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Model to Predict Pork Price Based on Broad Money Supply and Production Cycles in China

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Abstract: The price of pork in China has become the world's most watched economic indicator because it is directly related to the level of inflation, consumption and domestic demand. Therefore, it is significant to establish a proper model of pork price to forecast its future price trends. In this study, based on analyzing the change fluctuation data of the pork price, the Broad Money Supply (M2) and the pig growth cycle in recent 10 years, we establish a new pork price model by using linear regression and residual fitting method. Compared with the real pork price data, the fitting precision of the presented model can be smaller than 1.5%. This pork price model can be used to forecast the future distribution range of pork price in China in the future roughly.

Key words: Price of pork, broad money supply, amount of currency in circulation, linear regression, residual fitting

INTRODUCTION

In China, consumption has accounted for 40% of Gross Domestic Product (GDP), so a direct way to concern the change of consumption level is to focus on the change of the price of main food. The pork is the most popular meat for Chinese, so the pork price has an important effect on the inflation forecast of consumers (Hu *et al.*, 2012). Because of this direct correlation between the pork price and the level of inflation and consumption, the price of pork has been the direction way to measure the inflation and domestic demand in China. As a result, the price of pork has become a key indicator which is concerned mostly by the whole world as the data of employment in America.

Since, the sale system of pork become free in China, the pork price is mostly decided by the market supply and demand and it kept increasing steadily during the cycle fluctuation (Hu *et al.*, 2012; Wu *et al.*, 2011). It has increased from 6 yuan per kilogram in 2000 to 29 yuan per kilogram in 2013. The constant increase of pork price becomes not only the social hot spot but also the problem that people concern mostly. Under the background situation of people's small income rising, the increasing price of pork will account for the decrease of the people's consumption capacity and affect the expansion of the domestic demand and limit the growth of economy.

The constant growth of M2 is one of the factors that lead to the increase of pork price. The speech in the eighteenth National Congress of China put forward that:

The aim that has the GDP and the income of both urban and rural residents in 2010 increased double will be achieved in 2020. But if the amount of currency in circulation increases constantly, the pork price will increase constantly which directly leads to the Consumer Price Index (CPI) increasing greatly. In that way, before the people's income double, the pork will have been regarded as a luxury. Therefore, the regulation should be applied to M2 in order to control the pork price. Only in this way, people consume can be balanced and economy growth be promoted very well.

The nature growth cycle of pig is another important factor that influences the pork price. As for pig production, it has a long growth cycle. It needs nearly 13 months to realize the pork supply process from breeding to market. The government should control this situation. For example, when the pork price is at its trough, the government should offer supply; while at its peak, the government should limit it by policy. All these efforts are to stabilize the pork price which in turn ensures many levels steadily, such as the rising level of people's consumption, the residents' living level and the development level of national economy (Kong *et al.*, 2013).

Therefore, how to forecast the pork price accurately has been becoming an important guiding role to make policies for the government. In this study, a model to predict pork price in China is established by using linear regression method.

ANALYSIS INFLUENCE FACTORS OF PORK PRICE

The change data of pork price and CPI from 2000 to 2012 in China were analyzed in order to obtain the effect of influence factors on the pork price.

Figure 1 shows the fluctuation of pork price from January, 2000-April, 2013 (<http://bj.zhue.com.cn/>). As seen from the data, the pork price was less than 10 yuan from 2000-2006, but it began increasing very fast from 2007 abruptly. The pork price was doubled during this short time. From 2000 to present, the pork price increases linearly and periodically.

Figure 2 shows the change trend of CPI in China from 2000-2012. From Fig. 2 we can observe that CPI in China has been increasing in the recent four years and reach the peak at present (<http://data.eastmoney.com/cjsj/cpi.html>).

Comparing Fig. 1 and 2, we can confer that the fluctuation of pork price is an important factor affecting the change of CPI in China.

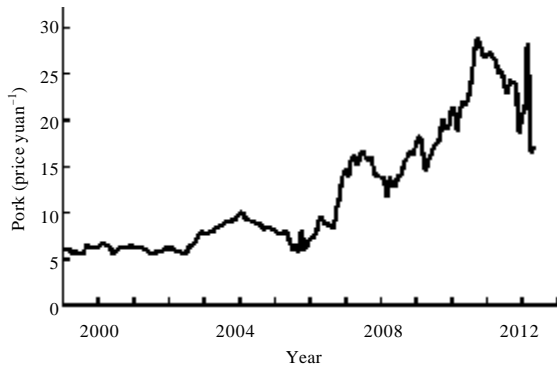


Fig. 1: Fluctuation of pork price from 2000-2013

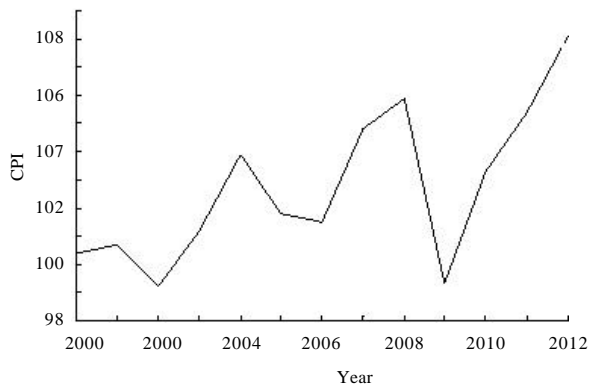


Fig. 2: Trend of CPI in China from 2000-2012

According to the State Statistical Bureau report, food price accounts for 33% of CPI and pork price accounts for 3%. Therefore, the pork price is the main reason reflecting on the level of consumption.

One more important factor affecting the pork price is M2 in China. Although the increase or decrease of pig can directly lead to the increase or decrease of pork price, it is not the main reason. The most important reason leading to the increase of price pork is M2. For the operation of the national economy, money supply has extremely important reference value and it is a major economic regulation mean for government to control economy.

Figure 3 shows the fluctuation trend of M2 in China from 2004-2013 (<http://www.stats.gov.cn>).

From Fig. 3 we can observe that the increase of M2 really has an important influence on the living standards of residents definitely. So, M2 is closely related to the fluctuation of pork price.

MODEL OF PORK PRICE

We will use the regression analysis and residuals of fitting methods to analyze the relationship between pork price, M2 and its production cycle.

Pork price and M2: Figure 4 shows a comparative analysis on the relationship of pork price and M2 from January in 2004 to July in 2012 in China.

From Fig. 5 we can observe that pork price appears a cyclical fluctuation and overall upward trend which is in accordance with the trend of development of M2. So, we can infer that there is a close relationship between pork price and M2. This relationship can be assumed by Eq. (1):

$$f(t) = A(t).sin(\omega t + \varphi) + b_0 + b_1.M_2 \quad (1)$$

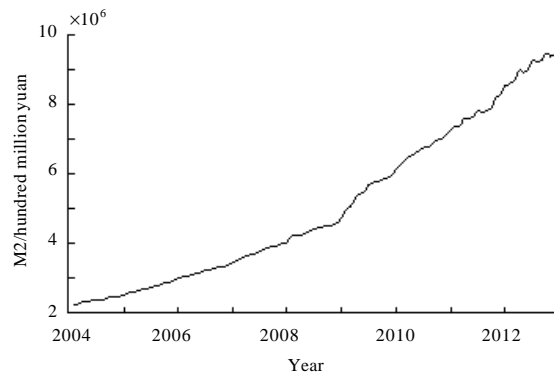


Fig. 3: Fluctuation trend of M2

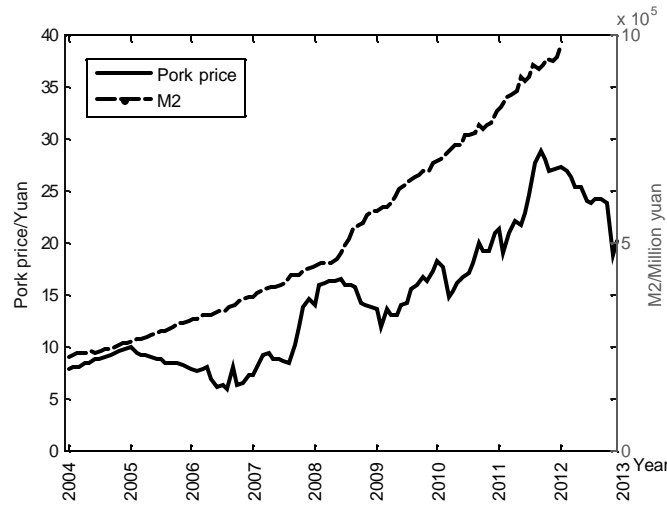


Fig. 4: Relationship between pork price and M2

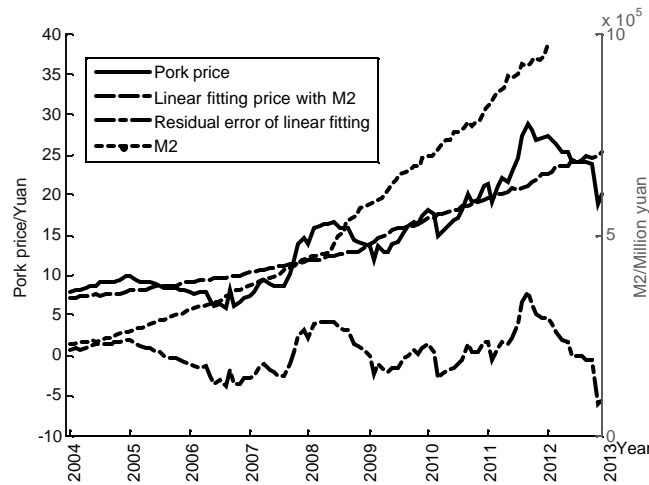


Fig. 5: Linear fit residual z

where, t is time, month; $f(t)$ indicates a fitting pork price, yuan; $A(t)$ is a enveloping line of trigonometric function; M_2 is the broad money supply, billion yuan; b_0 and b_1 are regression coefficients; w is production frequency; φ is initial phase.

In the following parts, we will analyze the relationship between pork price, M2 and production cycle.

Linear relationship between pork price and M2: In this analysis, we just consider the relationship between pork price and M2 without considering the influence of production cycle. The statistical data of the pork price and M2 from January in 2004 to December in 2012 are chosen. By using the linear model, we fit the relationship, as shown in Eq. 2:

$$f_1(t) = 1.6897 + 0.0000355 \cdot M_2 \quad (2)$$

$f_0(t)$ represents the true pork price and $z = f_0(t) - f_1(t)$ represents the residual error of linear fitting with M2. The analysis result is shown in Fig. 5.

Relationship between production cycle and pork price:

We can know that the linear residual error of M2 and pork price can be approximately fitted by a trigonometric function with no mean value. The peak value's coordinate can show that the period of time from the 33 month (September in 2006) to the seventy-five month (March in 2010) can be nearly a time cycle which is about 52 months (3 years and 4 months) and every peak value increases linearly with time. So, it can be expressed as:

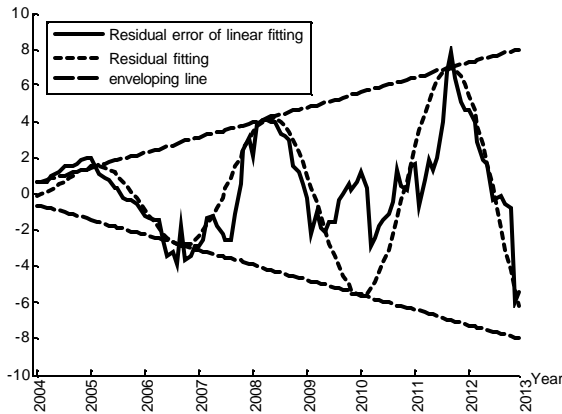


Fig. 6: Fitting error

$$g(t) = (0.0692 \cdot t + 0.55) \cdot \cos\left(\frac{\pi}{20}t - \frac{13}{21}\pi\right) \quad (3)$$

where, $g(t)$ means the fitting error.

By using Eq. 3 and the fitting error of pork price, as shown in Fig. 6.

This trigonometric function with no mean value can fit the linear residual error very well. The part of:

$$\cos\left(\frac{\pi}{20}t - \frac{13}{21}\pi\right)$$

in Eq. 3 represents a conception of production cycle. From Fig. 6, we can know that the production cycle of a pig is about thirteen months by the cycle function fitting.

Pork price model depended on M2 and production cycle:

From the above section analysis, we know that the pork price depends on M2 and production cycle closely. Therefore, from Eq. 3 and 4, we can obtain the relationship:

$$f_2(t) = (0.0692 \cdot t + 0.55) \cdot \cos\left(\frac{\pi}{20}t - \frac{13}{21}\pi\right) + 1.6897 + 0.0000244 \cdot M_2 \quad (4)$$

Figure 7 shows the compared result of fitted pork price curve, by using Eq. 4 and the real pork price curve. From Fig. 7, we know that:

- The fitted pork price is very near the real one in most cases, so the model in Eq. 4 is set up very well
- The fitted pork price is slightly different with the real one in the time from July, 2009 to July, 2010. We can see that the real pork price was higher than the fitting

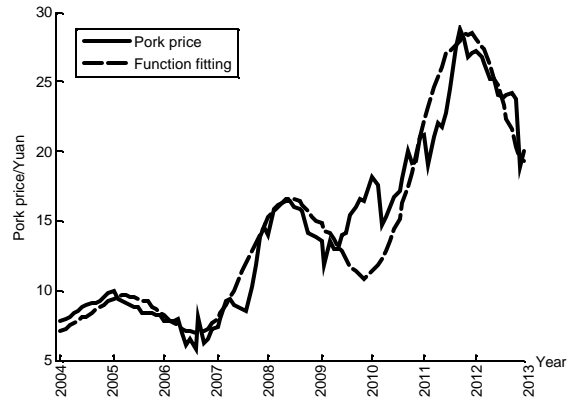


Fig. 7: Comparison of fitted value and real value

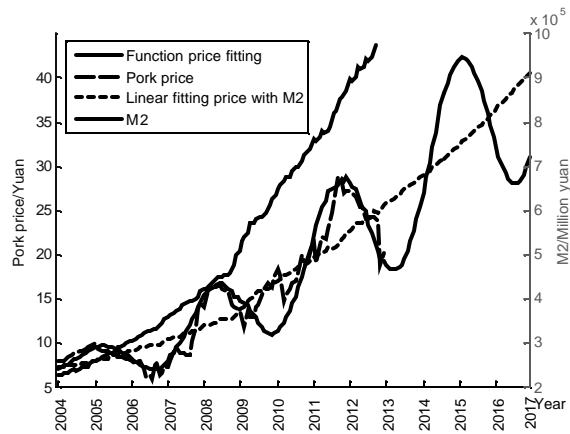


Fig. 8: Prediction of pork price

one. The reason might be the global financial crisis burst in 2008 which caused currency inflation and the increasing of commodity price in this time

PREDICTION OF PORK PRICE

We can learn from the above-mentioned analyses that as long as knowing M2 and production cycle, we are able to predict the pork price in the future.

The departure of currency issuance tells us that money supply of every year is a year-on-year growth of thirteen percent than last year, so we can forecast the money supply in the next four years, from 2013 to 2016, according to recent M2 data and then forecast pork price.

The predicted result of future pork price is shown in Fig. 8.

Because there must be some errors, so the real pork price fluctuates near the fitting curve. We need to find the

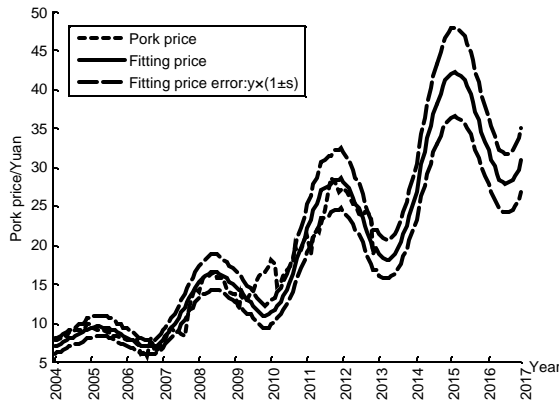


Fig. 9: Fluctuating range of pork price

price fluctuating range that is, we have to find the standard deviation σ of the relative error $[y-f_0(t)]/y$. The fluctuating range of pork price is $f_0(t) \times (1 \pm \sigma)$, shown in Fig. 9.

CONCLUSION

Based on analyzing money supply and pig interior running mechanism in China, we establish a pork price model by using the linear regression and residual analysis methods. By comparing the model value and the actual pork price, we can get the following conclusions:

- The increase of money supply drives the pork price up constantly that is, M2 directly affects the port price and it is a primary factor

- The factor of pig growth and breeding cycle just affects the pork price in short-term
- By combining these two factors, M2 and the growth cycle, we can establish a good model to reflect and forecast the future pork price

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