Decomposition and measurement for conduction and interaction of pig price fluctuation in Guangdong

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Abstract: The price conduction and interaction in the circulation of agricultural products affect the development of the whole swine industry. In recent years, the imbalance between the conduction and interaction of the price of pork has caused the contradiction between residents' consumption and pig breeding enterprises. In this paper, Granger causality test, pulse function test and variance decomposition test were conducted on price fluctuations in the processes of production, wholesale and retail based on VAR model, it was found that the price fluctuation in the production, wholesale and retail of pig market in Guangdong obviously presents the characteristic of “demand driving and the tendency of “cost push” is not statistically significant.

1. Introduction

At present, pig breeding in Guangdong has a large scale and a high degree of intensiveness, with breeding by large enterprises gradually becoming the mainstream in the market. The proportion of large-scale breeding of pigs is up to 86%, being 20% higher than the national average level, and ranking among the top in the country [1]. According to the market structure theory, as pig breeding in Guangdong has presented the large-scale intensive development trend, and large breeding enterprises have become the main market players [2], the cost-driven mechanism of “production-circulation (wholesale)-retail” will inevitably formed. In other words, the rising of breeding cost will inevitably result in the rising of price during circulation and retailing [3]. In the respect of pork circulation, the proportion of pork circulating from the wholesale market to the retail market accounts for over 90%, while that of the pork directly sold from the pig breeding enterprises to the pork retail market accounts...
for less than 10%. In addition, only a small amount of pork from Guangdong Yihao Pig Co., Ltd. and WENS Group, etc. is circulating through such direct selling modes as independent production and marketing, and farm-supermarket cooperation; moreover, the degree of self-sufficiency of pork in Guangdong is only 60%, with the remaining part being allocated and transported from other places.

[4] The above two factors directly make pig breeding enterprises in Guangdong be confronted with a highly competitive external market. Based on the market structure theory, the highly competitive external market will greatly weaken the breeding enterprises’ control ability on the retail market price, thus forming the demand-driven mechanism of “retail-circulation (wholesale)-production”. That is, as the pork price fluctuates ((drops in particular), enterprises can only accept the price transferred to the production link due to their weak ability of controlling the market price. Moreover, pig breeding enterprises have strong monopoly power on the breeding market, which will inevitably lead to depression of price of breeding materials by breeding enterprises and finally subject the price of breeding materials to a downward trend [5-12].

2. Framework for analysis of conduction and interaction of pig price fluctuation in Guangdong

The large-scale production and large market of pigs in Guangdong directly result in two completely opposite mechanisms of action: "production-circulation (wholesale)-retail" cost-driven mechanism and "retail-circulation (wholesale)-production" demand-driven mechanism. The superiority between the two will directly determine the price conduction and interaction of “production-wholesale-circulation”. To study this problem in depth, VAR model and its related theories are used in this paper to conduct empirical analysis on price conduction and interaction among the production, wholesale and retail links of the pig market in Guangdong, which is based on the monthly evidence of pork in Guangdong from 2012 to 2015, trying to reveal the economic mechanism of price conduction and interaction among the production, wholesale and retail links. The VAR model is composed of benefit change (cost) during production, benefit change during wholesale (wp) and benefit change during retail (rp), with the specific form as below:

\[ Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_k Y_{t-k} + u_t \]

Among them, \( Y_t=(\text{cost}, \ wp, \ rp)^T \), \( A_0 \) is a constant item, \( K \) is the delay order number, the specific data need to be determined according to the Lag Order selection criteria table. The test methods for determining the delay order number are: Likelihood ratio test, AIC information criterion and SC information criterion.

3. Variable selection and data analysis

As the feed cost accounts for over 70% of the pig breeding cost, and corn cost accounts for over 60%-70% of the feed cost [5], in light of data availability and representativeness, change in the transaction price of corn in Guangdong ports is considered as the benefit change during production; change in the marketing price of live pigs is considered as the benefit change during wholesale; change in the price of the skinless bone-in pork is considered as the benefit change during retail. The time span for the data is from November 2012 to June 2015. Unit root test is required in this paper in order to test the stability of each variable data. The most common ADF test is used herein. Differential treatment will be made if this variable data is not stable, then unit root test will be performed until it
becomes stable (see Table 1), and then descriptive statistical analysis will be performed on the stable data obtained (see Table 2). Finally, quantitative analysis will be made.

Table 1. ADF unit root test for price change data during production, wholesale and retail.

| Variable | COST (Benefit change during production) | RP (Benefit change during retail) | WP (Benefit change during wholesale) |
|----------|----------------------------------------|-----------------------------------|--------------------------------------|
| ADF test t value (concomitant probability p) | -7.2866 (0.0000)** | -3.9928 (0.0045)** | -3.5830 (0.0123)** |

Note: *** indicates 1% significance level; ** indicates 5% significance level; * indicates 10% significance level.

Table 2. Statistic analysis on price change during production, wholesale and retail.

| Variable | COST (Benefit change during production) | RP (Benefit change during retail) | WP (Benefit change during wholesale) |
|----------|----------------------------------------|-----------------------------------|--------------------------------------|
| Mean     | 0.0094                                 | 0.0109                            | 0.0079                               |
| Median   | 0.0031                                 | 0.0067                            | 0.0048                               |
| Maximum  | 0.0871                                 | 0.1055                            | 0.1509                               |
| Minimum  | -0.0546                                | -0.0721                           | -0.1380                              |
| Std.Dev. | 0.0278                                 | 0.0410                            | 0.0584                               |
| Skewness | 0.2403                                 | 0.5211                            | 0.2800                               |
| Kurtosis | 3.8514                                 | 3.1826                            | 3.8901                               |
| Observations | 31                                    | 31                                | 31                                   |

4. Granger causality test based on VAR model

Results of the Granger causality test show that, under the 1% significance level, price change during retail process is the change in the production cost; under the 10% significance level, price change during retail is the Granger causality of the price change during wholesale; under the 1% significance level, price change during wholesale is the price change during production. This indicates that the interaction strength of the demand-driven mechanism is greater than that of the cost-driven mechanism, in other words, price fluctuation during retail will affect the price during wholesale, and price fluctuation during wholesale will further affect pricing during production.

Table 3. Results of granger causality test based on VAR model.

| Parameter | Cost   | WP     | RP     |
|-----------|--------|--------|--------|
| Cost      | —      | 2.9506 | 22.5944 |
|           |        | (0.0625)* | (0.0000)*** |
5. Test of impulse response function based on VAR model

Under the impulse of one standard deviation in the price fluctuation during retail, a positive response of 0.031 is generated on itself within the first month, and the accumulative response amplitude reaches 0.048 within 6 months; the accumulative response to the price fluctuation during wholesale is a positive response of 0.035 in the first month, and the accumulative response is a positive response of 0.053 within 6 months; the accumulative response to the price fluctuation during production is a positive response of 0.0019 in the first month, but it turns to be a negative response of 0.0017 in the second month, and the accumulative response is a negative response of 0.0021 within 6 months. From the “demand driving” perspective, the rise of retail price leads to significant rise in the wholesale price and thus raises the breeding cost obviously at the initial stage. This fully reflects the very obvious “demand-driven” mechanism in the pig market in Guangdong, which is completely consistent with results of the Granger causality test.

| WP      | 0.6675  | —     | 2.7192 |
|---------|---------|-------|--------|
|         | (0.4139)|       | (0.0898)* |
| RP      | 1.4872  | 0.8665| —      |
|         | (0.2226)| (0.3519)|         |

Note: *** indicates 1% significance level; ** indicates 5% significance level; * indicates 10% significance level.

Figure 1. Impact of price change during retail on itself and on price change during production and wholesale.

Under the impulse of one standard deviation in the price fluctuation during wholesale, a positive response of 0.042 is generated on itself within the first month, and the accumulative response amplitude reaches 0.071 within 6 months; the accumulative response to the price fluctuation during retail is a positive response of 0.026 in the second month, and the accumulative response is a positive response of 0.033 within 6 months; the accumulative response to the price fluctuation during production is a positive response of 0.0019 in the first month, its intensity drops gradually in the second month and it turns to a positive response of 0.0054 in the third month, and the accumulative response is a positive response of 0.0061 within 6 months. From the “intermediate diffusion”
perspective, on the one hand, rise in the wholesale price will cause the rise in the retail price, which tends to be stable very rapidly; on the other hand, the breeding cost will also take on a trend of significant rise.

\[\text{Accumulated Response of RP to WP} \quad \text{Accumulated Response of WP to WP} \quad \text{Accumulated Response of COST to WP}\]

Figure 2. Impact of price change during wholesale on itself and on change during retail and production.

Under the impulse of one standard deviation in the price fluctuation during production, a positive response of 0.026 is generated on itself within the first month; the accumulative response amplitude drops significantly in the second month, being 0.017; the accumulative response amplitude within 6 months reaches 0.020. The accumulative response to the price fluctuation during wholesale is a negative response of 0.014 in the second month, and the accumulative response is a negative response of 0.017 within 6 months. The accumulative response to the benefit fluctuation during retail is a negative response of 0.012 within 6 months. From the “cost driving” perspective, with the rise of breeding cost, there is no positive growth in both the prices during wholesale and retail; instead, there are negative changes. All of these indicate that the “cost-driven” mechanism in the pig market in Guangdong is not so obvious.

\[\text{Accumulated Response to Cholesky One S.D. Innovations ± 2 S.E.}\]

Figure 3. Impact of price change during production on itself and on benefit change during wholesale and retail.

6. Conclusions and Suggestions
Based on the above three analyses, it can be concluded that price change fluctuation during retail is relatively independent, subject to certain (but not obvious) influence from the wholesale and almost no
influence from the production; price change during wholesale is greatly affected by the retail (approximately 40%), subject to almost no influence from the production; price change during production is significantly affected by the wholesale (approximately 40%), subject to little influence from the retail. This fully reflects that there is very obvious “demand-driven” mechanism, rather than “cost-driven” mechanism, in the pig market in Guangdong, indicating that price fluctuation during production, wholesale and retail of the pig market in Guangdong is remarkably characterized by being “demand-driven” instead of “cost-driven”.

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