The Volatility Characteristics of Hog Prices and the Relations between Hog Prices and CPI in China

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Abstract: The article analyzed the data about the average market price of live pigs between from 2001 to 2011, separating out the trend component and cyclical fluctuations component by HP filtering method. The article revealed that its price fluctuations presented characteristics with the spider divergent wave; On this basis, we analyzed the relationship between hog prices fluctuate with the changes in CPI based on VAR model and got the conclusions that hog prices was Granger cause of changes in China's CPI and CPI just can affect the movements in hog prices. Finally, the article also analyzed the cause of the spider pig prices’ changes showing divergent patterns and provided the policy suggestions to preventing against this change in trend.

1. Introduction

As the main meat food of Chinese residents, the price fluctuation of pork has always attracted people's attention, even sometimes it acts as a barometer of the general price level of China. As a kind of agricultural product, its price fluctuation also has the characteristics of agricultural products. It presents the state of starting from the scattered cobweb model fluctuation. At the same time, it is also the necessities of residents. In this way, when the price of pork is too high, the residents can not afford to eat meat, which affects their living standards. When the price of pork is too low, the pig farmers may lose money and affect their enthusiasm for production. In a word, the frequent and violent fluctuation of pork price will cause the adverse effect of "the low price of grain will hurt the farmers and the high price of grain will hurt the people". Although this situation is what we do not want to see, but in recent years, the price of pork in our country has not been able to avoid big ups and downs. On the one hand, it directly has a certain adverse impact on the living standards of residents; on the other hand, it also plays a role in promoting the rise of the general price level of the whole society. So, what are the characteristics of pork price fluctuation in China? What is its impact on CPI? The solution of these two problems will help the government to issue a good policy of pork price control and pork industry development.

There are many literatures about the fluctuation of pork price or the relationship between pork price and CPI. Yang Weiyian (2008) 1 used the cobweb theory to study the fluctuation of pig price in China, and got the conclusion that the pig price was in the "divergent cobweb" fluctuation state. Peng Tao et al. (2009) 2 found that the fluctuation of pig price in China is in two forms: normal fluctuation and abnormal fluctuation, and analyzed the causes of the fluctuation and how to systematically control the abnormal fluctuation of pig price. In terms of influencing factors of pig price fluctuation, Xin Xian and Tan Xiangyong (1999) 3 measured the factors affecting the price fluctuation of pig and pork in China, and elaborated the factors of pig price fluctuation from three aspects of supply, consumption and circulation. In terms of the impact of pig price on CPI, Xu Qiyuan (2010) 4 made an outlook on China's CPI through the analysis of pig production and its price fluctuation trend, and explained the relationship between the two theoretically. Han Yijie and Liu Xiuli (2011) 5 used the input-output price impact model to measure the impact of pork price volatility on the prices of products in other sectors and on CPI in China. The results showed that the impact of pork price on CPI was more significant. Most of the existing literatures discussed the reasons of the fluctuation of pig price and the influence of the fluctuation of pig price on CPI in theory. This paper hopes to measure the normal fluctuation (trend component) and abnormal fluctuation (periodic component) of pig price in China, and then determine the relationship between pig price and CPI.
through VAR model.

2. The Present Situation and Characteristics of Abnormal Fluctuation of Pork Price

2.1. Data Selection and Source

In order to facilitate the research, the pig market price was the only research object, whose fluctuation can better represent the price fluctuation of different kinds of pork in the market. The period covers 2001-2011. All the data were collected from the China Animal Husbandry and Veterinary Information Network.

2.2. The Current Situation of Abnormal Price Fluctuation in Pig Market

In order to show the characteristics, this study used the H-P filtering method to separate the trend component and the periodic component of China's pig market price, so as to clearly see the impact of the long-term trend and the periodic fluctuation on the price of China's pig market. The principle is as follows:

Suppose \( \{Y_t\} \) is a time series including trend component and periodic fluctuation component, \( \{Y_t^T\} \) is the trend component and \( \{Y_t^c\} \) periodic fluctuation component. Then:

\[
Y_t = Y_t^T + Y_t^c, t = 1,2,\ldots, T
\]

In order to separate the trend component from the periodic fluctuation component, the solution of the following minimization problem is usually found:

\[
\min \sum_{i=1}^{T} \{(Y_i - Y_i^T)^2 + \lambda[c(L)Y_i^T]^2\}
\]

\( c(L) = (L^{-1} - 1) - (1 - L) \)

Substituting formula (3) into formula (2) yields formula (4) as follows:

\[
\min \sum_{i=1}^{T} (Y_i - Y_i^T)^2 + \lambda \sum_{i=2}^{T-1} [(Y_{i+1}^T - Y_i^T) - (Y_i^T - Y_{i-1}^T)]^2
\]

According to general experience, the value is 14400 in monthly data.

In views software, the trend component and periodic fluctuation component of pork price can be separated directly. The results are shown in Figure 1:

It can be seen from Figure 1 that the current situation of market price fluctuation of pig in China shows the following characteristics:

1. The market price of pigs in China is generally on the rise. It can be seen from the trend component line of pig market price time series in the figure that, on the whole, the market price of pig in China has increased from 6.02 yuan / kg in January 2001 to 17.03 yuan / kg in December...
2011. The rising trend of pig market price in general is consistent with the economic development of our country and the continuous improvement of residents' living standards, which is also an inevitable trend in the continuous development of China's economy.

2. There were huge fluctuations of pig market price in China. From the perspective of the cyclical components separated from the graph, the price of China's pig market has experienced three times of cyclical fluctuations from peak to trough to peak from 2001 to 2011. The frequency of such fluctuations is very frequent. There is a cycle in less than 4 years on average, i.e. less than 2 years on average, and the price of China's pig market will fall from the peak to the lowest, or from the lowest price to the highest price. It can also be seen from the figure that the range of this periodic fluctuation is also growing, that is, the price fluctuation of the pig market in China presents a "divergent" cobweb model.

3. The Relationship between the Market Price of Pig and CPI in China

In recent years, the frequent changes of pig market price have also affected China's CPI, showing a significant positive correlation between the two. However, what is the relationship between the two needs further empirical analysis.

3.1. Selection of Variables and Sample Data

The analysis data selected in this paper are the monthly pig price data and CPI from January 2001 to December 2011. As CPI is the consumer price index, the pig price is also converted into the year-on-year price index, so 120 monthly data from January 2002 to December 2011 can be obtained. JG is the price of pig.

3.2. Correlation Analysis

According to the above, by indexation, the relationship among pig price (JG), its trend composition (jgqs) and CPI can be obtained as shown in Figure 2. The trend composition of pig price has a high correlation with CPI. Theoretically, the trend composition of pig price is determined by the overall price level.

3.3. Causal Relationship between the Pig Price Trend and CPI

In order to explore the relationship between the fluctuation of pig price and the change of CPI, we can build VAR model between them. Because the trend components of pig price are highly correlated with CPI, we can't build VAR model between them. So we only built a VAR model below. The VAR model between the real fluctuation sequence of pig price and CPI is used to explore the relationship between them.

1. Stability test

The non-stationary time series will lead to the problem of pseudo regression. Therefore, it is necessary to test the unit root of the original variable sequence to determine the stability of the sequence. The test result was shown in Table 1:

<table>
<thead>
<tr>
<th>Variable</th>
<th>test type(c,t,k)</th>
<th>ADF value</th>
<th>p value</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>JG</td>
<td>(c,t,1)</td>
<td>-2.614246</td>
<td>0.2748</td>
<td>unstable</td>
</tr>
<tr>
<td>CPI</td>
<td>(c,t,3)</td>
<td>-2.576826</td>
<td>0.2916</td>
<td>unstable</td>
</tr>
</tbody>
</table>

2. Cointegration test

In addition to the difference processing of the original series variables, we can also carry out cointegration analysis. If the linear combination of non-stationary series is stationary variables, it is considered that there is a long-term equilibrium relationship between these variables. The result of cointegration test was shown in Table 2
Table 2 co integration test results between pig price index series and CPI

<table>
<thead>
<tr>
<th>Original hypothesis</th>
<th>eigenvalue</th>
<th>trace statistic</th>
<th>5% critical value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.236310</td>
<td>38.56301</td>
<td>15.49471</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.050448</td>
<td>6.211816</td>
<td>3.841466</td>
<td>0.0127</td>
</tr>
</tbody>
</table>

It can be seen that there is at least one cointegration relationship between pig price JG and CPI. The maximum cointegration relationship between the two is:

\[ JG = 2.826251 CPI \]  

(5)

We can get the long-term equilibrium relation that JG and CPI are both positively correlated.

3. Granger causality test

Granger causality can be used to test whether all lagged terms of one variable have an impact on the current value of another or several variables. In this paper, Granger causality is used to test the causality between JG and CPI. The stability test results of VAR model are shown in Figure 3:

The points in the unit circle in the figure represent the reciprocal modulus of AR characteristic root. It can be seen that these points fall inside the unit circle, indicating that the VAR model established is stable, and Granger causality test can be carried out.

the result of Granger causality was shown in Table 3 below:

Table 3 Granger causality test results of pig price and CPI

<table>
<thead>
<tr>
<th>Original hypothesis</th>
<th>p value</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>JG is not Granger cause of CPI</td>
<td>0.0159</td>
<td>reject the original assumption</td>
</tr>
<tr>
<td>CPI is not Granger's reason of JG</td>
<td>0.4288</td>
<td>Accept the original assumption</td>
</tr>
</tbody>
</table>

Figure 4 Impulse response function of pig price and CPI
It can be concluded that pig market price is the Granger influence factor of CPI fluctuation, while CPI is not the Granger influence factor of pig market price fluctuation. Next, we use impulse response function and variance decomposition to better observe the relationship between JG and CPI. Figure 4 and figure 5 are impulse response function and variance decomposition.

From the impulse response function chart, we can see that the impact of pig price on CPI keeps rising in the first few months, and will continue to increase in the next few months; however, the impact of CPI on pig price is not so significant, and there is a little positive impact in the first few months, and the impact disappears after the fifth month, which is similar to Granger causality test. In the result of variance decomposition, it can also be seen that the part of CPI variance caused by the change of pig price keeps rising until it reaches 40%, that is to say, about 40% of CPI variance can be explained by the change of pig price JG, while the part of JG variance caused by the change of CPI is almost zero.

4. Causes of Abnormal Fluctuation of Pork Price

There are many factors influencing the supply of pig market, but there are mainly two aspects:

4.1. Internal Supply Mechanism

1. The divergent cobweb phenomenon caused by the law of supply and demand. In China's pig market, due to the large number of pig farmers and the scattered demand, the market can be seen as close to the fully competitive market. In the above analysis of demand factors, we can see that the demand elasticity of pork is very small, but as an agricultural product, the supply elasticity of pork is very large. In addition, the dispersion of pig farmers in our country, everyone only makes decisions according to their own expectations, and from their own interests, it will cause a large increase and decrease in the supply of pigs. Therefore, in the absence of external counter direction interference, the spider web model will generally appear as a starting point.

2. The influence of pig production cycle on price. Pig production must go through three stages of breeding sows, farrowing and fattening to complete a cycle, which will take at least one and a half years. As a result, the signal of market supply shortage (surplus) cannot be immediately reflected in the output. This lag of pig production is easy to create a kind of illusion for producers.

It can be said that the pig production cycle is long and the decentralized management, the combination of these two factors will make the expectation and decision-making of pig farmers in...
China tend to be contrary to the market trend, resulting in the internal operation law of pig and pork market is the divergent cobweb model.

4.2. (II) Impact of External Factors

1. Impact of production cost. For pig farmers, their income can not only be measured by the price of pigs, but also their cost. The most important cost of pigs is feed cost, which generally accounts for more than 60%. Therefore, feed price will have a greater impact on the supply of pigs, especially the price changes of corn and soybean meal. There is an important law of "the profit and loss balance ratio of pig food", that is, the price of pork is more than 6 than that of corn, so the pig farmers can make profits, otherwise they will lose money.

2. Impact of emergencies such as epidemic situation. For example, the rise of pig market price since the third quarter of 2003 is inseparable from the SARS epidemic in 2003. During the outbreak, the number of people eating out decreased greatly, which led to a decrease in the demand for pork and a decrease in the meat orders of restaurants? In order to prevent the spread of the epidemic, at that time, some places closed the pig purchase and sale market, and took measures to restrict the flow of pigs one after another, setting up barriers and isolating each other, resulting in market segmentation, blocked circulation, and significantly reduced cargo flow. In this way, after the outbreak, with the recovery of tourism and catering industry, the demand for pork has risen rapidly, while the output of pigs has entered a low level. The external factor of SARS changed the supply pattern of pig and brought the pig market of our country into a period of huge price fluctuation.

5. Countermeasures and Suggestions

1. Invest more human, material and financial resources to monitor and predict the price of pork. From the cobweb model mentioned above, we can see that one of the main reasons for its divergence is the decision-making error caused by the expectation error of pig farmers. In the past few years, the establishment of pork futures market may be due to some inherent defects in China's futures market, which has not played a good role in price discovery. Therefore, the government has the obligation to establish a more scientific and reasonable price monitoring and forecasting system, and timely release the price information of pork to the market and pig farmers. Pig farmers can adjust their behavior in time according to the correct market information, so as to avoid large fluctuation of pig supply.

2. Develop large-scale production and operation. The large fluctuation of pork supply is also due to the fact that the pig industry in China is very scattered, most of which are produced by small-scale retail investors. In the vast rural areas, they are still in the stage of raising pigs one by one. Therefore, the government should use fiscal policies (such as tax preference) to support the large-scale operation of pig industry. When the price fluctuates, there will not be too many collective expectations and decentralized decision-making, which can stabilize the supply of pork; It is more conducive to the monitoring and management of the government, such as: on the price side, the government can timely subsidize the grain according to the price growth, and on the quality side, it can control the flow into the market from the source The quality of pork on.

3. Actively develop the downstream pork processing industry. At present, in response to the situation of excess supply and price decline of pork, only pork reserve can be used. It can be seen that the downstream industry of pork is insufficient. Pork should not be preserved only by freezing. At the same time, it can also develop other uses of pork, so that pork can be very good quality, so as to increase demand in excess supply, stabilize the downward trend, and also increase the space of government macro-control.

Reference


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