The Variation Law of the Market Price of Pork in Beijing City

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Abstract In order to research the fluctuation law of price of pork in Beijing City and determine its fluctuation cycle, we use level indicator analysis, speed indicator analysis, the coefficient of variation, the seasonal adjustment model and the HP filter method, to analyze the data on the market price of pork in 8 wholesale markets in Beijing City during the period 2002 -2011. The results show that the annual price of pork in wholesale markets in Beijing City shows a gradual upward trend; during the period 2002 -2011, the price of pork in Beijing City experienced three full fluctuation cycle, and each fluctuation cycle was roughly 38 months; the price of pork within the year shows a trend of " one trough, one crest" , and the interval of high prices is mainly concentrated in June-december; the amount of pork for sale within the year is basically inversely correlated with the price. Therefore, we should strengthen the monitoring of pig production information and market information, to ensure the sufficient supply of pork, and stabilize the market price of pork. In addition, according to the variation law of the market price of pork, improving the purchasing, storage and allocation work mechanism of the reserve meat is also necessary to stabilizing the market price of pork.

Key words Beijing City, Price of pork, Amount of pork for sale, Variation law

1 Introduction

Beijing City, as a super-large consumer city, is China's political, economic and cultural center, with a large population. In terms of pork, the annual demand for pork in Beijing is huge, greatly depending on other areas, for example, the annual pork output in Beijing City is about 0.12 million t, and the amount of pork for sale in wholesale markets is about 0.27 million t, with self-sufficiency rate less than 45%. Pork is regarded as the most important consumer good of meat for urban and rural residents, whose consumption accounts for more than 60% of the total meat consumption[1]. The ups and downs of the price of pork may have a direct impact on the CPI. According to estimates, the weight of price of pork in the CPI is about 3%[2], that is, when the price of pork rises by 10%, it will affect about 0.3 percentage points of the CPI. For example, the price of pork in Beijing City in 2008 rose by 21.3%, affecting 0.64 percentage points of rise in the overall level of the CPI; in 2010, the price of pork rose by 43.2%, affecting 1.3 percentage points of rise in the overall level of the CPI.

It can be found that the fluctuation in the price of pork has an important effect on the living standards of urban and rural residents, and especially since 2007, the fluctuation in the price of pork in Beijing has been constantly intensifying, imposing an increasingly deepened impact on the overall price level. Therefore, conducting in-depth study of the pork market and the variation law of the market price of pork, is of great significance to ensuring the market supply of pork and stabilizing the price of pork. Based on the data concerning the market price of pork in 8 wholesale markets in Beijing City during the period 2002 -2011, we use level indicator analysis, speed indicator analysis, the coefficient of variation, the seasonal adjustment model and the HP filter method to analyze the market price of pork in Beijing City, generalizing the variation law and characteristics of the market price of pork in Beijing City.

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2 Research method

2.1 Data source The data on the price and amount of pork for sale are all from the daily amount of white pork carcass for sale and daily weighted average price in 8 wholesale markets in Beijing City. 8 major wholesale markets include Xinfadi wholesale market, Dayang Road wholesale market in Chaoyang District, Yuegezhuang wholesale market, Shimen wholesale market of agricultural and sideline products in Shunyi District, Baliqiao wholesale market in Tongzhou District, Shuitun wholesale market in Changping District, Jin Xiu Da Di wholesale market and Huilongguan wholesale market.

2.2 Data processing method Data calculation: The ten-day, monthly and yearly amount of pork for sale is the summation of 8 major wholesale markets, respectively; the ten-day, monthly, and yearly average price is the weighted average price.

Data analysis: Using Excel 2007, we analyze the amount of pork for sale and the price trend in Beijing City, and draw the figure; using Eviews 5.0, we study the fluctuation cycle of price of pork in Beijing City.

3 Analysis of variation in amount of pork for sale in Beijing City

3.1 Analysis of variation in total amount of pork for sale From 2002, the annual amount of pork for sale in Beijing City showed a trend of increase along with fluctuation on the whole.

The amount of pork for sale increased from 43 000 t in 2002 to 250 000 t in 2011, an increase of 5.8 times.

In the period 2002 – 2006, the amount of pork for sale increased considerably, with an average annual growth rate of 51.6%. The reason for the substantial increase is the expansion of operation scale of wholesale market, and increase in the residents' consumer demand for pork after the income level is improved. In the period 2006 – 2011, the amount of pork for sale experienced inconspicuous increase, with an average annual growth rate of 1.7%. The reason for decline in the growth rate is as follows: on the one hand, the pork consumption remains at a relatively stable level, and increase in the population causes increase in the total amount; on the other hand, the proportion of pork operated by supermarket increases to some extent (Fig. 1).

3.2 Analysis of ten-day variation in amount of pork for sale Judging from the trend of ten-day amount of pork for sale during the period 2002 – 2011 (Fig. 2), the ten-day amount of pork for sale fluctuated around 5 000 t, and the amount of pork for sale in the period mid-October – late December was relatively large, mainly because this period was a busy season of pork demand in the year. Especially in late December and next year's mid-January, the amount of pork for sale increased more significantly; during the Spring Festival, the amount of pork for sale was drastically reduced.

In order to analyze the variation in the ten-day amount of pork for sale, we use the indicator of coefficient of variation to illustrate the degree of variation in the amount of pork for sale. The overall coefficient of variation of average ten-day amount of pork for sale in the period 2002 – 2011 was 0.568 8; omitting several time points affected by festival factor, the coefficient of variation of samples was further reduced to 0.537 8, further confirming that the pork amount of pork for sale was greatly affected by the festival factor (Table 1).

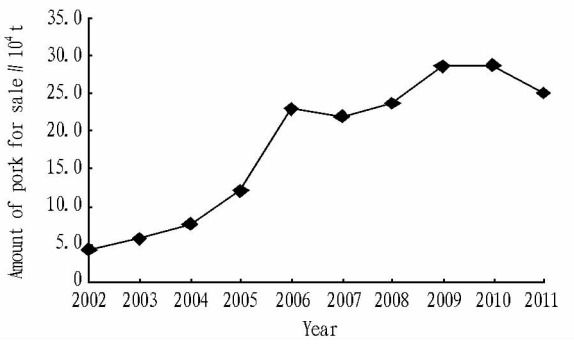


Fig. 1 The run chart of amount of pork for sale in Beijing City during the period 2000 – 2011

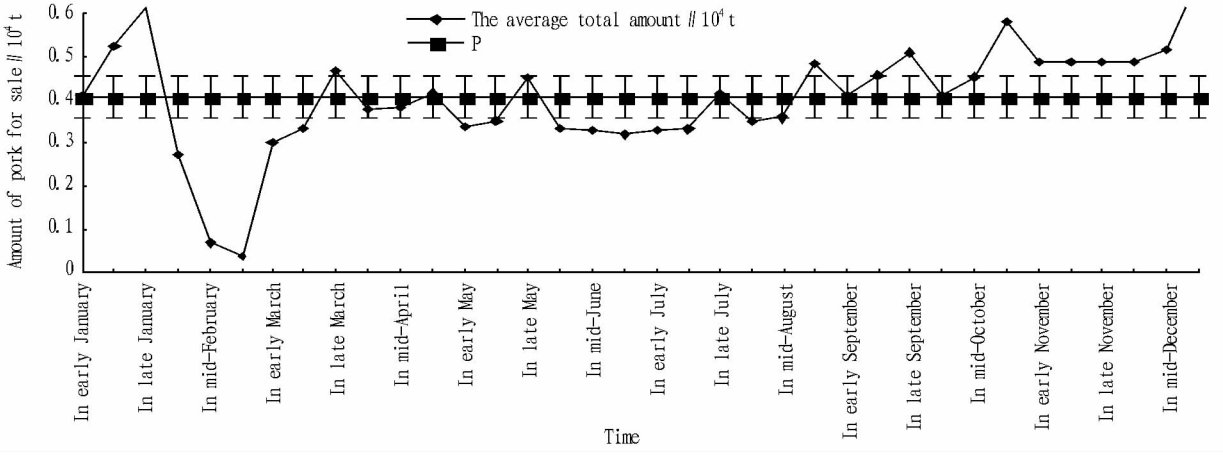


Fig. 2 Ten-day variation in amount of pork for sale in Beijing City

Table 1 The coefficient of variation of ten-day amount of pork for sale in Beijing City

Time	The 1st ten-day	The 2nd ten-day	The 3rd ten-day	The 4th ten-day	The 5th ten-day	The 6th ten-day	The 7th ten-day	The 8th ten-day	The 9th ten-day
The coefficient of variation	0.6320	0.6445	0.6660	0.7316	0.7375	0.5822	0.5596	0.5624	0.5627
Time	The 10th ten-day	The 11th ten-day	The 12th ten-day	The 13th ten-day	The 14th ten-day	The 15th ten-day	The 16th ten-day	The 17th ten-day	The 18th ten-day
The coefficient of variation	0.5561	0.5608	0.5683	0.5813	0.5665	0.5439	0.5411	0.5274	0.5187
Time	The 19th ten-day	The 20th ten-day	The 21st ten-day	The 22nd ten-day	The 23rd ten-day	The 24th ten-day	The 25th ten-day	The 26th ten-day	The 27th ten-day
The coefficient of variation	0.4803	0.5313	0.5243	0.5199	0.5159	0.5206	0.5375	0.5188	0.5152
Time	The 28th ten-day	The 29th ten-day	The 30th ten-day	The 31st ten-day	The 32nd ten-day	The 33rd ten-day	The 34th ten-day	The 35th ten-day	The 36th ten-day
The coefficient of variation	0.5206	0.5257	0.5168	0.5025	0.4991	0.5019	0.4923	0.4893	0.5124

4 Analysis of variation in the price of pork in Beijing City

4.1 Analysis of variation in the price of pork From the run chart of the price of pork in Beijing City during the period 2002 –2011, we clearly see that the price of pork in Beijing City rose in fluctuation, and the fluctuation tended to intensify (Fig. 3). Fluctuation in the price of pork can be divided into two stages, that is, the price was first stable then rose sharply in the run chart. In the period 2002 –2006, the price of pork was relatively stable, fluctuating moderately around 9.70 yuan per kilogram, with an average annual increase of 4.4%. In the period 2006 –2011, the price of pork rose greatly, with an average annual increase of 16.5%, and especially in the period 2006 –2008 and 2010 –2011, the growth rate of price of pork was 88.0% and 43.2%, respectively.

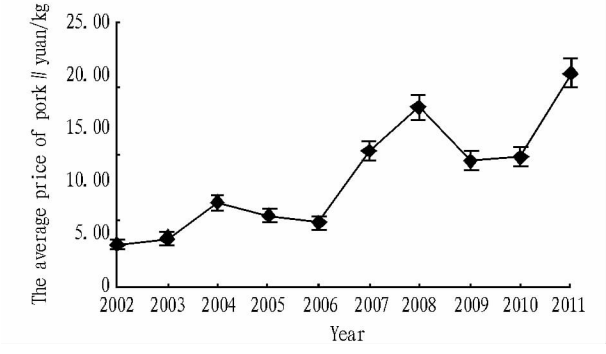


Fig. 3 Run chart of the price of pork in Beijing City during the period 2002 –2011

Fig. 4 shows that the average ten-day price of pork (P) fluctuates around 12.32 yuan/kg. Overall, the changes in the price of pork show a trend of "one trough, one crest". We call the period under P the trough period, namely the period early January – early June, and the change in the price of pork in this interval shows the "V" shape. The price of pork in early April is 12.05 yuan per kilogram, the lowest price in this interval. We call the period above P the crest period, namely the period mid-June – late December, and the fluctuation in the price of pork in this period is still great, showing the "N" shape. In late December, the price of pork reaches the crest value (14.42 yuan/kg), and the difference between the crest value and trough value is 2.37 yuan/kg.

The peak period of price of pork is from mid-June to late December, and the high-price interval is also within this period. The price of pork begins to be higher than 12.32 yuan per kilogram from mid-June, reaching 14.42 yuan per kilogram in late December.

The peak period of price is just the distribution area of traditional Chinese festivals, such as Mid-autumn Festival, National Day and Spring Festival; the market demand is huge, and the pork supply is relatively stable, so the price is naturally high[3]. And the peak time is long, lasting for 200 days, while the trough time lasts for 160 days. After the Spring Festival, the residents' demand is reduced, and the price of pork starts to decline; April in every year is basically the period with the lowest price of pork.

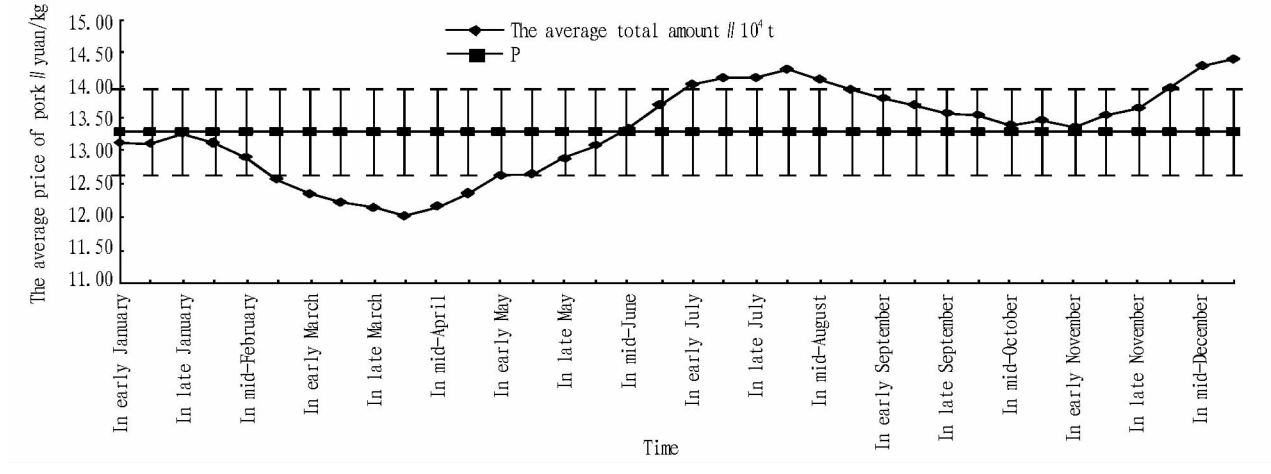


Fig. 4 The variation law of market price of pork in Beijing City

4.2 The annual alternating fluctuation in the price of pork There is a law in the annual price fluctuation of pork, that is, the price fluctuation shows the characteristics of "relatively stable – fluctuant – relatively stable". We calculate the coefficient of variation of average ten-day price during the period 2002 –2011, indicating that the coefficient of variation was more than 0.1 in 2003, 2006, 2007, 2008, 2010 and 2011, while the coefficient of variation in adjacent years was less than 0.1 (Table 2).

This shows that there is interaction between the prices in adjacent years in the market of pork, which is related to the unscientific production and management decision making arising from information asymmetry in the pork market at present[4].

Table 2 The coefficient of variation of the annual price of pork during the period 2002 –2011

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
The coefficient of variation	0.024	0.116	0.072	0.085	0.132	0.175	0.135	0.096	0.126	0.127

4.3 Fluctuation cycle of the price of pork in Beijing City

First of all, we use the seasonal adjustment method to conduct seasonal adjustment of the monthly price of pork in Beijing, and based on this, use the HP filter method to eliminate the trend component and get periodic component; then we analyze the statistical characteristics of the periodic component, so as to identify the fluctuation cycle of price of pork in Beijing City.

4.3.1 The seasonal adjustment model. The main purpose of time series decomposition is to break down the trends and seasonal factors in the time series, in order to clearly observe each part of fluctuation. The seasonal adjustment method of time series is to understand the constituent element of the time series from this perspective, and transform it into quantifiable seasonal model[5]. Fig. 5 is the seasonal factor analysis figure after the seasonal adjustment. From the figure, we see that the fluctuation in the price of pork is very seasonal, and the seasonal fluctuation of price tends to be violent. Consequently, it is very necessary and urgent to establish the early warning mechanism of pork price fluctuation.

The trend components and periodical components are regarded as a whole in the seasonal adjustment, so we still need to use the HP filter method to separate the trend components from periodical components. Assuming that P_TC is the economic time series containing the trend components and periodical components, Trend is the trend component, and Cycle is the periodic component, then P_TC = Trend + Cycle[6]. Through the HP filter decomposition after seasonal adjustment of pork price, the trend components we derive show that in the period 2002 –2011, the price of pork showed a gradual upward trend in Beijing City (Fig. 6).

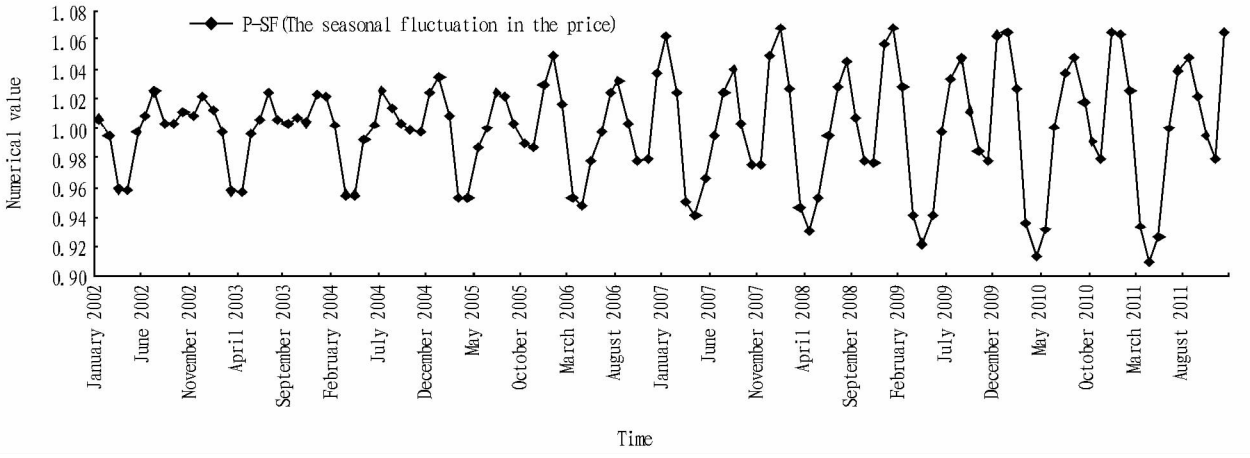
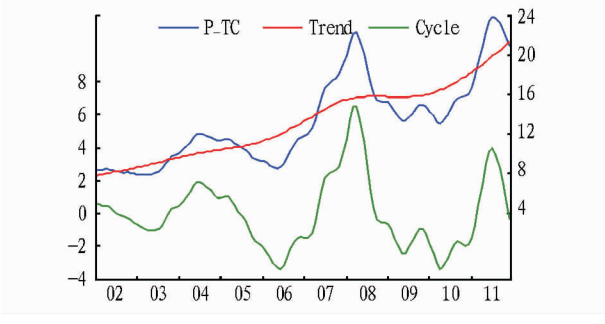


Fig. 5 Seasonal fluctuation in the price of pork in Beijing City



Note: This figure is from the analysis results of Eviews 5.0.

Fig. 6 The trend sequence and cycle sequence of price of pork in Beijing City during the period 2002 –2011

4.3.2 Identification of the fluctuation cycle. For the identification of the fluctuation cycle, we only need to research the periodical component (Cycle) derived using the HP filter method. After eliminating the trend components, we get Fig. 7.

In accordance with the law that three zero value points are one fluctuation cycle, we determine the fluctuation cycle of price of pork, irrespective of the small oscillation in some period. A complete fluctuation cycle includes four stages (depression, recovery, prosperity and recession)[1]. In the period of recession, the price declines, after it is down to the trough, the period of recovery comes; then the price rises, entering into the period of prosperity; after the price rises to the highest point, the price begins to fall, into the period of recession.

From Fig. 7, we can find that during the period 2002 – 2011, the fluctuation in the monthly price of pork in Beijing City tended to increase, roughly experiencing three full fluctuation cycles, the duration of each cycle of 38 months. Thus it can be inferred that the monthly price of pork in Beijing City fluctuates roughly with 38 months as a cycle.

(i) The first phase (July 2002 – August 2005): The price of pork fluctuated slightly around 9.89 yuan per kilogram.

(ii) The second phase (September 2005 – October 2010): The price of pork was 13.97 yuan per kilogram on the average, with the standard deviation of 4.54, and the fluctuation was significantly increased.

(iii) The third phase (November 2008-december 2011): The fluctuation in the price of pork decreased slightly compared to the previous phase; the price of pork is 16.79 yuan per kilogram on the average, increasing by 69.8% over the previous phase (Table 3).

From the duration of price in the crest period and trough period, the duration of price of pork in Beijing City in the trough period is gradually extended, the duration is 16 months, 21 months and 28 months, respectively; in the crest period, the

duration is gradually reduced, the duration is 21 months, 18 months and 10 months, respectively. This shows that with increased fluctuation in the price of pork, the duration of the depression period and recovery period of pork market in Beijing City is gradually extended; the duration of the prosperity period and recession period of pork market in Beijing City is reduced.

Table 3 Stage indicators of fluctuation in the price of pork in Beijing City during the period 2002 – 2011

Stage	Time	Mean	Standard deviation	Crest	Peak value	Trough	Trough value	Frequency of observation
1	July 2002 – August 2005	9.89	1.57	July 2004	12.25	April 2003	7.58	38
2	September 2005 – October 2008	13.97	4.57	February 2008	21.61	April 2006	8.22	38
3	November 2008 – 2011 December	16.79	2.01	July 2011	24.83	April 2010	11.92	38

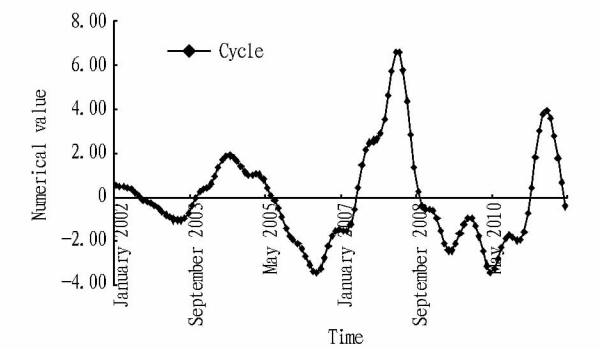


Fig.7 Division of fluctuation cycle of price of pork in Beijing City

5 Analysis of the relationship between the amount of pork for sale and variation in the price

The amount of pork for sale, feed costs, pig production cycle, the level of large-scale breeding, pig disease, and macro-environmental changes, all can affect the ups and downs of the price of pork to a certain extent[7]. Among them, pig production cycle, the level of large-scale breeding and pig disease, can also exert impact on the pork amount of pork for sale. The amount of pork for sale will have a effect on the price to a certain extent. The analysis of the annual amount of pork for sale and the price changes shows that the pork within the year is basically inversely correlated with the amount of pork for sale.

In terms of the trend of average ten-day price and ten-day amount of pork for sale, from the 1st to 36th ten-day, the growth rate of price of pork is 9.7%, with average ten-day growth rate of 0.3%; the growth rate of amount of pork for sale is 27.4%, with average ten-day growth rate of 0.7%. It indicates that the average ten-day growth rate of price of pork is lower than that of amount of pork for sale, that is, the pork amount of pork for sale can inhibit the rise in price to a certain extent.

From Fig.8, the amount of pork for sale is basically reversely correlated with the crest and trough period of prices. Removing the impact of Spring Festival in January and February (During the Spring Festival period, part of the markets are closed, and the statistics on the amount of pork for sale is incomplete.), in the first five months, the level of amount of pork for sale is high, while the price is in the trough period, and especially from the end of March to early April, the amount of pork for sale is large, and the price of pork drops to the bottom. After June, with the gradual decline in amount of pork for sale, the price of pork begins to rise, and enter into the price peak period. In the crest period, the price of pork still fluctuates along with increase and decrease in the amount of pork for sale, while the fluctuation in the price begins to decrease. It is worth noting that after December, with the New Year's Day, and Spring Festival approaching, the residents' consumer demand is increased, causing concurrent rise in amount of pork for sale and price, both reaching the peak in the year.

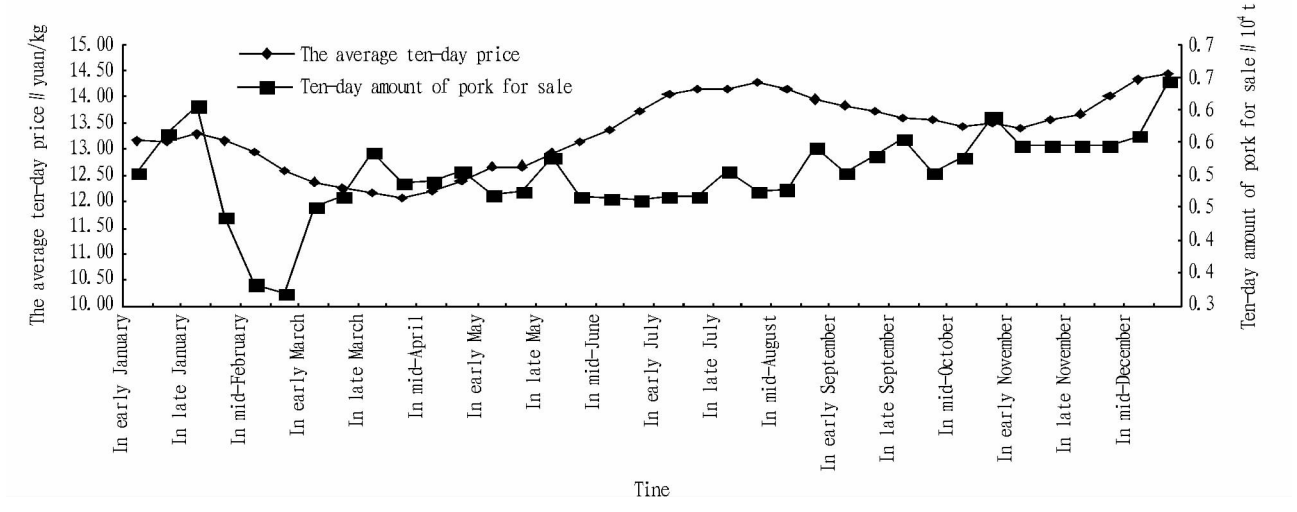


Fig.8 The relationship between the average ten-day amount of pork for sale and variation in the average price

6 Conclusions and recommendations

6.1 Conclusions

According to the monitoring data of the market price of pork in Beijing City, we analyze the changes in the market price of pork in Beijing City and draw the following conclusions:

(i) Basically one fluctuation cycle of pork prices in Beijing is 38 months.

(ii) The price of pork within the year shows a trend of "one trough, one crest", and the amount of pork for sale within the year is basically inversely correlated with the price.

(iii) Festival factors have a certain impact on the amount of pork for sale and pork prices.

During the holiday period of the New Year's Day, the Spring Festival, the Dragon Boat Festival, the Mid-Autumn Festival and the National Day, the pork amount of pork for sale is increased; the high price interval of pork is mainly concentrated after June, and basically the main distribution area of traditional festivals.

6.2 Recommendations

6.2.1 Strengthening the monitoring of pig production and stabilizing the supply of pork. Strengthening pig production and monitoring, and mastering the variation laws in various links of pig production, is an effective measure to ensure the sufficient supply of pig, thereby achieving the stable supply of pork. The pig price, plague, feed, labor costs and sources are four main factors restricting pig production. In order to strengthen the pig market monitoring, we should first strengthen the monitoring of these four factors, master the market price and variation laws, and when there are abnormal market changes, we should research the countermeasures as soon as possible, to ensure stability in pig production.

6.2.2 Strengthening the market supply the pork after June and stabilizing the price of pork. From the change trend of price of pork within the year, we see that the price of pork is high from June to December, and the highest price of the year is also in this period. In addition, the traditional Chinese festivals are mainly distributed in the second half of the year, and the market demand for pork is huge, stimulating the increase in the price of pork to some extent.

Therefore, at this time, we should focus on the adjustment of production, to appropriately improve the level of market supply of pork, especially the pork supply in July – August and November-december.

6.2.3 Strengthening the monitoring of pork market information and improving pork market forecast and early warning mechanism. The monitoring of pork market information is the basis for improving market forecast and early warning of pork. In particular, it is necessary to strengthen the monitoring of dynamic pork market information, establish effective prediction and early warning mechanism, grasp the variation law of the pork market, publish the information of changes in the pork market to the public in a timely manner, and guide enterprises to rationally arrange production. It can prevent the ups and downs in the price of pork to some extent.

7 Discussions

Pork is the most important meat consumer good for urban and rural residents, whose prices changes are always the problem that the producers, consumers and government pay close attention to. However, the great fluctuation in the price of pork in recent years, not only interferes with people's life and economic stability, but also greatly affects the stability in pig enterprises and pig farmers' income. Obviously, the study on the fluctuation law of price of pork can not only provide guidance for the producers' reasonable arrangement for production, but also provide the basis for the government's macro decision making. But there are many factors influencing the fluctuation in the price of pork, not only including factors in the production link, but also including the factors in the circulation and consumption links. Over the years, the scholars have conducted study on the factors influencing the fluctuation in the price of pork, using the theoretical analysis and empirical analysis, respectively.

In terms of the theoretical analysis, Yin Chuanlin and Zhou Bingbing[8] divide the fluctuation in the price of pork into three types (seasonal fluctuation, market fluctuation and proportionality fluctuation), and point out that the false demand arising from the intermediate demand in the circulation often leads to sharp increase and share decrease in the price of pork. The study of Bai Baoli and Liang Yongmei[9] shows that under the functioning of market mechanism, the market demand and supply characteristics of pork are the inevitable reason for cyclical rise in the market price of pork. Hao Zhaoyuan, Zhou Wei, *et al*[10-11] believe that the cyclical rise in the market price of pork is a comprehensive factor, and the most fundamental problem is the contradiction of market demand greater than supply. Zhang Hongwen[7] further states that in addition to the impact of traditional imbalance between supply and demand, the rise in the price of pork is also affected by some objective factors, such as rise in the feed prices, increase in the transportation costs and the animal epidemic situation. The study of Zhang Lei, Wang Na, *et al*[12] shows that the main factors influencing the rise and fall in the price of pork come from the the breeding link of pig, having little to do with the circulation link of pork and pig; it is necessary to stabilize the price of pork, and focus on the breeding of pig.

In terms of the empirical analysis, by analyzing the fluctuation in the price of pork in China, Xiao Bensong, *et al*[13] point out that the biological law of pig production, scale breeding, the market price of various alternatives and complementary products, residents' income, feed prices and other factors are responsible for fluctuation in the price of pork. Xin Xian and Tan Xiangyong[14] estimate the price elasticity of demand for pork, pig production price elasticity, and elasticity of substitution of marketing enterprise, to measure the impact of different factors on the fluctuation in the price of pork. Liu Yun and Wang Yang[15] use the Cobweb Theory to conduct in-depth analysis of the true reason for too high price of pork in China since May 2007, and point out that the lag of the current market economy makes the supply and demand of pork difficult to achieve stable equilibrium, thereby causing fluctuation in the price of pork.

According to the equilibrium transfer model of the price of pork, Yu Yi, Hu Hao, *et al.*[16] conduct empirical analysis of the factors influencing the price of pork, from the elasticity of demand for pork, the elasticity of production, the elasticity of substitution, and marketing enterprises' elasticity of supply. The results show that the supply of pig is affected by the prices of inputs, farming technology, risk, and other factors; the pork consumption is affected by the prices of substitutes, income, population and other factors; the variation in any factor will stimulate the market to generate new equilibrium and cause fluctuation in the prices. From the perspective of industry chain, Guo Lijing , Hu Hao, *et al.*[17] discuss the transmission of the price of pork in the longitudinal related industries, and point out that in order to regulate the pork industry, it is necessary to strengthen the macro-control on the slaughter, wholesale and retail links of pig, and create the mechanism that can make the breeding of pig reach the average profit level of the industry chain.

On the basis of the data concerning the price and amount of pork for sale in Beijing's wholesale markets, this article analyzes the variation in the market price of pork in Beijing City. The results show that the annual price of pork in wholesale markets in Beijing City shows a gradual upward trend; during the period 2002 –2011, the price of pork in Beijing City experienced three full fluctuation cycle, and each fluctuation cycle was roughly 38 months, basically consistent with Han Xiaohu and Huang Daqian's division of the fluctuation cycle of pork price in China[6]; the price of pork within the year shows a trend of " one trough, one crest", and the interval of high prices is mainly concentrated in June-december; the amount of pork for sale within the year is basically inversely correlated with the price.

It is worth noting that the conclusions in this article are based on the analysis of the basic data, giving insufficient consideration to the supply of pig, the purchase price, the retail price of pork, and the factors influencing fluctuation in the price of pork. Therefore, in future work, we should pay attention to the research of the impact of variation in feed and labor costs on the price of pork in Beijing City. Strengthening the price transmission mechanism of wholesale price of pork in the longitudinal related industrial chain, is of great significance to stabilizing the market price of pork in Beijing City as a very large consumer city.

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