize this idea, we transform the problem into a quantitative analysis of the degree of influence. First of all, parameters are set for each influencing factor of the event, which mainly considers the ladder type and difference of each influencing factor itself. Then, according to the relationship between influencing factors and parameters, the transformation of quantitative analysis is realized. Thirdly, by adjusting the influencing factors in mathematics to improve the relationship between the influencing factors, we study the key parameters of each index of the model, and improve the mathematical model by multiple regression equation. And through the analysis of the actual data, we can prove the feasible methods to improve the renewal rate, as well as the relevant economic, social and environmental impact.

This model can be used to infer other problems about purchase demand, and so on.

7. Strengths and Weakness

7.1 advantages of the model

Based on limited data, we consider as many factors as possible to perfect our computational model. For the problem of assessing influence, we must first grasp the impact factor, assign and calculate the impact factor, and transform the intangible and fuzzy problems into quantitative calculation models to make the problem solving more direct and objective. Through the professional and detailed classification of the price of piglets, the price of corn, the price of producers, the price of pork substitutes,

the per capita disposable income of urban residents and the sudden impact of the epidemic, the mathematical model is improved in many aspects. Through the data calculation of the model, objectively and directly solve the practical problems. Through the analysis and calculation of the actual data, the mathematical model is used to analyze the price fluctuation of pork. In the mathematical model, the influencing factors are rationally optimized and Adjusted, optimize the allocation of resources for the factors affecting the price fluctuation of the elbow, fully consider the influence of the influencing factors on the fluctuation of pork prices, and analyze the fluctuations and predictions of the price of pork and pork on the basis of data analysis, combined with the results of market research. This makes the mathematical model more accurate.

The model can not only statically analyze the fluctuation of pork price considering the influencing factors, but also dynamically adjust other influencing factors affecting the price fluctuation of the meat. Improve the accuracy of the mathematical model by optimizing the data model and adjusting the influence shadow. . Properly address the issue of fluctuations in pork prices.

7.2 Model's shortcomings and improvement directions

On the one hand, the limited amount of data in the survey and statistics makes the important impact on the collected data on the price of imported piglets, the price of corn, the expected price of producers, the price of pork substitutes, the disposable income of urban people, and the sudden epidemic. There are errors in the classification of factors, and there is a certain degree of interference to the accurate establishment of mathematical models, which reduces the accuracy of mathematical models and produces a certain degree of interference to the final results and solutions. On the other hand, the level of understanding of the pork market is not deep enough, the weight is not fine enough, and the professional level needs to be further refined. At the same time, the market industry is also constantly developing. There is still a lack of dynamic simulations of the industry development in the model, which is insufficient for the future development of the relevant pig industry.

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