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Building and Analyzing the Selection Model of Food Supply Chain Enterprises' Risk Behaviors

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Abstract

The root cause of food supply chain risks lies in the risk-taking behaviors of food supply chain enterprises. Therefore, it is of great significance for controlling the food supply chain risks to deeply analyze the selection mechanism of food supply chain enterprises' risk-taking behaviors. With the cost-effectiveness concept being the leading ideas, the food prices, the food supply chain enterprises scale, the productivity change coefficient, the food safety investment and the government's food safety confiscation being the major variables, this paper built a selection model for the food supply chain enterprises' risk behaviors. By analyzing this model, we conclude that factors influencing the selection of food supply chain enterprises' risk behaviorsinclude the productivity change coefficient and the food safety investment, in which, the productivity change coefficient is the key to induce the risk behaviors of food supply chain enterprises, while the more the government's food safety confiscation is, the less motivation the food supply chain enterprises have to increase food production by risk-taking behaviors. Therefore, the final goal of building a risk prevention and control system for food supply chain safety is to optimize the planting and production management of food supply chain enterprises to the furthest at the micro level.

Key Words: *Food Supply Chain Enterprises, Risk Behaviors, Regulate Production, Behavior Selection, Model.*

Introduction

The issue of food supply chain security risks has gained extensive attention from countries all over the globe. By food supply chain security risks, we refer to the damages or the possibilities of getting the damages suffered by enterprises on one or more links of the food supply chain, as the supply chain enterprises and their employees are unsure about the food safety consciousness, behaviors, responsibilities, rules, standards, etc. (Mu, 2012) Related studies show that though technical problems and environmental pollution are part of the reason why there is problems with the issue of food safety in China, the most important causes are the human-driven factors, that is, the misconduct from the production operators, the lawbreaking behaviors like the non-execution or non-strict execution to the existing food technical manual and standard system. (Wu et al., 2013) For food supply chain enterprises, they don't need to develop and

strengthen themselves by gaining profit, so the production and operating activities of food supply chain enterprises should be market-oriented, measuring the cost-benefit relations. As a result, they may adopt various legitimate or unwarrantable measures, or even some illegal means. For example, during the process of adopting proper means to conduct standard production and operation, they may seek to lower the production cost by technical transformation, to strengthen marketing by choosing multiple ways of promotion. However, during the process of adopting unwarrantable or even illegal means to conduct productions and operations, they may seek to pursue the maximized profit by cheating on workmanship and materials, selling seconds at best quality prices, or faking and copying, etc. All these illegal management and operations behaviors for maximizing self-interest under certain social, economic and technological conditions are called food supply chain risk behaviors, resulting food supply chain safety risks. (Liu and Chen, 2014).

The risk-taking behaviors of food supply chain enterprises can also be called the speculative behaviors when it comes to food safety, as the food supply chain enterprises may adopt some improper hidden production behaviors in order to capture extraneous earnings. The primary basis for the food supply chain enterprises to take risks is to earn profits. The food supply chain enterprises' profit on operation comes from the difference between the consumers' purchased price and the products' producing cost, so the price-cost gap is the direct factor influencing the food supply chain enterprises to decide weather to take risk behaviors. On one hand, it requires the food supply chain enterprises to enhance food safety supervision processing equipment and conduct personnel training as well as performing standard production, etc. to improve the food security. As the food safety investment will directly increase the food supply chain enterprises' operation cost, enterprises will set a higher price for getting more profits. On the other hand, paying little attention to the food safety investment, instead, the food supply chain enterprises choose to adopt risk behaviors to produce food, acquiring high yield with low lost. Although the government's food safety confiscation can increase the food supply chain enterprises' food safety investment to some extent, enterprises can still earn profits through relatively low food prices and great sales volumes.

At present, experts home and abroad and scholars have conducted wide research on the food supply chain safety risk issues from the perspectives of institutions, management, technologies, etc. with limited research on the food supply chain risk behaviors. Chen et al (2011) analyzed the influencing mechanism of the environment factors to the food safety behaviors of producers in the supply chain by utilizing the simulation model. They found that the food supervision approach ought to be refined, and the improvement of technical factors can effectively perfect the food safety level in China. Hirschauer et al (2012) analyzed the illegal behaviors in the food supply chain by adopting the theory of analysis and methods in the economics. They found that the goals multiplicity and opportunism are the behavioral motives of food producers to deliberately violate the food safety rules. Liu and Chen (2014) analyzed the food supply chain enterprises' and their employees' safety risk behaviors expressions. Liu (2015) built the food supply chain safety and risk control and prevention mechanism from the perspective of behaviors. All these researches have both significant theoretical value and practical value. However, there is still space for improvement in the following aspects: first, how to deeply analyze the food supply chain enterprises' risk behaviors selection mechanism from the perspective of food supply chain enterprises themselves. Second, how does the self-factors of food supply chain enterprises influence the selection of the enterprises' risk behaviors. This paper, therefore, aims to build a selection model of food supply chain enterprises' risk behaviors, with the price, the enterprises scale (represented by the total assets), the productivity change coefficient, the food safety investment and the government's food safety confiscation being the major variables of the food supply chain enterprises' producing food and conducting standard food selection model.

Fundamental Assumptions

The food market that the food supply chain enterprises are in is non-perfect competitive, non-monopolistic and non-oligarchic, as there existing demand for a certain kind of food while the food produced by the food supply chain enterprises can be sold out with appropriate prices. The price of this kind of food under

standard production mode is P_1, and the price of this kind of food under risk-taking behaviors production mode is P_2. The market for factors of production is a perfectly competitive market, where, the labor's wage is w; the capital cost rate is i; the total asset of food supply chain enterprises is A; the food safety investment is I_{fs}. The food supply chain enterprises shall conduct the production and operation activities by utilizing the labor force L and the capital K. (Chen et al, 2008).

When changing the standard way of production to the risk-taking behaviors way of production, the productivity change coefficient is T (as the food per unit yield under the standard way of production is usually lower than that under the risk-taking behaviors way of production, the setting is $T>1$). Benefit maximization being the ultimate goal of food supply chain enterprises, F_1 and F_2 stands for the profits acquired under the standard way of production and the risk-taking behaviors way of production, respectively. P_1^* stands for the market price of food when the food supply chain enterprises select the standard way of production to produce food in the critical point, while P_2^* stands for the market price of food when the food supply chain enterprises select the risk-taking behaviors way of production to produce food in the critical point. F^* stands for the profit of per unit of product when the food supply chain enterprises select the risk-taking behaviors way of production to produce food in the critical point.

When the food supply chain enterprises conduct standard production operations, the production function is Douglas Production Function: $Q=L^{\alpha}K^{1-\alpha}$. When the food supply chain enterprises conduct risk-taking behaviors productions, the production function shall be $Q=TL^{\alpha}K^{1-\alpha}$. The government's food safety confiscation is τ when the food supply chain enterprises produce food under the risk-taking behaviors way of production, assuming that the government's food safety confiscation can be greater, equal and less than the supply chain enterprises' food safety investment when the food supply chain enterprises adopt the risk-taking behaviors way of production, that is, $0\le\tau\le I_{fs}$ or $0\le I_{fs}\le\tau$ (For convenience of research, the food safety investment of the food supply chain enterprises under the risk-taking behaviors way of production is 0).

Model Specification

When conducting standard production operations:

$$Q=L^{\alpha}K^{1-\alpha} \tag{1}$$

$$\text{Max}F_1=QP_1-(Lw+Ki+I_{fs}) \tag{2}$$

$$\text{s.t. } Lw+Ki+I_{fs}\le A \tag{3}$$

When conducting risk-taking behaviors productions:

$$Q=TL^{\alpha}K^{1-\alpha} \tag{4}$$

$$\text{Max}F_2=QP_2-(Lw+Ki+\tau) \tag{5}$$

$$\text{s.t. } Lw+Ki+\tau\le A \tag{6}$$

If $F_2>F_1$, the food supply chain enterprises will choose to produce the food in a risk-taking way.

Solution Method for Model

When the food supply chain enterprises conducts standard production operations, with formula (1), (2) and (3), we can get the following equation:

$$\begin{aligned} F_1^* &= \left[\frac{\alpha(A-I_{fs})}{w}\right]^{\alpha}\left[\frac{(1-\alpha)(A-I_{fs})}{i}\right]^{1-\alpha}P_1-\left[\frac{\alpha(A-I_{fs})}{w}\right]w-\left[\frac{(1-\alpha)(A-I_{fs})}{i}\right]i-I_{fs} \\ &= (A-I_{fs})\left[\frac{1-\alpha}{i}\right]^{1-\alpha}\left[\frac{\alpha}{w}\right]^{\alpha}P_1-A \end{aligned} \tag{7}$$

When the food supply chain enterprises conduct risk-taking behaviors productions, with formula (4), (5) and (6), we can get the following equation:

$$F_2^* = T(A-\tau)\left[\frac{1-\alpha}{i}\right]^{1-\alpha}\left[\frac{\alpha}{w}\right]^{\alpha}P_2-A \tag{8}$$

When the food supply chain enterprises choose to produce the food in a risk-taking way, that is, $F_2^* \geq F_1^*$:

$$T(A-\tau)\left[\frac{1-\alpha}{i}\right]^{1-\alpha}\left[\frac{\alpha}{w}\right]^{\alpha}P_2-A \geq (A-I_{fs})\left[\frac{1-\alpha}{i}\right]^{1-\alpha}\left[\frac{\alpha}{w}\right]^{\alpha}P_1-A \tag{9}$$

To simplify:

$$P_2 \geq \frac{1}{T}\frac{1}{(A-\tau)/(A-I_{fs})}P_1 \tag{10}$$

When the equality holds, the critical point with optimum conditions for the food supply chain enterprises to choose to produce food in a risk-taking way is as follows:

$$\frac{P_2^*}{P_1^*} = \frac{1}{T}\frac{1}{(A-\tau)/(A-I_{fs})} = \frac{1}{T}\frac{1}{1-(\tau-I_{fs})/(A-I_{fs})} \tag{11}$$

$$F^* = \left(\frac{1}{T}\frac{1}{1-(\tau-I_{fs})/(A-I_{fs})}-1\right)P_1^* \tag{12}$$

To take the logarithm to both sides of the formula (11):

$$\begin{aligned} \Delta P &= Ln\left(\frac{P_2}{P_1}\right) = Ln(P_2)-Ln(P_1) = Ln\left(\frac{1}{T}\frac{1}{1-(\tau-I_{fs})/(A-I_{fs})}\right) \\ &= Ln\left(\frac{1}{T}\right)+Ln\left(\frac{1}{1-(\tau-I_{fs})/(A-I_{fs})}\right) \end{aligned} \tag{13}$$

Model Analysis

With the formula (11) and (13), the condition for the food supply chain enterprises to select risk-taking behaviors way of production is as follows: The price ratio P_2/P_1 between the food price of food produced under the risk-taking behaviors way of production and that under the standard way of production should be equal at least with the product between the productivity change influence value $1/T$ and the risk-taking behaviors food confiscation value $1/(1-(\tau-I_{fs})/(A-I_{fs}))$. In addition, the food price change variable

$\Delta P = Ln(P_2) - Ln(P_1)$ is broken up into the productivity variation effect $Ln(1/T)$ and the risk-taking behaviors food production confiscation effect $Ln(1/(1-(\tau - I_{fs})/(A - I_{fs})))$.

When the food supply chain enterprises produce food under the risk-taking behavior way of production, the productivity increasing ($T > 1$), the price loss can be compensated in a higher way with greater sales volume. The greater the food supply chain enterprises' total asset A is, the less the food safety investment I_{fs} will be, with the government's confiscation for food supply chain enterprises' risk behaviors ever increasing. At this moment, the decision critical point P_2 of enterprises' selection of risk-taking behaviors way of production will increase continually. Therefore, the food supply chain enterprises need a greater profit incentive unit F^* of risk-taking behaviors way of production to make the decision to take risk behaviors way of production. When the government's confiscation τ to the food supply chain enterprises' risk behaviors increases to $A-(A-I_{fs})/T$, $F^* = 0$, there is no extra profit for the food supply chain enterprises under the risk-taking behaviors way of production to acquire, which may restrain the happening of risk-taking behaviors.

Conclusion

1) The productivity variation effect $Ln(1/T)$ that influences the food supply chain enterprises' risk-taking behaviors decisions is the productivity coefficient of variation T. If the productivity coefficient of variation T is big (the per unit yield being high), it requires a relatively lower price incentive to promote the food supply chain enterprises to decide to produce food under the risk-taking behaviors way of production.

2) The confiscation effect influencing the risk-taking behaviors way of production include three aspects: the scale of the food supply chain enterprises, the scale of the standard production food safety investment, the level of government's confiscation to the food supply chain enterprises under risk-taking behavior way of production. For food supply chain enterprises, the scale is a key factor influencing their decision on taking risk behaviors way of production. The greater the scale of the food supply chain enterprises, the smaller the share of food safety investment, the smaller its proportion in the total asset and the higher the government's confiscation to the food supply chain enterprises under risk-taking behavior way of production are, the weaker the food supply chain enterprises' impulsion to take risk behaviors way of production will be. Therefore, in order to reduce or even eliminate the food supply chain enterprises' risk behaviors, effectively preventing and controlling the food supply chain risks, the government should reinforce its confiscation intensity to the food supply chain enterprises' risk-taking behaviors way of production.

3) The general effect influencing the food supply chain enterprises' risk behaviors decisions include the productivity variation effect and the confiscation effect of risk -taking way of production, with the productivity variation effect being the key component of the general effect. The productivity variation effect is the important factor influencing the enterprises' profit when producing food under the risk-taking behaviors way of production, as well as the key point inducing the food supply chain enterprises to conduct nonstandard productions and operations violating laws and rules.

4) The ultimate goal of building a food supply chain risk prevention and control system is to furthest optimize the food supply chain enterprises' planting and production management. Only by clarifying the key factors influencing the food supply chain enterprises' planting and production management and executing effective and matched policy mix measures, can the safety curtain effectively preventing and

controlling the food supply chain risks be finally built in the micro-level, with a combination of measures.(Wu et al., 2011)

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Reference

Chen, Y., Chen, K., Li, Y. (2011). Simulated Analysis on the Influencing Mechanism of Environmental Factors on the Food Producers' Security Behaviors in the Supply Chain.*Journal of Safety Science and Technology*, 7(9), 107-114.

Chen, Y., Qiao, J., Li, D. (2008). Decision Behavior Analysis of Food Safety Production under Quality Investment Model.*Technical Economy*, 27(5), 74-77.

Hirschauer, N., Bavorova, M. (2012).An Analytical Framework for a Behavioral Analysis of Non-Compliance in Food Supply Chains.*British Food Journal*, 114(9), 1212-1227.

Liu, Y. (2015). Study on the Preventing and ControllingMechanism of Food Supply Chain Security Risk: Behaviors-Based Perspective. *Social Science of Beijing*, (7), 47-52.

Liu, Y., Chen, J. (2014). Formation Mechanism of Food Supply Chain Security Risk: Based on BehavioralEconomics Perspective. *China Business and Market*, (3),60-65.

Mu, J. (2012).Study on the Food Safety Supervision Model Innovation and Food Supply Chain Safety Risk Control.*Food and Industrial Technology*, 33(10), 49-51.

Wu, L., Wang, J., Zhu, D., et al. (2013). *Report on China's Food Security Development2013*. Beijing, China: Peking University Press.