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An analytical framework of food supply chain risk formation mechanism based on behavioral perspectives

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ABSTRACT

Most of current researches discuss sources or factors affecting food supply chain risk based on supply chain entities, processes and specific risk nature or contents. Studies from behavioral perspective are rare. In this paper, a multi-disciplinary comprehensive analytical framework is proposed integrating behavioral theories in economics, business management, sociology and psychology. How food supply chain risks are formed is illustrated from two aspects which are individual factors and situational factors. The paper concludes from normative analysis that risk attitude, subjective norm and risk perception of supply chain enterprises and their employees have important influence on their risk behaviors, the degree of uncertainty and complexity of which are further increased by ever changing situations.

KEYWORDS

Food supply chain; Behavioral perspective; Risk formation mechanism; Analytical framework; Risk behavior;

INTRODUCTION

With the rapidly economic development and scientific and technological progress, food supply chain is becoming increasingly complex. Meanwhile, the food supply chain risk problem is getting worse, and food safety and quality increasingly become prominent social and economic problems. Focusing on the influencing factors, controlling measures and other aspects, domestic and foreign scholars have been making researches on food supply chain risk issues, forming a number of important academic achievements. In terms of influencing factors, there have been many researches from the supply chainlinks, supply chain environment, which reveals part of the causes of food supply chain risk, but few studies explain the formation of supply chain risk from the behavioral perspective and the interaction of different risk factors. Major food safety accidents at home and abroad in recent years indicate that compared with purely technical risks and environmental risks that are difficult to predict, the behavioral risks from a personal and organizational level cannot be ignored. According to "China Food Safety Report"[1], Chinese current food safety risk is mainly due to human factors, and some behaviors of Chinese food production, processing, marketing and other behavior subjects are improper and illegal. Thus, it might get more academic value and practical guiding significance if we made researches on the formation mechanism of food supply chain risk from the behavioral perspective and proposed appropriate prevention and control strategies and measures. In this paper, we use behavioral economics, behavioral theories and models of management for reference, presented an analytical framework of food supply chain risk formation mechanism based on behavioral perspectives. And to reveal the behavioral motivation andintrinsicmechanism and lay the foundation for the later study of the food supply chain risk controlling, we refine empirical research hypotheses from the framework.

STATUS QUO OF THEORETICAL RESEARCH ON FOOD SUPPLY CHAIN RISK FORMATION

The formation of the food supply chain risk is quite complex. Literature at home and abroad is mainly for supply chain risks descriptive classification, aiming at particular subject or the nature and sources of risk for specific links.

Xi et al.[2], Lv[3] and Zhang et al.[4]analyzed the possible causes of supplying, manufacturing, distribution and recycling of all aspects in food supply chain. Zhang et al. (2012)[5]considered that the important influencing factors of agriculture (food) supply chain risk are supply, demand, information, cooperation, logistics and environmental risks six categories. Wu[6] discussed the constitution of food supply chain risk quality factors. Chen et al.[7] analyzed the influencing mechanism of the environmental factors on security behavior choices of manufacturing enterprises in food supply chain. Li[8], according to the authoritative database that collect from Chinese food quality and safety nets in 2008-2011, made statistical analysis on food quality testing data,finding that supply chain links where food safety problems happened most frequently are followed by food processing areas, planting and breeding sectors preparation and processing areas, and the critical control points are agricultural application, processing environment, staff health and harmful inputs added and so on. Moore[9] from the perspective of consumer behavior, using incentive model, behavior setting model and three-stage analysis model, made researches on the food safety risk problems that are resulted from consumers' weak food safety knowledge and poor awareness. Wang et al.[10] using the theory of planned behavior, made empirical analysis on the impact factors of consumers who buy "green" authentication pork in Beijing urban, finding that factors of the degree of the quality and safety information concerning, risk perception, food certification awareness, education level, income level, etc. have a significant impact on consumers' purchase of "green" certified pork. Lin et al.[11]and Wang et al.[12]through the questionnaire study, found that there are significant differences in the factors affecting food quality safety between different consumer groups, whose concerning degrees aboutrisks of all supply chain links have big differences,

too. Yin et al.[13]have shown that consumer satisfaction evaluations of governments, manufacturers and certification and other subjects are generally low. Government regulator evaluation has significant impact on consumer confidence, while manufacturer behavioral characteristics and reputation have higher impact than the certification body.

Moreover, terrorism, structural characteristics of supply chain (such as the relative position of supply chain body of manufacturers, retailers and government regulators)[14], whether the supply chain across borders[15], as well as incentive misleading, the government oversight, market failures and other institutional factors[16-18] are alsoimportant sources of food supply chain risks.

There are some studies focused onanalyzing from the meaning and content of risk, but the common problems are no indication what the major risks may exist between the food supply chain and their formation process and the possible relationships between risks. As Peck[19] proposed nine supply chain risks, namely product contamination and recall, terrorist attacks, consumer protests, the production site damage, lack of production capacity, staff turnover, loss of suppliers, contract risks and the risks of double source of goods. Van Rijswijket al.[20] think that the food supply chain security risks arising from the technical aspects of food production, processing and distribution, but food supply chain quality risk relates primarily to the nature of the food, including consumer perception of food quality. Diabat et al.[21] summarized the case of the food company's supply chain risks as product/service management risk, macroeconomic risk, demand risk management, supply management and information risk management risk. Yang[22] combined with the characteristics of China's food industry, summing that the common risks of the food supply chain include quality risk, market risk (the risk of expansion, innovation, marketing, etc.), logistics risk (dividing into third-party logistics risk and cold-chain risk). Liu et al.[23] analyzed the 1460 food quality safety incidents that occurred in China from 2001 to 2010 by building food quality safety of supply chain- the key factor in determining the orientation matrix, classified the food supply chain security issuesaccording tothe essential reasons. Hirschauer et al.[24] used theoretical analysis of behavioral economics, finding multiple targets and opportunistic behaviors are the motives of food producers who deliberately violate food safety rules. And the study proposed the concepts of residual income risk and morally residual income, which is one of the rare literatures that analyzed supply chain risk factors from the behavioral perspective.

Overall, the majority of existing studies only answered the question what the food supply chain risk is, but not told how to deal with the food supply chain risk issues. However, we not only need to know where the food supply chain risk and how to behave, but also need to know how the food supply chain risk form and its consequences, which is the only way to make a targeted prevention prescription. Considering this, this paper will present an analytical framework based on behavioral perspective, and explore the microscopic mechanism of the formation of the food supply chain risk.

THE BEHAVIORAL PERSPECTIVE ANALYSIS ON FOOD SUPPLY CHAIN RISK FORMATION MECHANISM

The food supply chain is a top-down food supply and demand network that consists of supplier of agricultural production, farmers or agricultural companies, processors, logistics providers, distributors, retailers and consumers. At present, the academic concept of the food supply chain risk connotation and denotation has big differences. This paper argues that the most fundamental target of the food supply chain is to maximize overall value of the supply chain by providing safe, healthy and nutritious food. The connotation of the food supply chain risk refers to the uncertainty of achieving the above objectives, namely the uncertainty of process and outcome safety of food supply chain, and thus to bring the economic and social losses for most of enterprises in food supply chain. The second part of a brief review of the literature suggests that the source and influencing factors of the food supply chain risk are quite a lot and complicated. But the same risk factors in different individuals and organizations may produce different behavioral consequences. In the evolution path from the risk factors to the risky

behaviors until the consequences, what functions and evolution of the psychological variables such as personal and organizational risk awareness, attitudes and perceptions have, which are worthy of study. This article attempts to open the middle black box between the risk factors and the behavioral consequences, usingthe research paradigm of behavioral "antecedents - behavioral processes - behavioral effects". And from the perspective of dominant production and processing enterprises in food supply chain, we analyzedthe microscopic formation mechanism of the food supply chain risk from the food production enterprises and risk behavior motivation of employees, behavioral processes and environmentetc. point of view.

The food supply chain risk behavior is the food supply chain companies and their employees in a certain socio-economic and technological conditions, in order to pursue to maximize their own benefits, who are rationally bounded by individuals and organizations in business operations, operation and management of the process, leading to food acts of supply chain quality and safety risks, which can be divided into the food supply chain risk behaviors of enterprises and employees. Among them, the enterprise risk behavior is a kind of organizational risk behavior, which reflects risk behaviors of business leaders and key executives. Employees risk behavior is a kind of personal risk behavior, which reflected risk behaviors of general staff, especially in food production business line operational risk behavior of employees.

Theory of reasoned action

Theory of Reasoned Action (TRA) mainly explains the causal relationship among the behavioral attitudes, subjective norms, behavioral intentions and behaviors. It considers that behavioral attitudes and subjective norms may indirectly affect behaviors through behavioral intentions, therefore we can directly examine human behaviors through behavioral intentions. If we wanted to predict what action people would take, the best way is to understand their behavioral intentions. The so-called behavioral intention is if people are going to take some action orwhat extent they want to try the action, and how much effort they would like to pay. The behavioral intention depends on two factors. First is the attitude of the act, which is a function of two variables, namely individual beliefs and evaluations of behavioral outcomes. Second is subjective norm (SN), namely the codes of conduct that exist in the mind, or the perceived social pressure, which depends if thebelief of "reference" (an important references or reference groups) took some action and personal submitted to the motive of reference. Reference belief is called "normative beliefs", which means thatsubjective possibilities if "significant others" individuals perceivedtook action. "Obey motive" means the desired motivation that individual is subordinate to the reference. The basic framework of the theory is shown in Figure 1[25].

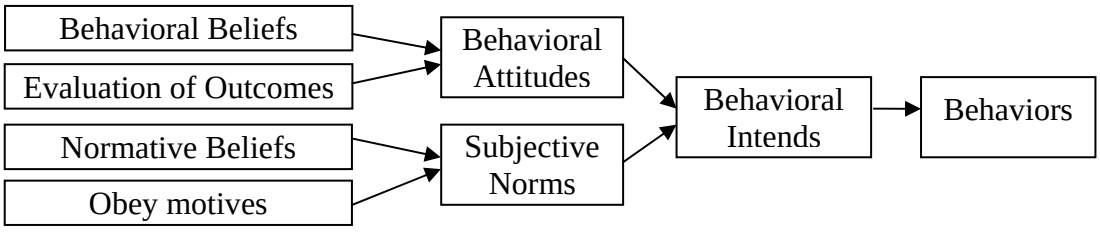

Figure 1 : Basic Framework of Theory of Reasoned Action

According to the analytical framework in Figure 1, the food supply chain risk behaviors of their companies and employees to some extent are decided by the subjective intent, and the subjective intent is jointly decided by risk behavior attitudes and beliefs of enterprises or employees, and expectations that they improve their risk behavior from the outside worldand their subjective willingness. If the business and its employees were not only subjectively willing to avoid the risk behavior, and in line with their own code of conduct, but also be able to submit to the required social norms, then the risk behavior

would not occur, otherwise it would make risky behavior, leading to entire food supply chain risks quickly.

Theory of planned behavior

Theory of planned behavior (TPB) is proposed by Ajzen who extended the Theory of Reasoned Action. In order to increase the predictive power of the theory of reasoned action,Ajzen (1985) added a new concept of self "Perceived Behavioral Control" (PBC) to rational action model, which then develops a new theory of behavior patterns - Theory of Planned Behavior. The basic framework of the theory is shown in Figure 2[25].

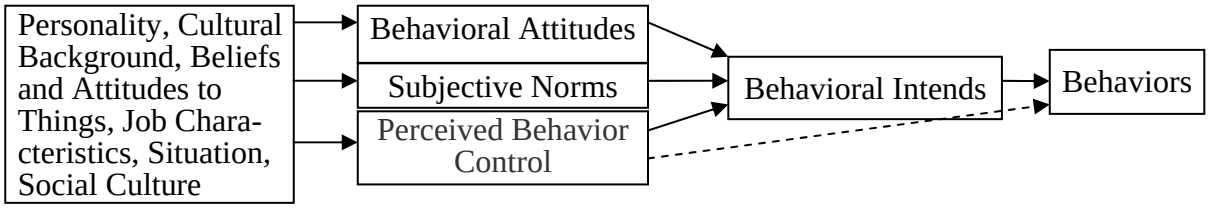

Figure 2 : Basic Framework of Theory of Planned Behavior

Theory of planned behavior considers that behavioral attitudes, subjective norms, and perceived behavioral control will affect the real behavior through behavioral intentions. Among them, perceived behavioral control consists of two parts, one is the individual's self-efficacy sense of their own complete behaviors, and the second is the ability to control if they implement the individual's behavior. Perceived behavioral control reflects the actual status of the control conditions, so it can be used as an alternative measure index of actual control conditions, directly predicting the possibility of behavior occurring (dashed line in Figure 2), and the forecast accuracy depends on the true extent of the perceived behavioral control. The subjective norm, perceived behavior control and tendency attitudes of behavior depend on the personality, cultural background, beliefs and attitudes to things, job characteristics, situation and social culture and so on.

According to this theory, if the food supply chain enterprises lacked stringent internal control processes and incentives, its officers and employees would feel their actions have adequate and flexible control, thus they might consciously or unconsciously implement risk behaviors that affect food quality safety.

Taking food additives for example, we combine the theory of reasoned action and planned behavior, assuming that food companies and the general staff have cautious attitudes and high risk of subjective norms for the abuse and illegal use of additives. But ifperceived behavioral control were strong, namely constraint of the external environment is weak, the latter will weaken the former self-restraint from the individual, inducing enterprises or employees to make illegal and irresponsible behavior. Conversely, if the food companies and ordinary employees due to the aggressive risk attitudes and weakly subjective norms lead to low individual binding, however, perceived behavioral control is weak, that is to say they constraint by strongly external environment, the latter will be a certain deterrent and warning pressure, inhibit businesses and employees to make inappropriately risky behaviors.

Clearly, on the basis of the theory of reasoned action which only considers individual psychological factors such as risk attitudes and subjective norms and so on, theory of planned behavior began to take into account the impact of individual behavior and environmental context. From two parts included by perceived behavioral control, the latter involves situational and environmental factors, although the former is "the individual's self-efficacy sense of their own complete behaviors", the sense of efficacy may also relate to the environment where individuals are. Now, we will take economics and management behavior analysis theories and ideas for reference, and deeply analyze the various factors that influence the perception of behavioral control.

Mass-following psychology, anchoring effect and similarity bias

Mass-following psychology, also known as "herding" or "Herd behavior", refers to people who have a tendency to follow groups in the aspects of language, behaviors, attitudes, and so on. When people make decisions, they are affected by others and the environment, leading to imitation, competition, follow and mutual infection[26]. Anchoring effect, means that in the absence of certainty, people often use a reference point to reduce ambiguity, and then draw final conclusions through some adjustments[27]. Similarity bias, refers to the cognitive bias when people forecast future according to the relevant information of current or recent events.

The above three theories of behavioral economics show that when people make decisions in the risk environment, they will be influenced by the early similar personal behaviors and others similar behavior experience judgment. Another explanation of mass-following psychology could be the speculation psychology of "law is not responsible for the masses". For instance, if that you addedmelamine in milk is an undeclared secret in the industry, we would be all in the same boat and punished together, so food companies and their employees would ignore the hazards and consequences of abuse of additives. If some enterprises or employees repeatedly violated provisions in operating procedures, techniques and sanitation norms without being punished, anchoring effect and similarity bias will further enable these businesses and employees to relax their vigilance and self-restraint, forming the habit of risk behavior, resulting in risk of accumulation and conduction internal the enterprises even in the entire supply chain.

Obviously, mass-following psychology, anchoring effect and similarity bias are due to the framing effect, that is, people will choose the frame of reference when making decisions. When society lacks good reference standards such as integrity, conscience, business ethics and social responsibility in general, for instance, lemon market effect of bad money driving out good money can only provide people with poor frame of reference, which is inboth vertical and horizontal food supply chain risk issues are very common. Framing effects eventually lead to the "overconfidence" for implementation of certain risk behaviors, that’s to say, they deem that "someone else did all right, I'll be fine; It’s OK when I've done this before, now and in the future will be OK, too", which make enterprises and employees who are of free personality or like adventure have a very strong perceived behavioral control on their own risk behaviors, leading to irrational behaviors.

Risk construction and behavioral science management theories

Sociology thinks people’s perception and judgment for risk are not formed invacuum, but rather affected by their organizations. Risk forms in the social process, and is embedded in the social structure. Sociological constructionism emphasizes two-way effect of individual risk perception and social structure, that’s to say the social structure affect the individual perception, and individual perception shapes the social structure.

Behavioral science management theory apparently well absorbed sociological idea about risk construct theory. Mayo's Hawthorne experiment, which is originated in the early 1920s and middle 1930s, proposed a humanistic assumption of "social person". The main features of contemporarilybehavioral science management theory is to consider the human factors as the most important management factorsand takebehaviors aspeople's thoughts, feelings, desires reflected in the action, and the role of management is to make peoplestimulated by measures then produce motivation. Based on this understanding, in the aspect of management idea and means, the behavioral science management emphasizes on integrity and overall development of the organization, the flow of information and feedback within the organization, the emotional and social factors, social environment, the impact of the relationship between peopleto labor efficiency and thepower inspired by the nature of human behavior, whileweakens effects of formally organizational functions as well as rational and economic factors in management, and takes incentive measures. Affected by behavioral science

management theory, in risk management, from internal control framework to the overall risk management framework, a significant change is to absorb the relatively psychological and behavioral concepts and methods such as the risk appetite, risk tolerance, risk measures, stress testing, scenario analysis and others into risk analysis and management process.

Obviously, the food supply chain is a complex system, which makes its risk formation complex. Any supply chain links are likely to be the source and fuse. Even businesses and employees who are rational enough may also make mistakesand precipitate risk. The important factors affecting the food supply chain risk formation in food supply chain is the structure of supply chain and node enterprise organizational structure characteristics and so on. These factors may directly cause food supply chain risk, and they are also able to indirectly lead to the formation of the supply chain risk by influencing the behavioral risk of supply chain enterprises and their employees. When the food supply chain structure and specific food production or technical processing are complex, companies or their employees will have a sense of uncertainty for the efficacy of their risk behavior, and perceived behavioral control will be relatively weak. At this time, businesses or employees will seek ways to recognizeand mitigate risks. The integrity and moral deficiency that exist in marketing economic development transition phase do not necessarily lead to critically social crisis of food quality and safety, and we still have reason to believe there still exista lot of rational and conscientious people. However, in many cases, it may be the complexity of the problem itself or the system that the issuesare in that leads to the risk problems.

Combiningbehavioral studies in various disciplines, both "bounded rationality" of behavioral economics and "social person" hypothesisof behavioral science management theory agree with the presence of actors in individual differences. In contrast, economics is more focused on the integration with psychology, emphasizing perceived differences such as individual cognition, attitudes, tendencies, and so on, which is considered asindividualism of methodology, focusing on the "perception - behavior" and "expect - behavior" processes. While, behavioral science management prefers the integration with sociology, emphasizing the differences between individual environment and situation, which is considered as contextualism of methodology, focusing on the "organization - behavior" and "structure - behavior" processes. We believe that the food supply chain risk is decided by both the risk perception of food supply chain companies and their employees and the structure and organization characteristics of food supply chain.

THE ANALYTICAL FRAMEWORK OF FOOD SUPPLY CHAIN RISK FORMATION MECHANISM BASED ON BEHAVIORAL PERSPECTIVES

On the basis of the theory of planned behavior model, combiningthe behaviorally theoretical results of the fields of behavioral economics et al., this paper proposes ananalytical framework of food supply chain risk formation mechanism based on behavioral perspectives, which is shown in Figure 3.

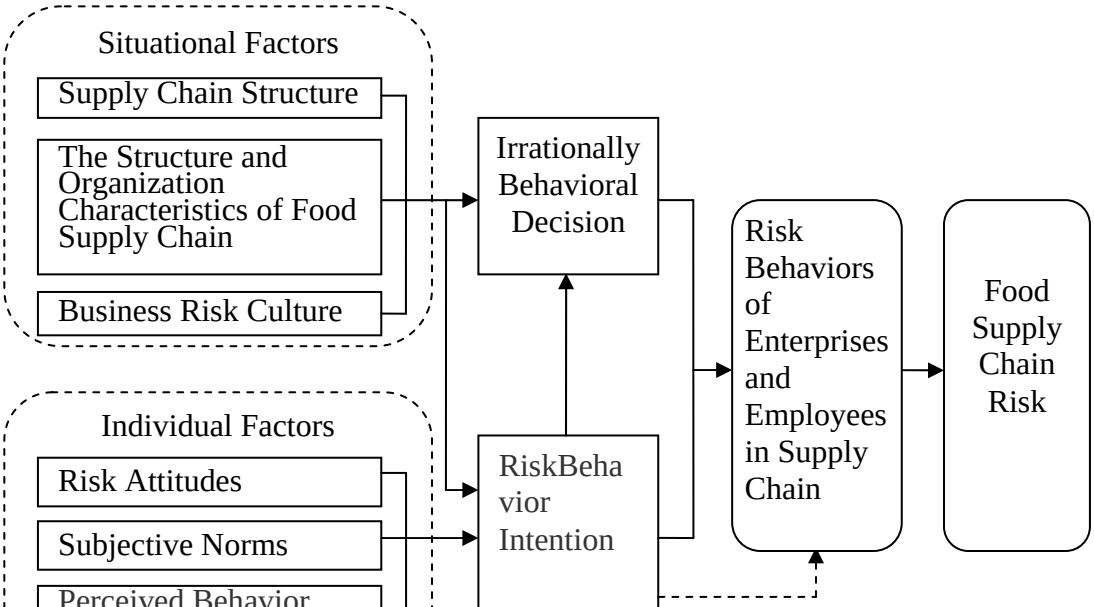

Figure 3 : The Analytical Framework of Food Supply Chain Risk Formation Mechanism Based on Behavioral Perspectives

In the above analysis framework, the formation of the food supply chain risk is determined by the supply chain risk behaviors of the enterprises and employees, while, the risk behavior is the results of irrational decision-making and risk behavior intention. Risk behavior intention is the illegally operating behavior tendency of supply chain enterprises and employees, which is mainly influenced by individual factors of risk attitudes, subjective norms andrisk perception, and these individual factors determine the risk perceptionlevel of action subjects, which may be associated with gender, age, education, religion and so on. In the process of supply chain risk formation, the deviation resulting from the limited cognitionor constraint of the subjectsfinally producesdeviant behaviors of a single enterprise and the entire supply chain. Meanwhile, situational factors play a role of moderator among individual factors and behavioral risk intentions,and may strengthen or weaken the effects of individual factors on behavioral risk intention. Situational factors include formal and informal factors such as food supply chain structure, supply chain organizational structure, ownership structure and businessrisk culture.

CONCLUSIONS

These are the preliminary study on an analytical framework of food supply chain risk formation mechanism from behavioral perspectives, explicating the forming path of the food supply chain risks, and the internallylogical relationship among the various risk factors. On the formation mechanism of the food supply chain risk, the current theories mostly analyze from the points of the food supply chain links, the food supply chain subjects, the external environment of food supply chain, and so on, and there is not ananalysis framework from behavioral perspective. This paper summarized the existing theoretical results, with influentially theoretical analysis in behavioral studies, and proposed ananalysis framework of food supply chain risk formation mechanism, initially revealing the risk factors and internal mechanism of food supply chain, then offered the further empirical research hypotheses. Given the complex and dynamic nature of the food supply chain risk formation, this analysis framework is only a preliminary research, and it also needs to be improved in further theoretical and practical studies.

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