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Full Length Research Paper

Risk and regulation of emerging price volatility of non-staple agricultural commodity in China

Xin Miao[1]*, Bo Yu[1], Bao Xi[2] and Yan-hong Tang[1]

[1]School of Management, Harbin Institute of Technology, 150001, Harbin, China.
[2]School of Public Administration, Dalian University of Technology, 116024, Dalian, China.

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The development of agriculture penetrated in China's history but recently has to face emerging challenge of drastic price volatility caused by pernicious speculation. The year of 2010 saw drastic price volatility of non-staple agricultural commodities, such as green beans, garlic and ginger, in China's agricultural market. The drastic price volatility brought immense adverse effect to Chinese market expectation and people's daily living, and aroused extensive social concern in China. Speculation and price manipulation emerged from information asymmetry may induce herd behavior under the pressure of high inflation and people's panicky emotion. The related risks were analyzed and suggestions were put forward as to what possible cures are effective countermeasures and what ways may contribute to prevention of emerging price volatility of non-staple agricultural commodity. This paper contributed to identifying risks and vulnerable parts of non-staple agricultural commodity market, and was important for preventing cascading risk effects. It offered a new insight for agricultural market regulation, and contributed to agriculture research as well as market management and public administration. As other developing countries may also face similar problems in their agricultural markets, this paper has potential broad sense and enlightenment.

Key words: Agricultural market regulation, non-staple agricultural commodity, price volatility, risk, speculation, China.

INTRODUCTION

China's agriculture dates from about the 75 centuries B.C., and the history and culture of this richly civilized land are indivisible from its agriculture. Agriculture is always the footstone of supporting the development of the country with the largest population in the world. After joining WTO, China's agricultural market is increasingly improving itself in other to be close to the global agricultural market integration and an open market for overall agricultural products is on its way. However, China's agricultural market still bear some defects such as imperfect market system, market dysfunction, price signal distortion, etc, which make China's agricultural producers and traders face huge market risks, of which the price risk is the main risk (Zhao et al., 2010).

The year of 2010 saw drastic volatility in price of green beans, garlic and ginger in China's agricultural market. Although these non-staple agricultural commodities are not the basic living necessities, the drastic price volatility brought immense adverse effect to Chinese market expectation and people's daily living, and aroused extensive social concern in China. Therefore, it is necessary to analyze the risks of emerging price volatility of non-staple agricultural commodity and improve agricultural market regulation.

Cobweb theorem (Barten and Vanloot, 1996; Bacsi, 1997) may explain the price volatility of non-staple agricultural commodity to a certain extent. Farmers usually determine the planting area for non-staple agricultural commodity according to the former price. This phenomenon is in accordance with the basic assumption of the cobweb model, that is, the current output depends on the former price and the current price determines the current consumption. Non-staple agricultural commodity usually lack demand elasticity., in particular, ginger, garlic, green beans and so on, as they are not the basic living

*Corresponding author. E-mail: miaoxin@hit.edu.cn, miaoxin@yahoo.cn.

necessities, even if their price declines, the consumption of them will not significantly increase; while their price rises, the consumption will not substantially decrease. However, price directly affects farmers' income, and accordingly, production and supply are more sensitive to price. It is difficult to rely solely on market force to achieve stable price equilibrium. Cobweb theorem can partly explain long-term price volatility. However, the complexity and dynamics of the new phenomena in China's agricultural market call for further pondering and studies.

The recent drastic volatility in price of non-staple agricultural commodity in China is mostly related to speculation and price manipulation. The character of non-staple agricultural commodity makes it easy to be manipulated. Severe information asymmetry between farmers and consumers facilitate middlemen hoarding and pushing up price. China lacks large scale planting of non-staple agricultural commodity and scattered planting is the dominant. At the same time, unlike staple agriculture commodity, the main production of non-staple agricultural commodity concentrates in a few areas of China that lead to the production vulnerable to natural disasters. For example, the production of green bean concentrates in the northeastern provinces and Inner Mongolia Autonomous Region of China. Because there was severe drought in the Northeast of China in 2009, the production of green bean reduced by 50%, that is, 13.5 million tons less than that of 2008. The production of garlic concentrates in Shandong, Henan, Jiangsu and Hebei provinces. As low-temperature, scant sunlight, freezing rain and other climate change occurred in the first half of 2010, a substantial decline emerge in the yield of garlic. This became the premise of emerging speculation on non-staple agricultural commodity. Besides, as seasonal product, most non-staple agricultural commodities are collected in the hands of middlemen for most of the time throughout the year. For example, farmers harvest garlic from late May to early June every year in China. Generally, most of the new garlic surge to market and/or warehouses of middlemen from July to August, and middleman can control 70 to 80% of the total garlic output of the year. After August, middlemen have the advantage to manipulate garlic price in market until the harvest of next year. Different from scattered farmers and consumers, middlemen possess a wide market information sources, a strong speculation sense and a solid capital foundation. They tend to use their information superiority to disseminate false information or hide useful information to misdirect farmers and consumers, leading to price volatility and obtaining substantial profit from disordered market.

Meanwhile, the total output of non-staple agricultural commodity is usually relative small and easy to be collected, stored and manipulated by speculative funds. Through supply control, speculator can push up price and obtain huge profit. For example, the Chinese green bean output in 2009 was only 769,000 tons, and if they are calculated with a high price, say 15 thousand CNY per ton, it needs only about 11.5 billion CNY to monopolize the green bean supply of the whole nation. Theoretically, speculators need only several hundred million CNY to hoard the green bean that may cause imbalance between market supply and demand, and thus affect the market price. Nevertheless, in fact, speculators may need much less money to manipulate market price. For example, these speculators hoarded ginger at a low price, and then used some money to buy ginger on the market with a high price. After a few days, ginger price was quickly pushed up. The speculators then immediately sell their product at a high price, cash out, and leave. These speculators often buy at least 2 to 3 kilotons of ginger, and gain a profit of 2 to 3 million CNY (PRNewswire-Asia, 2010).

Speculation is a hot topic in the areas of exchange rate and stock market but seldom draw attention in agriculture research domain. Some articles in agriculture research may be helpful for us to study this topic although they did not directly contribute to analyze and solve the problem. Lapp and Smith (1992) argued that macroeconomic policy, especially monetary policy, affected agricultural commodities' price and variability. Fafchamps (1992) pointed out that food price is volatile in imperfect agricultural market condition and is highly correlated with agricultural output. Smith and Lapp (1993) validated that relative price variability was positively correlated with instability in the macroeconomy. Subervie (2008) indicated that macroeconomic factors (infrastructure, inflation and financial deepening) could influence price volatility of agricultural commodity in developing countries. Jackson et al. (2009) believed that sociological theory would be useful in agricultural price risk analysis.

ANALYSIS OF RISKS AND DYNAMICS

Speculation on agricultural products will bring damage to both farmers and consumers, and will cast enormous risks on China's economy. Firstly, farmers will suffer economic losses. Small-scale agriculture is dominant in China and farmers decide independently what to plant and how much to plant. When farmers saw certain agricultural commodity sold at high price, they will decide to plant this kind of agricultural product. If speculators manipulate the market, price will rocket to unbelievable high level and stimulate farmers' enthusiasm of planting. However, when speculators obtained enough profit and followers increasingly follow in speculators' steps, speculators will rapidly withdraw the hot money, leading to price slump suddenly and entrapping investors and framers. As a result, not only farmers suffered huge economic losses but also the supply and demand pattern and even the production order were distorted. The minor middlemen and speculators became the final winners. While farmers do not have bargaining ability in the

speculative market, they often obtain nothing from the price increase. Secondly, staple agricultural production will be harmed. Price surge will attract a large number of farmers to plant non-staple agricultural product, and accordingly, the planting of staple agricultural product will decrease. Current Chinese law gives farmers the right to plant what they want. However, the profit of planting staple agricultural product is relatively lower than planting non-staple agricultural product. Chinese government adopts protective price for public purchase of staple agricultural products from farmers that can reduce farmers' risks (Tavernier and Onyango, 2008; Chuku and Okoye, 2009; Sadati et al., 2010) in planting staple agricultural product and protect their benefits. Therefore, most of the risk-aversion framers choose to plant staple agricultural product and this is why the output of China's staple agricultural products can be maintained at a relative high level. Planting of non-staple agricultural product is a high risk and high return option. The irrational price rise could break current equilibrium of farmers' choice, and accordingly, strike the planting of staple agricultural product, which relate with people's living. Thirdly, stimulate inflation expectation. Sharp rise in price of non-staple agricultural commodity can also induce people's expectation on inflation, particularly food price increase. As it is well known, China has large population and staple agricultural product has significant meaning to China. Most of Chinese, particularly low-income groups, are sensitive to volatility of staple food price. This character leads to a strong conductivity and amplification with respect to volatility in food price. Drastic rise in price of non-staple agricultural product is likely to induce people's inflation expectation on the entire agricultural market and drive price rise of overall agricultural products in the short term. Consumers have to pay the bill ultimately and become the losers of this price game. This process will damage people's living standard and welfare, and threaten social stability.

We can model the above cascading dynamics by referring to the theory about herd behavior (Lux, 1995; Low, 2000; Helbing and Farkas, 2000). As we know, others' behaviors usually influence the buying behavior of an ordinary consumer. An ordinary consumer, who occupies incomplete information, will tend to imitate others in buying. If he saw others rush to purchase something, he will believe that this commodity must be in short supply and be afraid of price skyrocketing. Accordingly, he will join in the line of panic buying, which will lead to real short of supply. This is the so-called herd behavior. Mathematical model can depict the dynamics.

Let 2N denotes the total number of people. Let n_- denote the number of people who are panicky and incline to buy and n_+ denote the number of people who are calm and unwilling to buy. $n_+ + n_-$ =2N. Let n =0.5$(n_+ - n_-)$ and $x = n/N$, $x \in$ [-1, 1]. If x is equal to zero, it means that the number of the panicky is equal

to the number of the calm. If $x < 0$, the panicky will be the majority. If $x > 0$, the calm will be the majority. If $x = -1$, all people are panicky. If $x = 1$, all people are calm.

In fact, when the panicky people become the overwhelming majority, the calm will follow the panicky; while when the calm are the overwhelming majority, the panicky will follow the calm. Let P_{+-} denote the transfer probability of people from the calm to the panicky and P_{-+} denote transfer probability of people from the panicky to the calm. The distribution of x or n will determine transfer probability, that is,

$$P_{+-} = P_{+-}(x) = P_{+-}(n/N) \quad (1)$$

$$P_{-+} = P_{-+}(x) = P_{-+}(n/N) \quad (2)$$

The above formulas show that all the others will influence one person by the same manner. For simplification, assume that the personal attribute may change only once. The panicky may transform to the calm according to anticipation and vice versa. Further, assuming that everyone has the same probability of change, then, $P_{+-}n_-$ denotes the number of people transferred from panicking to calmness, and $P_{-+}n_+$ denotes the number of people transferred from calmness to panicking. The transfer ratio can be denoted as:

$$dn_+/dt = P_{+-}\ n_- - P_{-+}\ n_+ \quad (3)$$

$$dn_-/dt = P_{-+}\ n_+ - P_{+-}\ n_- \quad (4)$$

Since n =0.5$(n_+ - n_-)$ and $x = n/N$, then

$$\frac{dx}{dt} = \frac{0.5d(n_+ - n_-)}{Ndt} = \frac{1}{2N}\frac{dn_+}{dt} - \frac{1}{2N}(P_{+-}n_- - P_{-+}n_+ - P_{-+}n_+ + P_{+-}n_-) \quad (5)$$

That is:

$$\frac{dx}{dt} = \frac{1}{N}(P_{+-}n_- - P_{-+}n_+) \quad (6)$$

Since $n_+ + n_- = 2N$ and $n_+ - n_- = 2n$, $n_+ = N + n$ and $n_- = N - n$

$$\frac{dx}{dt} = \frac{1}{N}(P_{+-}n_- - P_{-+}n_+) \quad (7)$$
$$= \frac{1}{N}(P_{+-}(N - n) - P_{-+}(N + n)) = (1 - x)P_{+-}(x) - (1 + x)P_{-+}(x)$$

Since P_{+-} >0 and P_{-+} >0

Let $dP_{+-}/P_{+-} = adx$ and $dP_{-+}/P_{-+} = -adx$

Then,

$$P_{+-}(x) = ve^{ax},\ P_{-+}(x) = ve^{-ax} \tag{8}$$

Where, $\alpha \geq 0$ and v denotes the speed of change.

Then, the dynamics of the herd behavior is denoted as:

$$\begin{aligned}\frac{dx}{dt} &= (1-x)ve^{ax} - (1+x)ve^{-ax} \\ &= 2v[sinh(ax) - xcosh(ax)] = 2vcosh(ax)[tanh(ax) - x]\end{aligned} \tag{9}$$

Banerjee (1992) and Bikhchandani et al. (1992) put forward the concept of information cascade. An informational cascade occurs when it is optimal for an individual, having observed the actions of those ahead of him, to follow the behavior of the preceding individual without regard to his own information (Bikhchandani et al., 1992). It can explain the forming, frangibility and randomicity of herd behavior.

By reference to the basic ideas of Bikhchandani et al. (1992), we try to analyze the potential panic buying in China. China's economy is facing severe inflationary pressure, and the proportion of agriculture commodities in the Consumer Price Index (CPI) is on the high side. The roaring inflation is easy to trigger people's panic emotion of buying. A period of out of stock or rise in price will induce emergent behavior paradigm among people that will quickly spread and form social pressure to compel more people to imitate and follow, that is, the emergence of herd behavior.

Every person has two choices, that is, to buy or not to buy, denoted respectively as B and A, and both the probability is 0.5. Let L and H denote the private information. If V=A, individual is more likely to possess the information H; if V=B, individual is more likely to possess the information L. That is:

$$P(X = H \mid V = A) = p \tag{10}$$

$$P(X = H \mid V = B) = 1 - p \tag{11}$$

Where, $0.5 < p < 1$.

Similarly:

$$P(X = L \mid V = B) = p \tag{12}$$

$$P(X = L \mid V = A) = 1 - p \tag{13}$$

In addition to private information, each person can observe all other individuals' behavior before his decision-making.

The first person makes decision according to his own private information. Based on Bayesian formula, if he has private information L, he will choose behavior B. This is because:

$$P(V=B|L) = \frac{P(L|V=B)\times P(V=B)}{P(L|V=B)\times P(V=B) + P(L|V=A)\times P(V=A)} = \frac{p\times 0.5}{p\times 0.5 + (1-p)} > 0.5 \tag{14}$$

The second person makes decision according to his own private information and the behavior of the first person. If his private information is L and he observed the first person had chosen B, he will naturally choose B. If his private information is H, this situation is equivalent to decision-making under contradictory information and the possibility that he will choose A or B is the same.

The third person makes decision according to his own private information and the behavior of the previous two persons. If he observed both of them have chosen B, he will believe that their private information is L. Based on Bayesian formula, even if the third person has private information H, he will still choose B. This is because $P(V = A > 0.5)$ and information cascade of the B will emerge. It can be proved that the occurrence probability is $(1 - p + p^2)$. So, if $|N_A - N_B| \geq 2$, information cascade may emerge and easily lead to herd behavior.

We have known that the actions of preceding individuals can influence the behavior of the followers so that the followers ignore their own information and merely follow suit (Bikhchandani et al., 1992). This is why those speculators can mislead investors and consumers. The cascade dynamics may foresee the potential cascading risks triggered by speculators in a high inflation economy where people are shrouded in the panicky emotion.

DISCUSSION

On 26 May 2010, approved by the State Council of China, the National Development and Reform Commission, Ministry of Commerce, State Administration for Industry and Commerce, jointly issued an emergent official circular titled "strengthen regulation on agricultural market to maintain the normal market order". This document required all local governments and departments to organize and implement immediately to strengthen the supervision on and rectify the order of agricultural market. It required clearly cracking down on hoarding and speculation of agricultural products, and resolutely safeguarding the normal market order and keeping the overall price level stable. This circular also stressed that:

(1) Local governments and relevant departments should

strictly enforce the law, and for the large cases that have serious nature of adverse social impact, make them known to the public and confiscate all illegal income, and impose a fine of five times of the illegal income.
(2) If there is no illegal income to be found, a fine of at most 100 million CNY should be imposed on the speculators.
(3) For those repeated offenders, suspend their business or revoke the business license.
(4) For those seriously disrupt the market economy order and constitute a crime, investigate for criminal responsibility according to law.
(5) Give full play to the role of social supervision, encourage people to report and award whistleblowers once the report is verified.

These measures seem to have produced some success. According to the Xinhua Website of China, the prices of ginger and garlic in some provinces have declined more than 20%. Since mid-November 2010, the national ginger and garlic prices continue to fall, as of 25 December 2010, the cumulative decline amount to 12.0 and 10.2% (Xinhua Website, 2010).

The drastic volatility in price of non-staple agricultural commodity is a new unexpected phenomenon in China with respect to agriculture market, and the country has no previous experience in tackling this problem. China as well as other developing countries should pay attention to this aspect. As the saying goes, prevention is better than cure. Therefore, further improvement should be pondered according to the characteristics of non-staple agricultural commodity market. Viewpoints and suggestions are elaborated as follows:

1. Price volatility of non-staple agricultural commodity reflects relation disorder of not only production and circulation but also organization and economic relation. This means that regulation on price of non-staple agricultural commodity should cover not only production and circulation policies but also relation coordination between production and distribution. This integrated way may be effective in reducing price volatility induced by non-productive factors. Therefore, it is necessary to reshape the supply chain relation and build a vertically integrated supply chain for non-staple agricultural commodity to change the current situation of decentralized planting and business to achieve the scale operation.
2. Strengthen the monitoring and early warning. Set up a more sensitive monitoring and warning system and expand the price monitoring range, not only for staple agriculture commodity, but also for non-staple agricultural commodity. In order to detect the trend of market change in right time and make a quick response, it is necessary to monitor and investigate the market turnover and inventory, and provide an advance warning. Establish early warning mechanism for abnormal fluctuation of agricultural commodity price and improve the pre-arranged planning for abnormal fluctuation of agricultural market price. In the mean time, establish unified market information release platform for agricultural commodities and prices, and enhance information guidance to promote farmers' rational planting and stabilize planting areas. It is seldom to hear the public voice in China, since no institutional facility exists through which farmers and citizens can express their viewpoints and suggestions. However, farmers and citizens are quite likely to be the best monitoring actors and may effectively relay messages on market price or demand-supply relation to the principal reduce circulation cost and avoid information asymmetry.
3. Improve the regulatory policy. It is meaningful to support the local governments in main production regions of non-staple agricultural commodities to establish specific reserve systems so that the country can utilize these systems to counterbalance price volatility in time through storing in the off-season and selling in the peak-season. Regulate import and export, and timely adjust export rebate of not-staple agricultural commodities to stabilize the domestic market price. Encourage scale planting and support distribution system improvement for agricultural commodities. Standardize market access and business entities for agricultural products to reduce distribution cost.

Conclusions

This paper depicted the profile about the new phenomenon of price volatility of non-staple agricultural commodity throughout the year of 2010 in China. It analyzed the potential risk caused by the price volatility and provided a new insight on agricultural market risk regulation. Speculation and price manipulation as we have analyzed them in this paper is pernicious and complicated to weed out, and farmers and consumers will suffer the consequences finally. We hope that our analysis and suggestions may help devise a set of effective policies and regulations by pointing out where corrective actions are necessary to control excesses of information symmetry and reform vulnerable parts of agricultural circulation system. This paper contributed to agriculture research as well as market management and public administration. As other developing countries may also face similar problems in their agricultural markets, this paper has potential broad sense and enlightenment.

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