The Analysis of the Vegetables' Price Fluctuation with Cobweb Model

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Abstract

The fluctuation of vegetable prices is normal in the market economy. The level of the price and the fluctuation not only has a significant influence on farmers and consumers, but a reasonable and stable price also has an irreplaceable effect on the safe running of the vegetable market. On the basis of the cobweb model, this article makes an analysis of vegetable prices, and puts forwards the responding strategies and measures for guaranteeing the supply of the vegetable market and reducing the severe fluctuation of the prices, so as to provide a theory basis for the macro control of the vegetable market.

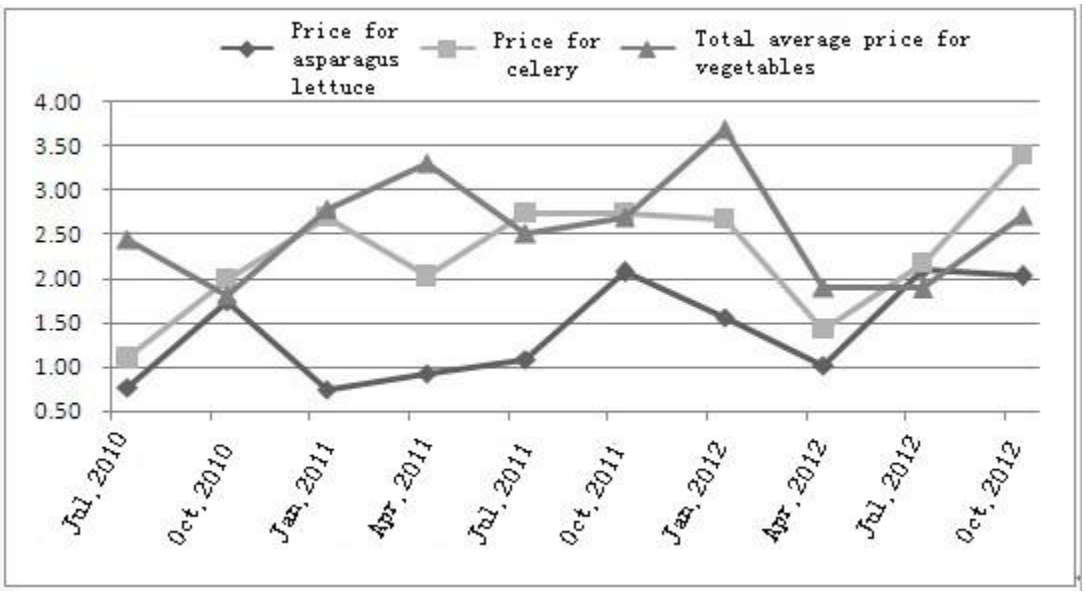
Keywords: Vegetable Prices; Cobweb Model; Price Fluctuation

1 Introduction

As vegetable is one of the most important consumer goods for residents, the fluctuation of the prices has a direct impact on people's daily life. Especially in recent years, the continuous increase in vegetable prices has drawn much attention from the government as well as the people. Data from the rural work committee of the Sichuan Provincial Party Committee of CPC demonstrates that the vegetable price in Chengdu has been on the rise. During the years from 2006 to 2010, the increase was 7.5%、2.1%、3.4%、39.6% and 9.9% respectively. The year of 2011 was special due to the similar climate situations of the north and south. The local vegetable and nonlocal vegetables were almost on the market at the same time. This caused the price to go down for several months in a row, and finally the vegetable price of the whole year went down by 5.6%. The monitoring demonstrates that the comprehensive average price of vegetables increased from 3.17RMB/kg to 4.96RMB/kg in 2011. The highest appeared in 2010, and it was 5.33RMB/kg. Calculation shows that from 2006 to 2011, the vegetable price in Chengdu increased by 64% accumulatively. And from the survey and research from vegetable's standardized technology demonstration park of Mengyang, Peng Zhou and Sichuan international

agriculture products trade center, we obtained the big picture of the price change for asparagus lettuce, celery and vegetable's total average price. See Chart 1-1.

Chart 1-1 The Vegetables Price Change in Chengdu Unit: RMB yuan/kg



Note: data from Chengdu Agriculture Information website
http://www.cdagri.gov.cn/index.aspx

Many scholars have conducted deep research in the rise of vegetable price. Ximing Zhang(1997) points out that the increase of the vegetable price are due to two reasons. First, it is because of the change of the production cost and planting structure. The other reason is that the market and circulation is more open after the vegetable price becomes open. Yu Shao (2011) thinks that the high price of the vegetables are resulted from the following reasons. The local supply of vegetable is not enough, therefore more work in market and circulation is needed. And the rise of production cost. Other scholars conduct research in the relationship between the vegetable supply and the responding price. As one of them, Li Suoping(2006) thinks that the vegetables can reflect the price to a very large extent and the price of vegetables last year played an important role in the production decision of this year.

In this thesis, the author will put forward some suggestions on how to control the planting area of vegetables and break through the dilemma by analyzing the relation between vegetables production and the prices with the help of the traditional cobweb model.

2. Introduction to the cobweb theory

2.1 Synopsis of the Cobweb Theory

The cobweb theory is one kind of dynamic balance analysis the western economists carried on in 1930s according to whether the equilibrium state is stable or not. In the theory taking the factor of temporal variation into consideration, after examining the interactions of the demands, supply volumes and the prices during different period, the relevant persons can discuss the actual undulation process and results of the output and price of such commodities with comparatively longer production cycle as agricultural products and products of animal husbandry after deviating from the equilibrium state.

Combining the market equilibrium theory and elasticity theory, the cobweb theory then involves examinations of the change in the market price and the yield, namely using the law of demand and supply to explain the repeatedly variation of the price and yield and impact on each other when the demand and supply of some commodities with long production cycle become imbalanced. The main products studied in the cobweb theory need a long production cycle from the manufacturing to its appearing in the market. Furthermore, once the scale of production is ascertained, it can't be changed on half-way until the manufacturing process finishes. And consequently the variation of the market price can just affect the output in the following cycle. Also the output this cycle depends on the price last cycle and in the same way the price this cycle will decide the output next cycle.

2.2 Types of the Model

(1) Convergent cobweb

When the elasticity of supply is less than that of demand ($E_s < E_d$), the extent of effect of the change in the market price on supply volumes will be less than that on demand. In this case, the effect of price fluctuation on the output will be increasingly weak and the fluctuation range of the price and yield will be smaller and smaller ultimately towards equilibrium spontaneously. Reflected in the graphics, it will be a cobweb with contraction inward and convergence in equilibrium point, and hence named convergent cobweb. See in figure 2-1.

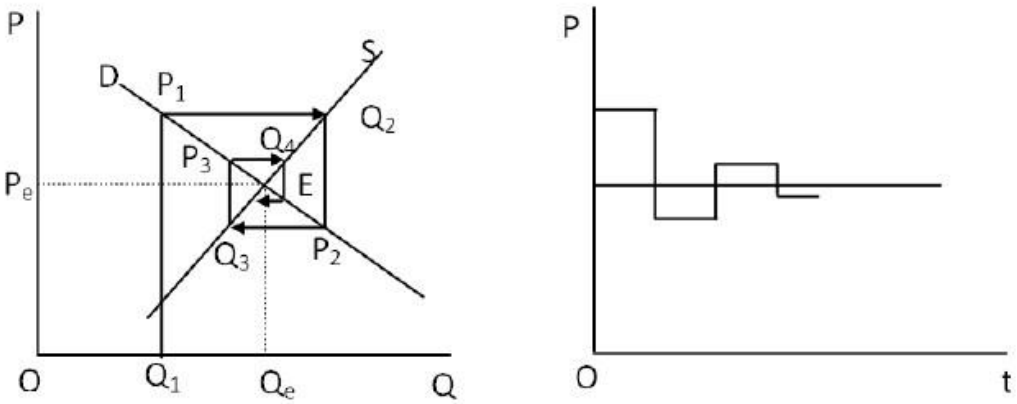


Fig.2-1 Convergent Cobweb Model

(2) Divergent cobweb

When the elasticity of supply is greater than that of demand ($E_s < E_d$), the extent of effect of the change in the market price on supply volumes will be larger than that on demand. In this case, the effect of price fluctuation on the output will be increasingly strong and the fluctuation range of the price and yield will be greater and greater ultimately farther and farther from the equilibrium point. Reflected in the graphics, it will be a cobweb spreading out and far from the equilibrium point, and therefore called divergent cobweb. See in figure 2-2.

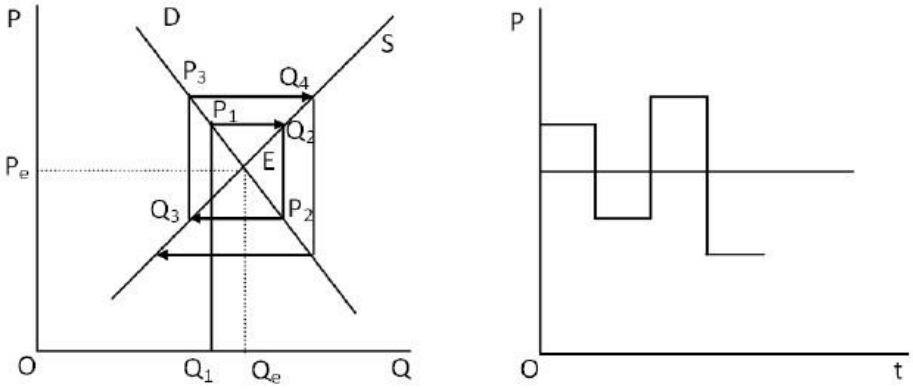
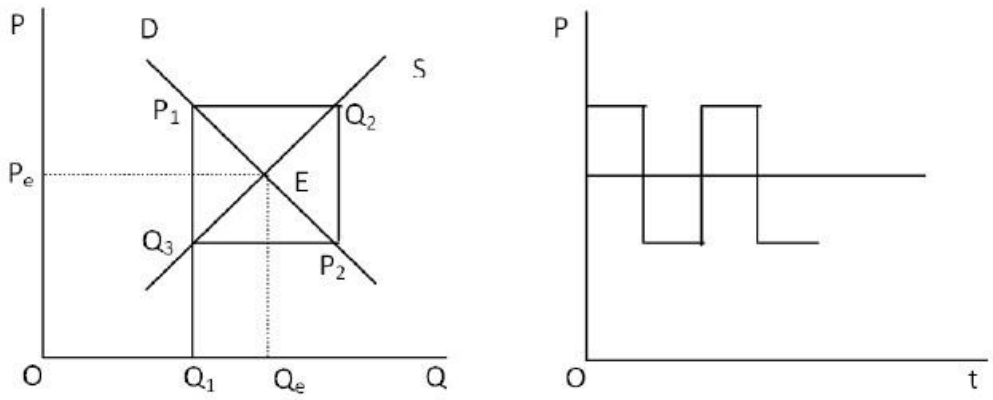


Fig.2-2 Divergent Cobweb Model

(3) Enclosed cobweb

When supply elasticity is less than demand elasticity ($E_s = E_d$), the influence of market price development on supply quantity is equal to that on demand quantity. On this occasion, the price and volume of production undergo the same fluctuation, neither close to the equilibrium point, nor far away from it. Price and production keep fluctuating around the equilibrium point in endless loop. As reflected in the picture, it forms a cobweb end to end, namely, the enclosed cobweb, see picture 2-3.



Picture 2-3 model of enclosed cobweb

2.3 Analysis of Enclosed Cobweb

There are two hypotheses of cobweb model: (1) the current production of certain product depends on its earlier price P_{t-1}, i.e. the supply function $Q_t^s = f(P_{t-1})$; (2) the current demand quantity of certain product depends on its current price, i.e. the demand function $Q_t^d = f(P_t)$. According to the hypotheses mentioned above, a cobweb model can be presented with the three following simultaneous equations:

$$Q_t^d = \alpha - \beta \cdot P_t$$
$$Q_t^s = -\delta + \gamma \cdot P_{t-1}$$
$$Q_t^d = Q_t^s$$

Within which, all α, β, δ and γare constants and positive numbers. Once time variable introduced into it, the cobweb model turns into dynamic one.

The traditional cobweb model is equivalent to $\alpha - \beta P_t = -\delta + \gamma P_{t-1}$ (1)

i.e. $P_t = \left(-\frac{\gamma}{\beta}\right) P_{t-1} + \frac{\alpha+\delta}{\beta}$, then the product price over the period t can be interpreted as this:

$$P_t = \left(-\frac{\gamma}{\beta}\right) P_{t-1} + \frac{\alpha+\delta}{\beta} = \left(-\frac{\gamma}{\beta}\right)\left[\left(-\frac{\gamma}{\beta}\right) P_{t-2} + \frac{\alpha+\delta}{\beta}\right] + \frac{\alpha+\delta}{\beta} = \left(-\frac{\gamma}{\beta}\right)^2 P_{t-2} + \frac{\alpha+\delta}{\beta}\left(1 - \frac{\gamma}{\beta}\right) = \cdots\cdots =$$
$$\left(-\frac{\gamma}{\beta}\right)^t P_0 + \frac{\alpha+\delta}{\beta}\left[1 + \left(-\frac{\gamma}{\beta}\right) + \left(-\frac{\gamma}{\beta}\right)^2 + \cdots\cdots \left(-\frac{\gamma}{\beta}\right)^{t-1}\right] = \left(-\frac{\gamma}{\beta}\right)^t P_0 + \frac{\alpha+\delta}{\beta} \cdot \frac{\left(-\frac{\gamma}{\beta}\right)^t - 1}{\left(-\frac{\gamma}{\beta}\right) - 1} = \left(-\frac{\gamma}{\beta}\right)^t P_0 +$$
$$\frac{\alpha+\delta}{\beta+\gamma}\left[1 - \left(-\frac{\gamma}{\beta}\right)^t\right]$$

(2)

Since the equilibrium price is $P_e = P_t = p_{t-1}$ at the market equilibrium, the equilibrium price can be derived from function (1): $P_e = \frac{\alpha+\delta}{\beta+\gamma}$. (3)

Substitute function (3) into function (2) and we can get:

$$P_t = (-\frac{\gamma}{\beta})^t P_0 + P_e\left[1 - \left(-\frac{\gamma}{\beta}\right)^t\right] = (P_0 - P_e)(-\frac{\gamma}{\beta})^t + P_e \qquad (4)$$

And three cases emerge as we analyze function (4):

Case one: when $t \to \infty$, if $\frac{\gamma}{\beta} < 1$, then $P_t \to P_e$. This indicates that if $\gamma < \beta$, as the time t goes on, the true price P_t will move around the equilibrium price P_e in ever-reducing range and finally approach the equilibrium price.

Case two: when $t \to \infty$, if $\frac{\gamma}{\beta} > 1$, then $P_t \to \infty$. This indicates that if $\gamma > \beta$, as the time t goes on, the true price p_t will move around the equilibrium price P_e in ever-growing range and finally endlessly deviate the equilibrium price. Thus it can be seen that allowing the market to adjust the vegetable production all alone will lead to both vegetable price and production deviating from the equilibrium price. And on the part of vegetable growers, the tremendous annual price fluctuation can result in frequent emergences of "the vegetable sales harming vegetable growers".

Case three: when $t \to \infty$, if $\frac{\gamma}{\beta} = 1$, then p_t is a constant. This indicates that if $\gamma = \beta$, as the time t goes on, the true price p_t will move around the equilibrium price P_e in the same range, neither further deviating nor approaching the equilibrium price.

The total average vegetable price in Chengdu in Picture 1-1shows: both the vegetable price in Chengdu rising and dropping suddenly and sharply and the vegetable breeding stock changing radically have deviated far away from the "equilibrium level", and the overall fluctuation tends towards an enclosed cobweb one.

3. Strategies and Proposals

Under some assumptions, the article, basing on the theoretical analysis of cobweb model, proclaims the law of market economy within a certain scope. The law require producer to keep a watchful eyes on the real prices in previous period when it comes to the quantity of product; Secondly, avoid blind expansion of production in the next production just for the price of product is higher than equilibrium price; Thirdly, carefully study relations between price changes and production scale, properly analyze price trend in market, and then rationally make decisions on production scale. Nevertheless, it still won't work to overcome the adversity of cobweb by simply relying on vegetable growers' response of to the market, and government department is

needed to give guidance on the matter, so relevant government department shall give guidance from the following aspects:

3.1 Actively promote the systematic construction of the circulation of vegetable plants under the background of urban-rural coordination.

The biggest constraint is logistics system in the market system of vegetable production and marketing. Therefore, it is a better channel to decrease the price of vegetables by strengthening the logistics system construction of vegetable. The construction involves two aspects: one is the of farm products, the other is the means of production of vegetable's popularity in countries. Establish the bidirection circulation system of "connecting urban to accelerate vegetable plants marketing in cities, and connect the countryside for means of production to it" through network integration, supermarket improvements, chain-store operation, logistic distribution improvements, etc.

(1) Facilitate vegetable plants go into town; positively explore the docking mechanism of supermarkets and countryside.

Key to the settlement of vegetable circulation in market is how we ensure the efficient transportation, storing and marketing of vegetable plants in towns. Only by linking up the production side and consumption side of vegetable circulation together, realizing docking mechanism of supermarkets and countries, decreasing circulation of vegetable, can we relieve the embarrassment of "lower price disappoints vegetable growers, while higher price distresses customers". Therefore, there is a need to actively explore and establish the two following models: "supermarket + cooperatives+ farmers" model for the docking of supermarkets and specialized cooperatives; "supermarket+ leading enterprises+ production base" model for connecting supermarkets and agriculture leading enterprises.

(2) Actively implement measures to promote relevant consumption goods on vegetable production go into towns, establish agricultural supermarket.

With the constantly rise of the price of agricultural production materials, the huge investment of Agricultural Materials is constantly encroaching on the profit space of vegetable planting and production. To ensure the stable price and production of vegetable ,we must solve the countryside circulation system construction of seeds, fertilizer, and farm machinery, and many other consumables related to vegetable production; construct agricultural market; reduce the cost and investment of vegetable production by using scientific and convenient, high efficient

and intensive methods to ensure a orderly and stable development of the scale of vegetable planting.

(3) Develop modern logistic and facilitate the circulation of agricultural products

The successful operate of agricultural products circulation need the support of excellent modern logistics infrastructure. The modern logistics base of agricultural products circulation includes: the construction of agricultural products wholesale market, the storage of agricultural products, the transportation condition, and transport machine and other facilities construction, and so on. And the matched comprehensive transportation network should be constructed as soon as possible by constructing roads, improving the storage methods, developing agricultural products processing and distribution center. Perfect warehousing and distribution facilitation, and advanced information network platform provide important material basic condition for the development of modern logistics.

3.2 Actualizing the diversification and differentiation of production vegetable products, and increasing the market value of agricultural products.

On the one hand, with the growth in the living standard, the demand of vegetable products becomes more diversified and high-end. On the other hand, vegetable products are very seasonal and alternative products. Therefore, we should make out corresponding strategy of product differentiation in accordance with the preference in the market to increase the value of agricultural products.

(1) Establishing the quality standard system, producing healthy and organic vegetable products.

We should strengthen monitoring of the vegetable quality and safety, and construct the vegetable production base which is pollution-free, healthy and organic. On the basis of the guidance to Standardized production, we should set up the authentication of safety agricultural products origin; set the stage for implementing the vegetable market access and establishing exported-oriented vegetable industry; and promote the standardization and institutionalization of vegetable quality standard system.

(2) Developing brand advantage, applying for registering brand-name products and opening up high-end consumption market.

Vegetable grower and planting enterprise should pay attention to the construction of introduction, cultivation, planting and processing capability of high-end vegetable

products and high value-added vegetable products, develop its own brand advantage then make it occupy the high-end consumption market. They should develop their specialty by brand development to avoid the convergence of vegetable products and to develop the production mode of diversification and differentiation, and to increase the additional value of agricultural products.

3.3 Strengthening the construction of the rural cooperative organization management, and establishing an effective vegetable production market system.

Farmers unify the production, processing and marketing of vegetables to realize the unification of "production, processing, marketing" integration through the establishment of their own cooperation organization. Farmers is the producers as well as the vendors. It can greatly reduce the cost of vegetable products circulation, and vegetable growers can share the profits of rising prices of vegetables.

(1) Improving the overall level of rural cooperative organizations, and regulating the rural professional cooperation organization operation mechanism.

Although vegetable industry has formed some special organizations, there are still some difficulties in financing, lack of talents and the operation mechanism is not perfect and so on. Governments at all levels should give increasingly support to the rural cooperation organization and strengthen the function of organizing manufacture, connect between leading enterprises and farmers, big market and farmers, and further innovate "leading enterprises plus special joint organization plus farmer", "farmers plus marketing agent plus market" business model according to preferential investment be and financing policies to improve the organization of production.

（2）The government supporting vegetable trading market information and large-scale construction.

First, speeding up information construction. Establishing a dedicated website for vegetable marketing in order to provide timely, accurate and comprehensive information service. Second, accelerating the construction of origin market. Through scientific planning, actively striving for the superiors and social capital investment in towns and villages and the major producing areas and the construction of key bases market, and constantly improving the storage and fresh-keeping, selection, sorting, packaging and other infrastructure and gradually optimizing origin market circumstances.

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