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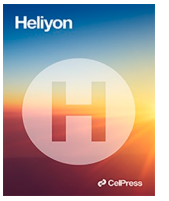

Research article

Research on the effectiveness of online food safety supervision under the existence of settled enterprises' myopic cognitive bias

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ABSTRACT

Although the scale of China's online food industry grew rapidly in recent years, the risky operational practices of business were not adequately prohibited. Based on the repeated illegal behaviors of online food enterprises, this study constructs the intertemporal utility model of online food enterprises from the perspective of behavioral economics. It was discovered that the presence of cognitive biases with a short-term focus in online food businesses would result in dangerous food sales behavior. The myopic unsafe online food quantity deviation of businesses would decrease as the cognitive deviation coefficient and penalty factor of online food businesses increase. Due to the existence of myopic cognitive bias, it is difficult for online food businesses to perceive the difference between the discount factor in the short term and the long term during the decision-making process. Therefore, they will not choose to sell a significant quantity of dangerous food. However, during the sales behavior phase, food-settled enterprises would opt to offer more dangerous food due to myopic cognitive bias. According to the different behaviors of online food enterprises in different periods, this study provides some corresponding supervision strategies for government regulators in the near and far future. Even though government departments could act quickly to investigate and deal with food safety incidents that are less harmful, the long-term solutions to ensure continued online food safety and optimize the online business environment are to build comprehensive system of online food safety regulation, improve information disclosure of online food enterprises, and enhance the government online governance structures.

1. Introduction

Frequently, there is a regulated issue in online food safety governance. Even if online businesses are able to provide safe food during law enforcement campaigns against food counterfeiting, once centralized governance is implemented, they may revert to unsafe business practices [1]. In late 2015, during collaborative law enforcement operations in Beijing's Tongzhou and Chaoyang districts, over 1000 unlicensed or unsanitary small dining establishments were removed from the online platform. In 2016, the China Media Group reported on the governance of these two districts during the '315' Consumer Rights television show, stating that tiny eateries in Tongzhou that had been closed owing to a lack of permits had been reopened. Unsafe online food enterprises reappeared in the

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Chaoyang district only two weeks after the joint law enforcement campaign concluded.

Government control over unlawful operations is sometimes time-limited, which is one of the primary reasons for the repeated prohibition of unsafe business methods in the online food market [2-4]. Due to the absence of long-term limits on governance mechanisms, the majority of regulatory processes take place via short-term centralized correction. Following the targeted food safety drive, some illicit firms chose high-yield operations without permits, putting short-term gains ahead of long-term rewards. Due to the reasonable and restricted nature of these established firms, they are unlikely to undertake investments such as security fees that must be paid now but will be recouped later. Established enterprises may choose to sell safe food to avoid being inspected in a somewhat strict governance system; in a relatively lax administration, they may choose to sell unsafe food at lower selling costs to increase profits. In the same way, the government department's ways of running things will change in response to the strategies of the food industry. In the process of government supervision of food safety, researchers found that the government would improve food quality and safety via a series of means. These means include the formulation of food safety related laws [5], the establishment of food safety standard system [4,6,7], and the promotion of social co-governance of food safety [8,9]. A large-scale food safety ecosystem was proposed by some researchers, who held the opinion that a good governance ecology should be established at the macro level and that the behavioral strategies of all ecosystem participants should be investigated [10-13].

But it should also be noted that the government's supervision is not a constant process of supervision. Market oversight will enact short- or long-term governance measures in response to real-world instances of established enterprises engaging in dangerous business activities. In the short run, when unsafe food is identified, the government will step up its oversight of online food enterprises. When substantial public concern about the safety of online food is expressed, the market supervision department normally responds promptly, concentrating its resources on investigating and reporting the online food enterprises' illegal conduct. For instance, shortly after a food safety violation was revealed on the '315' Consumer Rights TV show in 2020, Nanchang's market supervision agency launched an investigation into Burger King, resulting in the publication of administrative penalties a month later. In the long run, the government will take additional steps to bolster the market's business climate. The government's long-term initiatives will ensure the smooth operation of the online food market. For example, the Chinese government officially implemented the Measures for the Investigation and Punishment of Illegal Behaviors in Online Food Safety in October 2016, but it took an extended period of time from the initial proposal in 2015 to the solicitation of opinions, deliberation, approval, issuance of regulations, and official implementation. After more than four years of practice, the administration updated the measures once more in April 2021.

As demonstrated by the examples above, online food businesses may temporarily supply dangerous food in exchange for large profits due to a myopic impact. To maintain the safety and stability of the online food market, the government agency should adopt appropriate governance measures at each level of the sales process. Certain governance strategies can be implemented quickly, while others require considerable planning. Different from other studies, this research focused on the process of online food safety supervision from a microscopic perspective, and our research idea is to dynamically adjust the government's regulatory strategy according to the changes in the operating behavior of online food enterprises. The goal of this study is to examine established firms' intertemporal decision-making behavior and to make recommendations for short- and long-term strategies for the government sector's online food safety governance at various stages.

2. Literature review

Principal-agent theory is derived from the game theory of asymmetric information. Principal-agent theory focuses on how the principal can motivate the agent through mechanism design in the setting of asymmetric knowledge and competing interests. There are multiple interactions between principals and agents in food safety issues [14,15]. In a re-principal-agent relationship, for instance, customers entrust government regulatory agencies with the responsibility of overseeing food businesses. Moreover, the government contracts to food firms the responsibility of producing food and ensuring its quality and safety, which is a crucial principal-agent relationship. Since [16] viewed government regulation as an issue involving principal agents, the principal-agent paradigm has come to dominate government regulation. Some researchers construct a principal-agent model between regulators and consumers, analyze the reasons for the failure of food safety supervision from the perspective of system rationality, and make a number of reasonable recommendations to improve the assessment system of regulators, incentive mechanism, separation of detection and punishment power, etc [17-19]. Regarding government monitoring of food safety, the major agency is the government supervision department, while the food industry is the agent. Depending on the exact situation, food businesses (agents) comprehend the internal operation and external market environment better than government regulatory departments (principals). Businesses may create an information imbalance between themselves and the government in order to maximize profits, hence raising the complexity of government control.

Under the environment of food safety governance, effective structured division of labor and information management mode improve the possibility of smooth upgrading of skills [20]. A subject in the governance market does not exist independently, but in contract environment connected with other market subjects [21]. Based on this view point, we also found that previous researches on food safety governance mostly focused on two research methods. One type of research mainly started from different market subjects of food safety governance environment to discuss the behavioral strategies of food safety governance with the participation of different governance stakeholders [22-27]. The other type of research mainly focused on the discussion of the optimal punishment of government regulators [28-31]. The model construction method of game theory was mostly used in these two types of studies, and most of these studies were based on the perspective of the regulators. Although these studies enable us to understand the changes of behavioral strategies among various subjects in the food market and guide the regulator to make the optimal strategy choice, existing studies often neglect to directly start from the perspective of the online settled food enterprises to explore the reasons why some characteristics of

enterprises lead to the sale of unsafe food. Because the occurrence of food unsafe operation behavior is fundamentally produced by online settled food enterprises, food enterprises in the sales link of its safety or unsafe behavior will directly affect the safety order of the food market. Therefore, in this study, from the perspective of online settled food enterprises, we explore the influencing factors that may cause unsafe business behaviors of online settled enterprises in different periods of operation. However, the existing researches from this perspective are relatively few.

As the subject of bounded rationality, online settled food enterprises are affected by cognitive bias and will have different behaviors of selling safe food or selling unsafe food in different periods. Therefore, we believe that digging deeply into the behavioral characteristics of online settled enterprises and finding their sales behavior rules at different time nodes will help us understand the behavioral characteristics of enterprises under food safety governance. On this basis, we start from the relevant behaviors under the cognitive deviation of enterprises, to explore the operational changes of online food market in different periods, and on this basis to further put forward some valuable suggestions for government regulators to the governance strategy of online food enterprises in different periods. In intertemporal behavioral choice research, time preference theory is a major concern. The study of time preference in intertemporal behavior selection has evolved over a lengthy period of time. It has been discovered that time preference theory research in intertemporal behavior selection can be separated into three stages: classical time preference theory, neoclassical time preference theory, and hyperbolic discounting theory. This section will first talk about how time preference theory came to be and how it has changed over time. It will then look at the studies that have been done on governor and governed behavior in time preference.

The initial stage is the formulation of the classical temporal preference theory. Intertemporal selection was introduced for the first time in the early nineteenth century. Rae [32] was a pioneer in the study of intertemporal decision-making as a Scottish economist. Rae discovered in his research that people's desire to accumulate was a significant element influencing their intertemporal choices and so affecting national wealth accumulation. Additionally, Rae's research separates two types of accumulation desires: those that encourage accumulation and those that discourage accumulation. This new division method will have a huge impact on future research. Others followed in Rae's footsteps and elaborated on the issue of accumulated desire in intertemporal behavioral decisions, culminating in the establishment of two schools. The one embodied by Jevons' father and son [33] inherited the proclivity for accumulation and expanded the concept of expected utility. The researchers at this school discovered that individuals who possess the predicted utility are typically only concerned with their current utility. People will choose to delay consumption only when the increase in predicted utility is sufficient to compensate for the loss of primary utility. Individuals who place a premium on predicted utility go to great lengths to generate and leave more wealth for their country, society, and family, eroding their preference for time. Senior et al. [34] represented another group of scholars who created the concept of abstinence by lowering the desire for accumulation. This worldview is predicated on the premise that the group that adheres to abstinence is equivalent to the past, present, and future. People are more concerned with immediate utility than with delayed consumption, as delayed consumption results in self-control suffering. As a result of the abstinence concept, people are more likely to choose to consume in advance and have fun in the present, resulting in a drop in national income and savings and an increase in time preference. Abstinence promoters have a greater preference for time than accumulation promoters do.

With the birth of the neoclassical theory of time choice in the early twentieth century, the theory of time preference started its second stage of development. At the time, economists were interested in developing mathematical models based on classical time preference theory to express intertemporal consumption choices. In 1930, American economist Fisher [35] introduced the intertemporal choice problem using a two-commodity indifference curve and demonstrated that an individual's time preference rate is determined by the marginal utility of time preference and that time preference is a complex psychological motivator. Samuelson invented the discount rate and the exponential discounted utility model in Ref. [36]. This model incorporates the concept of discount rate and extends the standard term from two to numerous periods. The exponential discount model simplifies the process of calculating intertemporal utility, condenses the numerous complex psychological factors that influence time choice into a single objective discount rate, and generates a standardized theoretical model of time preference. Even though the exponential discount model's advice is in line with how compound interest is usually calculated, the model is based on the idea of a perfectly rational person, which makes it very unrealistic.

As experimental economics grew in the 1980s, researchers found that time preference may not match up with the neoclassical model, especially when it comes to discount rates in the exponential model. It varies according to the period, the characteristics of consumer goods, and the size of the subject matter. Simultaneously, scholars have begun to employ experimental methods to further quantify the discount rate in the model. For instance, Thaler's team discovered in the 1980s that certain anomalies in temporal preference may suggest a drop and reversal of the discount rate. Thaler et al. conducted a lottery-obtaining experiment in Ref. [37]; promising each participant a $15 lottery ticket of equal value. Participants can choose to use their $15 coupon immediately or wait to obtain more rewards. Thaler limited the time extension duration of the experiment to three options: one month, one year, or ten years, and asked participants to choose between them the projected time of receipt of the reward and the amount they were willing to claim as compensation for the delay. According to the experiment's findings, the average amount requested by participants was $20, $50, and $100 for three unique time delays of one month, one year, and ten years, respectively, with corresponding discount rates of 354%, 126%, and 19%. The researchers discovered that in another lottery-winning experiment, the discount rate may have reversed. Consumers would choose the former if offered $100 now over $110 tomorrow; they would prefer the latter if offered $100 in 30 days versus $110 in 31 days. The experiment will also last one day and will use the identical sum of $100. As a result of the instability in decision-making time coordinates, people's decisions will be inconsistent, causing the discount rate to reverse its trend. This result demonstrates that people's discount rates decrease over time.

In the 1990s, economist [38] established the concept of the short-term discount factor based on the exponential discount model, which was used to represent people's decreasing impatience, causing behavioral economics to develop a systematic time preference.

The hyperbolic discount model is a mathematical model that marks the beginning of hyperbolic discount theory. Laibson's hyperbolic discount model can be represented using a Formula (1).

$$U(t,s) = u_t + \beta \sum_{s=t+1}^{\infty} \delta^{s-t} u_s \tag{1}$$

As can be seen from the above Eq. (1), the discount factor structure of behavioral agent is shown as $\{1,\beta\delta,\beta\delta^2,\beta\delta^3\cdots\}$, in which the current utility is given weight 1. The coefficient δ is the standard discount rate indicating consistent time preference, and the coefficient β represents inconsistent time preference, reflecting people's self-control problem. The parameters t and s respectively represent the different periods in which the behavioral agent lives. In the majority of circumstances, the discount factor is restricted to a value range of 0–1. Laibson pioneered this strategy in attempting to explain why Europeans and Americans consume so much food. According to the study's findings, hyperbolic discounting may make it easier for individual consumers to succumb to the temptations of the current period, culminating in a generalized overconsumption habit.

In comparison to exponential discounting, hyperbolic discounting makes more realistic assumptions, is easier to compute, and is significantly more market-like. These qualities drew the attention of scholars during their investigation. Following that, scholars explored the hyperbolic discount model's applicability in a variety of contexts, focusing on the model's micro-level debate. Along with studies on consumption [39], related research has looked at procrastination [40], preference reversals [41], addictive behavior [42], principal-agent relationships [43], and financial product design [44].

When the research on the conduct of the governed and the governed under time preference was analyzed, it was observed that Chinese academics were more interested in topics of governance under time preference following the second millennium. The majority of pertinent research addresses time preference behavior from the standpoint of either the governor or the governed. Professor Ye of Jinan University's School of Economics was far early than other scholars in recognizing the importance of governance in time preference. Professor Ye [45] examined the effect of time preference on governors' conduct from the governors' perspective. As early as 2008, he noted in a report that the short-term system of local governments results in cognitive bias and, as a result, the phenomena of over-investment in local government governance. His research reveals that, as a result of their myopic cognition, local governments prioritize political accomplishment projects that promise a large amount of immediate cash in the short run. Local governments selectively postpone projects, such as environmental ones, that do not yield significant short-term revenues. Ye et al. [46] examined the myopia cognitive biases underlying local government's inability to reach an optimal inter-temporal implementation plan delay phenomenon and proposed the central government's "one ticket veto" appraisal system to assist local government in overcoming cognitive deviation and improving administrative efficiency.

Since then, a number of academics have explored environmental governance, food safety governance, tax governance, and financial governance. Cao and Hu [47] examined the influence of changing time preferences on investment decisions and supply chain performance in the context of carbon emission reduction through carbon emission management. They developed an intertemporal dynamic programming paradigm for decision makers whose time preferences are inconsistent. They discovered that temporal preferences influenced the anticipated utility of centralized and decentralized supply chain architectures. When decision-makers acquire less predicted utility, their temporal choices become more erratic. The government can exert significant influence over financial management by enhancing the management function of medium-term financial planning, emphasizing medium-term financial discipline, and establishing specialized intertemporal budget decision-making processes. According to Ref. [48]; local government officials will demonstrate inconsistent cognition when challenged with short- and long-term interests. Such naive thinking would result in a shift in government departments' willingness and behavior regarding food safety oversight, thus affecting the decision-making process of local government authorities. Li and Cai [49] studied the tax governance models used by local governments. They discovered that using hyperbolic discounting expands decision-makers' utility judgment from stationary time points to prolonged timelines, and that accounting for decision-makers' time preferences has a beneficial effect on local governments' tax scheme decisions. Zhang [50] researched the effect of government time preferences on financial governance and discovered that an intertemporal budget decision-making process might help reduce decision makers' dynamic inconsistency in their time preferences. Other publications investigate concerns of governance-related temporal preference from the governed sectors' perspective. For example, Ruan and Hu [51] examined the relationship between managers' time preferences and the incentive mechanism they use. Managers, they discovered, would engage in hedonistic behavior during the lock-up lifting period as a result of their contradicting temporal preferences, invalidating the equity incentive and degrading the managers' incentive mechanism. For example, Chen [52] identified the mechanism underlying myopic cognitive bias in state-owned enterprise CEO fraud and recommended the establishment of a fraud review committee, an independent director industry association, an executive integrity account, and other job fraud control strategies. Ruan et al. [53] investigated the relationship between corporate executives' time preferences and their incentive effects and discovered that their intertemporal choice preferences have a direct effect on their incentive effects. The longer the compensation term, the more detrimental the influence of time preference on the amount of effort CEOs are willing to put in becomes. According to Ref. [54]; enterprises' myopic cognitive biases boost their proclivity for counterfeiting, resulting in increased production of counterfeit and substandard goods.

From a review of the aforementioned literature, Chinese researchers continue to draw on the pioneering viewpoints of international scholars to illustrate their time preference theories in a variety of governance scenarios. The majority of governance research is concerned with how governors act in terms of their time preferences. Governance research has a tendency to focus on investment, taxes, and environmental protection, in accordance with governors' temporal preferences. There are limited insights from the perspective of the governed sector. As the Internet platform's economy has grown, online food safety has become a priority for the

government, the general public, and individuals from all walks of life. As a result of numerous online food safety issues, this study explores the fundamental causes of online food insecurity behavior and also presents related governance methods. The purpose of this study is to determine the root causes of online food safety breaches and to make policy recommendations for improving the efficiency of online food safety governance and monitoring through the use of time preference theory and a hyperbolic discount model.

Overall, we found that the majority of previous studies focused on the standpoint of food safety regulators, primarily to investigate the selection of behavioral strategies by regulators under various governance scenarios or to determine which governance systems are most effective. In this research, from the perspective of regulated online food enterprise, we examine the economic phenomena of myopic cognitive bias among online food enterprises. Due to cognitive bias, behavioral characteristics of online food enterprises would vary at different stages during the online food sales process, which may result in risky operating behavior. In this study, a hyperbolic discount model was developed to investigate the behavioral characteristics of online food businesses at various stages in the presence of cognitive myopia. We anticipate identifying important aspects influencing the safety of online food market supervision and proposing regulatory measures for government regulators in the near and far future.

3. Research methodology

Time preference variables may affect all parties involved in online food safety governance, not just governing bodies like as government offices or third-party platforms, but also supervised organizations such as online food resident corporations. For instance, government regulators' time preferences indicate that, in the pursuit of performance appraisal, local governments may prioritize investment projects with higher short-term returns while overlooking programs such as social governance that require long-term investment results and returns. Another example is the platform's choice for time preference. The platform may engage with its users to seek new benefits and occupy the market in order to achieve rapid scale expansion in the short term. In the case of food firms, their time preference results in their producing and selling harmful food at the expense of their reputation in order to maximize their illegal profits in a short period of time. While time preference variables impact all market participants, the governor's governance method will change in response to changes in established enterprises' conduct. As a result, by examining the governed sectors' time preference, an appropriate governing behavior can be recommended to the governor based on the governed sectors' behavior strategy alterations. The model chosen for this study is based on the time preferences of online food enterprises and does not bring government's time preferences into account.

During the creation of the food resident enterprises' intertemporal utility model, the occurrence scenarios of resident firms engaging in risky activity in the actual online food market are abstracted and optimized. In order to do research more effectively, we create an abstract research scenario based on a real-world event. In this context of online food safety governance, we believe that the enterprises of online food businesses are bounded rational economies. They are not fully rational economies. We postulate that online food businesses are bounded rational economies, which means that their behavior is consciously rational, but this rationality is constrained. They seek to maximize their personal gains, and as a result, their behavior will shift; that is, online food businesses will exhibit some cognitive bias. When the regulatory framework is somewhat lax, bounded rational people may sell dangerous foods for substantial profits. However, when regulatory environments are somewhat stringent, online food enterprises usually tend to sell safe food.

It is possible that an enterprise will choose to supply harmful food in order to swiftly boost its income in order to maximize its own interests. The occurrence of dangerous food sales by established firms involves a procedure in which established enterprises must measure the illegal earnings from unsafe food sales against the costs of investigation and punishment, and then decide if their illegal actions are worthwhile. To accurately characterize the intertemporal utility of food resident firms, the sales link is divided into three stages: decision-making, occurrence of sales behavior, and punishment of resident enterprises selling dangerous food. In the decision-making stage, the online food enterprise makes the decision whether to sell safe food or not, and then the online food enterprise enters the occurrence period of food sales behavior. In this process, if the online food enterprise selling unsafe food is found by the government regulator, it will be punished accordingly. Besides, because the market supervision department retains the regulatory authority with the capacity to enforce and penalize, the emphasis is on the government's governance of the food resident enterprise during the process of establishing the food resident enterprise's inter-temporal utility model. As a result, the punishment for businesses that settle in online food is limited to the penalty imposed by the government department on the settled firms during the model's development.

The primary objective of this study is to recommend appropriate governance strategies based on the behavior of established organizations. The research examines how resident enterprises' behavior in selling unsafe food has changed over time by developing an intertemporal utility model of food resident enterprises and analyzing the corresponding governance decisions that government administrators should make at various stages of the resident enterprise's behavior. This chapter demonstrates that in the online food sector, there are n firms that sell the same type of food. Assume that established firms have two strategies: they can choose to sell safe food or they can choose to sell dangerous food. The cost of selling safe food online is c_H, the cost of selling dangerous food is c_L, and the cost of selling food online is b. Online food businesses may be run by individuals who have a preference for myopic cognitive bias due to their time constraints. The hyperbolic discount model (1) can be used to describe this myopic cognitive bias, and the hyperbolic model can then be used to determine the inter-temporal utility model of food-enterprising businesses. Long-term and short-term discount factors are denoted by δ and β, respectively. The δ denotes the consistent time preference, which is equivalent to the standard discount rate. The β represents the inconsistent time preference, which is used to describe the myopic cognitive bias of settled online food enterprises. The smaller the value of β, the more myopic settled online food enterprises are. In the formula, the values of β and δ are between 0 and 1.

In this study, we analyze the decision-making behavior of food businesses in three phases, i.e., we assume that food business decision-making is separated into three phases: T = 0, 1, and 2. T = 0 is the interval during which established businesses decide whether or not to offer dangerous food. At this point, food businesses are merely planning their future behaviors, not putting them into action. T = 1 represents the real behavior of the established businesses selling dangerous food. This is the time when food companies begin to sell products and gain revenue. Food firms may have the option of selling either safe or dangerous food during this process. If the food resident enterprise sells safe food, the enterprise can earn $b - c_H$ from each unit of food sold; if the food resident enterprise sells hazardous food, the enterprise can earn $b - c_L$ from each unit of food sold. The quantity of safe food sold is $n- \omega$ if the total quantity of food sold by the food resident enterprise during the operation process is n and the quantity of dangerous food sold is ω. When T = 1, the food enterprises' immediate income is $(b - c_H)(n - \omega) + (b - c_L)\omega$. T = 2 is the penalty period during which the market monitoring department punishes established businesses for engaging in risky business practices when selling food online. If the food resident enterprise chooses to sell unsafe food in period T = 1 and is investigated and punished by the market supervision department, it will be punished in period T = 2, and the enterprise will be fined $\lambda\omega^2$ for violating relevant food safety regulations, including administrative penalties and reputational losses. λ is the coefficient for detecting and punishing businesses who offer unsafe food. The chance that the government regulator discovers that the established business provides dangerous food is p. The discount factor structure of food firms can be described as $\{1,\beta\delta,\beta\delta^2,\cdots,\beta\delta^t\}$, according to the hyperbolic discount model. That is, between the future T period and T+1 period (long-term), the discount factor utilized by settled firms is δ, whereas between the 0 period and the 1st period (short-term), the discount factor is $\beta\delta$. Main parameters and their related meanings were presented in Table 1 below.

When T = 0, the food resident enterprise is in advance of the sales planning stage, and the food resident enterprise's objective function is represented in Formula (2):

$$\pi_i = \beta\delta[(b - c_H)(n - \omega_0) + (b - c_L)\omega_0] - \beta\delta^2 p\lambda{\omega_0}^2 \tag{2}$$

Taking the derivative of ω_0 in the objective function, we can get Formula (3) and Formula (4),

$$-\beta\delta(b - c_H) + \beta\delta(b - c_L) - 2\beta\delta^2 p\lambda\omega_0 = 0 \tag{3}$$

$${\omega_0}^* = (c_H - c_L) / 2\delta p\lambda \tag{4}$$

When T = 1 and T = 2, that is, in the process of selling food, the corresponding objective function of the resident enterprise can be expressed by Formula (5).

$$\pi_i = [(b - c_H)(n - \omega_1) + (b - c_L)\omega_1] - \beta\delta p\lambda{\omega_1}^2 \tag{5}$$

The profit generated by the sale of safe and dangerous food in the first period; and the discount of the loss generated by the sale of unsafe food after the discovery in the second period. ω_1 can be used to derive the optimal goal function at this time. As shown in Formula (6) and Formula (7) below.

$$-(b - c_H) + (b - c_L) - 2\beta\delta p\lambda\omega_1 = 0 \tag{6}$$

$${\omega_1}^* = (c_H - c_L) / 2\beta\delta p\lambda \tag{7}$$

Because settled enterprises have myopic cognitive biases, it can be seen that when the settled enterprises have myopic cognitive biases, ${\omega_1}^* > {\omega_0}^*$, the quantity of unsafe food sold by the enterprise is greater than the quantity of safe food sold, and the enterprise's unsafe business behavior may intensify, resulting in network problems. Food safety concerns are becoming more important in the food sector. We define $\Delta\omega^* = {\omega_1}^* - {\omega_0}^*$ is the difference between the quantity of unsafe food sold by food resident firms during the period of sales behavior and the period of decision-making, which will be referred to in the following as myopic unsafe online food quantity deviation. Formula (8) can then be inferred.

Table 1
Main parameters and their related meanings.

Parameter	Implication
b	The income of online food sales of settled enterprises
n	The total number of online food products sold by settled enterprises
ω	The number of unsafe online food products sold by settled enterprises
c_H	The cost input when the settled enterprise sells safe food
c_L	The cost input when the settled enterprise sells unsafe food
λ	penalty coefficient
p	Probability of finding unsafe food for sale
δ	Long term discount factor
$\beta\delta$	short term discount factor
g	perfection degree of the governance structure of settled enterprises
N	The frequency of unsafe operation behavior of settled enterprises
ε	The prevalence of unsafe business behavior in the online food market
R	Standard of penalty intensity of settled enterprises
D	Information disclosure degree of food enterprises
G	The degree of local government protectionism

$$\Delta\omega^* = \omega_1{}^* - \omega_0{}^* = \frac{c_H - c_L}{2\beta\delta p\lambda} - \frac{c_H - c_L}{2\delta p\lambda} = \frac{(c_H - c_L)(1-\beta)}{2\beta\delta p\lambda} \tag{8}$$

We deduce the inter-temporal utility model of food resident firms using Formula (8) and arrive at Proposition 1 as follows.

Proposition 1. *With the increase of the myopic cognitive bias coefficient and the penalty factor of the online food enterprises, the myopic unsafe online food quantity deviation will decrease.*

In Formula (8), take the derivative of β and λ respectively to get Formulas (9) And (10).

$$\frac{\partial\Delta\omega^*}{\partial\beta} = -\frac{(c_H - c_L)}{2\beta^2\delta p\lambda} < 0 \tag{9}$$

$$\frac{\partial\Delta\omega^*}{\partial\lambda} = -\frac{(c_H - c_L)(1-\beta)}{2\beta\delta p\lambda^2} < 0 \tag{10}$$

The proof of Proposition 1 shows that the myopic cognitive bias factor has an impact on the occurrence of unsafe business behavior among settlement enterprises, and that this influence manifests itself as the lower the myopic cognitive bias factor of settlement enterprises, the higher the number of myopic network food. Furthermore, the penalty coefficient has an effect on the occurrence of risky business practices by businesses. The number of myopic online food will increase if the penalty coefficient is lower. Because of the existence of myopic cognitive bias, businesses' decisions to sell dangerous food vary with time. Because the firms in the settlement will not feel the difference between the discount factor in the short and long run, there is no noticeable time deviation during the decision-making period. In general, the settlement's businesses will not believe that selling dangerous food yields relatively substantial unlawful profits in the short run. As a result, businesses joining the market during the decision period are unlikely to offer a considerable quantity of dangerous food. However, during the period of sales behavior (T=1), due to the presence of myopic cognitive bias factor β, the discount factor of selling dangerous food is $\beta\delta$, which is smaller than the long-term discount factor δ, Food businesses will opt to sell more dangerous food if they are influenced by myopic cognitive bias. At this point, if the food into the company sales of unsafe food behavior has not been investigated and punished by regulators in a timely manner, enterprises will reap greater benefits in the short term than sales of safe food illegally. This may lead to enterprises knowingly selling unsafe food illegally in order to obtain more benefits and increase their sales of unsafe food.

The myopic cognitive bias of the companies will lead to the occurrence of the enterprises' unsafe food selling behavior, according to the analysis of the hyperbolic discounting model. The myopic cognitive bias element and penalty factor in Proposition 1 are further examined in order to develop the network food safety governance method based on the existing hyperbolic model. Based on preliminary research and literature review, it has been discovered that the governance method of platform firms, the frequency of corporate fraud, and the herd effect have a substantial impact on their business behaviors [55,56]. This study hypothesized that factors such as the degree of perfection of corporate governance structure g, the frequency of unsafe business behaviors N, and the prevalence of unsafe business behaviors in the online food market ε could influence the myopic cognitive bias factor of food enterprises on the Internet. Furthermore, it is expected that the lower the myopic cognitive bias factor of the firms, the higher the frequency of dangerous food sales and the prevalence of unsafe business activity in the online food market. The bigger the element of myopic cognitive bias, the higher the degree of improvement in corporate governance structure. Suppose a function $\beta = f_1(g,N,\varepsilon)$, and consider a special form of $\beta = g/(N+\varepsilon)$ to represent the relationship between variables. Furthermore, the severity of government punishment for businesses is linked to the government's ability to perfect relevant laws and regulations, the degree of enterprise information sharing, and local protection behaviors [57–59]. As a result, in the case of an online food market, market regulators to unsafe network food into enterprises punishment coefficient of the size of the set may be associated with network of food safety laws and regulations of occupancy business unsafe behavior punishment standard R, government information disclosure in the food into enterprise D, government in enterprise safety management behavior of the degree of local protectionism G. The higher the standard of punishment for unsafe business behavior of enterprises in network food safety related laws and regulations, and the higher the degree of disclosure of unsafe business behavior of enterprises in network food safety, the higher the punishment coefficient of enterprises in network food safety will be, it is assumed. The lower the government's penalty coefficient for businesses selling food online, the higher the level of local government protectionism. Suppose a function $\lambda = f_2(R,D,G)$, and consider a special form of $\lambda = (R+D)/G$ to represent the relationship between variables.

Substitute $\beta = g/(N+\varepsilon)$ and $\lambda = (R+D)/G$ into Formula (8) to get Formulas (11) And (12) below.

$$\Delta\omega^* = \frac{(c_H - c_L)(N+\varepsilon-g)}{2\delta p\lambda g} \tag{11}$$

$$\Delta\omega^* = \frac{(c_H - c_L)(1-\beta)G}{2\beta\delta p(R+D)} \tag{12}$$

Propositions 2 to 4 can be further deduced from formula (11) as follows.

Proposition 2. *The higher the frequency of selling unsafe food, the greater myopic unsafe online food quantity deviation in the food market.*

It is demonstrated that $\frac{\partial\Delta\omega^*}{\partial N} = \frac{(c_H - c_L)}{2\delta p\lambda g}$ can be derived by taking the derivative of Formula (11) with regard to N. There is $\partial\Delta\omega^*/\partial N > 0$ because $c_H > c_L$ and $\varepsilon, \delta, p, \lambda, g$ have value ranges greater than 0. It may be deduced that the more frequently firms offer dangerous food, the more food they sell on the myopic network. The reason for this can be explained by the positive feedback loop inherent in the

network economy. The existence of a mutually reinforcing force between objects, dubbed a positive feedback mechanism, will serve to reinforce the existing development trend. In this situation, an increase in the number of entering firms selling harmful food could result in an increase in the quantity of myopic network food, as the approaching firms sell more unsafe food.

Proposition 3. *The greater the prevalence of unsafe food sales in the online food market, the greater myopic unsafe online food quantity deviation in the food market.*

It is proved that by taking the derivative of Formula (11) with regard to ε, $\frac{\partial \Delta\omega^*}{\partial \varepsilon} = \frac{(c_H - c_L)}{2\delta p \lambda g}$ can be obtained. There is $\frac{\partial \Delta\omega^*}{\partial \varepsilon} > 0$ because $c_H > c_L$ and the value ranges of δ, p, λ, g, N are greater than 0. The higher the prevalence of unsafe food sales by enterprises in the online food market, the more opportunistic online food sales. Its reason can be further explained by the network effect in the food market, which states that when the market is widespread in the company sales of unsafe food behavior, namely "herd behavior", food enterprises in enterprise behavior decisions are influenced by other unsafe behavior in the industry, and the influence of performance discrepancies in enterprises choose to sell more unsafe food.

Proposition 4. *The greater self-governance that online food firms have, the less myopic unsafe online food quantity deviation in the food market.*

It is proved that by taking the derivative of formula (11) with regard to g, $\frac{\partial \Delta\omega^*}{\partial g} = \frac{-(c_H - c_L)(N+\varepsilon)}{2\delta p \lambda g^2}$ can be obtained. There is $\frac{\partial \Delta\omega^*}{\partial g} < 0$ because $c_H > c_L$ and the value ranges of $\varepsilon, \delta, p, \lambda, N$ are greater than 0. It can be deduced that the greater the degree of self-governance of businesses selling online food, the less myopic online food sales. This demonstrates the critical nature of enterprise autonomy; when food enterprises have a sound governance structure, they can more accurately grasp the short- and long-term, local and global interests involved in the development process; even when the self-governance structure of enterprises in a settlement reaches a certain level of completion, it can be implemented without the involvement of other governance bodies. However, if the organization's governance system is incomplete, the enterprise is more likely to sell dangerous food.

Propositions 5 to 7 can be further deduced from Formula (12) as follows.

Proposition 5. *The higher the threshold of punishment for firms engaging in unsafe business practices under online food safety laws and regulations, the fewer myopic unsafe online food quantity deviation in the food market.*

It is proved that by taking the derivative of Formula (12) with regard to R, $\frac{\partial \Delta\omega^*}{\partial R} = \frac{-(c_H - c_L)(1-\beta)G}{2\beta\delta p(R+D)^2}$ can be obtained. There is $\frac{\partial \Delta\omega^*}{\partial R} < 0$ because $c_H > c_L$ and the value ranges of β, δ, p, G, R are greater than 0. *It* is reasonable to conclude that the higher the hurdle for corporations engaging in risky business operations under internet food-related laws and regulations, the less myopic enterprises operating in online food. This is due to the growing use of severer punishment in internet-based food safety monitoring. Severe punishment could be construed as the implementation of harsher consequences in the online rectification of food insecurity situations. To some extent, the harsher punishment diminishes the utility of firms participating in riskier operations in the online food market, but also serves as a disincentive for new food enterprises to enter the market. The stricter the punishment threshold for online food safety, the higher the constraint and deterrent effect on entering firms that operate in an unsafe manner in the market, resulting in entering enterprises offering less risky food.

Proposition 6. *The more information the government discloses about food businesses' dangerous business methods, the fewer myopic unsafe online food quantity deviation in the food market.*

It is proved that by taking the derivative of Formula (12) with regard to D, $\frac{\partial \Delta\omega^*}{\partial D} = \frac{-(c_H - c_L)(1-\beta)G}{2\beta\delta p(R+D)^2}$ can be obtained. There is $\frac{\partial \Delta\omega^*}{\partial D} < 0$ because $c_H > c_L$ and the value ranges of β, δ, p, G, R are greater than 0. It can be concluded that the more information the government discloses about food firms' harmful business practices, the less myopic online food enterprises there are. The reason for this can be explained by the existence of information asymmetry in the online food market; consumers face a significant information asymmetry disadvantage when compared to food enterprises in the online market when it comes to obtaining information about the quality and safety of the food sold, and enterprises in the online market simply take advantage of this disadvantage to pursue illegal benefits. As a result of the government's information disclosure in safety management behavior, it is possible to reduce the degree of information asymmetry between consumers and located enterprises, preventing located enterprises from exploiting information asymmetry illegally, thereby regulating the behavior of network food enterprises in terms of enterprise safety management and resulting in a decrease in the quantity of unsafe food sold.

Proposition 7. *The lower the level of local government protectionism in the online food market, the less myopic unsafe online food quantity deviation in the food market.*

It is proved that by taking the derivative of Formula (12) with regard to G, $\frac{\partial \Delta\omega^*}{\partial G} = \frac{(c_H - c_L)(1-\beta)}{2\beta\delta p(R+D)}$ can be obtained. There is $\frac{\partial \Delta\omega^*}{\partial G} > 0$ because $c_H > c_L$ and the value ranges of β, δ, p, R, D are greater than 0. It can be deduced that the lower the government's level of local protectionism, the fewer myopic online food enterprises. During the early stages of emerging market development, government protection and inclusivity can help foster the growth of emerging markets to a certain extent. When inclusive monitoring devolves into local protectionism, however, it demonstrates the government's excessive market intervention. Local protectionism may result in adverse selection in the online food market, as "bad money drives out good money", disrupting not only the regular order of the online food market economy, but also easily resulting in market failure and unfair competition in the online food purchasing environment. Local government protectionism has a stronger impact on internet food enterprises, which sell more dangerous food.

4. The result of study

In this study, we constructed a hyperbolic discount model to explore the food sales behavior of online food enterprises in different stages under myopic cognitive bias, and analyzed the model extrapolation. On this basis, further simulation experiments were carried out. We chose the simulation experiment for two purposes. Firstly, through numerical simulation test, we can more vividly present the derived results in the formula as a figure, which can more clearly show a change relationship between variables, so that readers can better understand the influence of different factors on the change of online food enterprises' behavior. To validate the proposition's pertinent conclusions, to depict the influence of various variables in the proposition on the quantity of food entering the enterprise more vividly and intuitively, and to depict the intensity of the influence of various variables, the relationship between variables in the proposition can be further demonstrated through numerical simulation experiment. Secondly, we consider some realistic background of food safety supervision in the process of simulation experiment design, that is, the selection of parameters is based on the realistic consideration of real online food safety supervision to a certain extent, which can better reflect the actual online food supervision market. A simulation experiment is designed in two parts. To begin, in accordance with Proposition 1, a relationship between the coefficient of myopic cognitive bias, the penalty factor, and the quantity of myopic network food was simulated. After that, a relationship is simulated between the variables in Propositions 2–7 and the myopic unsafe online food quantity deviation.

We set high and low values of myopic cognitive bias coefficient and penalty coefficient, in order to more vividly and intuitively find some rules of behavior change of enterprises in the online food market through simulation results. In the parameter setting, in fact, we also follow some rules. For example, food delivery platforms in China usually set a minimum consumption amount for delivery. Usually, some online food platforms such as Eleme and Meituan will set it to 15RMB. When we take an order of 15RMB as an example, after deducting various fees charged by the platform, we set the costs of online food enterprises as 8 RMB when selling safe food, and 3 RMB when selling unsafe food in the process of online sales. For the myopic cognitive bias coefficient of online food enterprises and the punishment coefficient of the government, we selected two values, 0.2 and 0.8, respectively, to represent the changes in the sales behavior of online food enterprises under different degrees (high & low) of cognitive bias and government regulators under different degrees (high & low) of punishment. In addition, some other variables, such as the self-governance structure of the settled enterprises, the prevalence of unsafe selling behaviors, the standard of punishment, the degree of information disclosure, and the degree of local government protectionism, are all expressed by a relatively intermediate value of 0.5. Such parameter settings can better reflect the influence of cognitive bias and penalty coefficient on the operation behavior of online food enterprises in most conditions. In addition, we also add the analysis part of the simulation results.

We conducted numerical simulations on assumptions 1–7 and generated the following eight figures. The parameter assignment values are indicated at the top of each graphic. Additionally, Fig. 1–8 depict the change in food quantity in a myopic network. To make the simulation results more visually appealing, we set a value of 0.2 for the component of myopic cognitive bias and 0.8 for the penalty factor. Figs. 1–8 illustrates the deviation trend of several variables on the myopic unsafe online food quantity deviation.

A numerical simulation is performed on Proposition 1 under the assumption that parameter $c_H = 8, c_L = 3, \delta = 0.5, p = 0.5$. Simulation results indicate that when other variables are accounted for and the myopic cognitive bias factor of established businesses increases, the myopic unsafe online food quantity deviation $\Delta\omega^*$ falls swiftly and changes dramatically (see Fig. 1). Moreover, assuming that $\lambda = 0.8$ and $\lambda = 0.2$ represent the higher and lower punishment factors of government departments for unsafe business behaviors, it was discovered that, when the other variables are relatively certain, the higher government punishment factor can accelerate the reduction rate of the myopic unsafe online food quantity deviation. In Proposition 1, we also model the relationship between the government punishment element and the myopic unsafe online food quantity deviation. The simulation results indicate, assuming parameter $c_H = 8, c_L = 3, \delta = 0.5, p = 0.5$, that as the government's punishment factor grows and other variables are

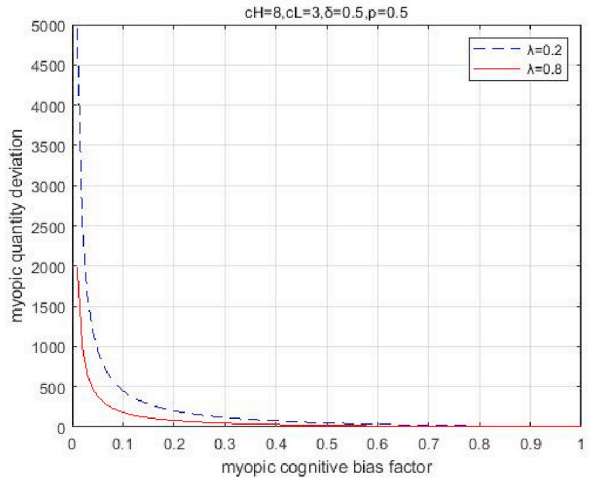

Fig. 1. Myopic cognitive bias factor & myopic unsafe quantity deviation.

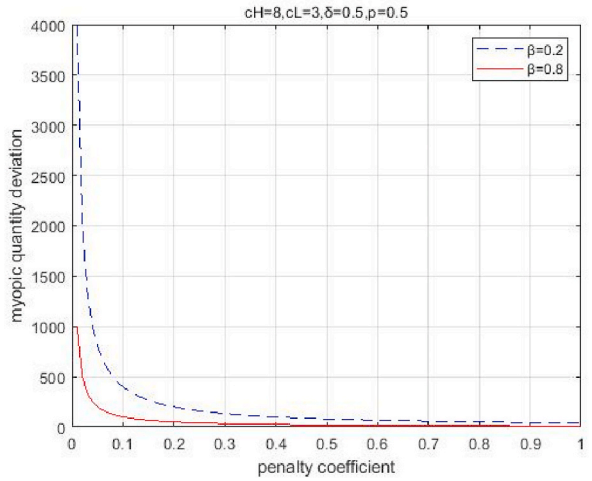

Fig. 2. Penalty coefficient & myopic unsafe quantity deviation.

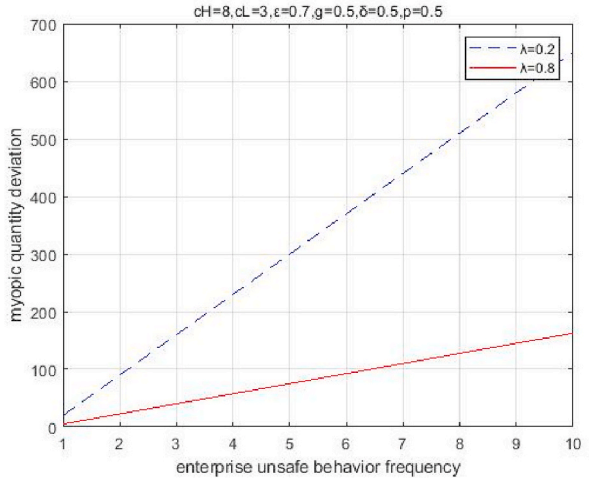

Fig. 3. Unsafe behavior frequency & myopic unsafe quantity deviation.

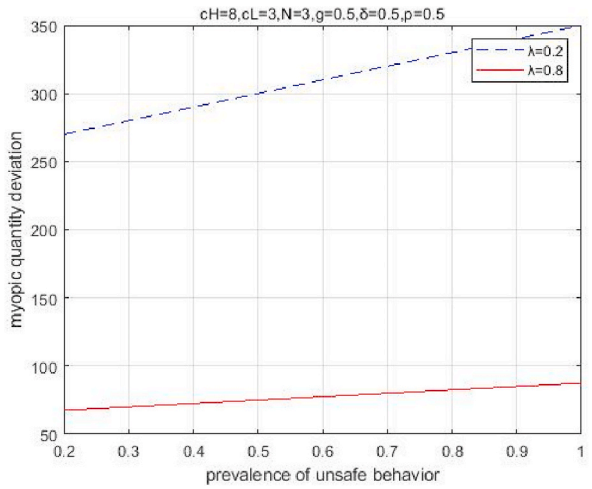

Fig. 4. Prevalence unsafe behavior & myopic unsafe quantity deviation.

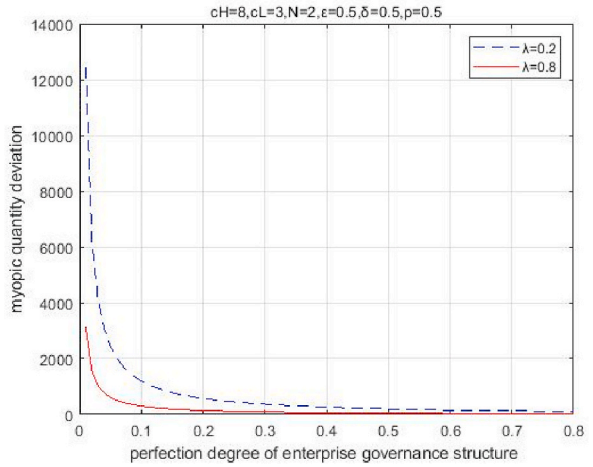

Fig. 5. Enterprise governance structure & myopic unsafe quantity deviation.

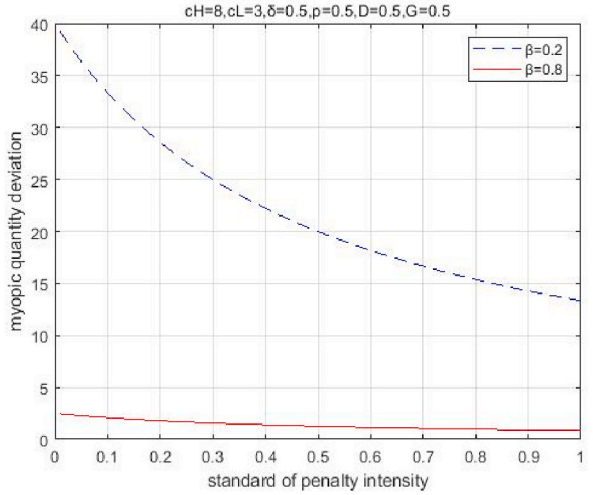

Fig. 6. Penalty intensity standard & myopic unsafe quantity deviation.

established, the myopic unsafe online food quantity deviation $\Delta\omega^*$ drops swiftly and varies dramatically (see Fig. 2). Also, if we assume that $\beta = 0.8$ and $\beta = 0.2$ represent larger and smaller myopic cognitive bias factors, respectively, we find that, when other variables are generally known, higher myopic cognitive bias factors of entering firms might speed up the rate of myopic online food quantity reduction.

The simulated experiment of Proposition 2 allows for a more intuitive examination of the effect of N on the myopic unsafe online food quantity deviation. Assuming parameter $c_H = 8, c_L = 3, \varepsilon = 0.7, g = 0.5, \delta = 0.5, p = 0.5$, the simulation findings indicate that when other variables are held constant, the more frequently online food businesses offer unsafe food, the bigger myopic unsafe online food quantity deviation. In this situation, food businesses are more likely to sell dangerous food (see Fig. 3). Likewise, it has been discovered that the punishment element of government oversight will also have an effect on $\Delta\omega^*$. It has been found that the increased punishment part of the government's department of oversight can slow the myopic unsafe food quantity deviation that can be bought online.

The simulation experiment of Proposition 3 allows for visual observation of the effect of ε on the myopic unsafe online food quantity deviation. Assuming parameter $c_H = 8, c_L = 3, N = 3, g = 0.5, \delta = 0.5, p = 0.5$, the simulation findings indicate that when other variables are held constant, the prevalence of risky operations in the online food market will increase the myopic unsafe online food quantity deviation. In this situation, food businesses are more likely to sell dangerous food (see Fig. 4). Simultaneously, a higher penalty factor imposed by government regulatory agencies can limit the myopic unsafe online food quantity deviation.

The simulation experiment of Proposition 4 allows for a more intuitive examination of the effect of g on the myopic unsafe online food quantity deviation. Assuming parameter $c_H = 8, c_L = 3, N = 2, \delta = 0.5, p = 0.5, \varepsilon = 0.5$, the simulation findings indicate that when other variables are held constant, the more perfect the governance structure of the food settlement company, the smaller the

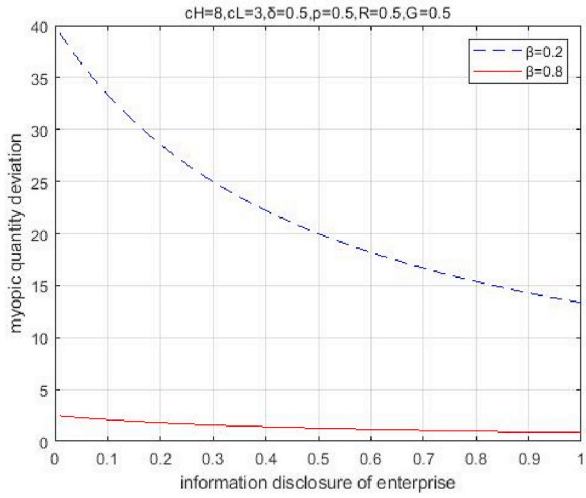

Fig. 7. Information disclosure & myopic unsafe quantity deviation.

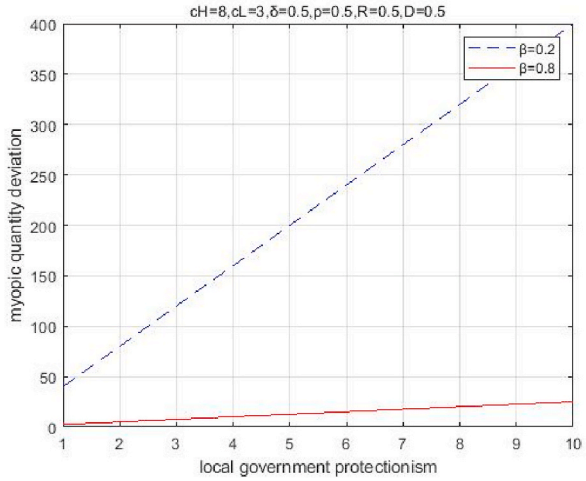

Fig. 8. Local government protectionism & myopic unsafe quantity deviation.

variance in the myopic unsafe online food quantity deviation. In this instance, the online food enterprises will sell a greater proportion of safe food (see Fig. 5). Simultaneously, a bigger punishment factor of government regulatory agencies can expedite the rate of decrease of the myopic unsafe online food quantity deviation.

The simulation experiment of Proposition 5 allows for visual observation of the effect of R on the myopic unsafe online food quantity deviation. Assuming parameter $c_H = 8, c_L = 3, \delta = 0.5, p = 0.5, D = 0.5, G = 0.5$, the simulated results indicate that when other variables are held constant, the stricter the punishment of online food safety standards, the less the variance in the amount of the myopic unsafe online food quantity deviation. In this circumstance, online food enterprises will likely sell safer food (see Fig. 6). Simultaneously, a larger myopic cognitive bias factor can also handle the myopic unsafe online food quantity deviation of new enterprises better than a smaller myopic cognitive bias factor.

The simulated experiment of Proposition 6 allows for a more intuitive observation of the effect of D on the myopic unsafe online food quantity deviation. Assuming parameter $c_H = 8, c_L = 3, \delta = 0.5, p = 0.5, R = 0.5, G = 0.5$, the simulated results indicate that when other variables are constant, the higher the information disclosure degree of the unsafe operation behavior of the online food enterprise, the smaller the myopic unsafe online food quantity deviation, and the food enterprise will tend to sell more safe food (see Fig. 7). The myopic unsafe online food quantity deviation is better controlled by the high myopic cognitive bias factor than it is by the low myopic cognitive bias factor.

The simulation experiment of Proposition 7 allows for a more intuitive observation of the effect of G on the myopic unsafe online food quantity deviation. Assuming that $c_H = 8, c_L = 3, \delta = 0.5, p = 0.5, R = 0.5, D = 0.5$, the simulated results indicate that when other variables are constant, the greater the degree of protectionism of local government, the greater the myopic unsafe online food quantity deviation, and the food enterprise will tend to sell less safe food (see Fig. 8). The myopic unsafe online food quantity deviation is better

controlled by the high myopic cognitive bias factor than it is by the low myopic cognitive bias factor. The emergence of local government protectionism may, to some extent, play a relatively protective role in local economy. But from the macro level, local government protectionism may lead to serious market segmentation and the potential risk of monopolizing the market. If the unsafe herd behavior in the online food market is common at this time, and the local government adopts a high degree of local protectionism, then the government's local protectionism will not benefit the healthy and safe development of the online catering market. The existence of government protectionism will hinder the online food market to provide safe and reliable food continuously and effectively. It is suggested that government departments need to balance the degree of their own supervision and the degree of protection for enterprises in the process of supervision. That is, excessive regulation will lead to the decline of market vitality, but excessive protection will not be conducive to the healthy and prosperous development of the entire online food market.

5. Short-term and long-term supervision strategies

5.1. Short-term supervision strategies

According to Propositions 2–4, three short-term governance strategies for online food safety governance can be advanced.

Strategy 1: Strengthen the implementation of the "three strikes and you are out" policy of online food safety governance.

The greater the frequency with which online food businesses are exposed to selling dangerous food throughout the process of supervision, the greater the enterprise selling unsafe food fraud impulse. If these online food businesses just have to follow the rules and regulations that are already in place, it will be hard to stop them from selling unsafe food.

To secure the safety of the online food market, optimize the business environment of the online food market, and minimize the quantity of unsafe food sales, policies such as "severe punishment for repeat offenders" or "three strikes and you're out" can be implemented to control the conduct of online food enterprises. This is because if the frequency of supervision spot checks is too low or if the punishment is not strong enough, bounded rational food businesses will continue to commit fraud in the face of high earnings. In 2015, the amended Food Safety Law of the People's Republic of China included the "three strikes and you're out" system, which applies to administrative penalties in the process of traditional food safety management [60]. In accordance with the requirements of the "three strikes and you're out" policy, if a food business enterprise has been investigated and dealt with more than three times within a year for violating the relevant provisions of the law, the market supervision department should order the suspension of production and the revocation of its business license. Due to its virtual nature, the online food industry is riskier than the traditional food market. Therefore, the "three strikes and you're out" policy of traditional food safety governance could be introduced to the governance process of online food market in order to prevent enterprises from engaging in risky business practices. In fact, online food safety incidents in China occur frequently. A typical case in point is the national consumer right television show in 2016, which exposed the criminal activity of numerous Beijing takeout businesses selling unsafe food. Photos released and depicted by online food ordering platforms were all light and spacious physical storefronts, with clean cooking burners and an assortment of food items. However, an undercover inspection discovered that the businesses lacked physical storefronts, operating permits, and did not meet sanitary conditions. After the issue came to light, the Beijing Market Supervision Bureau centralized the governance of online restaurants in various regions. After more than 40 instances of combined law enforcement, more than 1200 unlawful small catering businesses were shut down. However, shortly after the focus of the enforcement was removed, these unlawful tiny restaurants returned and continued to operate in silence. Another typical case was occurred in 2018 in Hefei city, when a food company offered takeout food packets with outdated and contaminated components. The company re-heats these inexpensive takeout packets, which cost only a few cents, and sells them for 20 RMB, with daily sales exceeding 200,000 units. After the issue came to light, the Hefei Market Supervision Bureau demanded that the company cease operations. However, following a brief time of correction, the company's food is back on the shelves. In light of the difficulty in eradicating the illegal practice of selling unsafe food on the online food market, we believe that the "three strikes and you're out" policy could be applied to the governance process of online food safety, and severe punishment should be imposed on recidivist online food enterprises in order to reduce the likelihood of unsafe business conduct. The primary effect of "severe penalty for serial offenders" or "three strikes and you're out" is to increase the expense of illicit online food businesses. However, the oversight of regulators on businesses repeatedly acting illegally will have a direct effect on the cognitive deviation of businesses in the online food market, thereby controlling the behavior of those selling unsafe food in the online food market in a short period of time.

Strategy 2: Strengthen the control of the leading enterprises in the online food market.

Faced with the prevalence of illicit sales of unsafe food on the market, the accompanying punishments can vary in accordance with the operational scale of online food businesses. In August 2022, a food safety supervision and punishment case attracted widespread attention in Chinese society. A tiny self-employed business owner in Yulin, Shaanxi province, who sold 5 kg of celery was fined 66,000 RMB for failing to show proof of purchase. After conducting an investigation, the state council inspection team determined that the Yulin market supervision bureau had sanctioned infractions. And if you consider the consequence of achieving twice the result with half the work, the focus of industry oversight should be on fraudsters and enterprise leaders [61]. Due to the conduction effect of the online enterprise safety operation behavior in the food market, the head has a significant impact on the enterprise industry. By strengthening the governance and control of the unsafe business behavior of the larger enterprises in the food market, the medium and small-scale food enterprises can form a warning and awe, "punish one to warn others" effect, thereby reducing the group effect of unsafe business conduct in the industry. In practice, the supervision of food businesses adheres to this idea. Whether it was more than a decade ago, the Chinese government to former dairy giants Sanlu, Yili, Mengniu, or in the rapid development of the online economy against the backdrop of market regulators to the giant food company Hema, such regulation demonstrates the government's "care" for the online food industry leading enterprises. Particularly in the governance of online food safety in the context of the post-COVID-19

pandemic, the government pays greater attention to handling major cases, strengthens the supervision of leading enterprises, warns numerous business entities in the market of their potential for fraud, and optimizes the market's business environment. Some leading enterprises in the online food retail industry have been exposed in recent years for their unsafe online operations. For example, the People's Daily highlighted Hema, an Alibaba affiliate, for selling stinky seafood and dead shrimp online during the outbreak of COVID-19. The current positioning of the "high-end snacks" brand of three squirrels in the food peroxide value exceeds the standard. With the backdrop of the growth of the platform economy, a number of significant conventional food companies have experienced food safety concerns in their online food sales. Yonghui Supermarket, which ranks among the top three in the supermarket retail industry, has exposed 14 batches of food that it sells online in the first quarter of 2021 in three cities in Fujian Province as unqualified. It is not difficult to observe that the "large" companies in the online food market are rapidly becoming the "focus" of the market monitoring division. When these food businesses are primarily overseen by the government, the unsafe operating behavior of relatively small businesses will be regulated to a certain level, hence reducing the likelihood that unsafe food being sold in the online market.

Strategy 3: Guide online food enterprises to improve their own governance structure.

According to the above analysis, the cognitive deviation of fraud in online food enterprises is attributed to the myopic factor, and in reality, the governance structure of online food enterprises is a constraint of the myopic element. When the administration of food enterprises in the online food market is more refined, the variance in the quantity of myopic online food in the market would decrease, and online food firms will prioritize long-term interests over immediate short-term profits. To protect the safety of the online food market, government regulators could assist food companies in enhancing their governance [62]. The government regulators can make efforts in two different ways. First, when food businesses enter the online food ordering platform, the government supervision department will regulate their rights and obligations to ensure that online food enterprises realize the significance of safe operation. Government regulators should make businesses more aware of their primary responsibility, how to follow the law, and how to avoid risks. They should also help online food enterprises keep improving their governance structure. Before the food enterprises officially enter the platform, the government market supervision department can organize the food enterprises to learn relevant laws and regulations and online food safety operation standards, so that the settled enterprises strictly adhere to the operation process from registration to food procurement, storage, processing, cooking, meal preparation, and distribution. Jiangxi and Guangdong provinces are currently leading the nation in implementing the market supervision department's management standards for food enterprises, clearing food operations, enhancing risk prevention awareness, and constructing a solid network food safety barrier. Second, before food enterprise enterprises enter the platform, government regulators strengthen the requirements for Internet food enterprises to enter the platform via a variety of learning forms, guide online enterprises to cultivate good faith management consciousness, and establish a strong sense of social responsibility in order to improve the governance structure of online food enterprises. For instance, in 2019, the Shanghai Market Regulation Bureau developed "Food Safety Class", the nation's first learning platform for online food practitioners, and opened exclusive accounts for online food producers and enterprises. "Food Safety Class" is a brief video course that teaches businesses the necessary requirements for joining the platform. Through standardized operation teaching, government regulators can help online food enterprises regulate their behavior in a relatively short period of time and help enterprises improve their own governance structure.

5.2. Long-term supervision strategies

Propositions 5-7 propose three long-term governance strategies for the online food safety governance process.

Strategy 1: Constantly improve the laws and regulations of online food safety supervision.

The more severe the penalty for violating online food safety laws and regulations governing the risky operating behavior of market enterprises, the less myopic market firms will be. Thus, in order to ensure the safety of online food markets and to restrict the amount of harmful food sold, more precise laws and regulations governing online food safety should be developed in order to create a system of online food safety legislation that is always evolving. This requires government agencies to expeditiously implement network food safety legislation and to pay close attention to its growth. On the one hand, government agencies should advocate for online food safety regulations in order to establish durable and stable safeguards for the Internet food market and a timely legal assurance for the rapidly growing Internet platform economy. China, for example, recently enacted a slew of related laws and regulations governing online food safety. Following the 2015 Food Safety Law's incorporation into online food safety supervision, the State Administration for Market Regulation issued three times in succession in October 2016, January 2018, and May 2021 ″Online food safety violations investigation measures", "Online catering service food safety supervision and management measures", "Online transaction food safety supervision and management measures", as well as other online food safety-related systems and regulations. On the other hand, while we should move quickly to build a legislative framework for online food safety, we should equally encourage its refinement. For example, the primary body's responsibility division in the online food market should be refined when developing online food safety laws and policies; optimize the network food safety management system's reward and punishment system; and food safety supervision and quantitative classification are ideal for a network catering service. We can make sure the online food market is safe to use by putting in place more and better laws and rules about online food safety.

Strategy 2: Continuously improve the transparency of food enterprises' qualifications and regulatory information.

The more the market supervision department publishes about enterprises' harmful business practices in the online food market, the less myopic the online food market will be. Thus, in order to ensure the safety of online food market operations and to reduce the number of dangerous food sales, information disclosure policies for online food enterprises should be strengthened. Given the government's authority and credibility with respect to food safety regulatory information, government agencies should take the lead in sharing and distributing regulatory data, ensuring that consumers exercise their right to know completely. Consumers face difficulty in

obtaining food safety information, in part because disclosure has lagged behind the pace of legislation. To ensure timely and effective disclosure of food safety information, the State Council's General Office issued the Key Points of Government Affairs Disclosure in 2017, requiring increased disclosure of food and drug regulatory information, as well as information on food and drug safety violations and associated penalties. Government oversight bodies should do an excellent job of disclosing information during the subsequent stages of online food governance. To begin, government regulatory agencies should establish a means via which customers may promptly and properly ascertain the business license, food production and operation license, and other critical credentials published by online food retailers. In June 2021, Shanghai demonstrated at this level. Shanghai's market supervision department took the lead in advocating for the nationwide integration of e-certificates (e-certificate of food business license) and licenses (e-business licenses) for food company operations. When consumers use the network platform to place an order, they gain access to the qualifications and real-time information of food providers who join the network via a QR code scan. Second, government regulatory authorities should report food sampling items, severe concerns, and sanctions on their websites on a regular basis. Government departments may be created via a column in an e-government platform to provide frequent updates on the network's food safety control, management, and exploration. By combining network information disclosure with electronic certification linkage, they enable consumers to learn about the qualifications of net-based food business enterprises while also learning more about net-based food businesses that have been sanctioned for maintaining illegal company records. Additionally, government organizations should advocate for the network's inclusion of customer ratings of food businesses. For example, market regulators in Shanghai's Pudong New Area are utilizing big data to develop a network of food safety application scenarios that enables direct evaluation of catering units and consumer direct push to wise regulatory application scenarios, which are then verified by territorial market regulators to ensure disposal, facilitate interaction between government and enterprises, and online linkage.

Strategy 3: Continuously improve the governance structure of government agencies.

Reducing government protection for food businesses will result in a fall in the number of myopic online food suppliers. Unsafe online food companies may develop as a result of local protectionism by the government. Thus, to end network government protectionism in the food market, ensure the security of online food market management, and reduce unsafe food sales, the government should develop and optimize internal and external governance structures that enable it to participate more effectively in the network of food safety regulation. On the one hand, because network food safety governance spans numerous departments, government agencies must excel at distributing power and responsibility throughout the process, boosting governance efficiency and eliminating collusion between government agencies and food firms. In response to the melamine food safety scare, the state established a food safety oversight system headed by the Food Safety Administration Commission, which is composed of eight ministries and commissions. In 2018, the State Administration for Market Regulation was established to further maximize the authorities and responsibilities of competent food safety management departments. The relevant branch established by the general administration of national market supervisors to participate in network food safety management currently consists of a law enforcement inspection bureau, a network trades to supervise management division, a food production safety to supervise management division, and a food management safety to supervise management division. Considering the participation of many online food safety governance institutions, the State Administration for Market Regulation should coordinate among various departments to avoid the possible "fuzzy zone" of the division of regulatory powers and responsibilities of the unclear division of the functions of various regulatory departments in the process of online food safety governance. On the other hand, government officials should build a system of social co-governance for online food safety that includes a broad variety of stakeholders. In comparison to traditional food safety governance, online food safety governance enables the incorporation of a greater range of sectors. The government should take the lead and coordinate efforts, develop a model for multi-party online food safety governance, and emphasize the involvement of third-party platforms, consumers, news media, and other multi-actors. For example, standardizing the governance rights and responsibilities of third-party platforms, encouraging consumer participation in governance through online comments, and making the most of the media's role as a watchdog are all ways to make sure that the different governance subjects in the online food market work together.

6. Conclusion

Based on the creation of a hyperbolic discount model from the standpoint of behavioral economics, this study conducted a comprehensive examination of the illegal behavior of online food businesses that sell dangerous food. It was discovered that the presence of cognitive biases with a short-term focus in online food enterprises would result in dangerous food sales behavior. The short-term online food quantity deviation of businesses will decrease as the cognitive deviation coefficient and penalty factor of online food businesses increase. Due to the existence of myopic cognitive bias, it is difficult for online food businesses to perceive the difference between the discount factor in the short term and the long term during the decision-making process. Therefore, they will not choose to sell a significant quantity of dangerous food. However, during the sales behavior phase, food-settled businesses will opt to offer more dangerous food due to myopic cognitive bias. If the behavior of food businesses that sell unsafe food isn't looked at and dealt with quickly by the supervision department, the businesses will soon make huge illegal profits, which could make them sell more unsafe food.

According to this paper's analysis, when faced with the dilemma of "campaign governance" in the online food market, it is more effective for government regulatory departments to build a safe and stable online food market environment by combining short-term and long-term measures. In the short term, the government should optimize the allocation of regulatory resources, for example, through the establishment of a blacklist, three strikes and you're out policy, and other systems that impose severe penalties for recidivism. At the same time, the government should focus on strengthening the supervision of the head food enterprises and on conducting short-term training and publicity activities for online food enterprises to improve their own management structures in

order to optimize the ecological environment. Long-term solutions for online food safety governance include developing an ideal online food safety rules and regulations system, improving online food business information disclosure, and strengthening the governance structure of government agency.

Combined with the research conclusions of this paper, some countermeasures and suggestions can be put forward for the third-party platform, the government, and the consumers to improve the efficiency of online food safety governance on the whole.

As a third-party platform for online commerce, it should take an active management role in online food businesses. While performing a good job with online information registration and sales process oversight, the platform should promptly report illegal activities of online businesses selling unsafe food to the government or inform the public in order to enhance its credibility. In addition, the platform should make full use of data linked to public opinion for mining and analysis, build a food safety risk warning mechanism, and enhance the self-awareness of food firms and merchants. In addition, the platform should also emphasize the important role of consumer participation in regulatory governance, encourage consumer groups to report and reward food safety problems, and guide the public to play an active supervisory role.

Government regulators should constantly optimize and perfect the supervision mode. Different regulatory duties can be categorized according to their employment of both short-term and long-term regulatory modes. In other words, government regulators should not only carry out the centralized regulation of online food safety and guidance of online businesses in the short term by using the necessary means, but should also plan the construction of an online food safety legal system in the long term and establish appropriate incentive and constraint mechanisms. Government regulators should encourage consumers, the media, and other social sectors to take part in the process of governing online food safety and create a social co-governance system for online food safety.

Consumers can actively participate in the food safety publicity campaigns organized by government regulators, comprehend the online food safety-related rules and regulations, and participate actively in food safety governance. When purchasing food through the online platform, consumers should also consider the elements such as online food enterprises' business license and reputation. For online food packaging and quality issues, consumers can protect their legitimate rights and interests by providing online food enterprises or online platforms with feedback and, if necessary, consumers can appeal to the government supervision department to safeguard their legitimate rights and interests.

As to limitation, due to the sensitivity of market supervision data and the fact that some measurement indicators are reaction degrees rather than precise numerical indicators, some data of actual online food safety supervision cannot be used in the numerical simulation portion of the model after it has been constructed. However, we assign values to these factors based on the status of the online food market's operation and control. In the future, we can employ techniques such as case analysis and empirical testing to investigate and examine the efficacy of online food safety governance in greater depth.

Credit authorship statement

All authors have read and agreed to the published version of the manuscript. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The article is the original work of all authors. We guarantee that this research is not submitted or published in other publication.

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