THE PSYCHOLOGY OF FOOD SAFETY AND CONSUMPTION

EDITED BY: Fu-Sheng Tsai, Xiao-Wei Wen and Shalini Srivastava
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THE PSYCHOLOGY OF FOOD SAFETY AND CONSUMPTION

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Editorial: The Psychology of Food Safety and Consumption

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Editorial on the Research Topic

The Psychology of Food Safety and Consumption

INTRODUCTION

Food safety and food security are both central issues for human welfare and well-being in modern society. The importance of these two issues has led global leaders to invest their efforts and capital heavily in improving food quality and governance. On the other hand, these issues as phenomena are especially critical when embodied in the context of food consumption. Issues regarding food safety, security, and consumption are greatly connected through psychological mechanisms. After all, it is the consumers' inner psychological and cognitive functions of food safety that may directly determine their intentions and behaviors toward food consumption. What might be equally important but long-neglected by empirical studies is the reverse logic that food consumption *per se* may alter consumers' psychological interpretation of food safety.

For either case, more innovative studies are required to advance our current knowledge, and to build a formal research stream. For example, trust in safety has long been examined as a vital factor in affecting food consumption, while the issues of "how," "when," and "why" daily or specific food consumption experiences may influence consumer's long-term trust in safety (and trust in "whom") have not been explored systematically. In such veins, further academic works are desired, in the topics such as the following: new psychological mechanism(s) exploration for food safety and consumption; research methodology and analytic approaches; contexts-specific (e.g., online food shopping) studies; integration with other disciplines (e.g., Sociology, Economics, Politics); comparative studies (e.g., same issues in different cultures or sub-cultures); further outcomes for the psychology of food safety and consumption (e.g., habit); policy- and governance-oriented studies/opinions; green and sustainable food safety and consumption, etc. New thoughts and insights need to be stimulated and generated for food safety and consumption research.

In the published Research Topic, several pioneer studies heeded the call and supported the intended development with their unique contributions. We will review these papers that successfully push the research frontiers of this literature and propose future possibilities in theoretical and practical developments. For integration, we develop a typology with two axes—level of analysis and physical vs. virtual spaces — to locate each of the published research's strategic position in the literature (see **Table 1** below).

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TABLE 1 | A typology of the published articles on food psychology.

Space / Level	Physical field	Virtual field
Macro-level	He et al. (cost-sharing strategy in food supply chains) Huang and Lin (food governance as a psychological mechanism for poverty alleviation) Hu et al. (Price policy of raw milk) Chen et al. (Food and environment and green eating)	Liu and Lin (online food shopping)
Meso-level	Liu and Lin (organizational culture and food safety construction) Meng et al. (Consumer behavior → social co-governance) Hu et al. (Global trade networks of dairy food) Nie et al. (balance between food safety control and food quality improvement)	Lin and Wu (food traceability system) Tsai et al. (System attributes of continuance intention toward food safety information from social media)
Micro-level	Wu et al. (comprise effect in consumer choice) Shan et al. (framing and anchoring effects and consumer intention) Ruangkanjanases et al. (green purchase behaviors) Xu et al. (Decoy effect and purchase for welfare animal product)	You et al. (purchase Intention of Organic Food *via* Social Media)

RESEARCH FRONTIERS AND IMAGINATION FOR FUTURE STUDIES

Wu et al. tried to uncover the face of the compromise effect in the specific context of consumer choices for food products. Having been well-discovered in general consumer behavior research, the compromise effect has not yet been examined well in the food consumption circumstance. The researchers investigated pork purchase decisions of consumers based on the setting of different decoy information, alone with consumer health-related factors considered together. As a result, they found that "… consumers exhibit significant compromise effects after receiving both low-price and high-price decoy information. However, when decoy information is presented after consumers have made choices without decoy information, their behavior changes systematically with a weakened compromise effect." The study's contributions are 2-fold: it not only contributed to the traditional consumer choice behavior research by extending its applications to food purchase context, but it also contributed to food safety and traceability studies by adding knowledge with the incorporation of the mature construct of compromise effect.

Ruangkanjanases et al. look deeply into consumers' green (organic) food purchase intention. A group of determinants (i.e., individual benefits, social benefits, willingness-to-pay, environmental responsibility, e-word-of-mouth, values, self-competence, convenience, and environmental literacy) were tested for their effects on the purchase intention. The results showed that all factors except for the subjective norms are positively influential on purchase intention. The implications for the social responsibility of consumption against the backdrop of "the green wave" in society are seriously discussed. The major contribution of this study is not just limited to the area of food purchase; on the contrary, the widely used and accepted Theory of Planned Behavior is extended by the authors' empirical efforts and conceptual reflections. From the paper, we could also observe that purchase intention for green products is inherently a multilevel, multidisciplinary, but not just psychological, phenomenon beyond ourselves. A complex world in the perception of the purchasers projected the real one and the consistency and/or conflicts between the two worlds implicitly guide the consumers' cognition and behavior consequently.

The knowledge-oriented article by Shan et al. explores consumers' attitudes and purchase intentions toward organic food from the framing and anchoring effects perspective. They found that whether being positive or negative, message framing significantly influences consumers' attitudes and purchase intention. Specifically, "a negatively framed message induces a more favorable attitude and purchase intention than a positively framed message, a low anchor price is more favorable than a high one, and the interaction effect of framing and anchoring is not significant at the 1% level." Moreover, an anchor price in advertisements alters a consumers' judgment. Finally, being equipped with less organic food knowledge makes consumers more susceptible to the aforementioned framing and anchoring effects. Together, such results clearly called for a delicate framing message strategy, integrating with price anchoring practices in the context of consumer knowledge.

He et al. asked an interesting question: "Whether the traditional revenue sharing or cost-sharing strategy is still efficient in the food supply chain." This is a typically good example of "old-wine-in-new-bottle" research that could make contextual contributions and add new knowledge. The paper's focus is on green innovation efficiently motivated by traditional cooperation contracts in the food sector. The Stackelberg equilibrium structure is utilized, which also makes a methodological contribution to the food sector studies. The results show that "when the supply is interrupted due to the insufficient stimulation of green consumption at the market demand side, manufacturers need to stimulate their green innovation efforts by sharing the cost of suppliers, and the cost-sharing proportion is affected by the marginal profit coefficient of manufacturers and suppliers." Such results also influence the marginal profit of suppliers and manufacturers and the overall income of the food supply chain.

You et al. argued that when consumers buy organic products in the market, complete information is lacking, as compared

to the traditional channels such as newspapers, magazines, and television advertisements. Against such backdrops of information asymmetry, social media rises and becomes a major informational source for organic foods. The analyses found that task characteristics and technology characteristics had significant effects on consumer expectation confirmation and perceived usefulness through the task-technology fit. Then, confirmed expectations and perceived usefulness, in turn, influenced satisfaction and continuance intention. The results are useful in that the practitioners know better about how to utilize social media as a platform-based strategy for organic food promotion.

In the Tsai et al. study, virtual community websites are depicted as a platform for people with common interests in food safety to extend their social relations and engagement in foods affairs in social media. Based on such premise, the study proposed a model for assessing antecedents of continuance intention toward food safety information from social media. Using Facebook as an example, an integrated model of the expectation-confirmation theory and technology acceptance model with technology readiness as a moderator has been examined. The results showed that "perceived ease-of-use, usefulness, and confirmation indirectly affected social media continuance usage intention through satisfaction; perceived ease-of-use, usefulness, and satisfaction were the direct determinants that affected users' social media continuance intention. Furthermore, positive technology readiness had significant effects on the relationship between perceived ease-of-use, usefulness, confirmation, satisfaction, and continuance intention toward food safety information." Overall, very rich information has been demonstrated for practical and academic references.

Liu and Lin's conceptual efforts tended to emphasize the fundamental differences between online vs. physical shopping in the food sector. She proposed that "1: The design and implementation of online food shopping (eco)systems should engage the consumers and other stakeholders to co-create collective and social values; 2: A better fit between technologies' and food businesses' natures could generate better applications for online food shopping; 3: A business model with sound finance systems becomes the core of a healthy online food ecosystem; 4: The interaction and transformation between online (virtual) and offline (virtual) food businesses determines the dynamic development of future food shopping." All of those propositions represent promising opportunities for future empirical examinations.

Meng et al. investigated consumers' agency in food safety social co-governance. The central functionality of active consumers for constructing food safety social co-governance was emphasized and examined. For examinations, the authors developed a multidimensional questionnaire on consumer psychological capital that could be used to measure the degree of consumer participation in food safety social co-governance. Analyses based on multiple samples showed that a 4-factor model with 23 items explained 61.05% of the total variance with reliability and validity were both confirmed. The developed questionnaire can serve as an instrument to follow by future studies to expand psychological capital-related research in the context of food governance.

Liu and Lin put culture and CSR back in the pursuit of high-quality food from an organized human resource perspective. A very frank statement reflected the truth of centering the practices back to people as the micro-foundation for supporting institutions. As they stated, "…No matter how regulations are coercively released and implemented, the free will and behaviors of human actors (e.g., employees) leads to a real result in food safety." And the solution proposed by the authors was an organizational culture that can mold personnel behaviors and stimulate safety-oriented actions. Almost perfectly, the authors used Walmart as an example to demonstrate interwoven green organizational culture, corporate social responsibility, and food safety. This article is another good example of taking stock of a mature issue and applying it in a significant new context to generate both theoretical and practical implications.

Huang and Lin article reads like one that is eager to resolve the grand challenge of poverty alleviation for all. True as it is, poverty is such a grand challenge and under its influences, food insecurity might be seriously affected (mostly in a negative direction). This article discusses food governance as a psychological mechanism to facilitate the sense of wellness in people's minds in the context of poverty alleviation. Mainly, we argued that when a government is implementing poverty alleviation, not only economic efforts for people's living but also good psychological feelings are required. We thus argued that sound food governance may increase the sense of wellness in the minds of people as food consumers, by increasing food safety and security. This perspective paper contributes by explicating the influences of macro-level governance design in safer and more secure food systems on people's psychological wellness, especially in the background of poverty alleviation in developing countries.

Lin and Wu put their attention toward food traceability systems that serve as an important modern mechanism for facilitating food safety. They tested for the influencing factors on the food traceability system from integrative theories. Push factor (information system success model), pull factor (ITM theory), mooring factor (TPB), and switching intention were integrated into the push-pulling-mooring theory (PPM) to form a useful framework to study the switching intentions of two-dimensional code traceability technology for dairy products. The results of the survey study indicated that the influencing factors of thrust, pull, and mooring force were identified. As consumer choice of traceable safe food is critical for public health and economic consumption, and the integrated multi-model framework that the authors proposed is of practical value in identifying ways to strengthen consumer willingness in using QR code traceable system for food products and to improve consumer confidence in the use of food technology.

Hu et al. offer a clear route in assessing the price policy of raw milk, with the impact of the policy implementation on milk price and profit distribution in the supply chain examined. The results told us that the price of raw milk differs with supportive vs. unimplemented price policies; that the aforementioned differences are obvious when considering regional differences; and that the guidance policy for milk price drives the price increase or price suppression due to an intent for a balanced profit distribution in the supply

chain. This study effectively links factors across different levels of analyses (i.e., psychological, organizational, industrial, and institutional) to explore the interlinked and sustainable dynamics between product, price, profit, and policy in the food sector.

Another study from Hu et al. constructed evolutionary network characteristics of the world dairy industries based on the overall trade pattern. Specifically, the evolution of trade blocs and the co-opetition relationships involving dairy products in major economies were compared. The results show that continuous and complex changes have taken place in the world's dairy trade network since 2001, while the number of trade entities in dairy products has stabilized since 2012. Mainly, a small-world effect and scale-free property exist in the world dairy trade network. Also, factors such as geographical positions, historical cultures, and political relations have led to the evolution of the trade blocs in the world. As the study sketched both the structural and social patterns of the trade networks, the results indeed offered a social-psychological foundation for policy-makers when making decisions of international dairy trade.

Chen et al. inform us that the imperatives of safe foods are highly tied to the affairs of a clean environment. As global climate change has become the central issue of all mankind, consumers' will and efforts to both maintain environmental soundness and food quality are affected by consumers' consumption habits (and their changes). The trend of food overconsumption with high food waste calls people to eat "greenly" and so eco-friendly. In such a background, the study examined intrinsic motivations (e.g., social recognition, environmental ethics, joy, etc.) and their interrelationships that influence consumers' green eating intention. The results showed that "social recognition and environmental ethics have significant effects on curiosity, joy of purchase, perceived usefulness, subjective norm, and perceived behavior control" and that "the mediator between environmental ethics and behavior intention are joy of purchase, perceived usefulness, subjective norm, and perceived behavior control." As to our knowledge, this study is among the first to construct a detailed and complex model to inform subtle factor structures for green eating. The results of this study, hence, can be referred to by other groups of people who also wish to eat in an environmentally friendly way.

Wu et al. looked into consumer preferences for traceable pork attributes based on a system composed of traceability, animal welfare, place of origin, and price attributes. Choice experiments and Bayesian inference analysis were adopted as methods of examination. Results showed that both complementary and substitutive relationships existed between dietary animal welfare and traceability information and also between health welfare and non-indigenous vs. indigenous production. These results are especially informative in the context of global health and food-related crises such as the COVID-19 pandemic. Specifically, the study suggested that "the government should encourage manufacturers to produce diverse traceable animal-derived food not only to protect animal welfare and promote the construction of ecological civilization, but also to develop new animal-derived food markets to satisfy different levels of consumer demand."

Xu et al. analyzed the relationships between consumer behaviors when purchasing meat products produced with animal welfare under different decoy scenarios. Hundreds of consumers purchasing pork and chicken were observed in four types of decoy scenarios based on breeding time, breeding model, diet cleanliness label, and price attributes. A decoy effect was observed in a bounded rational consumption situation in relation to both chicken and pork purchasing behaviors. Comparing the two types of consumption experiments, price decoy still played a significant role. The results of the experiments suggested strengthening people's knowledge of livestock welfare, designing a breeding model decoy or price decoy in the process of chicken sales, and designing a diet cleanliness label decoy or price decoy in the process of pork sales. Suggesting so, the study helps accurately understand consumer minds and behaviors and reduces biases during meat consumption.

Last but not least, Nie et al. noted that food safety that keeps the consumers safe and food quality that leads to consumer satisfaction must be considered together when studying food management systems. This study examined this by focusing on the influence of loss aversion on one's psychological level and of income effect on one's socio-demographic level. The findings indicated that "…loss aversion and income effect significantly influence the way consumers value food safety vs. quality labels when considering potential health risks and food price. High risk-averse and low-income consumers with strong loss aversion and a weak income effect show a higher demand for food safety labels as a way to ensure easy access to safety indications. Low risk-averse and high-income consumers with weak loss aversion and a strong income effect show a higher demand for food quality labels because they hope to gain more health benefits from high-quality food at good prices." The contribution of this study is to remind governments, manufacturers, consumers, and all related stakeholders to find a balance between food safety control and food quality improvement when facing diverse market demands and preferences transition.

CONCLUDING REMARKS

Psychology and Food Science are two distinctive but potentially highly linked fields of research. In this Research Topic, we see obvious and promising directions for further investigation. As we may see the rising of psychological studies of food safety and consumption in virtual contexts, the RT showed that current interests are still relatively favored phenomena in the physical world. In addition, to increase the efforts to study psychological issues of food safety and consumption in the virtual world, it might be even worthwhile if one can conduct studies to explicate the deeper factors, mechanisms, processes, etc. that drive cross- or trans-contextual phenomena between the physical and virtual worlds of food safety, governance, and consumption. For example, what would be the cognitive change in food value when one started to shift their shopping from physical to online markets? How would one's psychological state change if the experiences of shopping online vs. physically generate some conflict? What are the differences for one thing

(e.g., food fraud) that simultaneously exists in both the virtual and physical food worlds? All of the logics presented behind the above-discussed articles are also applicable to the research level's concerns. For example, is there cross-level existence of one identical phenomenon (e.g., food fraud, again) in different levels of analysis with different influencing antecedent factors, theoretical mechanisms, and consequences? How do those factors, mechanisms, and outcomes at different levels influence one another? Issues similar or beyond the aforementioned may stimulate brighter imaginations for the future of psychological research in the food sector.

AUTHOR CONTRIBUTIONS

F-ST, X-WW, and SS contributed equally in editing this Research Topic. F-ST wrote the original draft of this article. X-WW and SS reviewed and revised it mightily. All authors contributed to the article and approved the submitted version.

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Compromise Effect in Food Consumer Choices in China: An Analysis on Pork Products

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Compromise effect suggests that a product will have a higher chance to be chosen from a product choice set when its attributes are not the extremes (the best with the highest price or the worst with the lowest price). Few studies have examined compromise effect in food purchase. We investigate consumer pork purchase decision in the context of different decoy information intended to induce behavior and consider different presentation of decoy information. Furthermore, we explore compromise effect in relation to price, quality, and safety, which are directly related to consumer health. Results demonstrate that consumers exhibit significant compromise effects after receiving both low-price and high-price decoy information. However, when decoy information is presented after consumers have made choices without decoy information, their behavior changes systematically with a weakened compromise effect. This study highlights the implications of compromise effect in food marketing and policies related to food traceability and safety.

Keywords: compromise effect, consumer preference, decoy information, pork products, anchoring effect

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INTRODUCTION

In the *Wealth of Nations*, Adam Smith proposed the concept of an "economic man" and rational human behavior. The core of this theoretical hypothesis considers people as subjects pursuing maximum personal utility (Richard, 2016). Based on this hypothesis, the rational choice theory argues that consumers attach utility to each option in a product choice set and will choose a product or group of products with maximized utility, regardless of the choice set in which the product is placed (Simonson and Tversky, 1992; Aleskerov and Monjardet, 2007). In recent years, psychology theories have also been used to study human economic behavior. According to Herbert A. Simon, a pioneer of modern decision theory, human choice is an adaptation mechanism with bounded rationality, rather than an optimum mechanism with complete rationality (Herbert, 1988). To a substantial degree, consumer choices depend on the environment in which the choices are made (Ahn and Vazquez Novoa, 2016). Therefore, under bounded rationality, consumers may not always choose the option that maximizes utility, and preference for a product depends on changes in

consumption context (Huber et al., 1982; Payne et al., 1992; Li, 1995). This so-called context effect can be understood as a process in which consumers consider the absolute level of attributes of a target option, but at the same time are influenced by the location of the target option relative to other options in a choice set (Tversky and Simonson, 1993; Novemsky et al., 2007).

Huber et al. (1982) stated that compromise effect is a form of context effect. Simonson (1989) later summarized the concept of compromise effect, referring to it as a phenomenon "where an option is more likely to be chosen by consumers and attracts a larger portion of choices when it is a compromising or middle option in a choice set." Simonson (1989) and Dhar and Maach (2004) argued that during the consumer decision-making process, the most likely context effect is compromise effect. Existing literature suggests that compromise effect influences consumer choices, leading to violations of the principle of utility maximization in traditional economic theory, and reflecting the characteristics of bounded rationality (Chen et al., 2018). Understanding compromise effects has proven useful for manufacturers in market positioning, brand promotion, and creation of competition strategies (Simonson and Tversky, 1992; Ran et al., 2004). For example, to help sell a high-priced product, marketers can introduce another option with a higher price compared to the target product as decoy information (Lichters et al., 2017). Although considerable research has focused on compromise effect in general consumer products, few have explored the effect in consumer food purchasing behavior. Food safety is of great importance to human health and has thus attracted considerable consumer attention, particularly in developing countries such as China. Therefore, in this paper, we use pork products as a case to explore the existence of compromise effect in food purchases and investigate the effect under different consumption contexts.

We chose pork because it is the most popular type of meat produced and consumed in China. Data from the United States Department of Agriculture (USDA) show that China's pork production in 2017 was 53.50 million tons, accounting for 48.19% of the total pork output worldwide (111.03 million tons), with a per capita consumption of 39.12 kg, some 4.6 times the average of other countries. Nonetheless, pork and pork products have also triggered substantial quality and safety concerns in China. For example, Zhong and Wu (2019) reported that among the 22 436 quality and safety incidents regarding meat and meat products between 2006 and 2015, 65% of them were related to pork. These incidents were found in all areas of pork production, including breeding, slaughtering and processing, and circulation and sales, which accounted for about 39, 36, and 25% of the total number of pork-related incidents, respectively. Studying pork and measures to improve pork safety is thus relevant to food policy.

To enhance consumer knowledge and facilitate strengthened food safety, traceability measures of pork have received considerable attention in academia and industry (Heath and Chatterjee, 1995; Chuang and Yen, 2007; Chamorro et al., 2015). Although a complete food traceability system has not yet been established in China, many existing studies show that traceability plays one of the most important roles in improving consumer confidence in and consumption of pork products (Hobbs, 2004; Alfnes et al., 2018; Hou et al., 2019). As the increased costs of establishing a traceability system will also lead to higher sales prices of traceable pork, understanding consumer acceptance of traceable pork is crucial but is under-investigated in China. Therefore, in the present study, a separate goal is to also explore the future development of and consumer preference for traceable pork in China. With regard to compromise effect, if it exists in consumer purchase of traceable pork, food manufacturers and policy makers could take advantage of the compromise effect to improve acceptance and sales of traceable pork.

LITERATURE REVIEW AND RESEARCH HYPOTHESES

Previous studies have examined the consumer psychology aspects of compromise effect (Wernerfelt, 1995; Mourali et al., 2007). Dhar and Simonson (2003) proposed that consumers prefer the compromise option when they are uncertain but must make a choice so as to reduce losses associated with the extreme options and minimize expected loss. Simonson and Tversky (1992) and Sheng et al. (2005) called such consumer behavior the extreme circumvention principle. Consumer characteristics, product characteristics, and the external consumption environment are the main factors that influence compromise effect. However, consumer knowledge, psychological factors, product familiarity, consumption motivation, risk perception, and attitudes toward risks can all affect compromise effect (Mishra et al., 1993; Sheng et al., 2005; Mourali et al., 2007; Sinn et al., 2007; Drolet et al., 2009; Pinger et al., 2016). Although these factors are not the focus of this study, understanding these factors can also provide insight into the causes of compromise effect and should be a continued focus of future research.

For product characteristics, attribute importance (Belk, 1977), attribute comparability (Gourville and Soman, 2007), and brand effect of the option (Sinn et al., 2007) can affect compromise effect. In particular, brand image and reputation have a significant impact on consumer decision-making. Zeithaml (1988); Richardson et al. (1994), and González et al. (2015) demonstrated that consumers have higher expectation about product quality and higher willingness to buy when a product has a better brand image. Chuang and Yen (2007) studied the impact of the origin of various products (e.g., suitcases, watches, and sports shoes) on compromise effect and found that products from Germany can have more significant compromise effect on consumers than similar products from China. This is because a product originating from an origin with less quality image passes negative information about product quality to consumers and weakens the quality and price advantages of the compromise option.

Compromise effect is closely related to the external environment of consumption (Payne et al., 1992; Mourali et al., 2007). Kahneman and Tversky (1979) and Hoek et al.

(2006) stated that when the same product information is presented differently, consumers may experience different information evaluation, psychological response, or attitude toward the product, and may consequently exhibit different preferences. Yoo et al. (2018) found that product information produces a different compromise effect on consumers when manufacturers present them in different formats. For example, compared to text, information expressed in numbers, figures, or symbols can have a greater impact on consumer preference and can produce a more significant compromise effect (Frederick and Lee, 2008; Kim, 2017). The same product information can also differ in its influence on compromise effect when presented in either positive or negative context comparing to other products. For instance, Schneider et al. (2001) found that physicians are more persuasive to patients when expressing the same information in a negative frame, whereas Levin and Gaeth (1988) found that consumers prefer the presentation of information in a positive frame. The same product information can also affect compromise effect when presented in a different order (Monk et al., 2016). Chen et al. (2011) revealed that compromise effect still occurs when consumers face decoy information presented to induce consumption, but when respondents are asked to first make a choice in the absence of decoy information and then to make a choice in the presence of decoy information, the results of the two choices differ significantly and compromise effect disappears. In our analysis, we also consider decoy information, which is defined as information given to consumers to induce their focus on certain product attributes instead of presenting new product attributes.

To summarize, extensive research has been conducted on compromise effect in consumer behavior. However, previous studies have primarily focused on compromise effect in consumer purchase of general products, with few studies exploring the effects on food purchase behavior. Thus, in the current study, we investigated compromise effect and its impact on marketing and consumer choice of food products. We proposed and tested the following five hypotheses using pork based on a consumer survey conducted in Wuxi, Jiangsu Province, China. We differentiated low-price and high-price decoy information, where the former was intended to induce consumers to consider low-priced products while the latter reversed the intention.

$H1_0$: For consumers in a consumption context in the absence of decoy information, no compromise effect will occur in their behavior when choosing a pork product.

$H2_0$: For consumers in a consumption context with low-price decoy information, no compromise effect will occur in their behavior when choosing a pork product.

$H3_0$: For consumers in a consumption context with high-price decoy information, no compromise effect will occur in their behavior when choosing a pork product.

We further explored whether presenting decoy information at different stages of choice may affect choice behavior and compromise effect. This involved two stages: consumers were first asked to make a product choice without seeing any decoy information, and then they made another choice following the presentation of decoy information. Based on these considerations, we proposed the following two hypotheses:

$H4_0$: Whether the low-price decoy information was presented to consumers after they have made a choice in absence of decoy information does not affect compromise effect in their behavior when choosing a pork product.

$H5_0$: Whether the high-price decoy information was presented to consumers after they have made a choice in absence of decoy information does not affect compromise effect in their behavior when choosing a pork product.

EXPERIMENTAL DESIGN, IMPLEMENTATION, AND SAMPLE CHARACTERISTICS

We chose pork hind leg meat since it is commonly consumed in China (Wang et al., 2011). Our preliminary survey indicated that pork hind leg meat is sold at a similar market price in different urban areas of Wuxi, Jiangsu Province, China, where our study was conducted. Studying consumer behavior regarding the same pork cut can effectively reduce the influence of non-experimental factors on research conclusions (Wang et al., 2011). We considered three pork characteristics directly related to food safety; i.e., traceable, Voted-Trusted-Brand (VTB), and origin-labeled.

Based on pork quality and safety risks in real markets and the Hazard Analysis Critical Control Point (HACCP) system in the pork supply chain in China, as well as the impact of information asymmetry on pork safety risks, a whole-process traceable pork information system should at least cover the three main aspects: breeding, slaughtering and processing, as well as circulation and sales.

Compared with conventional pork, traceable pork inevitably has higher production costs (Meuwissen et al., 2009). Traceability system covering more players in the supply chain can better help consumers identify and reduce pork quality risks, but at the same time can also increase the price of traceable pork (Bai et al., 2017; Matzembacher et al., 2018). At present, there is no complete list of prices for various traceable pork cuts on the Chinese market (Wu et al., 2015). Hence, since our survey was conducted in Wuxi, Jiangsu Province, consistent with Wu et al. (2018), and the time lag between our study and that of Wu et al. (2018) was relatively short, we used the same traceable pork prices set by Wu et al. (2018).

In the literature review, we described the relationship between brand and product origin and consumer behavior. We also investigated two other pork hind leg meat attributes: brand and origin-label, in addition to traceable pork. Due to inconsistent pork quality, since 2005, China has been vigorously developing the program known as the consumers' Voted-Trusted-Brand (VTB) products. Each year, China's Brand Name Association assesses and recommends pork brands as VTB. The assessment is based on market consumption for the year and consumer evaluation collected through the assocation's country-wide consumer opinion surveys. Pork products sold in many food markets in China are considered safe but have only met safety standards at the minimum level. Compared with such pork

products, VTB pork products have better perceived quality, more reliable safety, and usually higher prices.

In China, an origin-labeled product refers to a product that is from a specific geographical region, after which it is named and upon approval by the China National Accreditation Committee. This is consistent with the definition of country-of-origin-labeled products provided by the World Trade Organization in regard to intellectual property rights. Displaying the origin of a pork product in the form of a label can provide quality or safety information (Lim et al., 2014). Origin-label and traceability have different implications. The former establishes the overall product quality in association with the customs and culture of the certified geographical origin, whereas the latter identifies the specific enterprises or individuals involved in pork production and circulation.

We designed three pork products, represented by *x*, *y*, and *z* for each of the three types of pork hind leg (pork hind leg with each of the three safety and quality characteristics), as shown in **Table 1**. For each type of pork, we designed different decoy information. During the survey, all pork products were presented to participants in the order of *x*, *y* or *x*, *y*, *z* (no option *z* in some sample groups) to ensure consistency and comparability of the products. As stated previously, in addition to compromise effect, a second goal of our study is to specifically examine consumer behavior regarding traceable pork. Therefore, for traceable pork, we investigated whether consumer behavior demonstrated compromise effect under both high-price and low-price decoy information, whereas for the VTB and origin-labeled pork, we only implemented high-price decoy information due to article length constraints.

To present participants a choice context similar to a real consumption environment, we conducted our survey in large-scale super stores, pork shops, farmers' markets, and shopping centers where consumers were engaging in actual grocery purchase in Wuxi, Jiangsu Province, China. The survey was conducted in August 2018 with a total of 1176 completed responses. Each respondent who completed the questionnaire was given a gift of 5 Yuan as compensation for their time. The interviewers were trained postgraduate students from a local university. The interviewers approached every third adult shopper came to their sight. Although respondents were not asked to make actual purchase, all pork products described in our survey were presented on site for participants to view and examine. Based on the objectives of the study, we designed eight sample groups, into which each survey participant was randomly assigned. **Figure 1** shows a choice set of traceable pork. The options were represented by *x*, *y*, and *z* in the same left to right order in all sample groups. The number of pork products and number of choice sets each respondent review was different but the order of products presented in each choice set followed the order of *x*, *y*, and *z* in **Table 1**. The detailed description of the eight sample groups is as follows:

- Sample group #1 (no decoy information, two traceable pork options): Respondents made a choice in the absence of decoy information from a choice set composed two traceable pork hind leg meat products *x* and *y*, as shown in **Table 1**.
- Sample group #2 (no decoy information, three traceable pork options): Respondents made a choice in the absence of decoy information from a choice set composed of three traceable pork hind leg meat products *x*, *y*, and *z*, as shown in **Table 1**.
- Sample group #3 (low-price decoy information, two traceable pork options): Respondents were asked to first review the low-price information and then make a choice from a choice set composed of two traceable pork hind leg meat products *x* and *y*, as shown in **Table 1**.
- Sample group #4 (low-price decoy information, three traceable pork options): Respondents were asked to first review the low-price information and then make a choice from a choice set composed of three traceable pork hind leg meat products *x*, *y*, and *z* as shown in **Table 1**.
- Sample group #5 (first no decoy information, three traceable pork options, followed by low-price decoy information, same three traceable pork options): Respondents were first asked to make a choice in the absence of decoy information from a choice set composed of three traceable pork options as *x*, *y*, and *z* shown in **Table 1**. Then, low-price decoy information was presented and the same respondents were asked to make a choice from the same choice set.
- Sample group #6 (no decoy information, three types of pork products): Respondents made a choice in the absence of decoy information for each of the three types of products (traceable, VTB, and origin-labeled pork). For each type of product, three options were presented (i.e., products *x*, *y*, and *z* as shown in **Table 1**).
- Sample group #7 (high-price decoy information, three types of pork products): For each type of three pork products (traceable, VTB, and origin-labled pork), respondents were asked to first review the high-price information and then make a choice from a choice set composed of three options for each type of pork (i.e., products *x*, *y*, and *z* for each of the three types of pork hind leg meat, as shown in **Table 1**).
- Sample group #8 (first no decoy information, three types of pork products, followed by high-price decoy information, three types of pork products): For each of three types of pork (traceable, VTB, and origin-labeled pork), respondents were first asked to make a choice in the absence of decoy information from a choice set composed of three options (i.e., products *x*, *y*, and *z* for each of the three types of pork, as shown in **Table 1**). Then high-price decoy information was presented and the same respondents were asked to make a choice from each of the same choice set for the three types of products, respectively.

Characteristics of the total of 1176 adult consumers recruited into the study are shown in **Table 2**. These characteristics coincided with those in previous studies involving Chinese pork consumers (Wu et al., 2012).

TABLE 1 | Product options and decoy information for pork products.

Type of pork	Product option	Decoy information
Traceable pork hind leg meat	15.4 Yuan/500 g, traceable information covers breeding link (x). 16.8 Yuan/500 g, traceable information covers breeding and slaughtering links (y). 18.2 Yuan/500 g, traceable information covers breeding, slaughtering, processing, and sales links (z).	*Low-price decoy information*: Considering limited income and limited budget for food consumption, you can save much from buying inexpensive pork to purchase other necessary foods such as fruits and vegetables. *High-price decoy information*: There are risks in consuming ordinary pork. Long-term consumption of pork containing clenbuterol or veterinary drug residue is not conducive to health. In contrast, traceable pork has a relatively better guarantee of safety and quality.
Voted-trusted-brand (VTB) pork hind leg※	24 Yuan/500 g, COFCO Joycome pork hind leg meat with skin (x) 36 Yuan/500 g, Zhili black pork hind leg meat (y) 40 Yuan/500 g, Netease Weiyang black pork hind leg meat (z)	*High-price decoy information*: There are certain quality and safety risks in consuming conventional pork, whereas VTB pork has generally better quality. A whole process safety traceability system is implemented for COFCO Joycome pork. Zhili black pigs are fed with pure grain, raised free-range, and have guaranteed quality. Netease Weiyang pork has not only assured quality but also a higher level of nutrition.
Origin-labeled pork hind leg※	40 Yuan/500 g, Guangxi Bama fragrant pork (x) 60 Yuan/500 g, Jinhua Liangtouwu pork hind leg meat (y) 80 Yuan/500 g, Daocheng Tibetan fragrant pork hind leg meat (z)	*High-price decoy information*: Origin-labeled pork is generally believed to have better quality and safety, in addition to its distinguished local characteristics. Guangxi Bama pork has a smooth taste, not greasy, and easy to digest. Jinhua Liangtouwu pork is popular country-wide for its thin skin, fine bones, not greasy meat, and rich flavor. Daocheng Tibetan pork is famous for its smooth, tender meat with high-level nutrition, good flavor, and leanness.

※*Prices for traceable pork hind leg meat in* ***Table 1*** *are based on Wu et al. (2018), and prices for VTB and origin-labeled pork were obtained from market surveys conducted in Wuxi, Jiangsu Province, China prior to this study.*

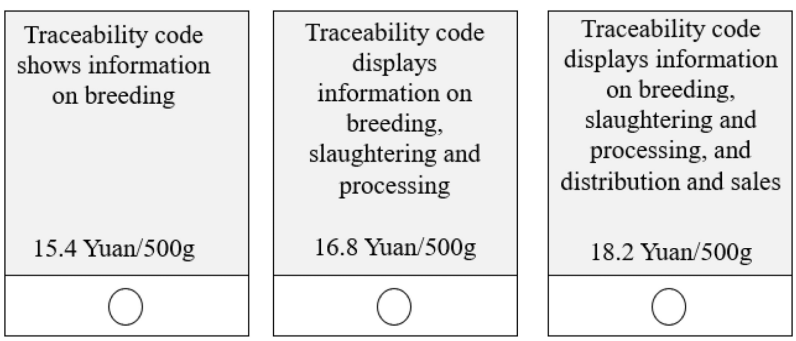

FIGURE 1 | Sample of traceable pork choice set.

ANALYSIS FRAMEWORK

Based on Chernev (2004), Eq. 1 calculates the change of the share of compromise option y being chosen between choice set $\{x, y\}$ and $\{x, y, z\}$:

$$\Delta p = P_z(y; x) - P(y; x) \quad (1)$$

where, P(y; x) is the share of option y relative to option x chosen from choice set $\{x, y\}$: and P_Z(y; x) is the share of compromise option y relative to option x chosen from choice set $\{x, y, z\}$. P_Z(y; x) indicates the attractiveness of compromise option y relative to x after the addition of the third traceable pork option z to the set, calculated using:

$$P_z(y; x) = \frac{P(y; x, z)}{[P(y; x, z) + P(x; y, z)]} \quad (2)$$

where, P(y; x, z) is the share of compromise option y from choice set $\{x, y, z\}$ and P(x; y, z) is the share of option x in choice set $\{x, y, z\}$.

TABLE 2 | Descriptive statistics of respondent characteristics.

Statistical indicator	Category	Frequency	Effective percentage (%)
Gender	Male	540	45.92
	Female	636	54.08
Age (year)	18–25	552	46.94
	26–35	381	32.40
	36–45	117	9.95
	46–55	81	6.89
	56–65	39	3.31
	66–72	6	0.51
Family size	1	75	6.38
	2	180	15.31
	3	436	37.07
	4	246	20.92
	5	239	20.32
Level of education	Primary school and below	86	7.31
	Senior high school (including technical secondary school)	191	16.24
	College	255	21.68
	University	537	45.67
	Postgraduate and above	107	9.10
Annual household income	≤ 50000 Yuan	81	6.89
	50001–80000 Yuan	187	15.90
	80001–100000 Yuan	237	20.15
	100001–150000 Yuan	215	18.28
	>150000 Yuan	456	38.78

H1 can be tested by observing the share of option *y* chosen in sample groups #1 and #2. $P1\ (y, x)$ can be defined as the share of option *y* chosen in the two-option choice set {*x, y*} in sample group #1, and $P2_z\ (y, x)$ can be defined as the share of option *y* chosen after option *z* was added to the set in sample group #2. If $P1\ (y, x) \geq P2_z\ (y, x)$, then hypothesis $H1_0$ cannot be rejected.

H2 can be tested by observing the share of option *y* chosen in sample groups #3 and #4. If $P3\ (y, x) \geq P4_z\ (y, x)$ (both with similar definitions as above), then hypothesis $H2_0$ cannot be rejected.

H3 can be tested by observing the share of options *y* and *z* chosen in sample groups #6 and #7. If $P7\ (z, x) \geq P7_z\ (y, x)$, then hypothesis $H3_0$ cannot be rejected. In this design, tests were conducted for each of the three types of products.

Using sample groups #2 and #4, $P2_z\ (y, x)$ and $P4_z\ (y, x)$ can be obtained. The values for $P5a_z\ (y, x)$ and $P5b_z\ (y, x)$ (which represent the share of option *y* chosen without and with decoy information, respectively) can be obtained from sample group #5. Then $P4_z\ (y, x) - P2_z\ (y, x)$ and $P5b_z\ (y, x) - P5a_z\ (y, x)$ can be calculated, respectively. If $P4_z\ (y, x) - P2_z\ (y, x) = P5b_z\ (y, x) - P5a_z\ (y, x)$, then hypothesis $H4_0$ cannot be rejected.

Using sample groups #6 and #7, $P6_z(y, x)$ and $P7_z(y, x)$ can be obtained. The values for $P8a_z(y, x)$ and $P8b_z(y, x)$ (with similar definitions as to $P5a_z(y, x)$ and $P5b_z(y, x)$, respectively) can be obtained from sample group #8. Similarly, if $P7_z(y, x) - P6_z(y, x) = P8b_z(y, x) - P8a_z(y, x)$, hypothesis $H5_0$ cannot be rejected. Tests can be conducted for each of the three types of pork products.

RESULTS AND DISCUSSION

In the absence of decoy information, the share of choosing compromise option *y* was 58.1% in sample group #1 (no decoy information and two traceable options) from choice set {*x, y*}, which increased to 72.5% in sample group #2 (no decoy information and three traceable options) from choice set {*x, y, z*} (see **Table 3** and **Figure 2**), with $\Delta P = 21.94\%$ ($\chi^2 = 29.26$, $p < 0.001$), $P1\ (y, x) < P2_z\ (y, x)$. Therefore, hypothesis $H1_0$ can be rejected, indicating compromise effect occurring in consumer behavior in the absence of decoy information.

Under the low-price decoy information context, the share of choosing compromise option *y* was 53.1% in sample group #3 (low-price decoy information and two traceable options) from choice set {*x, y*}, which increased to 75.2% in sample group #4 (low-price decoy information and three traceable options) from choice set {*x, y, z*} (see **Table 3** and **Figure 2**), with $\Delta P = 30.46\%$ ($\chi^2 = 45.35$, $p < 0.001$), $P3\ (y, x) < P4_z\ (y, x)$. Therefore, hypothesis $H2_0$ is rejected, showing compromise effect occurring in consumer behavior under low-price decoy information context.

We also test the influence of high-price decoy information on participant choices, as presented in **Table 4**. In group #7 (high-price decoy information for all three types of pork), the share of compromise option *y* chosen by participants from the three traceable pork choice set {*x, y, z*} was 45.19% and the share of option *z* was 39.95% ($\chi^2 = 23.08$, $p < 0.05$), suggesting that option *y* shows a compromise effect under this context. Also in group #7, the share of the VTB pork option *y* chosen by participants was 54.73% and that of option *z* was 14.46% ($\chi^2 = 36.36$, $p < 0.05$), demonstrating the existence of compromise effect in the share of option *y*. The share of origin-labeled pork option *y* chosen by group #7 was 41.76%, and that of option *z* was 31.49% ($\chi^2 = 5.20$, $p < 0.01$), suggesting the existence of compromise effect in option *y*. Based on these results, $H3_0$ can be rejected and participant choice behavior showed a compromise effect. As shown in **Table 3**, $P2_z\ (y, x)$ was 72.48% and $P4_z\ (y, x)$ was 75.17%. For sample group #5 (first no decoy information and then low-price decoy information for all three types of pork), the values for $P5a_z\ (y, x)$ and $P5b_z\ (y, x)$ were 51.01 and 36.24%, respectively. Hence, $P4_z\ (y, x) - P2_z\ (y, x) \neq P5b_z\ (y, x) - P5a_z\ (y, x)$ ($\chi^2 = 56.089$, $p < 0.01$). Therefore, hypothesis $H4_0$ can be rejected. In other words, whether the low-price decoy information is given after consumers have experienced non-decoy information affected compromise effect.

We next tested hypothesis *H5*, based on findings shown in **Table 4**. Results showed that $P7_z(y, x)$, $P8a_z(y, x)$, and $P8b_z(y, x)$ for traceable pork compromise option were 45.19, 41.67,

TABLE 3 | Choices under low-price decoy information (%).

Product option	Sample group #2 (*N* = 149)	Sample group #4 (*N* = 149)	Sample group #5 (*N* = 147)		Chi-squared Test
	Without decoy information	With low-price decoy information	Without decoy information	With low-price decoy information	
15.4 Yuan/500 g, Traceability information covering breeding link (*x*)	18.12	14.77	23.49	48.64	
16.8 Yuan/500 g, Traceability information covering breeding and slaughtering links (*y*)	72.48	75.17	51.01	36.24	56.089***
18.2 Yuan/500 g, Traceability information covering breeding, slaughtering, and sales links (*z*)	9.40	10.06	25.50	15.12	

****Means significant at 1% significance level.*

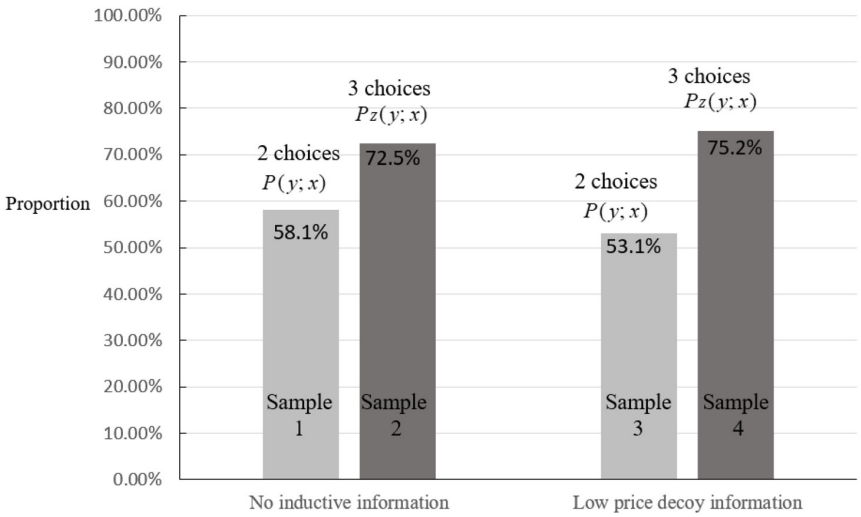

FIGURE 2 | Choice of compromise option *y* under low-price decoy information.

TABLE 4 | Choices under high-price decoy information (%).

Information presentation	Product option	Traceable pork	Voted-trusted- Brand (VTB) pork	Origin-labeled pork
Sample group #6, without decoy information (*N* = 144)	x	22.92	37.22	37.27
	y	47.50	45.14	40.92
	z	29.58	17.64	21.81
Sample group #7, with high-price decoy information (*N* = 148)	x	14.86	30.81	26.75
	y	45.19	54.73	41.76
	z	39.95	14.46	31.49
Sample group #8, without decoy information, then with high-price decoy information (*N* = 144)	x	20.09	32.62	34.76
	y	41.67	48.80	45.88
	z	38.24	18.58	19.36
	x	17.36	24.81	22.78
	y	39.59	30.69	32.64
	z	43.05	44.50	44.58
Chi-squared test		2.295	20.272***	2.261

****Means significant at 1% significance level.*

and 39.59%, respectively, hence, $P7_z(y, x)$–$P6_z(y, x) \neq P8b_z(y, x)$–$P8a_z(y, x)$ ($\chi^2 = 2.295$, $p = 0.317$). Values of $P7_z(y, x)$, $P8a_z(y, x)$, and $P8b_z(y, x)$ for VTB pork compromise option were 54.73, 48.80, and 30.69%, respectively, hence, $P7_z(y, x)$–$P6_z(y, x) \neq P8b_z(y, x)$–$P8a_z(y, x)$ ($\chi^2 = 20.272$, $p < 0.01$). Values of $P7_z(y, x)$, $P8a_z(y, x)$, and $P8b_z(y, x)$ for the origin-labeled pork compromise option were 41.76, 45.88, and 32.64%, respectively, hence $P7_z(y, x)$–$P6_z(y,x) \neq P8b_z(y, x)$–$P8a_z(y, x)$ ($\chi^2 = 2.261$, $p = 0.3230$). Therefore, $H5_0$ can be rejected for all three types of pork products. In other words, whether the high-price decoy information is given after consumers have experienced non-decoy information affected compromise effect.

Chen et al. (2011) revealed that the likelihood of a compromise option being chosen by participants decreases under decoy information in comparison to when no decoy information is presented. In contrast, however, our results showed that participants still preferred pork product option *y* and showed a significant compromise effect.

Results of testing hypothesis *H4* based on **Table 4** shows participant choices under different consumption contexts in the absence of decoy information and in the presence of low-price decoy information. When participants made choices without decoy information (sample group #2). Under this context, compromise option *y* was selected most often, and a significant compromise effect occurred. In sample group #4, participants made a choice in the presence of decoy information. Comparing sample groups #2 to #4, compromise option *y* exhibited an absolute advantage and had the largest choice share. However, in sample group #5, we found that if respondents first made a choice in the absence of decoy information and then made a choice again after receiving low-price decoy information, the share of option *y* decreased from 51.01 to 36.24% ($\chi^2 = 56.089$, $p < 0.01$) and compromise effect disappeared. Further analysis of sample groups #4 and #5 after the addition of low-price decoy information showed that consumer choices differed greatly. Specifically, the share of option *x* chosen by participants increased from 14.77% in sample group #4 to 48.64% in sample group #5, whereas that of option *y* decreased from 75.17 to 36.24%, respectively. Option *x* was traceable pork with the lowest price. The intention of the decoy information was to induce participants to consider low-priced traceable pork. However, this decoy effect did not occur in sample group #4.

Similar results were observed when testing *H5* based on **Table 3**. We observed the three choice decisions made by participants in sample group #8 and found that without decoy information, the shares of compromise option *y* were 41.67, 48.80, and 45.88%, respectively. When the same participants chose again after the addition of high-price decoy information, the shares of compromise option *y* decreased to 39.59, 30.69, and 32.64%, respectively. Further analysis revealed that the share of option *y* chosen by sample group #8 under a high-price decoy information context was significantly lower than that of option *z*, which then became the most preferred product.

These findings suggested that a change in the presentation of decoy information had an influence on compromise effect. Presenting the decoy information after a choice without decoy information weakened compromise effect (in sample group #5 and #8). However, for sample groups #4 or #7, significant decoy effect was still observed, even though these consumers were presented with the same decoy information. Overall, we find that when facing three pork options in a choice set {*x*, *y*, *z*}, participants generally considered it attractive to choose the compromise option, thus showing a clear compromise effect. When the presentation of decoy information is moved after a choice without decoy information, participant preference changed to exhibit less compromise effect.

CONCLUSION AND IMPLICATIONS

This paper focused on understanding compromise effect in consumer choices of pork products under a consistent sequence of product presentation. We also examined the impact of different decoy information and whether the information was presented with or without the respondents first making a choice with no decoy information. As demonstrated, consumer decision-making in pork purchases showed significant compromise effect. Furthermore, compromise effect exists under decoy information featured as high-price and low-price information in this research. However, when consumers made an initial choice without any decoy information, and then chose again following the presentation of decoy information, their choices were more spread out across all products in the choice set and the compromise effect disappeared. This is a reflection of how changes in the presentation of decoy information influenced consumer behavior.

In this study, we used pork to demonstrate that consumer choices exhibited compromise effect with or without decoy information. However, the size of compromise effect may not be identical for all types of food. As the main source of animal protein for Chinese consumers and a basic component of the Chinese CPI, demand price elasticity for pork is lower than that for most other foods. If a product with even lower demand elasticity was used in this study (for instance, rice or wheat flour), the intensity of compromise effect may need reevaluation when these products are compared in one choice set with those having higher demand elasticity. However, within one product category, we expect compromise effect still to take place.

In sample groups #5 and #8 in our study, in order to ensure that the choices of the same respondents before and after the decoy information were not influenced by the order of product presentation, we maintained a consistent product order in the choice set before and after the presentation of decoy information. This also allows a more direct comparison with choices made in other sample groups. This means that during our entire study, the products were always presented to the respondents in the order of *x*, *y*, and *z*. A drawback of this approach is that the order effect may be confounded with compromise effect. Furthermore, compromise effect is being tested predominantly in the literature by varying the number of products/attributes in a choice set. Another layer of confounding may occur between the number of products/attributes and compromise effect, although we argue that based on our consistent discovery of compromise effect in product choice sets with different

numbers of products/attributes, the possible confounding effect may not significantly undermine our findings. Limited by the current length of the article, we have not specifically tackled these potential confounding effects, which may be a valuable subject for exploration in future research.

The conclusions of this study have several policy implications. Much of our findings on traceable pork suggest that the Chinese government should encourage manufacturers to produce traceable pork with diverse levels of traceable information at varied prices to form a traceable pork system. This will not only satisfy the diverse demand for traceable pork, if traceability is deemed as the prominent tool to assist the construction of a safer national pork supply chain, manufacturers should be encouraged to increase the market share of traceable pork products by harnessing the compromise effect to promote traceable pork.

DATA AVAILABILITY STATEMENT

The datasets analyzed in this manuscript are not publicly available to protect subjects' privacy, and to comply with regulations set by Jiangsu Social Science Fund Major Project. Requests to access the datasets should be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by human ethics review board of the Jiangnan University of China. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

LW: proposing the research direction of the thesis and designing the structure of the article. XG: questionnaire and manuscript drafting. XC and WH: revise and propose.

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Elucidating the Effect of Antecedents on Consumers' Green Purchase Intention: An Extension of the Theory of Planned Behavior

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In this study, the extension of theory of planned behavior was developed to evaluate the effects of antecedents that influence consumers' intention to buy green products. The effect of nine determinants (i.e., individual benefits, social benefits, willingness-to-pay, environmental responsibility, e-word-of-mouth, values, self-competence, convenience, and environmental literacy) of the green wave on Taiwanese consumers was empirically tested by examining their perception of social responsibility through theory of planned behavior. Except for consumer subjective norms, the remaining factors exhibited significant positive correlations with the planned behavior, implying that the voluntary participation aspect of the green wave is considerably more critical than its mandatory social pressure. To diffuse this green wave more effectively, the Taiwanese government should encourage consumers to easily capture the detailed impact of the green wave on the society and allow consumers to use word-of-mouth marketing for the creation of relational value to improve their quality of life.

Keywords: theory of planned behavior, green consumption, green products purchase intention, green food, structural equating modeling, purchase intention

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INTRODUCTION

Following the implementation of the United Nations Framework Convention on Climate Change in 1994, diverse efforts have been made in the public and private sectors worldwide to achieve sustainable global development. At the 2015 United Nations Climate Change Conference in Paris, the twenty-first session of the Conference of the Parties agreed to limit the increase temperature to below 2°C above preindustrial levels in the global average. Moreover, the delegates agreed to continue their efforts to limit the temperature rise to 1.5°C above preindustrial levels. These agreements indicated that temperature-control efforts would greatly reduce the risks of climate change. To achieve the objectives of United Nations Framework Convention on Climate Change, 195 member countries must make clear the measureable efforts for global sustainable development. In particular, the public–private partnership in sustainable development is crucial for achieving this objective, including in Taiwan (Choi et al., 2016).

Taiwan is one of the most dangerous areas in the world from an environmental perspective (Tsai and Chen, 2011). More than 70% of the land area and population in Taiwan face the threats of more than three types of natural disasters simultaneously (World Bank and Columbia University, 2005). Such concerns are reflected in online activities and have led to diverse environmental movements in Taiwan. In October 2013, many netizens claimed that several soy sauce companies used hydrochloric acid to decompose soybean sauce, thus resulting in higher risks of kidney damage, cancer, and many other diseases. The Taiwanese society was traumatized by this terrible chemical disaster and hence emphasized food security concerns. Global warming, waste water and pollution, loss of species, the destruction of the ozone layer, and other environmental concerns have become key threats to sustainable human existence globally, particularly in Taiwan (Tanner and Wölfing Kast, 2003). Thus, the turmoil of the sustainable, or green wave, the third revolution in human history, has been affecting Taiwan.

Classical economies were defined by the "self-sufficiency paradigm" of these societies. Because supply creates its own demand, classical economies did not experience oversupply problems (Sowell, 2015). However, the industrial revolution introduced large-scale mass production led by companies with the new paradigm of "economies of scale." The more a company produces, the lower the unit cost is, resulting in a permanent oversupply problem of current societies. At the beginning of the industrialization period, companies and governments solved their oversupply problem through overseas colonies, but this imperialism was unsustainable because of the claims from latecomers such as Germany, Russia, and Japan. Because of the ever-increasing oversupply problems associated with energy-intensive economic structures, this company-led industrial revolution introduced excessive energy and resource consumption, resulting in global warming and the extreme bipolarization of societies and countries.

Therefore, after the 300-year industrialization period, the green wave revolution emerged with the new paradigm of "value creation based on the network management." Instead of competitive equilibrium or optimum of a single economic entity, which were the core paradigms of traditional economics and business management, the harmonized cooperation among many partners to improve quality of life has become the core objective in the green or sustainable wave. Rather than a strategy to obtain the largest portion of a pizza, the paradigm of the green wave is reflected by cooperative partnership to enlarge the size of the pizza to benefit all partners. Initially the emphasis of the green wave on the environmental protection was excessively strong; however, this emphasis has shifted toward harmonizing economic development for the needs of current and future generations. As environmental awareness among these new proactive consumers has increased, the concept of environmental protection has gradually become an invisible pressure on all economic entities, and this new environmental wave has slowly changed consumers' daily consumption behaviors. The behaviors of these green consumers are termed green consumption. If customers want to contribute to environmental protection, the simplest approach is purchasing green products. Green products should be defined on the basis of the wider perspective of green supply chain management, which aims to reduce pollution and resource consumption. This includes the acquisition of environmentally friendly raw materials, environmentally friendly manufacturing and distribution, energy reduction, and environmentally friendly disposal, including recycling, biodegradable disposal management, clean energy and water use, packaging reduction, and limiting toxic byproducts (Nimse et al., 2007). The actions of manufacturing companies and regulatory authorities are based on the strong but invisible pressure of green consumers, who are the drivers of all economic activities. Therefore, the behavior yielded by consumers' attitudes toward the green wave is crucial for the successful economic transformation of companies and governments.

To understand the social transformation toward the green wave, the nine determinants that promote green consumption were analyzed in this research through the theory of planned behavior. The rest of the paper is organized as follows. Section "Literature Review and Hypothesis Development" reviews the previous studies and then proposed hypotheses and the research model. Section "Research Methodology and Sample Structure" presents the empirical analysis and its results and implications. Finally, Section "Data Analysis Result" concludes several summary and strategic suggestions.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In this section, through a comparative analysis of previous studies, theory of planned behavior, including diverse sustainable factors, is introduced as a methodological basis. Hypotheses are established on the basis of common arguments.

Theory of Planned Behavior

Theory of planned behavior, which was derived from the theory of reasoned action (Fishbein and Ajzen, 1977), connects the beliefs and behaviors of potential consumers. Both models are based on the premises that individuals make logical, reasoned decisions to engage in specific behaviors by evaluating the information available to them. The theory states that consumers' attitudes toward their realized behavior are based on their subjective behavioral belief in the product or service and their cognitive evaluation of the possible results; these attitudes may be affected by the subjective norms derived from the more objective specifications of the faith on the consumption and obedience motivation of the consumer. Subjective norms are a type of perceived behavioral control mechanism of consumption. Combined with consumers' attitudes, subjective norms form individuals' behavioral intentions and their resulting behaviors. More specifically, consumer attitudes could be defined as the positive or negative evaluation of the self-expression of particular behaviors. This conceptual framework measures the extent to which the performance of consumers' behavior is positively or negatively associated with their purchase intentions. In this study, consumer attitudes were defined through consumers' positive evaluations of environmentally friendly fabricated products.

Subjective norms were defined as individuals' perception of a particular behavior, which are strongly impacted by the judgments of other individuals such as parents, friends, spouses, and teachers. In this study, subjective norms were defined as consumers' perception of environmentally friendly products in the face of social pressure, resulting in support for or opposition to green products, which negatively affects the environment. If consumers evaluate the suggested behavior regarding a product or service as positive (attitude), and if they consider this attitude as significant to others for them to perform the behavior more appropriately (subjective norm), higher intentions are obtained (motivations); thus, consumers are more likely to engage in this behavior. Many studies have demonstrated a high correlation between the consumers' attitudes, the surrounding subjective norms of behavioral intention, and the purchase behavior itself (e.g., Liao et al., 2007; Khalifa and Shen, 2008; Chen et al., 2009; Lu et al., 2009; Nasri and Charfeddine, 2012).

Ramayah et al. (2009) extended theory of planned behavior by introducing an additional factor of perceived behavioral control to the purchase intention, which is defined as an individual's perceived easiness or difficulty in performing the behavior. Perceived behavioral control is determined according to all the accessible control beliefs. If consumers receive more information related to the green characteristics on a product and thus have higher perceived behavioral control, then they have a greater purchase intention for environmentally friendly products. Intention is defined as an indication that a person is ready to perform a certain act and is considered as the direct antecedent of behavior. In this study, intention was defined as the possibility that consumers will choose to purchase the environmentally friendly products. The basic framework of theory of planned behavior is presented in **Figure 1**.

Hypotheses and Model Development

In this section, the development of the logical factors or determinants on the purchase intention of theory of planned behavior model shown in **Figure 1** is described in detail. Among the relevant arguments, individual as well as social benefits are defined as consumers' cognitive potential benefits of their attitude toward the purchase of environmentally friendly products. If a product uses an environmentally friendly coating to avoid harmful gases, consumers can alter their behavioral intention through personal interest, attitude, and psychological physiology for this green product (Bhattacherjee, 2000; Kotler and Keller, 2006). This study focused on the effect of the green wave paradigm shift from the competitive solution of profit-maximization on the production of environmentally friendly products. Therefore, the following hypothesis could be a valuable initial approach to consumers' attitude shift toward the green wave.

H1: Individual benefits have a positive influence on consumer attitudes.

Consumers obtain not only individual benefits from the purchase of environmentally friendly products but also social benefits. If a green product that includes recycled materials could reduce environmental damage, then most consumers would feel that they could contribute to social responsibility to preserve the environment by purchasing this product. Therefore, social benefits affect attitude. Manaktola and Jauhari (2007) emphasized that consumers with a strong social responsibility hold relatively positive attitudes toward environmentally friendly products. Thus, we propose the following hypothesis.

H2: Social benefits have a positive influence on consumer attitudes.

Because the cognition of green consumption has been widely accepted, consumers are willing to spend more money to buy green products. Ozanne and Vlosky (1997) found that US consumers were willing to pay 4.4–18.7% higher prices for environmentally friendly certified wooden products. Moreover, according to Rushmore (1993), US tourists are willing to pay 8.5% more for green hotels. Hansla et al. (2008) revealed that consumers are also willing to pay more for green electricity such as that generated from renewable sources. Thus, willingness to pay is strongly positively related to consumers' attitude regarding the purchase intentions for environmentally friendly products. Therefore, consumers have a positive attitude toward green products regardless of price level. According to Abeliotis et al. (2010), most consumers are willing to spend more money for products that have less impact on the environment, which indicates a positive attitude regarding purchase intention. Based on these arguments, the third hypothesis of willingness to pay is proposed.

H3: Willingness to pay has a positive influence on consumer attitudes.

Environmental responsibility is a type of consumer awareness of the responsibility to maintain the integrity of the environment, and it is indicated by proactive caring for the environment. Consumers have a sense of creating values when they engage in environmental protection. Indicated that responsibility should explain individuals' self-disciplined conduct and encourage consumers to make ethical decisions, plan ahead, try their best, and set a good example. Pearce and Gregersen (1991) used the variable of responsibility to indicate workers' perceptions. The responsibility of workers is to care for others, including customers and colleagues, and this is a type of mandatory feeling for them to help others. Bansal (2011) suggested that consumers with high environmental awareness as subjective norms exhibit preferences for green products. Therefore, the following hypothesis on environmental responsibility is established.

H4: Environmental responsibility has a positive influence on subjective norms.

Electronic word-of-mouth can be considered as a type of invisible constraint on certain group members through the relational sharing of information; thus, it can serve as the basis for the subjective norms of that group. Hanson and Kalyanam (2007) analyzed electronic word-of-mouth and found that the consumers face the social pressure to purchase environmentally friendly products because of the broad discussion and consensus

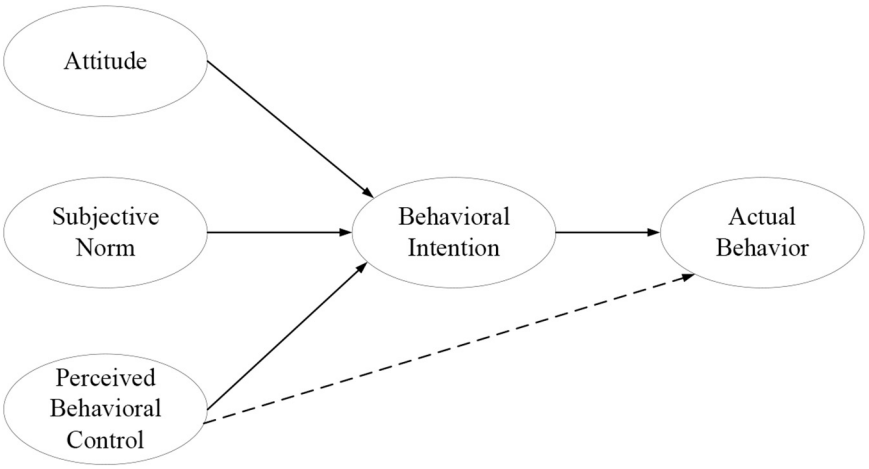

FIGURE 1 | Theory of planned behavior.

on the Internet about the influence of the green wave. According to Bickart and Schindler (2001), the higher the credibility of Internet goes by word-of-mouth, the stronger its influence on consumption is. Prior research also highlighted that electronic word-of-mouth affects subjective norms, resulting in a more positive attitude regarding behavioral intention (e.g., Jalilvand and Samiei, 2012; Fu et al., 2015; Husin et al., 2016). Thus, the fifth hypothesis on electronic word-of-mouth is proposed.

H5: Electronic word-of-mouth has a positive influence on subjective norms.

Subjective values that emerge from environmental protection activities could serve as social subjective norms. Schwartz (1992) emphasized values as the preference for a certain behavior or way of life of a person or social group with enduring beliefs. Manaktola and Jauhari (2007) concluded that consumers with higher altruistic values are very likely to be green consumers. Therefore, the following hypothesis on values is proposed.

H6: Perceived value has a positive influence on subjective norms.

In the context of environmentally friendly products, self-competence is defined as consumers having sufficient basic knowledge, skills, and income to choose and purchase the products. Ajzen (1991) noted that perceived behavioral control includes self-efficacy or self-competence to facilitate the surrounding conditions. The higher consumers' self-competence is, the more they are likely to implement the three Rs (reduce, recycle, reuse) for environmental conservation and protection (Teisl and O'Brien, 2003; Thapa and Graefe, 2003; Fraj and Martinez, 2006). Thus, we propose the following hypothesis.

H7: Self-competence has a positive influence on perceived behavioral control.

To promote environmentally friendly products, consumer convenience for purchasing green products will enhance their purchase intentions (Chiu, 2009). Convenience for purchasing products or obtaining information is very perceptive. Yoon and Kim (2007) indicated that consciousness of convenience is an external variable that affects consumer behavior. Hossain and Prybutok (2008) indicated that consciousness of convenience affects the intention to use. Therefore, the following hypothesis is proposed.

H8: Convenience has a positive influence on perceived behavioral control.

Roth (1992) argued that environmental literacy is crucial for consumers to consider environmental concerns. According to subject-oriented teaching study conducted by Culen and Volk (2000), students' literacy on environmental problems is an important determinant because their awareness of the relevant and perceptive behaviors is positively related to perceived behavioral control (McBeth and Volk, 2009; Bansal, 2011). Thus, the following hypothesis is proposed.

H9: Environmental literacy has a positive influence on perceived behavioral control.

Theory of planned behavior posits the relations between beliefs, attitudes regarding purchase intentions, and the resulting behavior. According to this model, consumer attitudes toward behavior are determined by their accessible beliefs about environmentally friendly production, where beliefs are defined as the subjective probabilities that the behavior will yield certain outcomes. Specifically, the evaluation of each outcome brings the attitude in direct proportion to the person's subjective probability that the behavior produces the outcome in question (Kalafatis et al., 1999; Ajzen, 2002; Chen et al., 2009; Han and Kim, 2010; Han et al., 2010; Cheon et al., 2012; Jekauc et al., 2015; Yadav and Pathak, 2017; Zampetakis et al., 2017; Verma and Chandra, 2018; Sun et al., 2019). Subjective norms are an individual's perceptions of a particular behavior, which are strongly influenced by the judgments of others (Trumbo and O'Keefe, 2005; Chung, 2016; Yadav and Pathak, 2017;

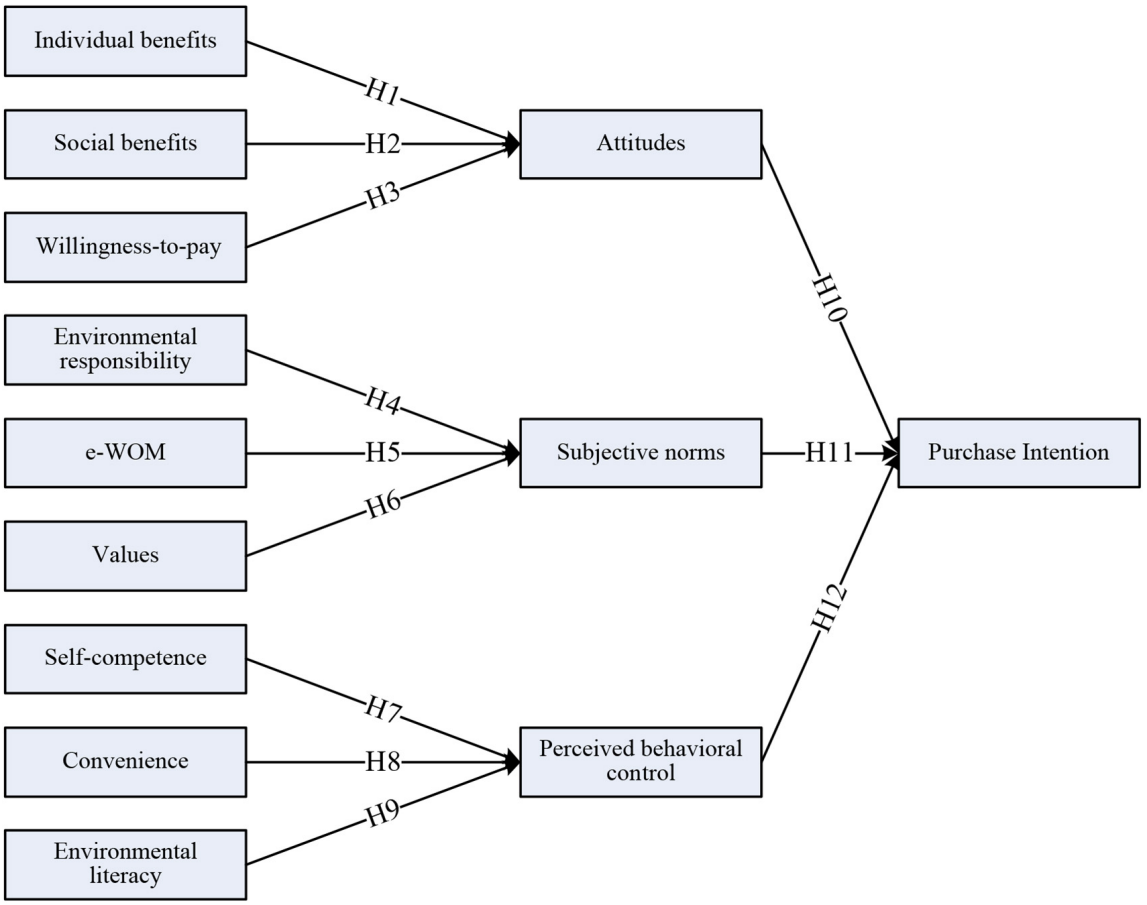

FIGURE 2 | Research model.

Verma and Chandra, 2018). Ajzen (1985) argued that perceived behavioral control is determined by the total set of accessible control beliefs. Therefore, the following hypotheses are proposed.

H10: Attitude has a positive influence on purchase intention.
H11: Subjective norms have a positive influence on purchase intention.
H12: Perceived behavioral control has a positive influence on purchase intention.

The research model, which is based on these hypotheses and theory of planned behavior model, is illustrated in **Figure 2**.

RESEARCH METHODOLOGY AND SAMPLE STRUCTURE

A questionnaire survey was employed to collect data. The measurement items, research framework, and operational definitions were based on the established hypotheses and other studies. Although most of the measurement items were from existing studies to establish the content validity (as shown in **Appendix**), we conducted a pilot test with master students to validate the measurement items. Based on the feedback of the pilot test, we revised the wording of the measurement items.

Participants with green products usage experience were recruited by visiting service and marketing relevant classes and asking for volunteers to finish surveys in the spring and summer quarters of 2014 in Taiwan. Then, the data collection launched as a convenience sampling and finally broadened a snowball sampling. A total of 389 samples were collected after our survey of this study. After eliminating the repetitive responses by checking the screening of e-mail and IP addresses, the final valid sample is composed of 353 participants.

To analyze the proposed model, the partial least squares approach was used for structural equation modeling with path and regression analysis. SPSS 18.0 and Smart Partial Least Squares 2.0 were employed to perform the partial least squares analysis (Ringle et al., 2005). We referred to previous studies to formulate the operational definitions and measurement items for all the variables. Finally, 410 questionnaires were collected, 353 of which were valid. To clarify the sample characteristics, **Table 1** shows the demographics of the participants. Male and female respondents constituted 51 and 49% of the sample, respectively. Furthermore, the majority of respondents were aged 26–45 years (83.8%). The largest group was college graduates (66.3%) and the

second largest was educated to master's degree level or above (24.4%). Most of the respondents were employed in the high-tech industry (24.4%), followed by the manufacturing sector (17%). Ninety percent of the respondents used the Internet for more than 60 min. All data samples appropriately reflected the societal structure of Taiwan, and the respondents appeared to be familiar with the green wave. The analysis of the outer and inner models on the basis of these samples is presented in the following sections.

DATA ANALYSIS RESULTS

Outer Model Analysis

This study followed a two-stage approach to execute data analysis (Anderson and Gerbing, 1988). The first stage is to measure the construct validity of the outer model (measurement model), and then the proposed casual model and research hypotheses were assessed by inner model analysis.

Outer model is defined as the relations between latent constructs and indicators in the partial least squares method. **Table 2** tabulates the factor loads and reliability testing results of all the construct items. The composite reliability values of all constructs were ≥0.7, suggesting that the constructs had satisfactory reliability. The convergent validity and discriminant validity tests were performed to assess factors' construct validity. According to Fornell and Larcker (1981), the requirements for convergent validity would be satisfied if the factor loads of the indicators are more than 0.5; the average variance extracted (AVE) is greater than 0.5; and the reliability is over 0.7. **Table 2** indicates that all the constructs satisfied the criteria suggested by Fornell and Larcker (1981), indicating their favorable convergent validity. In addition, a construct features discriminant validity if the square root of the AVE is greater than the correlation coefficient. **Tables 2**, **3** present the discriminant validity of the constructs. All dimensions had AVE and composite

TABLE 1 | Sample demographics.

Characteristics	Description	Frequency	Percent(%)
Gender	Female	173	49.0%
	Male	180	51.0%
Age	Under 25 years old	9	2.5%
	26∼30 years old	35	9.9%
	31∼35 years old	91	25.5%
	36∼40 years old	101	28.6%
	41∼45 years old	70	19.8%
	46∼50 years old	24	6.7%
	51 years old or above	23	6.3%
Education level	Primary school or lower degree	9	2.5%
	Middle school	10	2.8%
	High school certificate	14	4.0%
	Junior college	75	21.3%
	Undergraduate degree	159	45.0%
	Master or higher degree	86	24.4%
Job	Soldier, civil servants, teachers	16	4.5%
	Financial	37	10.5%
	Manufacturing	60	17.0%
	High-tech industries	86	24.4%
	Healthcare	9	2.5%
	Service industries	88	25%
	Freelance	13	3.7%
	Housekeeper	18	5.1%
	Other	26	7.3%

TABLE 2 | Reliability analysis and convergent validity.

Dimensions	Research variables	Factor loadings (>0.5) *T*-value (>2)	AVE (>0.5)	Composite reliability (>0.7)
Individual benefits	IB1	0.74 (17.21)	0.51	0.76
	IB2	0.74 (14.08)		
	IB3	0.66 (9.04)		
Social benefits	SB1	0.82 (20.26)	0.77	0.91
	SB2	0.90 (54.83)		
	SB3	0.90 (64.88)		
Willingness-to-pay	WTP1	0.91 (80.11)	0.78	0.91
	WTP2	0.88 (42.14)		
	WTP3	0.85 (37.30)		
Consumer attitudes	CA1	0.95 (99.73)	0.90	0.96
	CA2	0.95 (100.10)		
	CA3	0.95 (118.26)		
Environmental responsibility	ER1	0.67 (9.50)	0.57	0.80
	ER2	0.66 (9.09)		
	ER3	0.92 (40.89)		
e-WOM	EWOM1	0.86 (39.06)	0.72	0.88
	EWOM2	0.87 (50.00)		
	EWOM3	0.81 (29.64)		
Values	V1	0.93 (90.99)	0.81	0.93
	V2	0.93 (96.73)		
	V3	0.84 (25.76)		
Subjective norms	SN1	0.88 (41.93)	0.84	0.94
	SN2	0.94 (88.44)		
	SN3	0.94 (125.89)		
Self-competence	SC1	0.84 (58.28)	0.67	0.86
	SC2	0.80 (22.26)		
	SC3	0.81 (25.74)		
Convenience	CON1	0.78 (18.64)	0.68	0.86
	CON2	0.84 (26.27)		
	CON3	0.85 (51.13)		
Environmental literacy	EL1	0.79 (20.65)	0.61	0.82
	EL2	0.70 (11.97)		
	EL3	0.84 (39.53)		
Perceived behavior control	PBC1	0.81 (26.83)	0.63	0.83
	PBC2	0.69 (11.56)		
	PBC3	0.87 (48.26)		
Intention	INT1	0.94 (90.25)	0.83	0.94
	INT2	0.94 (111.25)		
	INT3	0.86 (25.48)		

TABLE 3 | Correlation matrix.

	IB	SB	WTP	CA	ER	EWOM	V	SN	SC	CON	EL	PBC	INT
IB	**0.72**												
SB	0.46	**0.88**											
WTP	0.35	0.41	**0.88**										
CA	0.49	0.61	0.58	**0.95**									
ER	0.38	0.55	0.38	0.53	**0.76**								
EWOM	0.48	0.43	0.47	0.64	0.52	**0.85**							
V	0.40	0.49	0.80	0.67	0.47	0.64	**0.90**						
SN	0.37	0.37	0.67	0.60	0.44	0.61	0.75	**0.92**					
SC	0.46	0.35	0.57	0.52	0.42	0.69	0.66	0.63	**0.82**				
CON	0.36	0.49	0.47	0.58	0.55	0.61	0.57	0.55	0.62	**0.82**			
EL	0.33	0.55	0.38	0.52	0.55	0.44	0.45	0.38	0.41	0.59	**0.78**		
PBC	0.41	0.59	0.57	0.65	0.60	0.61	0.63	0.60	0.64	0.70	0.65	**0.79**	
INT	0.35	0.54	0.50	0.65	0.61	0.53	0.59	0.53	0.50	0.64	0.59	0.72	**0.91**

IB, individual benefits; SB, social benefits; WTP, willingness to pay; CA, consumer attitudes; ER, environmental responsibility; EWOM, eWOM; V, values; SN, subjective norms; SC, self-competence; CON, convenience; EL, environmental literacy; PBC, perceived behavior control; INT, intention.

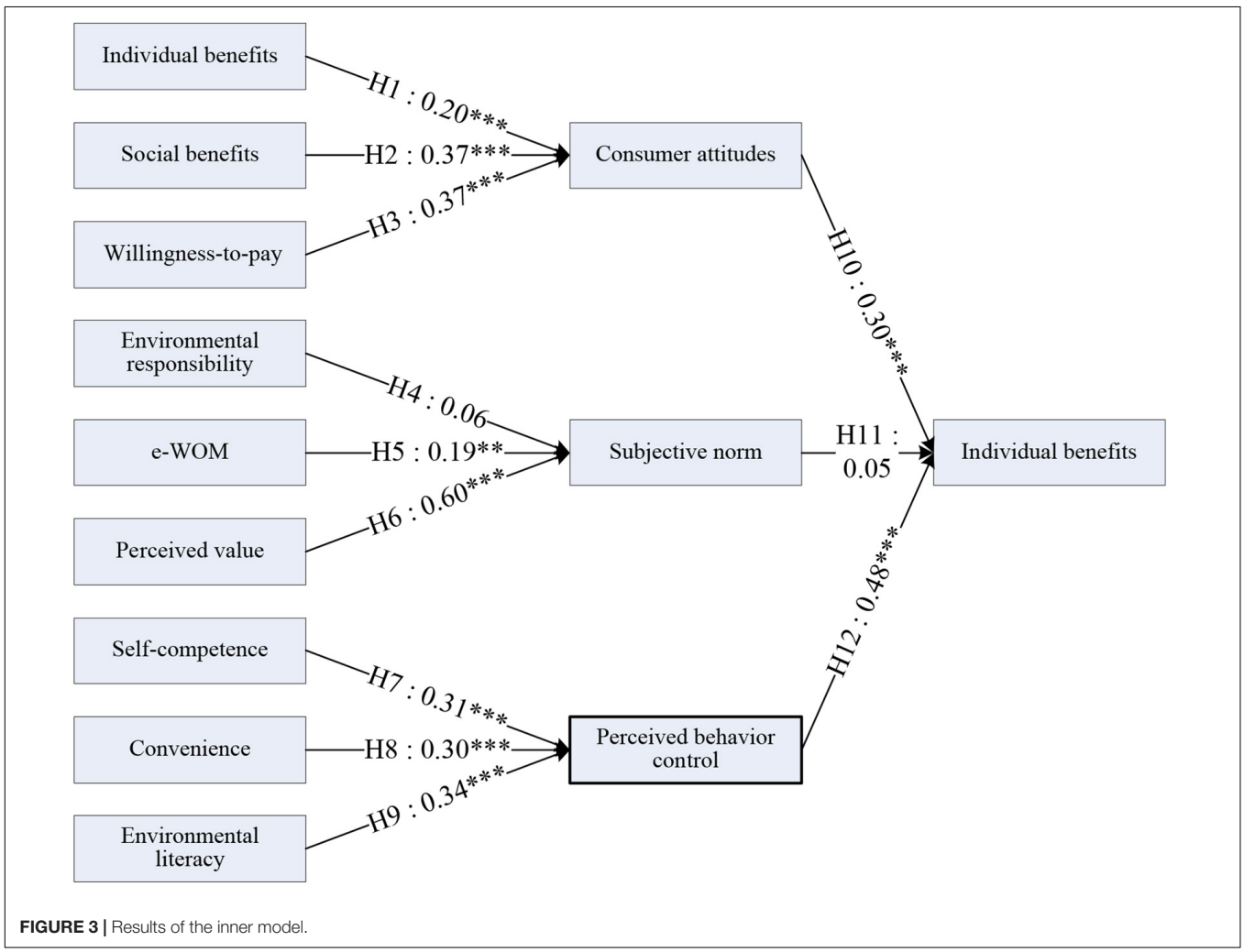

FIGURE 3 | Results of the inner model.

reliability that exceeded the aforementioned cutoff values, which suggests a favorable convergent validity. Furthermore, because the square root of the AVE for each construct exceeded the correlation share among the constructs in our proposed model, discriminant validity was also satisfied (Fornell and Larcker, 1981; Hair et al., 2016).

TABLE 4 | Hypotheses testing result.

Hypothesis	Standardized path coefficient	*t*-value	Result
H1: Individual benefits have a positive influence on consumer attitudes.	0.195***	3.558	Supported
H2: Social benefits have a positive influence on consumer attitudes.	0.366***	5.639	Supported
H3: Willingness to pay has a positive influence on consumer attitudes.	0.366***	5.475	Supported
H4: Environmental responsibility has a positive influence on subjective norms.	0.057	1.155	Not supported
H5: e-WOM has a positive influence on subjective norms.	0.193**	2.759	Supported
H6: Perceived value has a positive influence on subjective norms.	0.604***	8.281	Supported
H7: Self-competence has a positive influence on perceived behavioral control.	0.313***	6.083	Supported
H8: Convenience has a positive influence on perceived behavioral control.	0.301***	5.352	Supported
H9: Environmental literacy has a positive influence on perceived behavioral control.	0.340***	8.481	Supported
H10: Attitude has a positive influence on purchase intention.	0.300***	3.902	Supported
H11: Subjective norms have a positive influence on purchase intention.	0.057	0.784	Not supported
H12: Perceived behavioral control has a positive influence on purchase intention.	0.487***	6.544	Supported

***p-value < 0.01 and ***p-value < 0.001.*

Regarding the overall quality of the proposed model, we computed the Goodness of Fit (GoF) following the formula by Tenenhaus et al. (2005). The GOF is calculated as:

$$\text{GOF} = \sqrt{\overline{Communality} \times \overline{R^2}} = \sqrt{0.717 \times 0.680} = 0.698$$

GoF for the outer model as a whole indicate the fitness of the proposed model explains the empirical data. According to above result, GoF is 0.698 which exceeds the cut-off criterion of 0.36 for a large effect size (Wetzels et al., 2009). Therefore, our empirical data concluded the proposed model has an appropriate overall fit, and concede us to conclude our proposed model performs well compared to the baseline values defined above.

Inner Model Analysis

In the PLS approach, the inner model is formed of the path structures between constructs. The hypothesis testing results for the inner model with path coefficients and their significance levels are illustrated in **Figure 3** and **Table 4**. The direct influence of E on H and H on M was not significant, and thus H4 and H11 were not supported. Apart from H4 and H11, the remaining 10 hypotheses formulated in this research were supported at a significance level of 95%. The empirical results revealed that consumers' attitude and perceived behavioral control strongly supported the purchase intention for green products, whereas the effect of subjective norms obtained from the societal background on the purchase intention was not strong. Therefore, although the Internet diffuses awareness of the green wave, global warming, and climate change, consumers do not strongly believe the information and discussions obtained through the Internet. In particular, consumers do not understand the green wave as a type of environmental responsibility; thus, this type of social norm does not affect consumers' purchase intentions. The public pressure for the green wave is not important for individuals' decision-making, an effect that is unique to Taiwan. By contrast social subjective norms have a very strong effect on individual decision-making in Japanese culture.

The estimates of the R-Square exceeded the respective cutoffs proposed in previous studies, confirming that the measurement model exhibited a reasonable fit with the data collected. **Table 5** examines the influences of each construct, including direct effects, indirect effects, or both. The path coefficient from a predictor variable to a response variable assesses the direct effect, and the product of the coefficients from a predictor variable through a mediator variable measures the indirect effect.

In contrast to the rejection of the relationship between environmental responsibility and purchase intention, electronic word-of-mouth and perceived value had positive effects on the purchase intention with subjective norms as a mediator. This implies that even if the social pressure is unimportant to individual decisions, the recommendations from intimate social relations are still supportive. Therefore, the public–private partnership is critical to the sustainable transformation of the Taiwanese economy. Instead of mandatory or pseudo pressure by the public for environmental protection, consumers should voluntarily participate in the environmental movement, and the government should implement nudge policies by managing sustainable networks for consumers to voluntarily share information and experiences of environmental protection. For this purpose, the public–private partnership is crucial in Taiwan and other Asian countries such as China and Korea, where the role of the government is culturally limited.

TABLE 5 | R-square for the endogenous constructs.

Endogenous construct	R^2 (>0.36)
Consumer attitudes	0.69
Subjective norms	0.71
Perceived behavior control	0.63
Intention	0.69

Testing of Mediation Effects

This study adopted Sobel, Aroian, and Goodman tests to analyze the mediation effect of three behavioral factors of the consumers, namely their attitude, subjective norms, and perceived behavioral control. A significant mediation effect between consumers' attitude and perceived behavioral control is

TABLE 6 | Mediation effects testing.

Equation	Relationship	*t*-value	Sobel test	Aroian test	Goodman test
IB → CA → INT	IB → CA	3.5575	2.63	2.58	2.68
	CA → INT	3.9020			
SB → CA → INT	SB → CA	5.6393	3.21	3.18	3.24
	CA → INT	3.9020			
WTP → CA → INT	WTP → CA	5.4755	3.18	3.14	3.21
	CA → INT	3.9020			
SC → PBC → INT	SC → PBC	6.0825	4.46	4.43	4.48
	PBC → INT	6.5436			
CON → PBC → INT	CON → PBC	5.3524	4.14	4.11	4.17
	PBC → INT	6.5436			
EL → PBC → INT	EL → PBC	8.4808	5.18	5.16	5.20
	PBC → INT	6.5436			

IB, individual benefits; SB, social benefits; WTP, willingness-to-pay; CA, consumer attitudes ER, environmental responsibility; EWOM, eWOM; V, values; SN, subjective norms; SC, self-competence; CON, convenience; EL, environmental literacy; PBC, perceived behavior control; INT, intention.

present if the absolute value of z is greater than 1.96 (Aroian, 1947; Goodman, 1960; Sobel, 1982). The direct influence of environmental responsibility on consumers' attitude, perceived behavioral control, and subjective norms was insignificant; thus, mediation effects were not necessary to assess. The remaining constructs also underwent mediation effect testing, and the results are tabulated in **Table 6**.

From the result of mediation effect analysis, individual benefits, social benefits, and willingness-to-pay have the indirect effect on purchase intention through attitude. Furthermore, self-competence, convenience, and environmental literacy influence purchase intention significantly through perceived behavioral control. However, the results revealed that the mediatory role of the subjective norms is not effective. Therefore, the government should not regulate or promote through subsidies, but rather encourage consumers to voluntarily share their knowledge and experiences through their social networks and participate in the green wave as partners of the government instead of as passive helpers.

CONCLUSION

In this study, we analyzed the success factors for green consumption by using theory of planned behavior. According to Kalafatis et al. (1999), theory of planned behavior is a reliable and foundational model of intention to purchase green products. Therefore, this study adopts theory of planned behavior model to provide an additional perspective into the antecedents of purchase intention toward green products. The empirical findings revealed that consumers' attitude and perceived behavioral control strongly and sustainably impact purchase intentions for green products through individual and social benefits and self-competence, convenience, and environmental literacy, respectively; however, subjective norms do not affect purchase intentions. Consumers' attitude represents individual preferences, whereas perceived behavioral control represents the social pressure on the green consumption. Thus, these empirical results reveal that public regulation of the green consumption is unsustainable in Taiwan. To establish the effect missing in subjective norms, environmental responsibility should be replaced with strong partnerships between the private and public sectors.

For transformation toward sustainable growth, the governance of subjective norms should be complemented with the public–private partnership. However, in most Asian countries, government leadership is overemphasized and thus, the green wave presents a type of moral hazard in the private sector. Even if there is a wide consensus on green consumption on the Internet and among the public, economic transformation toward an advanced green economy is challenging if individual consumers understand green policy regulations as individual, intimate demands. In 2015, the Korean government initiated a nationwide emission trading scheme; however, the government fixed its carbon-reduction targets at substantially lower levels than originally proposed because of the complaints from the participating companies, which resulted in lack of governance for sustainable development. Therefore, without the support of the private sector, government- or society-driven sustainable transformation in developing countries is challenging. The harmonized management of the public–private partnership should therefore be implemented carefully and in detail to achieve performance-oriented governance.

The research limitations and future research directions are presented as follows. First, due to a single source that is applied to measure the whole measurement items, the possibility of a common method bias should be assessed. Although Harman's single-factor test was adopted to test for common method bias, a more detailed research design should be applied to evaluate the existence of common method bias. The second limitation is to ignore the assessment of differences among various types of users and actual behaviors toward green products. Future work may attempt to execute a perspicacious analysis including moderation and mediation effect examination if necessary. Finally, the generalizability of the findings might be cautiously made, for this study was conducted in a single-area setting (i.e., Taiwan). Future studies could use this model in various cultural settings, and compare and contrast the findings among them. Additional

effort across different areas or cultures should be discussed for generalizing the research findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

AUTHOR CONTRIBUTIONS

AR, J-JY, and S-WC contributed to research design. YM and L-CC performed the sample collection and data analysis. AR, YM, and S-CC wrote the manuscript. YM, S-CC, and L-CC developed the original idea for the study. AR and S-WC conducted the research design. All authors contributed to the article and approved the submitted version.

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APPENDIX

QUESTIONNAIRE

Individual Benefits

(Bhattacherjee, 2000; Kotler and Keller, 2006):

- Environmental-friendly products can avoid harmful gas (such as: environmental-friendly coating)
- I think the environmental-friendly products with high economic efficiency (such as: hybrid) helps me save spending for a long time.
- A bonus inspired me more willing to do recycling (such as: recycle bonus)

Social Benefits

(Mainieri et al., 1997):

- Use environmental-friendly products can reduce carbon emissions.
- Use environmental-friendly products is a hand to the society.
- In order to the future of human sustainable you should use environmental-friendly products

Willingness-to-Pay

(Ozanne and Vlosky, 1997; Wu and Hsing, 2006; Abeliotis et al., 2010):

- Environmental-friendly products with higher sale price is acceptable (such as: pure natural detergent)
- I have higher identity of the environmental label products with higher price (such as: contains no lead)
- Organic food can reduce the burden of the body or higher price is acceptable

Environmental Responsibility

(Hines, 1984; Simmons, 1991):

- I will buy environmental-friendly products on account of it helps to reduce damage to environment.
- I will buy environmental-friendly products on account of it can promote resource recycling.
- I will buy environmental-friendly products on account of it beneficial to the sustainability of the earth

Electronic Word-of-Mouth

(Bickart and Schindler, 2001; Hennig-Thurau, 2004; Hanson and Kalyanam, 2007):

- When I saw the collection point, I will try to concentrate of plastic bottle/batteries to there (such as: convenience stores collection points)
- Global environmental pollution problem is increasingly serious.
- I'm more and more concern myself with environmental pollution in Taiwan

Values

(Rokeach, 1973; Mainieri et al., 1997):

- I usually search the relevant information of environmental-friendly products on the internet.
- If anyone have falsely accused to some environmental-friendly products, I will put forward or reply my positive views.
- I will refer to others' experience who used environmental-friendly products as mine reference to purchase

Self-Competence

(Roth, 1992; Fraj and Martinez, 2006):

- I think the environmental label product is worth buying even though the cost is high.
- I think the products which use the environmental-friendly material is worth buying even though the cost is high.
- If most people think that use environmental-friendly products can be beneficial to the living environment, I will be willing to do

Convenience

(Chen, 2007):

- I'll be influenced by TV advertising to buy environmental-friendly products.
- I will buy environmental-friendly products on account of my friends are using
- I will buy environmental-friendly products on account of my family are using

Environmental Literacy

(Roth, 1992; Culen and Volk, 2000; Farmer et al., 2007):

- I have a deeper cognition on the natural environment after I used the environmental-friendly products (such as: natural lotion - soapberry)
- I have enough knowledge to identify with low polluting products
- I'm an environmental literacy citizen

Attitude

(Ajzen, 1985, 1991, 2002; Kotler, 1997; Blackwell et al., 2001)

- I will use environmental-friendly products on account of its easy to obtain (such as: natural crystal soap)
- Environmental protection information awareness programs to facilitate the public have a better understanding of environmental protection (such as: environmental protection information affixed to the bus, the MRT)
- I will use environmental-friendly products because of the convenience of shopping through the Internet

Subjective Norms

(Ajzen, 1985, 1991):

- I think it may impact on the environment to use of polluting products
- I think it may reduce the impact on the environment to use of environmental-friendly products
- I think there are close relationship between ecological balance and the survival and sustainable development of mankind

Perceived Behavioral Control

(Ajzen, 1985, 1991; Han et al., 2010):

- I will buy environmental-friendly products on account of satisfying experience
- I will buy reusable environmental chopsticks on account of bad experience to use disposable chopsticks (such as: pungent taste, bamboo chopsticks are not polished)
- I will buy environmental-friendly products because of the entrenched environmental concepts

Purchase Intention

(Ajzen, 1985, 1991; Chatzisarantis and Hagger, 2005):

- I'm willing to buy environmental-friendly products in the coming year
- If prices are no significant differences with others, I may purchase environmental-friendly products
- If quality are no significant differences with others, I may purchase environmental-friendly products

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ORIGINAL RESEARCH
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Influence of the Framing Effect, Anchoring Effect, and Knowledge on Consumers' Attitude and Purchase Intention of Organic Food

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This article explores consumers' attitude toward and purchase intention of organic food regarding the influence of the framing effect and anchoring effect and the role of knowledge. Our findings suggest that whether message framing describes the benefits of buying organic food or the loss resulting from a failure to buy organic food, significantly influences consumers' attitude and purchase intention. In addition, presenting an anchor price in advertisements also significantly influences consumers' judgment. These results indicate that a negatively framed message induces a more favorable attitude and purchase intention than a positively framed message, a low anchor price is more favorable than a high one, and the interaction effect of framing and anchoring is not significant at the 1% level. Finally, consumers with less organic food knowledge are more susceptible to framing and anchoring effects. These results provide suggestions for appropriate message framing and price anchoring to enhance consumption within the organic industry.

Keywords: organic food, framing effect, anchoring effect, consumers' attitude, purchase intention, product knowledge

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INTRODUCTION

Rapid growth in industrial development and improved living standards are increasing consumers' awareness of food safety and their desire to consume healthy and environmentally sustainable foods. Organic foods undergo a stringent certification process and are produced without the application of synthetic chemicals, such as fertilizers and pesticides (Basha et al., 2015). To this end, the attention paid to organic foods is increasing.

According to the International Federation of Organic Agriculture Movements (IFOAM), globally, organic agricultural land is growing at a rate of 20% per year. However, despite the global growth in production, the market for organic goods is still relatively small. Only 1.4% of agricultural land in the world is farmed organically and, for 56% of countries where data is available, less than 1% of their total farmland is organic farmland (FiBL and IFOAM-Organics International, 2019). In China, organic food only accounts for 0.6% of the domestic food market, and annual per capita consumption is less than $6. This is lower than the world average and far from the amount spent per capita in developed countries.

There are several reasons for the low consumption of organic food, including consumers' attitudes and purchase intentions. Most of the existing literature focus on the factors that influence these aspects, including consumers' product knowledge (Wu et al., 2019), trust (Yue et al., 2017), health awareness, and individual characteristics (Asioli et al., 2017) on the basis of the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (Zagata, 2012). However, to the best of our knowledge, no extant study has used the framing and anchoring perspectives for exploring ways to encourage consumers' positive responses.

Consumers today come across a variety of information when they browse available products. The information delivered through labels mainly includes product advertising messages and price information cues (Wu and Cheng, 2011). For example, Levin and Gaeth (1988) presented an advertisement for ground beef to two groups: one was framed as "75% lean" and the other as "25% fat." Participants responded more favorably toward the beef when it was described as 75% lean. Other studies have examined the effect of including the price of alternative products, label prices, and other information as "anchor value" (Chandrashekaran and Grewal, 2006; Rödiger and Hamm, 2015). For products of the same quality, consumers prefer products that are advertised as having a lower price compared to an internal reference price. The anchor price changes consumers' attitudes and purchase intentions (Chang and Wu, 2015; Paswan et al., 2016). Consumers tend to find "satisfactory solutions" using heuristic strategies and process information by identifying, editing, and evaluating based on their own product knowledge rather than relying on "optimal solutions" (Dale, 2015). Thus, individual decision-making can be influenced by the way information is presented and consumers with more product knowledge can process information more effectively and choose more suitable products (Wang et al., 2019). Therefore, consumers are often influenced by the message framing and anchor pricing in advertisements. Studies have examined framing and anchoring effects in investing, charitable donations, and consumption decisions (Levin et al., 2002; Sinha and Adhikari, 2017). However, consumers' attitude and purchase intention toward organic food based on the framing and anchoring effects has not been studied.

Therefore, this article applies framing and anchoring effects to study organic food consumers' attitude and purchase intention and investigats the moderation role of consumer's product knowledge on these two categories. Based on the findings in this study, it provides suggestions for adjusting consumers' attitudes and purchase intentions, increasing organic food consumption, developing potential markets for organic food, and developing the organic industry.

LITERATURE REVIEW AND HYPOTHESES

According to the theory of bounded rationality (Simon, 1955), consumers do not analytically edit external information on products and cannot perform subtle estimations due to their limited knowledge and uncertainty. Instead, consumers use heuristic systems to identify, edit, and make intuitive judgments based on their knowledge of a given product (Li and Ding, 2010; Shan et al., 2019). Consumers' attitudes and purchase intentions, therefore, are influenced by their product knowledge, advertising messages, prices, and the limitations of their information processing (Hoque et al., 2018). Specifically, more knowledgeable consumers tend to develop a better cognitive structure to process information effectively, while consumers with less product knowledge usually make biased judgments because of their limited experience (Bettman and Park, 1980). It is likely that consumers who are more knowledgeable about organic food are less likely to be influenced by framing and anchoring effects than those who with less knowledge.

Framing Effect

"Message framing" is a communication strategy used to influence judgment, attitude, and behavior through equivalent appeals, framed as the benefits gained or consequences incurred from buying a product (Levin et al., 1998). Negatively framed messages emphasize the undesirable consequences of refusing to buy a product or service, whereas positively framed messages emphasize the desirable profit or benefits of buying a product or service. Previous studies on message framing have shown mixed results: some indicate that positively framed messages are more persuasive (Van de Velde et al., 2010), while others find that negatively framed messages have greater power to enhance information processing and promote consumers' attitude and purchase intention. For example, Moon et al. (2016) examined bio-fuels, finding that highlighting the negative impact of gasoline use is most effective in increasing consumers' biofuel purchase intention. Likewise, Chen (2016) found that emphasizing the benefits of purchasing health care products is less convincing than emphasizing the loss of not purchasing the products. Therefore, loss aversion makes the negative frame more persuasive.

Message framing has a large impact on consumers' attitudes and purchase intentions; thus, the advertising message framing is crucial (Block and Keller, 1995; Zhu, 2014). This study used positively framed messages that suggest the environmental and personally benefit gained from purchasing organic food. The negatively framed message, meanwhile, emphasizes that consumers may cause environmental damage and incur personal losses if they do not purchase organic food. Although both convey information to induce favorable attitudes and purchase intentions (Martins et al., 2019), the extent of their impact may differ. The following hypotheses seek to explore this difference:

H1a: Respondents facing a negatively framed message will form a more positive attitude toward organic food than those facing a positively framed message.

H1b: Respondents facing a negatively framed message will be more likely to purchase organic food than those facing a positively framed message.

Knowledge of organic food reflects consumers' understanding of organic food concepts and corresponding attributes, while subjective knowledge reflects self-evaluation and consumers'

ability to process information, and can effectively predict consumer behavior (Teng and Wang, 2015). High knowledge levels improve the effectiveness and accuracy of consumers' information processing and help form stable consumer preferences and purchase intentions (Cai et al., 2016). Nelson et al. (1997) argue that participants with higher levels of professional knowledge actively compare different message frames and weigh the reliability of information, thereby strengthening the framing effect. However, other studies found that consumers' existing knowledge promotes information processing and weakens the framing effect and that consumers with less knowledge have less credible opinions and are more likely to make judgments based on incomplete experience and insufficient information processing, meaning they are more susceptible to the influence of the framing effect (Kinder and Sanders, 1990). Increased consumer product knowledge, therefore, should weaken the framing effect and decrease bias in consumer attitudes and purchase intentions (Haider-Markel and Joslyn, 2001; Jin and Han, 2014). This leads to another hypothesis:

H1c: Respondents with less knowledge about organic food are more susceptible to the framing effect.

Anchoring Effect

Tversky and Kahneman (1974) were the first to propose the anchoring effect. They suggest that consumers are not always rational when making decisions, often adjusting their estimates based on prior knowledge and reference information by the anchoring and adjustment heuristic. As a result, anchor value is an important factor. The anchoring effect is a robust idea that has been verified in different domains, including economic decision-making (Oechssler et al., 2009), value evaluation (Chang et al., 2016), and bank lending (Dougal et al., 2015). Here, the subjects are accustomed to an adjustment process to make their estimates, but if they face a low anchor, the final estimates will be lower than those of someone who began with a high anchor (Tversky and Kahneman, 1974; Northcraft and Neale, 1987).

In general, when there is uncertainty about a product, consumers are prone to form their attitudes and purchase intentions according to accessible information, such as advertising prices. For example, Santosh and Mrinalini (2015) found that the last number of the label price plays an important role in consumers' behavior. Moreover, Shen et al. (2016) suggest that higher external price information for other goods presented in the decision-making environment increases consumers' acceptance of actual prices, so consumer attitudes and purchase intentions will be more favorable. However, organic food in domestic China is still in the primary period of development, and is, therefore, barely known to general consumers. Also, the price of organic food is 3–5 times—and sometimes even 8–10 times greater than the price of non-organic food in China (Certification, and Accreditation Administration of the People's Republic of China, 2014). As a result of unfamiliarity with and limited knowledge about organic food, consumers use other prices as their internal reference point, such as the price of conventional, non-organic food (Lin and Chen, 2017). Such consumers find conventional food for a lower price than the organic label price, leading to a feeling of deception and unfairness toward the external anchor price (Weisstein et al., 2016). This affects consumers' perceived benefits and results in a different anchoring effect (Niedrich et al., 2001; Rödiger and Hamm, 2015). Thus, it is reasonable to argue that general consumers will form more negative attitudes and lower purchase intentions toward organic food when they are presented with the high anchor prices. This leads to the following hypotheses:

H2a: Respondents facing a low anchor price for organic food will have a more positive attitude than those given a high anchor price.

H2b: Respondents facing a low anchor price for organic food will be more likely to purchase organic food than those given a high anchor price.

The role of knowledge in anchoring effect investigations has different results depending on the domains (Englich, 2008). For example, Northcraft and Neale (1987) demonstrate that the anchoring effect is moderated by participates' knowledge. Although both participants with and without related knowledge are influenced by anchoring effects, the anchoring effect's influence is less on respondents who are more well-informed compared to those who are less. Zhang and Zhao (2016), meanwhile, report that respondents' familiarity with risk also affects the anchoring effect; the less familiar someone is with a product, the more prone they are to judgment biases based on different anchor values. Consumers' behavior is no exception. Consumers with a high degree of product knowledge are more accurate and confident in their estimation, consequently influencing their attitudes and purchase intentions (Biswas and Sherrell, 1993). Therefore, it is reasonable to hypothesize:

H2c: Respondents with less knowledge about organic food are more susceptible to the anchoring effect.

MATERIALS AND METHODS

Message Framing and Anchor Price

Based on the research of Grewal et al. (1994) and Chang (2007), this study adopted positively and negatively framed messages for organic food advertisements. It positively framed organic lettuce by saying:

Organic food uses natural and ecological production methods, not only providing you with safe food but also fostering sustainable environmental development, thereby benefiting everyone. When you decide to purchase organic lettuce, you are making a healthy decision that also protects the environment. There is no doubt that there are many benefits to purchasing and eating organic lettuce. By choosing organic food, you are consuming lettuce that is free of harmful content such as chemicals, antibiotics, and pesticides. Choosing Organic lettuce is not only an advantage for your health but also reduces your impact on the environment. It is good for everyone.

For negative framing, it described the same product using the following phrasing:

TABLE 1 | Demographic characteristic of participants.

Demographics	Group 1	Group 2	Group 3	Group 4	Total (%)	*P*-value
Gender						
Male	35	39	28	35	37.2	0.371
Female	57	53	65	56	62.8	
Age						
18–25	33	41	33	36	38.9	0.271
26–35	33	34	33	28	34.8	
36–45	19	9	13	21	16.8	
46–55	5	4	8	5	6.0	
56–65	2	4	6	1	2.2	
Marital status						
Married	44	49	41	50	50.0	0.433
Unmarried	48	43	52	41	50.0	
Education						
Less than junior college	25	25	30	17	25.6	0.858
Junior college	26	21	18	30	25.8	
Higher than junior college	41	47	47	44	48.7	
Annual income						
36,000 RMB and less	33	30	37	25	34.0	0.567
36,000–50,000 RMB	9	16	14	11	13.6	
50,000–80,000 RMB	16	12	12	23	17.1	
80,000–10,000 RMB	17	18	13	14	16.8	
More than 100,000	17	16	17	18	18.5	
Health status						
Healthy	80	84	73	76	85.1	0.475
Moderately healthy	12	7	18	15	14.1	
Unhealthy	0	1	2	0	0.8	

TABLE 2 | Validity and reliability of study variables.

Variables	Latent variables	Factor loadings
Product Knowledge Cronbach's alpha = 0.73	PK1: Compared to others, how knowledgeable do you think you are with organic food?	0.709
	PK2: Do you know how to distinguish organic food?	0.738
	PK3: Do you think you can purchase organic food satisfactorily based on only your own knowledge?	0.628
Attitude Cronbach's alpha = 0.86	A1: Organic food is extremely bad-extremely good.	0.778
	A2: Organic food is extremely unhealthy-extremely healthy.	0.845
	A3: Organic food is extremely unattractive-extremely attractive.	0.823
Purchase Intention Cronbach's alpha = 0.94	PI1: I will purchase this organic lettuce even if I have already purchase one.	0.909
	PI2: I tend to purchase this organic lettuce.	0.930
	PI3: I will suggest my friends to purchase this organic lettuce.	0.913

Organic food uses natural and ecological production methods, not only providing you with safe food but also fostering sustainable environmental development. When you decide against purchasing organic lettuce, you are making an unhealthy decision and harm the environment. Obviously, there are many disadvantages to purchasing and eating non-organic lettuce. By choosing non-organic lettuce, you are consuming lettuce that contains high levels of harmful content, such as chemicals, antibiotics, and pesticides. Choosing non-organic not only harms your health but also increases your negative impact on the environment. It is nothing but harmful.

To determine the anchor price, this study relied on the work of Chapman et al. (2002). Because there is a significant anchoring effect when a respondent pays more attention to the "anchor value," it used the label price of the organic lettuce as the anchor value. Using Jacowitz and Kahneman's (1995) concept of the external anchoring index (AI), the quintiles of 85 and 15% of the estimation in the control group acted as high and low anchor values in the test groups, respectively. Responses to a pre-survey

TABLE 3 | Average variance extracted and correlation of constructs.

Variables	AVE	Product knowledge	Attitude	Purchase intention
Product knowledge	0.48	0.693*		
Attitude	0.67	0.067	0.816*	
Purchase intention	0.84	0.048	0.735	0.917*

**The diagonal row numbers are square roots of the AVE. Off–diagonal numbers are the correlations among variables.*

administered to the control group where participants were asked to estimate the price of the organic lettuce, determined the 85% (15 RMB) and 15% quantiles (3 RMB).

Experimental Design

There are two questionnaires for the control group and four for the test groups. In the control group, surveyed consumers were asked to estimate the price of organic lettuce with different message frames and without related price information. In contrast, respondents in the test groups were given 15 (high) or 3 (low) RMB as the price anchor and then instructed to make respective judgments using a positively or negatively framed message.

After conducting a pre-survey in Wuxi, Jiangsu Province, China, the questionnaires underwent revision to ensure validity. The pilot study was conducted in January 2019 with a random sample of 60 respondents (24 males and 36 females). Of these, three had difficulty judging the price of organic lettuce giving no suggestions and did not answer the question regarding price. Excluding these, the average estimated price was 7.4 RMB, which is less than the market price. The pre-survey suggested that respondents could not seriously form attitude and purchase intention without price information. As a result, the final survey used high and low anchor prices alongside positively and negatively framed messages to investigate the anchoring and framing effects.

There were three parts to each questionnaire. The first part addressed the respondents' knowledge of organic food. The second provided respondents with information about organic lettuce, including price and advertising message, and the third measured the respondents' attitudes toward organic lettuce and their purchase intention.

Experimental Organization

All interviewers were from the Institute for Food Safety Risk Management at Jiangnan University. We recruited 400 respondents by selecting every third consumer (Wu et al., 2012) from five administrative districts of Wuxi, who were randomly assigned to one of the four groups to ensure the representativeness of the sample. This also ensured that each consumer had an equal chance to be chosen and improved the fit of the sample to the whole group.

The formal survey was carried out between June 5–20, 2019. The interviewers collected a total of 368 valid questionnaires, including 92 from Group 1 (low anchor × positive framing), 92 from Group 2 (low anchor × negative framing), 93 from Group 3 (high anchor × positive framing), and 91 from Group 4 (high anchor × negative framing). Each respondent who completed the survey received RMB 5 in compensation.

Of the total respondents, 37.2% of them were male, 74.5% had a college-or university-level education, and 57.6% were aged 26–55 years old. Thirty-four percent were low-income individuals (annual income of 36,000 RMB or less). In addition, most respondents agreed that they were in good health. Differences in demographics between groups were examined using χ^2 tests. The results indicate no significant differences among any demographic variables (**Table 1**).

Validity and Reliability

This study used SPSS 20.0 and AMOS 7.0 to test the reliability and validity of the questionnaire based on scales in prior studies

TABLE 4 | Results of ANOVA test.

Manipulation	*N*	Attitude		Purchase intention	
		Mean	*F*	Mean	*F*
Negatively framed message	183	4.461	61.430***	4.031	56.728***
Positively framed message	185	3.580		3.096	
Low anchor price	184	4.591	104.516***	4.219	113.629***
High anchor price	184	3.446		2.902	
Framing × anchoring	368	4.018	0.752	3.561	4.582**

$R^2_{attitude} = 0.315$; $R^2_{intention} = 0.325$. ***$p < 0.001$, **$p < 0.05$.

TABLE 5 | Hierarchical multiple regression results for framing effect.

	β					
Models	**Attitude**			**Purchase intention**		
Gender	−0.064	0.006	−0.018	−0.166	−0.088	−0.113
Age	−0.105	−0.072	−0.018	−0.145	−0.110	−0.055
Marital status	0.224	0.291*	0.229	0.309	0.381**	0.317*
Education	−0.167**	−0.159**	−0.141**	−0.210*	−0.203***	−0.185***
Health	−0.187*	−0.179**	−0.145*	−0.192*	−0.182*	−0.147
Income	0.026	−0.001	−0.017	−0.023	−0.052	−0.069
X_1		−0.435***	−0.436***		−0.461***	−0.463***
M		0.150**	0.168***		0.188***	0.206***
$X_1 \times M$			0.332***			0.341***
ΔR^2	0.035	0.131	0.063	0.047	0.125	0.054
ΔF	2.205**	28.242***	29.440***	2.934**	27.082***	24.972***

X_1 = message frame, *M* = product knowledge. ***$p < 0.001$, **$p < 0.05$, *$p < 0.1$.

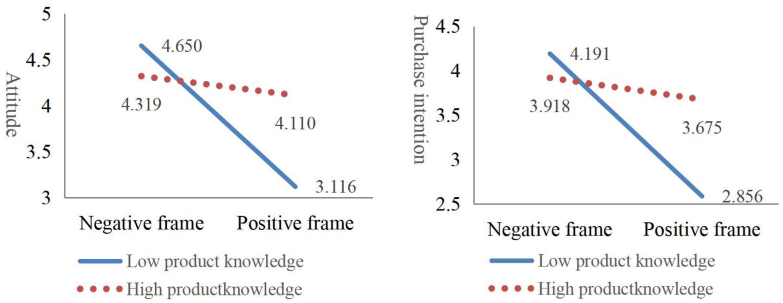

FIGURE 1 | Respondents' responses in different message framing.

TABLE 6 | Hierarchical multiple regression results for anchoring effect.

	β					
Models	**Attitude**			**Purchase intention**		
Gender	−0.064	0.032	0.022	−0.166	−0.055	−0.064
Age	−0.105	−0.055	−0.055	−0.145	−0.088	−0.088
Marital status	0.224	0.198*	0.169	0.309	0.28**	0.254*
Education	−0.167**	−0.136**	−0.132**	−0.210*	−0.177***	−0.172***
Health	−0.187*	−0.148**	−0.131*	−0.192*	−0.147*	−0.132
Income	0.026	0.017	−0.040	−0.023	−0.034	−0.046
X_2		−0.545***	−0.557***		−0.622***	−0.633***
M		0.120**	0.024***		0.151***	0.063***
$X_2 \times M$			0.400***			0.363***
$\triangle R^2$	0.035	0.194	0.089	0.047	0.207	0.059
$\triangle F$	2.205**	45.190***	46.700***	2.934**	46.690***	30.783***

*X_2 = anchor price. ***p < 0.001, **p < 0.05, *p < 0.1.*

(Kim et al., 2008; Cucchiara et al., 2015; Konuk, 2018). It measured consumers' attitude and purchase intention toward organic food using a 7-point Likert scale. Higher scores revealed a stronger purchase intention and a more positive attitude. Similarly, consumers' knowledge about organic food was scored on a 5-point Likert scale (1 = good understanding, 5 = ignorant), with a low score displaying higher knowledge.

Table 2 shows the reliability of each item using Cronbach's alpha. The values were 0.73 (knowledge), 0.86 (attitude), and 0.94 (intention). These reliability coefficients are all higher than the critical value of 0.70, suggesting high internal reliability (Fornell and Larcker, 1981).

Discriminant validity, showing the degree of constructs measured in different methods, is distinguishable (Fornell and Larcker, 1981). One principle for discriminant validity is that the correlation coefficient between one construct and the others should be less than the square root of the average variance extracted (AVE) for each variable. The diagonal of **Table 3** shows the AVE square roots, all of which are greater than the correlation coefficient, indicating a favorable discriminant validity.

$$\text{Average variance extracted (AVE)} = \left(\sum \text{standardized loading}^2\right) / \left[\left(\text{standardized loading}^2\right) + \sum \varepsilon_j\right]\right) \quad (1)$$

RESULTS AND DISCUSSION

We used analysis of variance (ANOVA) to test the framing and anchoring effect on consumers' attitude and purchase intention toward organic food. Further, we examined the role of consumers' knowledge using hierarchical multiple regression (HMR).

The Main Effect of Framing and Anchoring

The ANOVA results reveal that framing and anchoring had no significant interaction effect on consumer's attitude and intention ($F_{\text{attitude}} = 0.752$, $P > 0.01$, $F_{\text{intention}} = 4.582$, $P > 0.01$). The R^2 of attitude and intention are 0.315 and 0.325, indicating a main effect construct of 31.5 and 32.5%, respectively (**Table 4**).

Moreover, for the different message frames and anchor prices, the significance of the F statistics of consumer attitudes and purchase intentions are less than 0.01. This indicates that the main framing and anchoring effect on consumers' attitude and purchase intention of organic food was significant. Specifically, the consumers exposed to the negatively framed message rated the organic lettuce more positively ($M_{\text{attitude}} = 4.461$) and had a higher intention to purchase ($M_{\text{intention}} = 4.031$) than those exposed to the positively framed message ($M_{\text{attitude}} = 3.580$, $M_{\text{intention}} = 3.096$). These results are consistent with those of

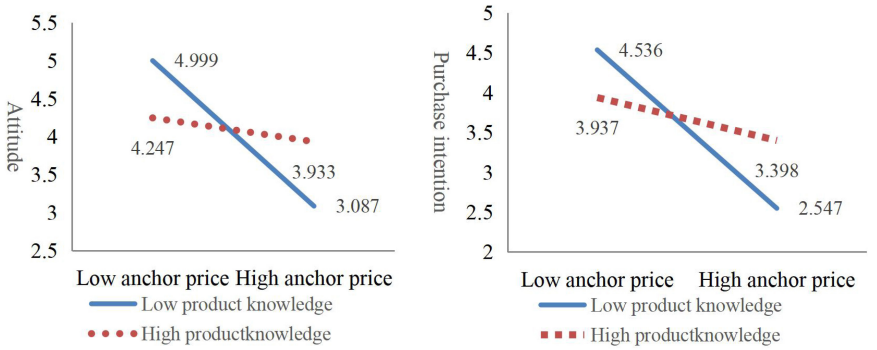

FIGURE 2 | Respondents' responses in different anchor price.

previous studies (Maheswaran and Meyers-Levy, 1990). Negative framing promotes deep processing of information and improves persuasiveness, so it is possible that the consumers' tendency toward loss aversion makes the potential loss of not buying organic lettuce more unacceptable.

In addition, the consumers exposed to a low anchor price rated the organic lettuce more positively ($M_{attitude}$ = 4.591) and revealed a higher purchase intention ($M_{intention}$ = 4.219) than those exposed to a high anchor price ($M_{attitude}$ = 3.446, $M_{intention}$ = 2.902). This finding is inconsistent with those of previous studies, such as those by Shen et al. (2016). This may be because the anchor price for their study was based on the reference price of a counterpart food, in this case, a high anchor value is conducive to increasing the consumer's recognition of the target product. In the present study, however, the high anchor price highlights the gap between organic and conventionally produced lettuce, resulting in a strong contrast effect and reducing consumer acceptance and purchase intention toward organic food. This is consistent with the findings of Wilson et al. (1996) in that there is a significant anchoring effect on consumers' attitude and purchase intention and that low anchor price information can improve consumers' attitude and increase their purchase intention. Thus, Hypotheses H1a and H1b and Hypotheses H2a and H2b are confirmed.

The Role of Product Knowledge in Framing Effect and Anchoring Effect

The study went on to examine the role of product knowledge on framing and anchoring effects by conducting HMR models.

The results shown in **Table 5** and **Figure 1** are clear; the interaction coefficients of the message frame and product knowledge ($\beta_{attitude}$ = 0.332, $P < 0.01$ and $\beta_{purchaseintention}$ = 0.341, $P < 0.01$) indicate that they have a positive influence on attitude and purchase intention. When categorized based on their knowledge level according to their survey scores, more knowledgeable consumers were less likely to change their attitudes or purchase intentions based on the message frame (**Figure 1**).

These results indicate that those with more knowledge were less influenced by the framing effect. This finding is inconsistent with those of Bullock and Vedlitz (2017). One reason for this is the difference in subject area; Bullock and Vedlitz (2017) examined controversial public policies. People who know little about public policies are indifferent and thus do not respond strongly to the framing effect. However, food safety is closely related to consumers' daily lives. Concerns about food safety prompt many to pay attention to product information, so consumers who have less knowledge of organic food will rely on external message frames, thereby creating a stronger framing effect. This finding confirms Hypothesis H1c.

To analyze the role product knowledge plays in the anchoring effect, this study also involved developing HMR models (**Table 6**). The interaction coefficient between anchor price and knowledge—$\beta_{attitude}$ = 0.400 ($P < 0.01$) and $\beta_{purchaseintention}$ = 0.363 ($P < 0.01$)—indicates the interaction between attitude and purchase intention. Consumers with a high knowledge level are less likely to change their attitudes or purchase intentions at different anchor prices, indicating that those with more product knowledge are less affected by the anchoring effect (**Figure 2**). This aligns with Englich et al. (2016) who found that consumers with a deeper understanding of organic food can edit price cues based on their own product knowledge, generate spontaneous anchors, reduce the impact of external anchors, and reduce the anchoring effect. This confirms Hypothesis H2c.

CONCLUSION

This study shows significant framing and anchoring effects in consumers' attitude and purchase intention toward organic food. With a non-significant, 1% level interaction effect between them, the framing and anchoring effects can be replicated in the consumption of organic food, an area neglected in prior research. The results of this work suggest that a negatively framed message and a low anchor price enhances the persuasion of advertisements in relation to consumer responses regarding attitudes and purchase intentions. Further, this paper confirms the moderating role of product knowledge on framing and anchoring effects, demonstrating that less knowledgeable consumers are more susceptible to both effects.

Improving consumers' purchase intention and attitude toward organic food is critical to long-term consumption. Our results suggest that the government should take advantage of the internet, television advertisements, and other media to educate the public on health problems caused by pesticide residues and antibiotics in much of the food supply, emphasizing through a negatively framed message, that these chemicals may cause health problems. They should explain to supermarkets and organic farms how organic certification may improve consumers' knowledge to enabling them to identify, purchase, and consume organic food, thus making healthy consumption choices. In addition, our results indicate that consumers' attitudes and purchasing intentions are significantly lower when organic food has a high anchor price. Therefore, the government should increase support for the organic industry, provide appropriate organic facilities, organic conversion subsidies, organic certification subsidies and input subsidies for organic production enterprises to lower the production cost of organic food gradually. Companies should lower the circulation costs of organic food and decrease the price gap between organic and other foods, thereby improving consumers' attitude and purchase intention.

There are a few limitations to this study. First, past studies have included three types of framing effects; however, this work only considered goal framing. Including attribute framing, which has also been examined in marketing, would be beneficial in future research. Second, this article pays attention to anchor prices related to organic food. However, it may also be worthwhile to explore whether an unrelated anchor value has the same effect on consumers' responses.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Jiangnan University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LW: conceptualization and writing – review and editing. HD: data curation and formal analysis. LS: validation. LS and HD: writing – original draft. All authors contributed to the article and approved the submitted version.

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Online Food Shopping: A Conceptual Analysis for Research Propositions

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Shopping foods online is different from shopping other things online. To stimulate more thinking and enrich potential future research imagination, this paper reviews for online food shopping features, offers a commentary, and proposes future research directions. The propositions include the following: (1) The design and implementation of online food shopping (eco)systems should engage the consumers and other stakeholders to co-create collective and social values; (2) A better fit between technologies' and food businesses' natures could generate better applications for online food shopping; (3) A business model with sound finance systems becomes the core of a healthy online food ecosystem; (4) The interaction and transformation between online (virtual) and offline (virtual) food businesses determines the dynamic development of future food shopping.

Keywords: online food shopping, conceptual analysis, future research, propositions, theory and practice

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INTRODUCTION

Most studies on online shopping focus on the implications and benefits of e-commerce. This focus is expected to increase as more people are pushed toward shopping online in a bid to avoid crowded shopping malls for fear of contracting the dreaded COVID-19 virus. A gap in the literature, however, is that while the topic is rife with studies detailing how online shopping works, there is limited research on shopping foods online, which is inherently with very different characteristics from buying other kinds of commodities via the World Wide Web. Nonetheless, food is one of the most common products for the mankind, and so are with great impact for human's online shopping life. A critical analysis for in-depth understanding of the special attributes that online food shopping has can facilitate the construction of a precise (for stakeholders' needs) and high-quality (for stakeholders' safety and satisfactions) online food shopping ecosystem. This paper presents a conceptual analysis aimed at explicating the significant themes within the current literature. The review will conduct critical propositions reflected from these studies to propose future research directions. The academic review is significant to both researchers and online food stores as people across the world start embracing online shopping more than ever before.

BACKGROUND DESCRIPTIONS

Before beginning the conceptual analysis with literature review, a broader background discussion is needed. Practically, the broader background constitutes: e-commerce

platforms, consumer preferences and attitudes, marketing approaches, and packaging and delivery considerations.

E-Commerce Platforms

Silva et al. (2017) define e-commerce platforms as the set of technologies designed to help online businesses to manage their marketing, sales, and operations. Wei's et al. (2018) study sought to examine the purchase intention of fruits among online shoppers. The authors argue that the past few years have seen the emergence of online purchase platforms for fruits, a trend that has significantly advanced e-commerce development and improved the quality of human life. Although their study sought to investigate consumers' purchase intention, the results reveal that compared to other products, the e-commerce platforms for fruits did not play a major role in influencing a buyers' purchase decision. On the contrary, the success of fashion products and electronics is dependent on how online customers perceive their e-commerce platforms (Huete-Alcocer, 2017). For example, customers are less likely to purchase luxury fashion products from a poorly designed website (Kang et al., 2020) and (Buckley, 2016). Thus, while there are limited studies on the differences between buying food and other products online, at least the current studies evidence that e-commerce platforms do not play a significant role in influencing buyers' purchase decisions.

Consumer Preferences and Attitudes

Kim Dang et al. (2018) study on consumer preference and attitudes regarding online food products examines how the Internet has changed people's food-buying behaviors. The study is significant because it establishes the underlying consumers' concerns with regards to food safety information, especially for online food products. Compared to other products, consumer preferences and attitudes toward buying food online differs in that the perceived risks and information quality do not play major roles in influencing their buying behavior (Li and Bautista, 2019; Sanchez-Sabate and Sabaté, 2019; Zieliñska et al., 2020). Kim Dang et al. (2018) study relies on a cross-sectional study conducted in Hanoi, Vietnam. The findings are reliable as they are based on responses gathered from over 1736 customers through face-to-face interviews. While the preferences and attitudes toward buying food online differ from buying other commodities, Kim Dang et al. (2018) note that the laws governing e-commerce in Vietnam are the same. As such, the findings provide practical advice to online food retailers and the Vietnam government on how to implement appropriate legislation with regards to trading online food products.

Martínez-Ruiz and Gómez-Cantó's (2016) study emphasizes that using the Internet to seek food service information has now become a common practice among people today. More people than ever before have positive attitudes toward finding information about food online (Martínez-Ruiz and Gómez-Cantó, 2016; Maison et al., 2018). Also, people are more likely to search information about food on the Internet than any other product or service (Hidalgo-Baz et al., 2017; Whiley et al., 2017; Wong et al., 2018). However, Kim Dang et al. (2018) study found that a significant number of consumers were unconcerned about the accuracy of the evidence regarding food safety they found online in selecting food products on the Internet. The conclusions drawn from the current article review produces practical pieces of advice to consumers buying food online as well as the food retailers selling food over the Internet.

Marketing Approaches

Rummo et al. (2020) examine the relationship between youth-targeted food marketing expenditures and the demographics of social media followers. The authors sought to establish the extent to which teenagers follow food brands on Twitter and Instagram by examining the relationships between brands' youth-targeted marketing practices and the overall percentages of adolescent followers. The study provides evidence showing that unhealthy food brands, especially fast food and sugary drink have more adolescent followers on social media (Rummo et al., 2020). These study results are consistent with Salinas et al. (2014) findings which show that unhealthy food products enjoy a higher market base than the healthy ones. The high percentage of teenage followers is concerning among health experts mainly because most of the advertisements from these companies are biased and do not highlight the unhealthy consequences associated with eating these foods. Compared to other products, food companies are often not required by regulations to highlight their negative consequences (Salinas et al., 2014). For example, cigarette and alcohol companies are mandated to disclose their effects of use on all marketing materials (Gravely et al., 2014). Consequently, with the ubiquitous use of social media by teenagers, young people are more exposed to food and beverage advertising which occurs across multiple digital channels.

The failure to address digital advertising when formulating policies makes it harder to governed youth-targeted food marketing. Food products are often marketed using the general techniques and approaches applied in other products and services. Juaneda-Ayensa et al. (2016) note that food marketing topics such as market segmentation, strategic positioning, test marketing, branding, consumer research, targeting, and market entry strategy are highly relevant. Moreover, food marketing is affected by the major challenges that affect conventional markets such as dealing with perishable products whose availability and quality varies as a function of the current harvest conditions (Hongyan and Zhankui, 2017). However, Topolinski et al. (2015) note that the value chain in food marketing is particularly important because it highlights the extent to which sequential parties within the marketing channel add value to the final product. According to Linder et al. (2018) processing new distribution options often provides additional opportunities available to food marketers to provide the final consumer with convenience. However, when overhead costs such as marketing and processing are added they result in significantly higher costs (Lou and Kim, 2019).

Demographics play an essential role in food marketing almost more than any other product. According to Qobadi and Payton (2017), food companies must utilize statistical demographics to understand the inherent characteristics of a population. For food marketing purposes, such knowledge can help firms develop a better understanding of the current market place as well as predict future trends (Isselmann DiSantis et al., 2017). For

example, with regards to the current market, food companies interested in entering a new market with sports drinks might first study the overall number of people between the ages of 15 and 35, who would constitute a particularly significant market. In such cases, most food companies often prefer shifting their resources toward products consumed by a growing population. As such, the success of the marketing strategy employed by a food company is contingent on how good it studies the demographical makeup of its target market.

Packaging and Delivery Consideration

One of the primary consideration food consumers take into account when making a purchase decision online involves packaging and delivery. According to Chen et al. (2019), the modern consumer is more interested in food products that utilize sustainable packaging and delivery systems. Hu et al. (2019) add that most customers today are more focused on recyclable packaging systems. Grace (2015) further notes that sustainability is one of the primary sustainability attributes online shoppers look for. For example, over 33% of online consumers believe that packaging and recyclability are more important to them when ordering food items online (Gutberlet et al., 2013). Additionally, 13% of online shoppers cite a lack of packaging information available online, which suggests that there is an existing opportunity for e-retailers to increase their sustainability information (Quartey et al., 2015).

As the world continue grappling with the COVID-19 pandemic, online purchases for fresh food is gradually becoming the norm across the world. As such, food producers must be able to adapt accordingly to take advantage of the emerging market. However, the majority of consumers are still concerned about freshness and food waste (Yu et al., 2020). Unlike in a brick-and-mortar store where shoppers can visibly check the freshness of their produce, this is more difficult with home delivery (Song et al., 2016). Thus, brands must try and opt for packaging that can keep food safe and fresh during transit and displays its freshness to re-assure customers. Moreover, to meet sustainability goals, fresh food brands need to balance the use of more sustainable, recyclable materials, with packaging that continues to extend shelf life and avoid food waste.

CONCEPTUAL ANALYSIS FOR FUTURE RESEARCH PROPOSITIONS

The article review shows that sufficient studies have been conducted on online food shopping. As more people start shopping online, the number of articles on online food shopping is expected to increase. However, despite studies on online food shopping and business models remain rife, there are key gaps in research. These gaps are a result of the majorities of the researchers' focus on highlighting their perspectives and largely ignore those of the consumers and businesses. Moreover, these studies do not consider crisis (e.g., COVID-19 pandemic) when making these future predictions. The forecasts made about future help in developing a better understanding of the various implications of ordering via mobile apps. Also, it provides a background for examining the emerging technologies in online food ordering. As such, the critical propositions reflected in the literature review propose the following four future research directions.

Value Co-creation With Stakeholders

From a business perspective, getting partners and investors on board is not easy and most restaurants tend to stay away from technology. Thus, the preposition made involves conducting research aimed at developing a better understanding of the customer and business' perspectives. According to Chen et al. (2018), setting the commission rates with restaurants is a major problem within the online food industry. Moreover, the majority of startups are depended on restaurants to deliver food at the customer's doorstep (Onyeneho and Hedberg, 2013). Hwang et al. (2020) argue that relying on technology is not the main focus of a restaurant because preparing food is its main core business. As such, even if an investor trusts a food startup, integrating technology within its business process will always be perceived as a high risk. The lack of sufficient evidence on the business' perspective toward technology and online platforms make it more difficult for rescuers to tailor their studies to generate crucial insights that help in making better business decisions.

One of the problems identified from the consumer's perspective is that most of the things mentioned in the online food menus are often not available. Instead, they act as click baits designed to entice online users to continue interacting with their platform and marketing content (Lara-Navarra et al., 2020). In rare cases, some clickbait links often forward online users to pages that require them to make payments, register, or even fill in their payment details. Consequently, a significant communication gap exists between consumers and restaurants while shopping on phone and online. While numerous studies examine the purchase intention of food among online shoppers, few highlight the inherent challenges experienced by consumers as they go about their day.

While it is crucial to investigate both perspectives, more studies need to be conducted on the customer ones. This is because most online businesses often find it difficult to deal with customers, but Ho et al. (2014) note that this is usually because they do not see things from the buyers' point of view. The authors, however, refutes the popular phrase that "customer is always right" and notes that even when they are completely wrong, they can always win. For example, customers can criticize a business online or even refuse to pay their bills. As such, failing to grasp a customer's perspective can result in a meltdown with them which is always bad business. It is also essential for future businesses to take into consideration the fact that work is much more enjoyable and profitable when people work alongside the customer rather than against them. Thus, conducting more studies aimed at understanding customers can help develop the necessary recommendations to help businesses see things from their point of view.

One of the ways future studies can explore to better understand the customer's perspective involves exploring the issues related to empathy. Charles et al. (2018) note that empathy does note naturally to most people but it reinforces one's ability

to understand and share the feelings of a customer by placing themselves in their shoes. Future studies should highlight how online businesses can ask questions about how their current and potential customers would feel in different circumstances. Also, future studies must examine how well online businesses can listen to their customers. Afshar Jahanshahi and Brem (2018) notes that the first step in customer relations involves actively listen to them. Finally, future studies must be able to provide recommendations on how online food businesses can grow trust and show respect to their customers. The prepositions made with regards to the business and customers' perspective provides the background information for future studies. Also, bridging the current research gaps will help business adopt a more effective online model that maximizes customer satisfaction when purchasing foods. Based on the discussions above, this article suggests the following proposition to both identify the gap in the literature and the corresponding future research directions.

Proposition 1: *the design and implementation of online food shopping (eco)systems should engage the consumers and other stakeholders to co-create collective and social values.*

Technological Nature

Although smartphone apps provide an efficient way to replace the conventional methods of ordering food through a phone call, there lacks sufficient evidence on the implications of placing orders through them. A partial but potentially important reason is the lack of in-depth and broader understanding of the technology *per se*. Mobile ordering apps have caused a significant change in food delivery and pickup business (Onyeneho and Hedberg, 2013). With more and more retailers and restaurants adopting these technologies, the modern consumer is willing to place fewer delivery and pickup orders through their phones. Instead, they are now opting to utilize mobile apps. Studies aimed at exploring the implications of food delivery apps help in establishing whether it is hurting or assisting the business. Thus, as a restaurant owner, one has to be careful with regards to utilizing third-party services to do business. For instance, apps such as Uber Eats have endless possibilities as they make delivery faster, for both the customers and the business. However, future studies must examine the potential disadvantages to using such third-party services. Firstly, the added cost of a food delivery app may be prohibitive to most customers. For example, the cost of using services like Uber Eats changes how businesses price their meals. In the end, customers are likely to end up paying more. Thus, future studies have to consider this fact when developing recommendations on how businesses can use food delivery apps without undermining their financial positions. Also, these studies will help show how customers are likely to react to a price surges.

Subsequent studies on the implications of ordering food through mobile apps should also focus on the issues relating to control and accountability. Cecchi and Cavinato (2019) note that some customers have complained about being unable to control the food ordering process. For example, once the customer's food is in the possession of the Uber driver, there is little left for them to do, which is perceived as a bad thing. Also, Isoni Auad et al. (2018) note that customers lack control over how their drivers handle their food. One of the consequences of being unable to control the process is that when a customer's food is mishandled or ends up late, the restaurant is the one that is held accountable. Finally, with regards to the implications, future studies must monitor their third party service to safeguard their brand's reputation. As such, subsequent studies need to ensure that they highlight the importance of maintaining an effective brand image. Mao et al. (2018) recommend online food businesses to monitor how long it takes their delivery people to transport their customers' food to establish whether it is being handled with the necessary care it deserves. However, more studies are required to highlight the customer's grievance which can easily fall on the businesses when the delivery issues are ignored.

Despite the various implications of using mobile apps to order food online, there are numerous benefits associated with online models. As such, as the growth of online applications continues, the subsequent studies need to add to the existing literature on the benefits businesses are likely to accrue from adopting such technologies. According to Li et al. (2020), this trend is a result of the numerous benefits associated with using the apps compared to the conventional methods of shopping over the phone or waiting in line. These benefits are 2-fold, they include benefits to the consumer and the restaurants. Firstly, there are numerous consumer benefits of using mobile ordering apps to purchase food.

Consumers across the world are downloading mobile ordering apps at lightning speed. For example, When Chick-fil-A, one of the largest American fast food restaurant chains, released its first official app, it reached first place in the app store in only 3 days after it was launched. Mayordomo-Martínez et al. (2019) note that these apps are popular for four main reasons. Firstly, customers feel that no one is waiting in line or getting put on hold. Secondly, customers can pick up food on the go. Thirdly, customers get the whole menu right at their fingertips, including items they may not have known existed. Finally, most restaurants award patrons' loyalty reward points. In most cases, these points are easy to track directly through applications and lead to big savings if the customer order frequently.

The restaurant benefits from the mobile ordering apps too. While these apps may be created for the customer, they achieve some important objectives that can greatly help out the restaurant or retail store as well (Ferguson and Solo-Gabriele, 2016). For example, they can handle more orders as is the case with Chipotle, an American chain of fast-casual restaurants, which claims that it is capable of processing six additional orders every hour when placed through a mobile app (Ferguson and Solo-Gabriele, 2016). Moreover, customers are more likely to spend more through an ordering app than in person because they have more time to decide since the entire menu is in front of them and they typically want to score more reward points. Based on the discussion above, this article made the propositions as follow.

Proposition 2: *A better fit between technologies' and food businesses' natures could generate better applications for online food shopping.*

New Business Models and Finance Systems

Although numerous studies have highlighted the various emerging trends in buying food online, most were conducted before the COVID-19 pandemic. As such, future studies need to capture how the pandemic has affected the online ordering industry. Such studies will provide the insights necessary to help the business withstand emerging competition as well as keep up with the ever-changing customer demands and the latest trends and technological advancements. Wang et al. (2020) note that the various responses to the COVID-19 global pandemic will shape the online food delivery industry in 2020 and beyond. Thus, future studies need to identify and critically examine the top online food shopping trends that customers and businesses must remain aware of.

For the better part of the year 2020, global cities have become deserted and shopping malls closed. The restaurant sector is one of the most affected as people are recommended to maintain social distancing and remain at home. As the Coronavirus continue spreading across the world, the pandemic is projected to have more economic implications than undermine global health. Thus, future studies must offer people a glimpse of how lockdowns will affect the online food industry, which is hailed as the future in the restaurant sector. However, even at the current stage of the Covid-19 pandemic lifecycle, several lessons are already emerging from China with regards to how people can cope with the commercial and social disruptions. For example, the pandemic is a key driver for digital technologies.

There are three areas that future studies need to focus on. They include the emergence of digitally enabled delivery systems and consumer comfort with the online food sector. Firstly, the prevalence of digitally enabled delivery systems is expected to grow in the coming years. As such, studies are needed to develop a better understanding of how these online delivery systems will affect the food industry. For example, since the COVID-19 pandemic began, more people than ever before purchase their groceries and other food items online (Hua and Shaw, 2020; Zhang and Ma, 2020). This is mainly a result of the growing deployment of digital technologies across the country in an attempt to limit interactions among people and mitigate the spread of the virus. Secondly, subsequent studies must examine the factors affecting consumer comfort within the online world. It is projected that in the next decade, online platforms will transform people's purchasing behaviors, especially with regards to acquiring food items. Thus, studies are needed to help businesses identify the existing opportunities and mitigate the main threats likely to undermine growth within the online food ordering business. Last but not least, more detailed academic investigation and practical development of payment mechanisms are needed. By its nature, payment mechanisms deal with technological development of payment methods and techniques that constantly try to improve user convenience and experiences of payments. Hence, existing discussions/examinations relied heavily on technical aspects of payment mechanisms (or schemes). However, technologies in business world can generate implications beyond technical dimension, but also in the social, cultural, psychological, and/or even political dimensions (e.g., Yang et al., 2012; Koenig-Lewis et al., 2015; Nelms et al., 2017; Verhoef et al., 2019). Hence, interdisciplinary works, either conceptual or empirical, can contribute to the literature for analyzing on more complex dynamics of online payment – not just about the technology/system *per se*, but also about the ecosystem composed of human, system, and knowledge in it. In sum, the discussions in this section emphasize the importance of business models with high-quality finance (e.g., payment) systems. This article makes the following proposition.

Proposition 3: *A business model with sound finance systems becomes the core of a healthy online food ecosystem.*

Online-Offline Interactions and Transformations

Shopping food online is viewed by most researchers as one of the biggest disruptions in the supermarket and grocery business models. From smaller stores to fewer discounts and more service and robots, these are just a few of the changes brought about by online platforms (Kuss and Griffiths, 2011). The problem is that few studies are examining whether new disruptions will continue emerging or whether the online food sector has reached maturity. Such studies are necessary because they will help manufacturers and retailers react accordingly. These studies can focus on trying to understand how consumers can purchase food in the future, which can be online or in physical stores or from larger or smaller stores. Some of the research questions can focus on establishing whether future customers will continue buying to take dine at home or consume right on the spot.

Despite the numerous uncertainties, with regards to brick-and-mortar stores, Burgoine et al. (2017) note that they may survive even with the growth and prevalence of online businesses. As such, future studies must explore how changes in e-commerce will affect shoppers and online businesses. Such studies are essential because the current findings on consumer behavior seem to suggest that customers prefer interacting at a physical store by seeing, smelling, and even touching products they find there. Moreover, there is an immediate satisfaction when a customer picks up something. The insights generated from such studies can help retailers establish the inherent need to focus their attention on emotional elements as well as create unique experiences.

Studies focused on making future forecasting will help in understanding how online food platforms can achieve the social roles enjoyed by supermarkets. Otten et al. (2017) note that supermarkets increasingly place their shopper firsts and tap into their individual needs in an attempt to mitigate the rising competition from online shopping. As such, studies must thoroughly analyze the existing demographic data to make future predictions on whether the online food ordering platforms can ever enjoy the same social roles which are currently the precincts of supermarkets. Finally, a sufficient number of studies have predicted that artificial intelligence and robots are likely to take over the responsibilities of human beings within the online food sector. However, while most of these studies make future predictions, they do not take into

account how automation and artificial intelligence will help online supermarkets to become more efficient. Thus, subsequent studies should establish a balance between human interaction and automation. This article makes the following proposition according to the discussions here.

Proposition 4: *The interaction and transformation between online (virtual) and offline (virtual) food businesses determines the dynamic development of future food shopping.*

CONCLUSION

The majority of studies examining online food shopping have provided sufficient evidence highlighting both the implications and benefits of e-commerce. However, most of these studies generalize all forms of online shopping and ignore the fact that shopping foods online is inherently different from buying other commodities. As such, the comprehensive academic review conducted helps at explicating the significant themes within the current literature. Hence, the critical propositions that reflected from these studies help in proposing the following four future research directions. They include conducting studies to highlight the customer and business' perspectives, making future predictions, understanding the implications of ordering via mobile apps, and examining the emerging technologies in online food ordering. The academic review and prepositions made are significant to both researchers and online food stores as people across the world start embracing online shopping more than ever before.

Theoretical Implications

To generate theoretical implications in a more holistic and comprehensive level, this article focuses on the inter-relationships between the four propositions derived after our conceptual analysis. To recall, the four propositions are inherently about: engaging stakeholders to co-create values, in-depth understanding of technological natures, well-designed business models and finance systems, and online-offline dynamics. One suggestion for future research directions is to develop a holistic-view, often qualitative investigation of a online food shopping ecosystem that composes of interested stakeholders operating with diverse technological sets embedded in well-designed business models that simultaneously incorporate concerns of both online and offline developments of food shopping. Complexity is a point to be explored but is often oversimplified if we could not take a eco-systematic perspective and analyze for both qualitative-quantitative data sources. For a better theoretical development and practical design, the complexity of a food shopping ecosystem can help identify research questions, sketch phenomenon structures and elements, as well as specify heterogeneous interests for policy making. Following this point, another suggestion for future research directions is to address established issues/research questions through cross-disciplinary explorations. As has been discussed, complexity characterizes modern food shopping system, especially the online one. To explore in-depth knowledge of complexity, single disciplinary system of thoughts might limit the imaginations one can create. A cross-discipline approach for studies on online food shopping can both offer fresh explanations for unanswered questions or that in tension, and also help identifying unnoticed phenomenon for further exploration.

Practical Implications

For online retailers, conceptual analyses and the four resulting propositions can generate practical implications too. First, when designing a online food shopping business/system, practitioners need to adopt an ecosystem viewpoint to prevent incomplete thinking and ignorance of any stakeholder's opinion. Second, practitioners need to take care of the interfaces between the virtual and physical sub-systems even if it is an online food shopping ecosystem. By considering the interfaces between the sub-systems, not just connection and coordination works would be cared about, but also transformation work should be articulated. For example, the transformation of values in the process flows between material (e.g., food products), informational/technological (safety labels; blockchain applications in supply chain communications; human-machines interface in online purchase procedures, etc.), financial (budgeting; pricing; payment, etc.), human (i.e., stakeholders), and other sub-systems should be implemented with a fully consistent and engaging logic.

Limitations

In nature, a conceptual analysis is done without empirical and original data collection. However, this article has tried to avoid such inherent limitation by conducting the conceptual analysis with as many practical examples as possible. Additionally, our analysis focuses on the online shopping for foods only. Future studies can also take a similar approach but discuss other characterized industries, such as online shopping for precious metals, intangible services, and so on. Also, our focus on food is limited to foods in general. Future studies can be more detailed, by characterizing more for different food categories (e.g., organic vs. non-organic foods).

AUTHOR CONTRIBUTIONS

C-FL was the major author of this article. C-HL reviewed and revised the manuscript. Both authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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How Can Manufacturers Promote Green Innovation in Food Supply Chain? Cost Sharing Strategy for Supplier Motivation

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In the innovation of production activities by green product manufacturing or application, food supply chain cooperation is an important method to optimize the allocation of internal and external innovation resources, strengthen their own core capabilities and achieve sustainable development of enterprises. Whether the traditional revenue sharing or cost sharing strategy is still efficient in the food supply chain cooperation aiming at green innovation attracts a lot of attention. Further research about whether the traditional cooperation contract can effectively motivate suppliers to maximize their innovation efforts is required. In this paper, the green innovation effort level parameters are designed and the constraint factor of the green preference of consumers at the market end is applied to discuss the incentive strategy of cost sharing led by manufacturers. Stackelberg equilibrium structure is utilized in the incentive model in this paper to discuss the existence of the optimal cost sharing ratio, the optimal effort level and the optimal income of green innovation cooperation in the food supply chain. The results show that when the supply is interrupted due to the insufficient stimulation of green consumption at the market demand side, manufacturers need to stimulate their green innovation efforts by sharing the cost of suppliers, and the cost sharing proportion is affected by the marginal profit coefficient of manufacturers and suppliers. When the relationship between the marginal profit of suppliers and the marginal profit of manufacturers reaches a certain threshold, manufacturers use the cost sharing contract, which can effectively stimulate the green innovation efforts of suppliers and optimize the overall income of the food supply chain.

Keywords: food supply chain, cost sharing, supply interruption, motivation, green innovation

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INTRODUCTION

In the innovation of production activities by green product manufacturing or application, supply chain cooperation is an important means to optimize the allocation of internal and external innovation resources, strengthen their own core capabilities, and achieve sustainable development of enterprises (Shah et al., 2018). In the complex external environment, how to coordinate the relationship between member enterprises is the basic problem of supply chain management, and

the establishment of a cooperation mechanism that can motivate all parties is the focus of enterprise relationship in the food supply chain (Sunny and Shu, 2019). This is particularly important for the supply chain green innovation activities with long R&D cycle and high complexity, due to the high uncertainty of the results of innovation activities, the information asymmetry characteristics in innovation cooperation, and the dilution effect of Technology Spillover on the innovation income of specific enterprises (Iyer and Soberman, 2016). It is difficult for enterprises to obtain the favor of capital market in the initial stage of green innovation activities, and the decision-making process of green innovation activities is long. These make the close strategic cooperation and coordination between the upstream and downstream enterprises in the food supply chain extremely important. Traditionally, the cooperation mode between upstream and downstream enterprises in the food supply chain includes two ways: one is to invest in the other party and provide guarantee for the other party's income to encourage it to join the cooperation, such as short-term capital injection, joint venture, integrated operation and other single capital behaviors (Gui et al., 2018); the other is to complement resources and share risks through long-term contracts, strategic cooperation and other ways, such as through revenue benefit sharing contract, wholesale price premium contract, cost sharing contract, and other ways to achieve diversified cooperation (Ghosh and Shah, 2015; Mensah et al., 2019; Post et al., 2019). These collaborations are usually based on a clear understanding of demanding a stable market and knowing the cost-benefit status of each cooperation subject, with the goal of maximizing the current profit of the food supply chain as the decision-making goal, and focus on discussing what kind of contractual or non- contractual form will bring the best profit to all participants to reach an optimal decision.

Compared with the traditional food supply chain cooperation incentive, the green innovation activities in the food supply chain need to take into account both economic benefits and environmental performance. In the cooperation mode, more attention is paid to the effort level and long-term strategic cooperation willingness of food supply chain members. The effort level of members determines the quality and efficiency of the green innovation activities in the supply chain (Truong and Berrone, 2015; Hafezalkotob, 2017). Current research shows that manufacturers are more likely to become the initiators and leaders of green innovation activities, and seek guidance or control over upstream suppliers, because they are closer to the market and more sensitive to the information contained in the market such as consumers' green preferences and price effects (Zissis et al., 2015). They can make use of the advantages of leading force and asymmetric information in product design or technical scheme formulation, which enable them to maximize personal benefits. They can also use cost subsidies, revenue sharing and other ways to stimulate the innovation efforts of suppliers to maximize system revenue (Lou et al., 2018; Hong and Guo, 2019). Apart from that, there have been many meaningful researches on introducing cost sharing into food supply chain strategic cooperation or innovation cooperation. For example, some research have explored the existence of the relationship among sharing coefficient, unit revenue and effort degree in food supply chain cost sharing, and whether the relationship is affected by game elements such as decision-making environment, decision-making order and decision-making purpose (Liao et al., 2018; Jung et al., 2019; Valero et al., 2019); There are also discussion about the effects of different cost sharing objects, sharing quantity and sharing periodicity on cost sharing strategy selection (Kunapatarawong and Martinez-Ros, 2014; Geng and Dai, 2018).

The cost sharing ratio of manufacturers and suppliers may have a more profound impact on the depth of cooperation and the probability of successful cooperation between the two sides with the guidance of green innovation. It also plays a decisive role in stimulating the efforts of suppliers, which worth more attention (Yalabik and Fairchild, 2011; Parker and Van Alstyne, 2017; Gui et al., 2018). Also, when the manufacturer is assumed to be the initiator and leader of green innovation cooperation, the innovation efforts (Agrawal and Ülkü, 2012; Hong and Guo, 2019), net profit level (Töbelmann and Wendler, 2020), cooperation scale (Yenipazarli, 2017; Aragon-Correa et al., 2018) and R&D cost (Madani and Rasti-Barzoki, 2017) in the supply chain cooperation may change, especially when the non-linear change of cost sharing ratio may bring new impact on the green innovation decision-making of the food supply chain. This is especially when the manufacturer seeks optimal solution of green innovation incentives (Chen et al., 2019; Abbas, 2020). Based on this, the impact of the change of cost sharing coefficient on the green innovation decision-making of the whole food supply chain in the manufacturer led food supply chain green innovation cooperation will be explored in this paper. It will also be discussed how the manufacturer can effectively motivate the supplier through cost sharing, so as to improve the level of green innovation efforts, realize Pareto improvement of the food supply chain system profits, and promote the whole food supply chain green innovation activities with sustainable growth and green development.

LITERATURE REVIEW PROBLEM DESCRIPTION AND SYMBOL DESCRIPTION

Problem Description

In this paper, a secondary food supply chain composed of upstream intermediate product supplier (s) and downstream final product manufacturer (m) is studied. In the face of the green demand of consumers in the market, manufacturers have a higher willingness to innovate. So it is assumed in this paper that manufacturers are the initiators of green innovation cooperation. For example, in the food supply chain, when there is an increasing green preference of consumers, the manufacturers encourage suppliers to jointly improve the energy exhaust system, improve the fuel utilization efficiency or adopt green innovation activities such as new energy and new power system to provide the market with higher green degree products, so as to obtain a higher market share. In the traditional supplier manufacturer relationship, these incremental revenues are mainly obtained by the manufacturer, and the supplier can only obtain certain

TABLE 1 | Symbol description.

Symbol	Description
$I_i(t)$	The level of green innovation efforts of food supply chain members at a specific time
C_i	Cost of green innovation efforts of food supply chain members
k_i	Green innovation cost coefficient of food supply chain members
φ	Manufacturers' share of green innovation cost to suppliers
J_i	Net present value of food supply chain members' profits at a specific time
$\prod_i^j$	Profit of food supply chain members in the context of cost sharing
ρ_i	Marginal profit of products of member units in food supply chain
ρ	Discount rate
$j = d$	Stackelberg game under cost sharing
$i = \{m, s\}$	Supply chain members (manufacturers, suppliers)

indirect income through the increase of supply. Therefore, the incentive in the incremental sales of green products is very limited, which is prone to supply interruption (Cohen et al., 2015). At the same time, due to the high cost of green innovation and the high risk and uncertainty in the innovation process (Bendell, 2016), in order to effectively control the investment scale and reduce the investment risk, manufacturers often hope that suppliers can make more green innovation efforts, so they take measures to provide suppliers with a certain share of green innovation cost, so as to encourage suppliers' enthusiasm for green innovation and promote suppliers to participate in green innovation in depth New activities to realize resource coordination of green innovation in food supply chain.

Symbol Description

In this section, the main parameters and variable symbols involved in the later game model construction and reasoning are described according to the definition specification of food supply chain in **Table 1**. Some parameters and variables only appear in individual models, which are not listed in this table. These will be explained when they appear.

THE GAME MODEL OF MANUFACTURER PROVIDING COST SHARING

Model Assumptions

(1) All members of the food supply chain are rational subjects, which means manufacturers will maximize their profit and consumers will pursue optimal utility. The cost of green innovation activities is affected by their own level of green innovation efforts (Bray et al., 2019), which is continuously rising with the increase of the level of green innovation efforts. Considering the convex characteristics of the cost of green innovation activities, it is assumed that the cost of green innovation of members of the food supply chain is $I_i(t)$, and a convex function $C_i = \frac{1}{2} k_i I_i^2(t)$, $(i = m, s)$. And since green innovation belongs to one-off scientific research investment, it will not affect the fixed production cost of unit product. The higher the level of green innovation efforts, the green degree of the product will be higher, and more environmentally friendly. In practice, enterprises transmit their green innovation input and other information to consumers through ecological labels.

(2) Same with Stefano (Ramanathan et al., 2018), the reference price model which combines memory and stimulation is adopted in this paper adopts. And it is assumed that the change of reference price of products follows the following dynamic equation:

$$\begin{aligned} \dot{r}(t) &= \alpha \left[p - r(t)\right] + \beta \left[I_m(t) + I_s(t)\right] \\ r(0) &= r0 \end{aligned}$$

Where $r(t)$ is the reference price of the product at the moment t, $\dot{r}(t) = \frac{dr(t)}{dt}$ is the change rate of the reference price $r(t)$ at the moment $r(t)$, r_0 is the initial reference price of the product i. $\alpha(\alpha > 0)$ is the "memory parameter" of the consumer, and $\beta(\beta > 0)$ represents the influence factor of the green innovation input of the product on the reference price.

(3) It is assumed that the green attribute of the product can stimulate the market demand, and the demand is a linear function of the level of green innovation efforts (Ramanathan et al., 2018). On the basis of classical function, the influence of consumer's green preference behavior and reference price effect on market demand is introduced as below:

$$Q(t) = a - bp + \delta \left[r(t) - p\right] + \eta \left[I_m(t) + I_s(t)\right]$$

It can be seen from the above functions that the actual demand of consumers for green products is affected by the sales price, green degree level and reference price effect of green products. $a(a > 0)$ refers to the potential market demand of green products, $b(b \in (0, 1))$ refers to the price elasticity coefficient of demand Q. $\delta(\delta > 0)$ refers to the reference price coefficient, which shows the sensitivity between the actual price and the reference price of consumers, that also means the reference price effect. In special cases, $\delta = 0$ refers to no reference price effect. In addition, $\eta(\eta \in [0, 1])$ indicates the sensitivity coefficient of consumers' green degree. The larger the coefficient η is, the more consumers prefer green products.

Model Establishment and Solution

In the supply chain green innovation cooperation with cost sharing as the link, manufacturers play a leading role while suppliers play a follower role. In order to encourage suppliers to participate in green innovation activities, manufacturers provide suppliers with a certain proportion of cost sharing. From the perspective of long-term and dynamic equilibrium, the two decisions on the level of green innovation efforts constitute a Stackelberg differential game model between upstream and downstream manufacturers.

Manufacturers and suppliers make independent decisions to maximize their profits. In the first stage, manufacturers

decide their own level $I_m(t)$ of green innovation efforts and the proportion $\varphi(t)$ of green innovation cost sharing provided to suppliers. In the second stage, suppliers decide their own level $I_s(t)$ of green innovation efforts according to the given $I_m(t)$ and $\varphi(t)$. The manufacturer's decision-making problem can be obtained via below:

$$\max_{I_m,\varphi} J_m^d = \int_0^\infty e^{-\rho t}\{\rho_m Q - C_m(I_m) - \varphi C_s(I_s)\}dt \tag{1}$$

Given I_m and φ, the decision problem of the supplier is:

$$\max_{I_s} J_s^d = \int_0^\infty e^{-\rho t}\{\rho_s Q - (1-\varphi)C_s(I_s)\}dt \tag{2}$$

Proposition 1: The optimal level of green innovation effort of manufacturer is $I_m^{d^*} = \frac{\rho_m(\rho\eta+\alpha\eta+\beta\delta)}{k_m(\rho+\alpha)}$. The optimal level of green innovation effort of supplier is $I_s^{d^*} = \frac{(2\rho_m+\rho_s)(\rho\eta+\alpha\eta+\beta\delta)}{2k_s(\rho+\alpha)}$. The optimal cost sharing ratio of manufacturer to supplier is $\varphi^{d^*} = \frac{2\rho_m-\rho_s}{2\rho_m+\rho_s}$. And the optimal profit value function of manufacturer and supplier is

$$\begin{cases} J_m^{d^*}(r,t) = e^{-\rho t}(a_1^{d^*} r + b_1^{d^*}) \\ J_s^{d^*}(r,t) = e^{-\rho t}(a_2^{d^*} r + b_2^{d^*}). \end{cases}$$

$$\begin{cases} a_1^{d^*} = \frac{\rho_m \delta}{\rho+\alpha} \\ a_2^{d^*} = \frac{\rho_s \delta}{\rho+\alpha} \\ b_1^{d^*} = \frac{\rho_m}{\rho}\left[\alpha - bp - \delta p + \eta\left(\frac{\rho_m\eta+\beta a_1^d}{k_m} + \frac{2\rho_m\eta+\rho_s\eta+2\beta a_1^d+\beta a_2^d}{2k_s}\right)\right] \\ -\frac{\left(\rho_m\eta+\beta a_1^d\right)^2}{2\rho k_m} - \frac{\left(2\rho_m\eta+2\beta a_1^d\right)^2-\left(\rho_s\eta+\beta a_2^d\right)^2}{8\rho k_s} \\ +\frac{a_1^d}{\rho}\left[\begin{array}{l}\alpha p+ \\ \beta\left(\frac{\rho_m\eta+\beta a_1^d}{k_m} + \frac{2\rho_m\eta+\rho_s\eta+2\beta a_1^d+\beta a_2^d}{2k_s}\right)\end{array}\right] \\ b_2^{d^*} = \frac{\rho_s}{\rho}\left[\alpha - bp - \delta p + \eta\left(\frac{\rho_m\eta+\beta a_1^d}{k_m} + \frac{2\rho_m\eta+\rho_s\eta+2\beta a_1^d+\beta a_2^d}{2k_s}\right)\right] \\ -\frac{\left(2\rho_m\eta+\rho_s\eta+2\beta a_1^d+\beta a_2^d\right)^2}{8\rho k_s} \\ +\frac{\left(2\rho_m\eta+2\beta a_1^d\right)^2-\left(\rho_s\eta+\beta a_2^d\right)^2}{8\rho k_s} + \frac{a_1^d}{\rho}\left[\begin{array}{l}\alpha p+ \\ \beta\left(\frac{\rho_m\eta+\beta a_1^d}{k_m} + \frac{2\rho_m\eta+\rho_s\eta+2\beta a_1^d+\beta a_2^d}{2k_s}\right)\end{array}\right] \end{cases}$$

Prove: The optimal profit function of the supplier at time t can be expressed as:

$$J_s^{d^*}(r,t) = e^{-\rho t} V_s^d(r) \tag{3}$$

while, $V_s^d(r) = \max_{I_s} \int_t^\infty e^{-\rho(s-t)}\{\rho_s Q - (1-\varphi)C_s(I_s)\}ds$.

It can be seen that the supplier optimal control problem satisfies the following HJB equation:

$$\begin{aligned} \rho V_s^d(r) = \max_{I_s} \Big\{ & \rho_s[a - bp + \delta(r-p) + \eta(I_m + I_s)] \\ & - \frac{1}{2}(1-\varphi)k_s I_s^2 + V_s^{d'}(r)[\alpha(p-r) + \beta(I_m + I_s)] \Big\} \end{aligned} \tag{4}$$

Formula (4) is known to be a concave function of I_s. The following equation can be obtained according to the first order condition:

$$I_s = \frac{\rho_s\eta + \beta V_s^{d'}(r)}{(1-\varphi)k_s} \tag{5}$$

In the same way, the optimal profit function of manufacturer at time t can be expressed as:

$$J_m^{d^*}(r,t) = e^{-\rho t} V_m^d(r) \tag{6}$$

within this, $V_m^d(r) = \max_{I_m,\varphi} \int_t^\infty e^{-\rho(s-t)}\{\rho_m Q - C_m(I_m) - \varphi C_s(I_s)\}ds$.

It can be seen that the manufacturer's optimal control problem satisfies the following HJB equation:

$$\rho V_m^d(r) = \max_{I_m,\varphi}\{\rho_m Q - C_m - \varphi C_s + V_m^{n'}(r)\dot{r}\} \tag{7}$$

Take the response function (5) of the supplier into Equation (7) and expand to obtain the following:

$$\begin{aligned} \rho V_m^d(r) = \max_{I_m,\varphi}\{ & \rho_m[a - bp + \delta(r-p) + \eta(I_m + \frac{\rho_s\eta + \beta V_s^{d'}(r)}{(1-\varphi)k_s})] \\ & -\frac{1}{2}k_m I_m^2 \\ & -\frac{\varphi}{2}k_s[\frac{\rho_s\eta + \beta V_s^{d'}(r)}{(1-\varphi)k_s}]^2 + V_m^{d'}(r)[\alpha(p-r) \\ & +\beta(I_m + \frac{\rho_s\eta + \beta V_s^{d'}(r)}{(1-\varphi)k_s})]\} \end{aligned} \tag{8}$$

According to the Haisai matrix, formula (8) is a concave function with respect to I_m and φ, which can be obtained from the first order conditional formula as below:

$$I_m = \frac{\rho_m\eta + \beta V_m^{d'}(r)}{k_m}, \quad \varphi = \frac{2\rho_m\eta - \rho_s\eta + 2\beta V_m^{d'}(r) - \beta V_s^{d'}(r)}{2\rho_m\eta + \rho_s\eta + 2\beta V_m^{d'}(r) + \beta V_s^{d'}(r)} \tag{9}$$

By introducing I_m, I_s and φ into Equations (4) and (8), we can infer that the linear optimal value function of r is the solution of HJB equation.

So the expression of function sum $V_m^d(r)$ and $V_s^d(r)$ can be expressed as:

$$V_m^d(r) = a_1^d r + b_1^d, \quad V_s^d(r) = a_2^d r + b_2^d \tag{10}$$

Within this equation, a_1^d, b_1^d, a_2^d, b_2^d are all unknown constants. If equation (10) is taken into the arrangement, the constraint equations can be obtained about a_1^d, b_1^d, a_2^d, b_2^d. Solve the equations, a_1^d, b_1^d, a_2^d, b_2^d can be obtained. Bring it into equation (10), the expression of function $V_m^d(r)$和$V_s^d(r)$ can be obtained:

$$V_m^d(r) = a_1^{d^*} r + b_1^{d^*}, \quad V_s^d(r) = a_2^{d^*} r + b_2^{d^*} \tag{11}$$

By substituting Equation (11) and its first derivative into Equations (5) and (9), we can see that the equilibrium solutions of manufacturers and suppliers are, respectively, below.

$$I_m^{d^*} = \frac{\rho_m(\eta\rho+\eta\alpha+\delta\beta)}{k_m(\rho+\alpha)}, \quad \varphi^{d^*} = \frac{2\rho_m-\rho_s}{2\rho_m+\rho_s}, I_s^{d^*} = \frac{(2\rho_m+\rho_s)(\eta\rho+\eta\alpha+\delta\beta)}{2k_s(\rho+\alpha)} \tag{12}$$

Taking Equation (12) into Equation (1) and Equation (4), it can be get the optimal profit function of manufacturers and suppliers.

Proposition 2: At that time $-2 < \frac{\rho_s}{\rho_m} \leq 0$, the optimal level of green innovation efforts of manufacturers and suppliers was positive. The green innovation activities of the whole food supply chain were in the "double driving" mode, which means they were continuously influenced by the green preferences of consumers at the demand end of the external market, the reference price effect and the positive incentive of internal cost sharing, in which the incentive from internal cost sharing was the secondary part.

Proof: Because $I_m^{d^*} = \frac{\rho_m(\rho\eta+\alpha\eta+\beta\delta)}{k_m(\rho+\alpha)}$, $I_s^{d^*} = \frac{(2\rho_m+\rho_s)(\rho\eta+\alpha\eta+\beta\delta)}{2k_s(\rho+\alpha)}$, we can get

$$\begin{cases} \rho_m \leq 0, I_m^{d^*} \leq 0 \\ \rho_m > 0, I_m^{d^*} > 0 \\ \frac{\rho_s}{\rho_m} > -2, I_s^{d^*} > 0 \end{cases}$$

At that time $-2 < \frac{\rho_s}{\rho_m} \leq 0$, the optimal level of green innovation efforts of manufacturers and suppliers was positive.

It is shown with further analysis of Proposition 2 that, at that time $\rho_m \leq 0$, the manufacturer's optimal green innovation effort level is negative or zero, which means they should cut down investment on innovation. At this time, the manufacturer will not choose to carry out green innovation activities. At that time $\rho_m > 0$, the manufacturer's optimal green innovation effort level is positive, which indicate that at this time, the consumer's green preference and reference price effect have obviously encouraged the manufacturer's green innovation willingness. At that time $2\rho_m + \rho_s > 0$, the supply. The level of green innovation efforts is positive, which shows that the demand for green products at the market demand side and the cost sharing of manufacturers to suppliers can play an effective incentive role. To sum up, at that time $-2 < \frac{\rho_s}{\rho_m} \leq 0$, the green innovation efforts of suppliers and manufacturers were positively encouraged, and the green innovation activities of the whole supply chain were in the "double driving" mode. This means that they were continuously stimulated by the incentives of green preferences of consumers in the demand side of the external market and the reference price effect and the internal cost sharing.

Corollary 1: At that time $\frac{\rho_s}{\rho_m} \leq -2$, the level of green innovation efforts of suppliers was negative. For suppliers, the marginal profit of green raw materials was too low, and there was basically no profit space. Providing green raw materials to manufacturers could not help suppliers to achieve the annual profit goals of enterprises, and the suppliers' subjective willingness to carry out green innovation activities was low, so there would be supply interruption. At the same time, the demand stimulation from the market end is weak, which cannot directly stimulate the efforts of green innovation activities in the food supply chain. Manufacturers must effectively encourage suppliers through cost sharing, which is greater than normal. Otherwise, the problem of supply interruption will be infinitely enlarged to the whole supply chain through "bullwhip effect," and even cause the green production in the food supply chain Production and manufacturing of products, logistics, transportation and other aspects of the problem.

Proposition 3: There is a threshold $\frac{\rho_s}{\rho_m} = 2$ of marginal profit ratio between suppliers and manufacturers. Within the threshold range $0 < \frac{\rho_s}{\rho_m} \leq 2$, cost sharing has an obvious incentive effect on suppliers' green innovation efforts, and the incentive effect of cost sharing is stronger than that of market demand.

Proof: $I_m^{d^*} - I_m^{n^*} = \frac{\rho_m(\eta\rho+\eta\alpha+\delta\beta)}{k_m(\rho+\alpha)} - \frac{\rho_m(\eta\rho+\eta\alpha+\delta\beta)}{k_m(\rho+\alpha)} = 0$

$$I_s^{d^*} - I_s^{n^*} = \frac{(2\rho_m+\rho_s)(\eta\rho+\eta\alpha+\delta\beta)}{2k_s(\rho+\alpha)} - \frac{\rho_s(\eta\rho+\eta\alpha+\delta\beta)}{k_s(\rho+\alpha)} = \frac{(2\rho_m-\rho_s)(\eta\rho+\eta\alpha+\delta\beta)}{2k_s(\rho+\alpha)}$$

当$\rho_s > 2\rho_m$时, $I_s^{d^*} < I_s^{n^*}$; 当$\rho_s < 2\rho_m$时, $I_s^{d^*} > I_s^{n^*}$

Among them, $I_m^{n^*} = \frac{\rho_m(\eta\rho+\eta\alpha+\delta\beta)}{k_m(\rho+\alpha)}$, $I_s^{n^*} = \frac{\rho_s(\eta\rho+\eta\alpha+\delta\beta)}{k_s(\rho+\alpha)}$ are the optimal level of green innovation efforts of manufacturers and suppliers in NASH non-cooperative game, respectively.

Proposition 3 shows that cost sharing, as an effective incentive behavior of green innovation activities in food supply chain, has its boundary condition. This means that within a certain threshold range, this kind of subsidy has a positive incentive effect, and makes the whole supply chain green innovation activities in the "double driving" mode, and manufacturers and suppliers have strong green innovation enthusiasm. Once it is beyond the threshold range, the impact of cost sharing on the green innovation activities of food supply chain is greatly reduced. At this time, manufacturers will not provide cost sharing to suppliers. The green innovation activities of the whole supply chain are in the "single driving mode." The green innovation efforts of manufacturers and suppliers are only affected by the change of consumer behavior characteristics from the market demand side, and the impact of cost sharing can be ignored temporarily.

Corollary 2: At that time $\frac{\rho_s}{\rho_m} > 2$, the incentive effect of cost sharing on suppliers was low, but both manufacturers and suppliers with a high level of green innovation efforts. This shows that in the mature stage of green innovation activities, manufacturers and suppliers get higher product margin through green innovation activities in the food supply chain, and food supply chain members are more spontaneous to carry out green innovation activities, and gradually achieve the balance between economic performance and environmental performance.

Proposition 4: In the green innovation activities that manufacturers provide cost sharing to suppliers, the cost sharing ratio of manufacturers to suppliers is positively related to the marginal profit of manufacturers, and negatively related to the marginal profit of suppliers.

$$\textbf{Proof}: \varphi = \frac{2\rho_m - \rho_s}{2\rho_m + \rho_s}, \frac{\partial \varphi}{\partial \rho_m} = \frac{4\rho_s}{(2\rho_m + \rho_s)^2} > 0,$$
$$\frac{\partial \varphi}{\partial \rho_s} = -\frac{4\rho_m}{(2\rho_m + \rho_s)^2} < 0,$$

$$\frac{\partial^2 \varphi}{\partial \rho_m^2} = -\frac{16\rho_s}{(2\rho_m + \rho_s)^3} < 0, \frac{\partial^2 \varphi}{\partial \rho_s^2} = \frac{8\rho_m}{(2\rho_m + \rho_s)^3} > 0$$

Proposition 4 shows that in the whole life cycle of green innovation activities in food supply chain, cost sharing by manufacturers to suppliers is an effective measure to stimulate suppliers to participate in green innovation activities. In this process, manufacturers will constantly adjust the cost sharing proportion of suppliers according to the actual situation, so as to ensure the maximization of both sides' green innovation benefits and promote green innovation in food supply chain system Efficiency improvement. Therefore, the cost sharing ratio is actually in a dynamic change. In order to improve the cost sharing ratio of manufacturers to suppliers in green innovation, the marginal profit of manufacturers can be increased and the marginal profit of suppliers can be reduced.

Application Analysis

The third part of this paper proves and analyzes the influence of green innovation cost sharing on food supply chain equilibrium results through theoretical analysis. In order to verify the correctness of the proposed model and proposition, and further study its influence on food supply chain and enterprise net income, this section conducts sensitivity analysis on the cost sharing coefficient of green innovation through Mathematica Software. Two principles are adopted in the assignment of initial value of variable: one is to refer to the practice of relevant literature (Ramanathan et al., 2018; Li et al., 2019); the other is to assign median value when initial value of variable can be given relatively randomly without losing generality. **Table 2** shows the initial value assignment of variables.

According to the calculation results of the previous model, the cost sharing coefficient is determined by the marginal profit of the manufacturer and the supplier. This section mainly discusses the impact of the change of cost sharing coefficient on the green innovation efforts of manufacturers and suppliers in the food supply chain and the present value of profits. In order to more directly reflect the relationship between variables and the significance of their interaction, the sensitivity analysis in this section gives relatively high values when assigning marginal profits to manufacturers and suppliers as much as possible, so as to more intuitively describe how they affect the cost sharing ratio of manufacturers to suppliers. It also further analyzes how different sharing ratios cause green innovation efforts of manufacturers and suppliers is, and shows the degree of change of the food supply chain members have which have a certain impact on the present value of profits. Other variables are conventional parameter settings, mainly considering the influence of consumer green preference and reference price effect on green innovation activities.

From **Figure 1**, it can be seen that the cost sharing coefficient decreases with the increase of the supplier's marginal profit as a whole. The trend is moderate, and the final cost sharing coefficient is basically stable near "0." In more details, when the cost sharing coefficient decreases with the increase of the manufacturer's marginal profit, the increase of the supplier's unit marginal profit has a greater impact on the cost sharing coefficient. When the cost sharing coefficient increases with manufacturer's marginal profit, the supplier's unit marginal profit has a relatively small impact on the cost sharing coefficient.

It can be found with further analysis that, first, the larger the marginal profit of the supplier unit, the larger the profit of the supplier through the green innovation activities, the larger the profit space of the green products, and the smaller the incentive effect of cost sharing. The supplier will spontaneously carry out the green innovation activities, which is mainly stimulated by the green consumption at the market demand

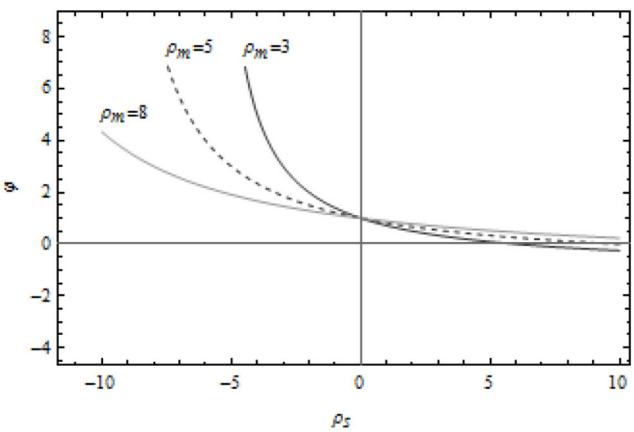

FIGURE 1 | Relationship between cost sharing coefficient and marginal profit of suppliers.

TABLE 2 | Variable assignment.

α	β	ρ	a	b	p	k_m	k_s	r_0	δ	η	ρ_m				ρ_s			
2	0.5	0.1	20	1	20	5	3	7	1	0.5	4	6	8	10	2	4	6	8

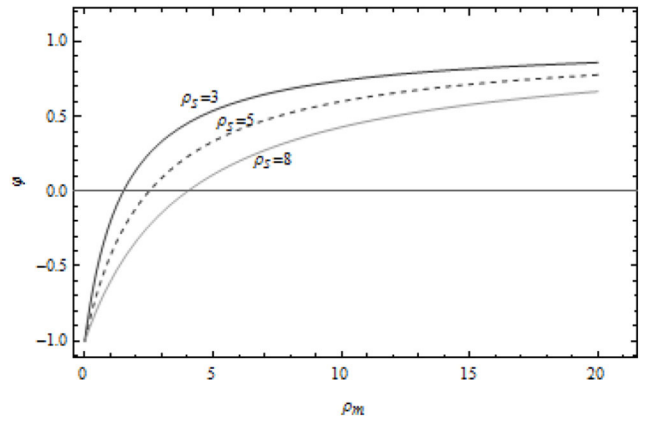

FIGURE 2 | Relationship between cost sharing coefficient and manufacturer's marginal profit.

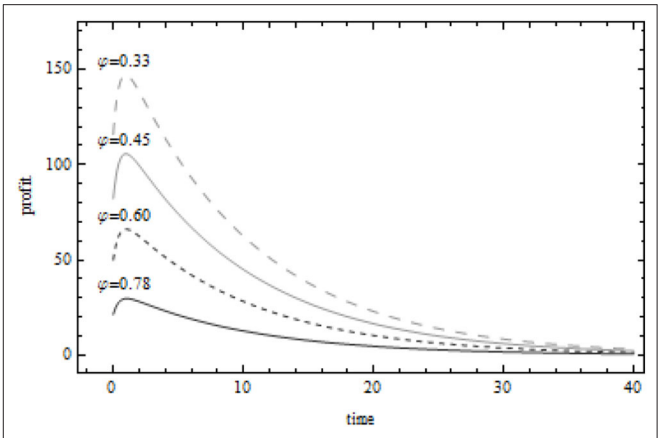

FIGURE 3 | Relationship between present value of supplier profit and cost sharing coefficient.

end. Second, the marginal profit of the supplier unit is In the case of negative value, the greater the manufacturer's marginal profit is, the more likely it is to share the cost of green innovation activities for suppliers, or even provide them with green information resource sharing, so as to ensure the stable supply of goods by suppliers and form a long-term strategic cooperation relationship. Thirdly, in the case of positive marginal profit of suppliers, the stronger the supplier's profitability is, and vice versa. With the continuous growth of green economy, green manufacturing has gradually evolved into an endogenous variable of enterprises. Enterprises in the food supply chain carry out green innovation activities with upstream and downstream enterprises to form core competitiveness, while the "capital sharing" of the cost of green innovation in the early stage will eventually feedback large manufacturers and enterprises, so as to keep leading in the green driven economic environment First place.

It can be seen from **Figure 2** that when the marginal profit of the supplier is fixed, the cost sharing coefficient increases with the increase of the marginal profit of the manufacturer. When the marginal profit of the manufacturer is fixed, the cost sharing coefficient decreases with the increase of the marginal profit of the supplier. In more detail, under the same conditions, the cost sharing coefficient of the supplier $\rho_s = 3$ is the largest, and the marginal profit of the supplier $\rho_s = 5$ is the largest. The cost sharing coefficient is in the middle, and the supplier's marginal profit $\rho_s = 8$ is the smallest. This shows that the cost sharing of manufacturers to suppliers is closely related to their own economic strength and marginal profit of suppliers. In essence, the green innovation activity of food supply chain is a "game" of manufacturers and suppliers' green innovation efforts. When both sides of the game are rational people, manufacturers will adjust the cost sharing ratio of suppliers according to the actual situation to achieve win-win.

When the manufacturer's marginal profit $\rho_m = 8$, **Figure 3** describes the change of the present value of the supplier's profit when the value of the supplier's marginal profit is $\rho_s = 2$, $\rho_s = 4$, $\rho_s = 6$, $\rho_s = 8$, respectively. The supplier's profit decreases with the increase of time. After obtaining high economic benefits in the early stage of green innovation activities, the supplier's economic benefits gradually decrease, which is mainly affected by the technical difficulty and uncertain benefits of green innovation activities, as well as the subsequent more enterprises joining in green innovation activities, forming a fierce competition relationship with each other. At the same time, enterprises will pay more attention to the environment in the future environmental performance, not economic efficiency. Further observation shows that when the marginal profit of the supplier is certain and greater than the marginal profit of the supplier, with the increase of the marginal profit of the supplier, the cost sharing proportion of the manufacturer to the supplier decreases, while the marginal profit of the supplier increases continuously, which further shows that the cost sharing of the manufacturer to the supplier is not always effective, and there is a threshold value within the threshold range. Cost sharing can become the "push hand" of green innovation activities in food supply chain and realize the green innovation incentive of manufacturers to suppliers.

When the supplier's marginal profit $\rho_s = 4$, **Figure 4** describes the change of the present value of the manufacturer's profit when the value of the manufacturer's marginal profit is $\rho_m = 4$, $\rho_m = 6$, $\rho_m = 8$, $\rho_m = 10$, respectively. When the marginal profit of the supplier is certain and less than the marginal profit of the manufacturer, the greater the marginal profit of the manufacturer, the greater the cost sharing proportion of the manufacturer to the supplier. Under the condition that the present value of the profit obtained by the manufacturer through green innovation activities is more similar, the present value of the manufacturer's unit profit increases first, then less and then increases with the increase of its own marginal profit. According to **Figures 3**, **4**, when $\delta = 0.6(\rho_m = 8, \rho_s = 4)$, the present value of the manufacturer's profit is 140 units, and the present value of the supplier's profit is 65 units. This shows that both manufacturers and suppliers can obtain considerable

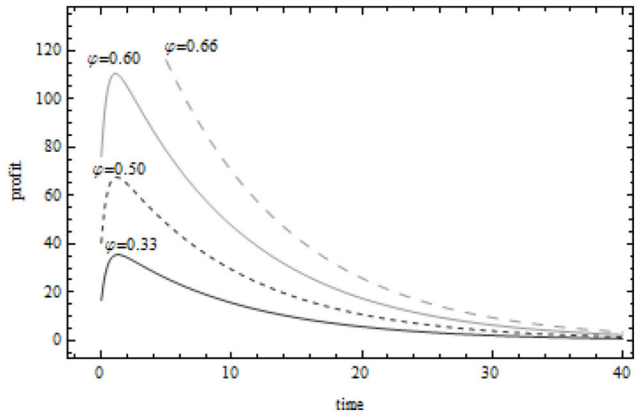

FIGURE 4 | Relationship between present value of manufacturer's profit and cost sharing coefficient.

benefits from green innovation activities in the food supply chain. The cost sharing contract, as the "promoter" of the cooperation between the upstream and downstream enterprises in the food supply chain, can indeed stimulate the green innovation activities of both sides in the food supply chain. More importantly, through the form of cost sharing, manufacturers and suppliers establish a trust mechanism to ensure their own long-term stable supply, reduce the uncertainty in green innovation activities, and realize Pareto improvement of food supply chain system profits.

CONCLUSION

In this paper, a food supply chain green innovation model based on Stackelberg game is established to describe the situation that manufacturers encourage suppliers' green innovation efforts through cost sharing contract. On this basis, the changes of manufacturers' and suppliers' optimal green innovation efforts, optimal profit level and subsidy effectiveness caused by the change of cost sharing coefficient are discussed. The following results is concluded.

First, in the Stackelberg game between manufacturer and supplier, the non-linear change of cost sharing will affect the green innovation decision of food supply chain, and there is an optimal sharing threshold $\frac{\rho_s}{\rho_m} = 2$. At that time $\frac{\rho_s}{\rho_m} \leq -2$, there will be supply interruption. Manufacturers need to stimulate suppliers to make green innovation efforts through cost sharing. At this time, the cost sharing ratio is higher than normal.

Second, at that time $-2 < \frac{\rho_s}{\rho_m} \leq 0$, the optimal level of green innovation efforts of manufacturers and suppliers is positive. At this time, the whole supply chain green innovation activities were in efficient operation and could achieve considerable economic benefits. Food supply chain members are in the "double driving" mode, that is, sustainability is encouraged by the green preference of consumers from the market demand side, the reference price effect and cost sharing. Among them, the market demand side incentives account for the main part.

Third, at that time $0 < \frac{\rho_s}{\rho_m} \leq 2$, cost sharing had an obvious incentive effect on suppliers' green innovation efforts, and the incentive effect of cost sharing was better than that of consumer's green preference and reference price effect at the market demand end. The cost sharing ratio of manufacturers to suppliers was positively related to manufacturers' marginal profits, and negatively related to suppliers' marginal profits.

From the overall content of the paper, the green innovation efforts of manufacturers and suppliers will be stimulated by the situation of consumers in the market. At the same time, the degree of green innovation efforts of suppliers will also be stimulated by the cost sharing of manufacturers. In terms of suppliers, the possible incentives are twofold, which can bring strategic suggestions for enterprises. First, in the early stage of the market, due to the high risk and uncertainty of green innovation activities in the food supply chain, the market scale of green products has not yet formed, which is prone to the problem of insufficient incentive to suppliers, and further leads to supply interruption. Therefore, large manufacturers need to pay close attention to the economic situation of upstream and downstream enterprises, establish good strategic cooperation relationship, ensure the sustainable development of green innovation activities in the food supply chain, create products with low energy consumption and high green degree, and establish green barriers for enterprises. Second, cost sharing is a powerful method for incentive of green innovation activities in food supply chain. Considering the advantages of manufacturers' rights, information and the need to cultivate strategic partners, large manufacturers can greatly encourage suppliers' green innovation efforts through cost sharing. And the cost sharing ratio can be determined according to the cooperation between the two sides, so as to achieve effective incentive and Pareto improvement of food supply chain profits. Thirdly, the green innovation activities of food supply chain are influenced by the green preference of consumers from the demand side of external market and the reference price effect, and the incentive of internal cost sharing means, and the incentive of cost sharing depends on the manufacturer's response to the demand side of external market. This requires enterprises not only to coordinate internal resources, but also to accurately grasp consumer preferences and make rapid product line decisions under the background of green consumption and service becoming the mainstream trend.

There are still some limitations in this study, which need to be extended in the future research. Firstly, the object of this research is constrained to a two-level food supply chain system composed of a manufacturer and a supplier, which can be introduced to the competitive environment of suppliers. Secondly, the cost sharing as an incentive means in this paper, but manufacturers can achieve effective incentives for suppliers through a variety of combinations. Thirdly, The simulation study of this paper only represents a purely rationale account of the phenomenon explored and cannot sufficiently interpret the practice of cooperation innovation in food industry supply chain. Therefore, further research can explore the feasibility of cooperation models bedsides cost sharing, such as wholesale price premium contract in supply chain green innovation activities.

DATA AVAILABILITY STATEMENT

All datasets presented in this study are included in the article/supplementary material.

AUTHOR CONTRIBUTIONS

JH and YL wrote the first draft of the original manuscript. YL and XF analyzed the major model and simulation. C-HL and C-HC conceptualized, reviewed, and edited the paper. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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Consumers' Purchase Intention of Organic Food via Social Media: The Perspectives of Task-Technology Fit and Post-acceptance Model

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In the past, consumers were mainly informed about organic food by newspapers, magazines, and television advertisements. However, when consumers buy organic products in the market, they cannot get a complete information about the products from the appearance of the various products. In order to overcome this information asymmetry, social media has become an indispensable part of the promotion of organic food by providing a clear distinction between certified organic products and other types of products in the market. The purpose of this study is to demonstrate the antecedents and consequences of the influence of social media on the consumers' selection of organic food, based on the post-acceptance model (PAM) and task-technology fit model. The empirical results indicated task characteristics and technology characteristics had the significant effects on confirmation of the expectations and perceived usefulness through the task-technology fit. Besides, the confirmation of expectations and perceived usefulness also influenced significantly the satisfaction and continuance intention, respectively. Finally, the results presented in this article would contribute to the practical and academic implications and recommendations on the promotion of organic food in the social media platform.

Keywords: organic food, social media, task-technology fit, post-acceptance model, partial least squares

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INTRODUCTION

For a long time, with the advancement of technology and commercial development, food products have been genetically modified and chemically processed from cultivation to mass production in order to pursue economic benefits while neglecting the potential harm to humans and the environment. As a result, the rise of the consumers' concept of health and wellness, coupled with the demand for the concept of safe and nontoxic food, has increased the acceptance of organic food, and organic food is gradually becoming a dietary trend (Michaelidou and Hassan, 2008; Benbrook and Baker, 2014; Ronald and Adamchak, 2017). Currently, organic food is a concept and a trend, in addition to the appeal of natural and healthy diet, but it also does not damage the natural environment (farmland, soil, and water), pay attention to the ecology, in order to achieve the principle of symbiotic sustainability between man and nature.

In the past, consumers were mainly informed about organic food by newspapers, magazines, and TV advertisements, and the main motivation for buying organic food is that they feel it is healthier for their health. The value of an organic product lies in the process of production

and manufacturing to the point where the final product complies with stringent organic regulations; however, when consumers purchase organic products in the market, they do not get the complete picture from the appearance of the product (Janssen and Hamm, 2012). In addition to its penetration and pervasiveness, social media is also efficient in gathering users of the same type or background (Allagui and Breslow, 2016). According to Palen (2008), survivors of social disasters or victims of major crises are often able to use social media to find others with similar experiences, to share their experiences, and to generate the support and connections that are characteristics of a victim's community.

Many prior research on social media has been conducted from a technology-acceptance perspective, discussing antecedents and consequences (Chen et al., 2012; Rauniar et al., 2014; Ayeh, 2015; Lin and Kim, 2016; Wamba et al., 2017; Zhao and Wang, 2020). However, the above research results only concentrated on the correlation between the IT and individual usage behavior, and these studies provided a little discussion on how social media influences consumer adoption or purchase intention of organic food. Through this study, we can understand the important factors through which consumers adopt social media to receive messages about organic food. In order to overcome this information asymmetry, social media is playing an important role in the promotion of organic food by clearly separating certified organic products from other types of products in the market and enabling the consumers to identify the labels of certified organic products. At the same time, the transparency of organic food information will increase the consumption of organic food. Therefore, this study devoted effort for developing an integrated model designed to explain and predict the consumers' purchase intention of organic food based on the concepts of the post-acceptance model (PAM) by Bhattacherjee (2001) and the task-technology fit (TTF) model by Goodhue and Thompson (1995). In addition, previous empirical studies on the impact of organic food purchasing intentions in the past were based on the pre-consumer attitude toward organic food (e.g., Yin et al., 2010; Paul and Rana, 2012; Basha et al., 2015; Singh and Verma, 2017). Therefore, the purpose of this study is to demonstrate the antecedents (three antecedents including task characteristics, technology, and task-technology fit, and two factors including the confirmation of expectations and perceived usefulness) and consequences (two factors including the satisfaction and continuance intention toward organic food social media platform) of the influence of social media on the consumers' selection of organic food based on the PAM and TTF model using a partial least square (PLS) approach.

THEORETICAL BACKGROUND

Post-acceptance Model

The expectation confirmation theory (ECT), proposed by Oliver and Richard (1980) and originated in the field of marketing, is based on the concept that (1) consumers had a certain level of expectation for a particular product (or service) before they buy it; (2) after the consumer had experienced the product (or service) for some time, he/she develops a new awareness of the performance that the product (or service) brings; (3) Then, the consumers will compare the perceived performance after experiencing the product (or service) with their initial expectations in order to assess the consistency (i.e., the degree of confirmation); (4) The results of the comparison will affect the level of satisfaction, and the level of satisfaction will affect the likelihood of repurchase or reuse. ECT was extensively used to evaluate consumer satisfaction and behavior after purchase (e.g., repeated purchase and complaint) as well as general service marketing in a past literature review of consumer behavior research (Oliver and Richard, 1980; Tse and Wilton, 1988; Anderson and Sullivan, 1993; Oliver, 1993; Patterson et al., 1997; Dabholkar et al., 2000).

Bhattacherjee (2001) argued that (1) an information system user's ongoing adoption decision is similar to a consumer's repurchase decision behavior; (2) affected by the first experience (information system or product); and (3) may eventually reverse the initial decision. Bhattacherjee (2001) argued that the past ECT was somewhat controversial and irrational, and took into account the need to effectively predict and explain the continuous adoption behavior of information system users. Bhattacherjee (2001) modified ECT one by one to make it conform to the use of information systems and proposed the PAM of IS continuance, the main points of which are as follows: (1) PAM focuses on the adoption of the post-acceptance variable because the impact of the adoption of the pre-acceptance variable is covered by the concepts of confirmation and satisfaction. (2) The original ECT only investigated the pre-consumption expectation, but the users' expectations changed over time, so the postconsumption expectation was especially emphasized in the continued adoption model after the IS acceptance. (3) In the IS acceptance PAM, the post-experience expectations are interpreted as perceived usefulness, a concept consistent with the expectations defined by ECT (i.e., the set of personal beliefs or interbeliefs), and perceived usefulness appropriately represents a user's significant cognitive beliefs about the information system (Davis, 1989). In recent years, although scholars have been using the PAM to explain the continued adoption of various innovative technologies (e.g., Roca et al., 2006; Bhattacherjee et al., 2008; Chen et al., 2013, 2018; Oghuma et al., 2016; Park, 2020), little is known about the determinants affecting the consumers' usage intention and evaluation of social media platform to gather relevant information of organic food. Social media operators, which provided and promoted the organic food information should think how to gain rapid acceptance and usage of social media by potential users or consumers. Therefore, this study applied PAM as the basis and extended it to assist social media operators to predict and explain the acceptance of social media platform toward organic foods.

Task-Technology Fit

Goodhue and Thompson (1995) distinguished the job characteristics in terms of non-routineness and interdependence. Among them, a high level of routine indicates that this type of

problem is more likely to be a simple or problematic task. When such tasks are not routine, they tend to be decision-making tasks, judgmental tasks, or vague tasks where the degree of interdependence refers to whether the task can be completed alone or requires the assistance of other departments or other personnel. Tasks with a low level of interdependence may be simple or problematic. Tasks with a high level of interdependence may be problematic, decision making, judgmental, or ambiguous.

The task-technology fit theory proposed by Goodhue and Thompson (1995) emphasizes the impact of technology on individual performance, which is the result of the fit between task, technology, and individual, and an ideal fit can effectively enhance performance. Dishaw and Strong (1999) first attempted to extend task-technology fit and showed that this integration model improved the ability of the model to interpret information technology use. Relevant studies regarding task-technology fit is implemented after Dishaw and Strong (1999) presented the extension of task-technology fit. Klopping and McKinney (2004) studied the propensity and actual purchase behavior of online shopping using an integrated TTF extended TAM model, and the results showed that the degree of interpretable variation of the integrated model was higher than that of the simple TAM model. Larsen et al. (2009) explored information systems through the integration model of the TTF and ECM—the user's related behavior. Chang (2010) applied the integrated models of a task-technology fit into TAM to evaluate the users' acceptance of online auctions. Khan et al. (2018) developed an integrated model including the task-technology fit, social motivation, and self-determination theory to represent the technology-oriented, social, and psychological needs of learners regarding the adoption of massive open online courses (MOOCs) in Pakistan.

Therefore, according to the above discussion, the task-technology fit could improve the shortcomings of the PAM and allow this study to take into account the other more relevant factors that influence the consumers' willingness to purchase organic food through social media.

HYPOTHESES DEVELOPMENT AND RESEARCH METHODOLOGY

Research Hypotheses Development

Task-technology fit, defined as how the capabilities of the infrastructure such as information systems match the tasks that the users must perform, is a key determinant in explaining performance levels (Goodhue et al., 2000). The model of task technology, developed by Goodhue and Thompson (1995), has been adopted in various information system/information technology acceptance research (Schrier et al., 2010; Yen et al., 2010; Lu and Yang, 2014; Khan et al., 2018), and it focuses on the matching of the technology to the task, thereby increasing the individual performance (Goodhue et al., 2000). Therefore, we hypothesize the following:

H1: Task characteristics positively affect the perceived task-technology fit in an organic food social media forum.

H2: Technology characteristics positively affect the perceived task-technology fit in an organic food social media forum.

Previous research believed that the perception of whether a particular task-technology fits well with the perceived usefulness could be the basis for constructing perceptions of actually adopting the information technologies (Kim et al., 2010; Wu and Chen, 2017). Empirical evidence has illustrated that the perceived usefulness is affected by the task-technology fit; that is, when the fit between the task and technology is higher, consumers perceive the digital tool to be useful for that task (Larsen et al., 2009; Chang, 2010; Schrier et al., 2010; Lin and Wang, 2012; Wu and Chen, 2017). Moreover, the empirical result from Cheng (2020) also found the positive linage from the task-technology fit to confirmation. Thus, we proposed the following two research hypotheses:

H3: Perceived task-technology fit positively affects the perceived usefulness in an organic food social media forum.

H4: Perceived task-technology fit positively affects the confirmation in an organic food social media forum.

Satisfaction is critical to promote the successful implementation toward information systems/information technologies (Au et al., 2008). Therefore, satisfaction plays a critical role in PAM (Bhattacherjee, 2001; Chen et al., 2013, 2018). Prior research evidently supported the confirmation of expectations and perceived usefulness continuance intention through satisfaction toward various digital and mobile services (Lin et al., 2005; Chen et al., 2013; Oghuma et al., 2016; Park, 2020; Tam et al., 2020). According to the above evidence, a summary of research hypotheses related to PAM and intention to use social media in gathering organic food information environment are presented as follows:.

H5: Confirmation positively affects the perceived usefulness in an organic food social media forum.

H6: Perceived usefulness positively affects the continuance intention in an organic food social media forum.

H7: Perceived usefulness positively affects the satisfaction in an organic food social media forum.

H8: Confirmation positively affects the satisfaction in an organic food social media forum.

H9: Satisfaction positively affects the continuance intention in an organic food social media forum.

Research Methodology

Considering the above nine hypotheses, we designed a questionnaire to measure and understand the users' perceptions in the organic food social media forum. For content validity, all the measurement items for each latent variable in the questionnaire were from existing studies. PAM, including the continuance intention, satisfaction, perceived usefulness, and

confirmation, were adopted from Bhattacherjee (2001) and Chen et al. (2013). The concept of the task-technology fit, including the technology characteristics and task characteristics, were slightly modified from Chang (2010) and Wu and Chen (2017). Each measurement item was replied following the seven-point Likert's scale. For example, range from 1, "strongly disagreement" to 7, "strongly agreement."

In this study, the partial least squares (PLSs) is used as the data analysis tool for the research model. The PLS is a structural equation modeling (SEM) analysis technique based on a regression analysis, which is a statistical method derived from the path analysis. By using PLS analysis, both the measurement model of the research tool and the structural model of the research component can be examined. Past research has shown that PLS can evaluate both the measured model and the theoretical structural model and is, therefore, superior to the traditional regression analysis and factor analysis methods (Urbach and Ahlemann, 2010; Hair et al., 2012; Henseler et al., 2015). In addition, compared with the LISREL method commonly used in the academia, PLS requires a smaller sample size for analysis, and the observational data is not available. PLS requires multivariate constant assumptions and is better at prediction. Model flexibility is also greater (Ringle et al., 2012). PLS analysis software used in this study is the SmartPLS (version 3.3.2) and uses bootstrap resampling method to check the significance of the paths in the structural model. The research hypotheses of this research are shown in **Table 1**, and the research framework is shown in **Figure 1**.

A questionnaire survey was used to collect data by convenience sampling method, and questionnaires were collected from four organic food promotion Facebook communities. To ensure the content validity, all samples had relevant experience in participating in organic food discussions or purchasing behavior through social media. The sample recall period was 4 weeks. The total number of samples collected was 284. After data checking and deletion of invalid questionnaires, the remaining number of valid samples was 235. Among them, 41.2% were male and 58.8% were female. Sixty-two percent (60.2%) of the samples had university education, and most of them (72.6%) were aged 26 to 40 years old.

DATA ANALYSIS

Outer Model

In order to further examine the reliability and validity of the scale questionnaire, this study uses the PLS statistical software to check the appropriateness of the measurement model. The validation of

TABLE 1 | Research hypotheses.

Hypothesis	Hypothesis statement
Hypothesis 1	Task characteristics positively affect the perceived task-technology fit in an organic food social media forum.
Hypothesis 2	Technology characteristics positively affect the perceived task-technology fit in an organic food social media forum.
Hypothesis 3	Perceived task-technology fit positively affects the perceived usefulness in an organic food social media forum.
Hypothesis 4	Perceived task-technology fit positively affects the confirmation in an organic food social media forum.
Hypothesis 5	Confirmation positively affects the perceived usefulness in an organic food social media forum.
Hypothesis 6	Perceived usefulness positively affects the continuance intention in an organic food social media forum.
Hypothesis 7	Perceived usefulness positively affects the satisfaction in an organic food social media forum.
Hypothesis 8	Confirmation positively affects the satisfaction in an organic food social media forum.
Hypothesis 9	Satisfaction positively affects the continuance intention in an organic food social media forum.

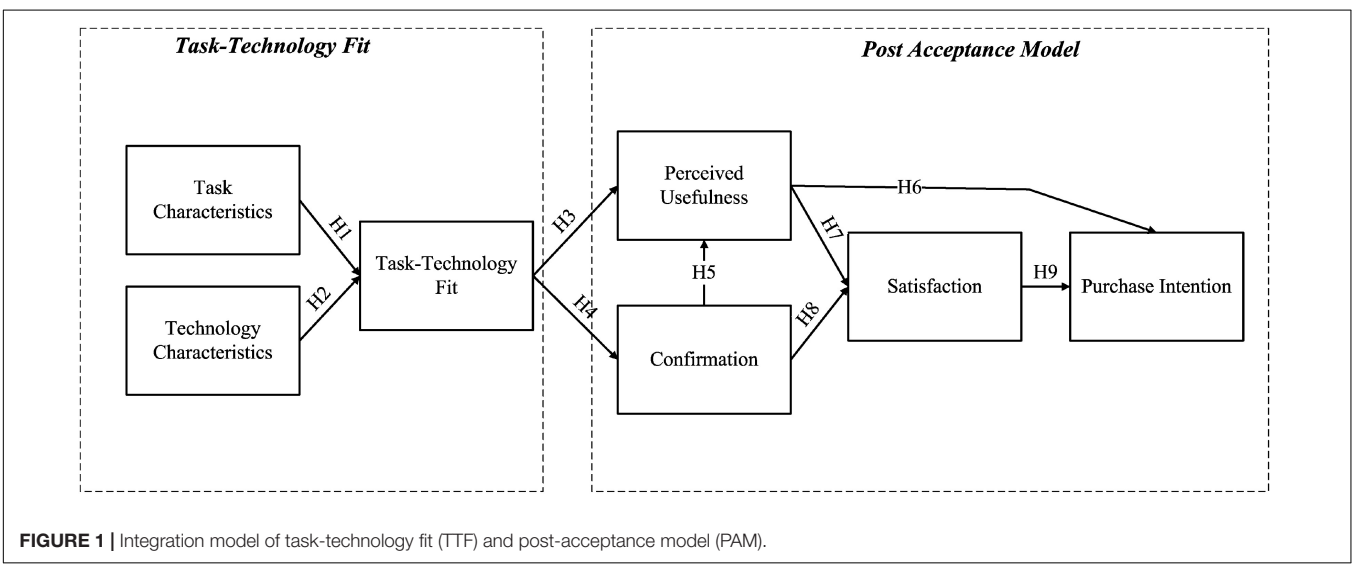

FIGURE 1 | Integration model of task-technology fit (TTF) and post-acceptance model (PAM).

the measurement model includes checks for internal consistency, convergent validity, and discriminate validity. Reliability is the correctness and accuracy of a measurement tool, which has two meanings. Stability is the degree of reliability of retesting and consistency is the measurement of the internal consistency among the items in the questionnaire. This study adopts the composite confidence level of the least square method (PLS). Reliability was analyzed with the Cronbach's α and composite reliability. According to Fornell and Larcker (1981), the composite reliability (CR) and Cronbach's α should be above 0.7 to ensure that the measurement variables are internally consistent. While the CR values in this study were all above 0.880 (as shown in **Table 1**), the Cronbach's α values were all above 0.728 and above, indicating that the internal consistency of the measurement tools designed in this study is acceptable.

Convergent validity indicates the degree to which multiple variables measure the same dimension. According to the suggestion of Fornell and Larcker (1981), the average variance extracted (AVE) for each individual component must be greater than 0.5, and the factor loadings of each component must be greater than 0.5 (Hair et al., 2010). The factor loadings of each component must be greater than 0.5 to be considered as having sufficient convergent validity. The AVE values of each structure are above 0.699 (as shown in **Table 2**). According to the above analysis, it means that the measurement model in this study passes the test and satisfies the need for the convergent validity (as shown in **Table 2**).

The discriminant validity is to check how well the measurement variables discriminate between the different configurations. The correlation between each variable and other variables of the same dimension should be higher than the correlation between the variables of the different dimensions. In order to pass the test of discriminant validity, the square root of AVE from an individual component should be greater than the correlation coefficient (non-diagonal value) between that component and the other components in the model to indicate the discriminant validity (Fornell and Larcker, 1981). **Table 3** shows the matrix of correlation coefficients between each component, and the diagonal lines are the square roots of the AVE of that component. **Table 3** shows that the square roots of the AVEs for each of the structural measurement items are larger than the correlation coefficients between the two components, which means that the questions of different components in the questionnaire of this study can be discriminated adequately. In addition, by comparing the factor loadings and cross loadings within each study construct, it can also be seen that this study has a good discriminant validity (as shown in **Table 4**).

TABLE 2 | Reliability and convergent validity.

Construct	Cronbach's alpha	Composite reliability	AVE
CI	0.890	0.932	0.821
CON	0.919	0.943	0.804
PU	0.901	0.931	0.771
SAT	0.935	0.959	0.885
TASK	0.846	0.907	0.764
TECH	0.857	0.903	0.699
TTF	0.728	0.880	0.786

AVE, average variance extracted. CI, continuance intention; CON, confirmation; PU, perceived usefulness; SAT, satisfaction; TASK, task characteristics; TECH, technology characteristics; TTF, Task Technology fit.

TABLE 3 | Correlations and discriminant validity.

Construct	CI	CON	PU	SAT	TASK	TECH	TTF
CI	**0.906**						
CON	0.734	**0.897**					
PU	0.558	0.680	**0.878**				
SAT	0.714	0.835	0.598	**0.941**			
TASK	0.546	0.601	0.625	0.640	**0.874**		
TECH	0.527	0.575	0.474	0.610	0.666	**0.836**	
TTF	0.523	0.582	0.618	0.557	0.659	0.537	**0.887**

CI, continuance intention; CON, confirmation; PU, perceived usefulness; SAT, satisfaction; TASK, task characteristics; TECH, technology characteristics; TTF, task technology fit. The diagonal value represents the square root of the AVE. The nondiagonal value represents the correlation value of each component. The bold values means the square roots of the AVE.

Inner Model

In this study, PLS is used as an analytical tool to analyze the strength and direction of the relationship between the study variables in the structural model. The structural model

TABLE 4 | Factor loadings and cross loadings.

	CI	CON	PU	SAT	TASK	TECH	TTF
CI1	**0.927**	0.643	0.541	0.635	0.480	0.463	0.445
CI2	**0.939**	0.656	0.545	0.616	0.495	0.425	0.477
CI3	**0.849**	0.693	0.430	0.686	0.507	0.540	0.496
CON1	0.627	**0.892**	0.606	0.695	0.511	0.524	0.478
CON2	0.643	**0.905**	0.598	0.710	0.514	0.512	0.531
CON3	0.620	**0.892**	0.628	0.807	0.544	0.491	0.489
CON4	0.738	**0.898**	0.606	0.777	0.583	0.536	0.585
PU1	0.482	0.529	**0.839**	0.445	0.515	0.385	0.544
PU2	0.429	0.551	**0.885**	0.482	0.560	0.383	0.597
PU3	0.475	0.622	**0.921**	0.543	0.565	0.445	0.572
PU4	0.563	0.671	**0.865**	0.612	0.553	0.446	0.468
SAT1	0.639	0.734	0.525	**0.921**	0.571	0.519	0.482
SAT2	0.680	0.794	0.579	**0.963**	0.615	0.593	0.545
SAT3	0.695	0.826	0.581	**0.938**	0.619	0.605	0.542
TASK1	0.509	0.520	0.584	0.569	**0.879**	0.570	0.614
TASK2	0.480	0.573	0.563	0.592	**0.887**	0.586	0.526
TASK3	0.440	0.488	0.490	0.520	**0.856**	0.592	0.581
TECH1	0.479	0.473	0.424	0.486	0.560	**0.806**	0.526
TECH2	0.320	0.348	0.316	0.404	0.473	**0.827**	0.336
TECH3	0.457	0.514	0.378	0.523	0.538	**0.894**	0.417
TECH4	0.463	0.550	0.435	0.595	0.624	**0.814**	0.467
TTF1	0.458	0.525	0.541	0.497	0.630	0.488	**0.893**
TTF2	0.469	0.507	0.555	0.491	0.537	0.464	**0.880**

CI, continuance intention; CON, confirmation; PU, perceived usefulness; SAT, satisfaction; TASK, task characteristics; TECH, technology characteristics; TTF, task technology fit. The bold values means standardized factor loadings.

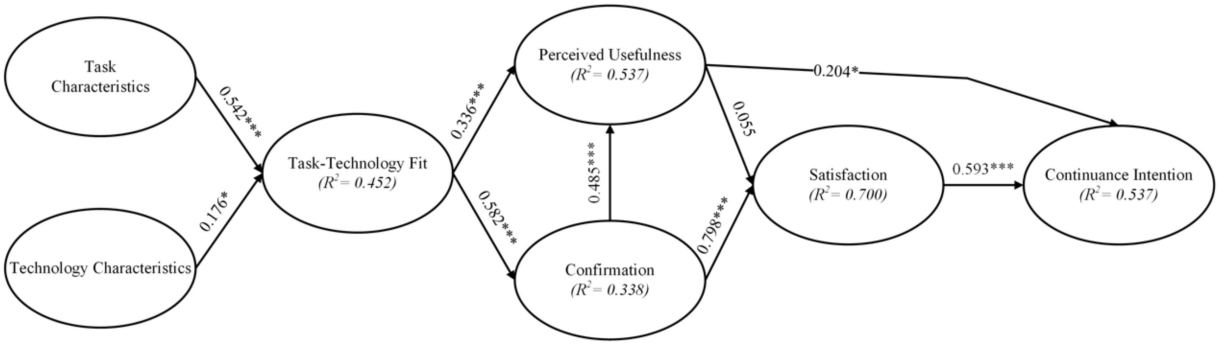

FIGURE 2 | Inner model.

TABLE 5 | Inner model and path analysis.

	Original sample (O)	Standard deviation (STDEV)	*T* Statistics (|O/STDEV|)	*P*-values
H1: TASK → TTF	0.542	0.080	6.747	0.000
H2: TECH → TTF	0.176	0.082	2.154	0.031
H3: TTF → PU	0.336	0.079	4.262	0.000
H4: TTF → CON	0.582	0.060	9.690	0.000
H5: CON → PU	0.485	0.083	5.858	0.000
H6: PU → CI	0.204	0.083	2.462	0.014
H7: PU → SAT	0.055	0.068	0.807	0.420
H8: CON → SAT	0.798	0.058	13.839	0.000
H9: SAT → CI	0.593	0.067	8.828	0.000

CI, continuance intention; CON, confirmation; PU, perceived usefulness; SAT, satisfaction; TASK, task characteristics; TECH, technology characteristics; TTF, task technology fit.

is validated mainly in terms of the estimated path coefficients and *R*-values. The coefficient of path represents the strength and direction of the relationship between the study variables and should be verified as significant and consistent with the expected direction of the hypothesis. The *R*-value is the percentage of variation explained by the exogenous variables versus the endogenous variables and represents the predictive power of the research model. The path coefficients and *R*-values together show how well the structural model and data fit together. The results of the analysis of the structural model of this study are shown in **Figure 2** and **Table 5**.

Each component affects the part of the persistent use of intention, including the perceived usefulness (β = 0.204, $p < 0.014$) and satisfaction (β = 0.593, $p < 0.001$); both of these two constructs have a significant effect on the persistence of the intention. The effect of partial confirmation of the satisfaction (β = 0.798, $p < 0.001$) on the satisfaction was significant, but the perceived usefulness was not. The effect of β (β = 0.055, $p = 0.420$) on the satisfaction was not significant. In the section on the perceived usefulness of each component, the confirmation (β = 0.485, $p < 0.001$) and task-technology fitness (β = 0.336, $p < 0.001$), both components had a significant effect on the perceived usefulness. Task-technology fit (β = 0.582, $p < 0.001$) has a significant effect on the degree of recognition. Finally, in the component of task-technology fitness for each construct, the task characteristics (β = 0.542, $p < 0.001$) and technology characteristics (β = 0.176, $p < 0.05$), the effect of the task-technology fit is significant for both structures.

DISCUSSION AND CONCLUSION

The study contributes to the theoretical assessment by integrating PAM and TTF as the research framework to investigate the factors that influence the consumers' adoption of organic food information through social media. Our study adopted the PAM presented by Bhattacherjee (2001) as the framework basis, adds TTF as the external variable, and establishes a research framework to understand the influence of PAM on the consumers' purchase intention toward organic food via social media. This framework analyzes the factors when the users use cloud computing services, such as TTF, perceived usefulness, confirmation, satisfaction, and continuance intention, to assess the influence of TTF on the continuance intention. After that, the data were collected through questionnaires, and the model was validated using the PLS method, and many significant findings were obtained. Compared with the individual TTF and PAM models, the integrated model provides more explanation power on the consumers' adoption toward an organic food social media platform. The proposed model of this study provides more precise results than the PAM and TTF model do separately, and the extended model assists practitioners and scholars in understanding the dynamics of organic food information toward social media platform.

The purpose of this survey was to understand and validate the proposed model of integrating PAM and TTF to assess the influencers of the consumers' continuance intention to gather the information regarding organic food in social media environment. Important findings were outlined as follows. First, as theorized by TTF, both task characteristics and technology characteristics significantly influence the task-technology fit. TTF, by itself, is also a robust model in which the task and technology characteristics significantly determine the correspondence between information acquisition of

organic food (i.e., task requirements) and technology functionality of social media platform. In addition, the task characteristics were found to be more influential than the technology characteristics. By decomposing TTF, we offer relevant perspectives as to which task and technology dimension becomes critical in the consumers' acceptance decisions for the organic food social media platform. Second, for the PAM model, except for the perceived usefulness to satisfaction, the other four paths—the perceived usefulness and satisfaction to continuance intention, the confirmation to perceived usefulness and satisfaction—have positive and significant impacts. Because satisfaction is the most critical determinants of the continuance intention (explaining 70% of variance) relative to the other determinants, the consumers dissatisfied with an organic food social media platform may stop using it, despite having positive perceptions with regard to other factors. Third, we also found that there exists correlations between the TTF and PAM ones (i.e., confirmation of expectations and perceived usefulness). In recent years, due to changes in dietary patterns, the number of people eating out has increased, resulting in many health problems caused by excessive and unbalanced diets. In addition, the pesticides and chemicals used by farmers in the past to grow crops with beautiful appearance and integrity have seriously contaminated the soil, water, and air, leaving a large amount of harmful substances on the surface of the crops or inside the organisms, which can cause diseases. Therefore, understanding how to find and promote organic food information and food safety through social media is an important issue in the relevant research area. All countries have strict organic product labeling regulations and state that only products that comply with national organic regulations can be sold with organic labels or organic names, and prohibit other products that do not comply with organic regulations from using labels that mislead consumers into thinking that the product is organic.

RESEARCH LIMITATIONS AND FUTURE WORK

This study strives to be rigorous, objective, and thorough in its process and analysis in order to obtain good research results. However, due to time, manpower, and environment-related factors, there are still the following research limitations. First, the sample of this study was drawn from consumers who purchased organic food through social media, which was sufficient to ensure the content validity. However, in the future, it is recommended that a consumer segmentation analysis should be conducted on different ethnic groups, consumption patterns, and habits in order to better understand the pre-purchase factors of different consumer groups for organic food. Second, cost-related factors have not been included in this study. There is little literature on the cost of promoting organic food behaviors through social media, and most of the literature on the price and behaviors is in the marketing research area. Therefore, we suggest that the follow-up study can be extended to examine how the cost and willingness to pay for organic food through social media affects the consumers' purchasing behavior.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

J-JY and DJ developed the original idea for the study, contributed to research design, and performed the sample collection and data analysis. J-JY, DJ, and UW wrote the manuscript. All authors read and approved the final manuscript.

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Green Organizational Culture, Corporate Social Responsibility Implementation, and Food Safety

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Food safety, ultimately, is a human-centered work. No matter how regulations are coercively released and implemented, the free will and behaviors of human actors (e.g., employees) lead to a real result in food safety. A real motivator of such free will and behaviors is organizational culture that stimulates meaningful organizational actions. Based on such rationale, this conceptual article sets to discuss the relationships between green organizational culture, corporate social responsibility implementation (hereafter CSR), and food safety. As organizational culture has been largely discussed in Management and Business literature, green organizational culture and its impacts on socially and environmentally friendly organizational behaviors, as well as public health outcomes like food safety, is wanted. With the clarification of the relationships between these three important constructs, theoretical implications for future research and practical implications for governance and policy-making are well generated.

Keywords: green organizational culture, corporate social responsibility, food safety, Walmart, perspective

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INTRODUCTION

Environmental challenges, including pollution and global warming, are rationalized and identified as the primary issue that makes organizations and individuals evaluate measures for preserving the environment. The environmental challenges led to the initiation of environmental issues with marketing and consumer perception on the quality of products (Clark et al., 2019). The green consumerism urges organizations to put more emphases on advertising and promoting eco-friendly products with message content such as recycling, healthy, reusable, recycling, and eco-friendly (Liu et al., 2016). To date, however, green consumerism touches on a broad but external scope like marketing and advertising, with less concerning about internal imperatives such as green culture and its influences. By definition, green culture is a collective belief toward an ecological, environment-friendly style of (co)production shared by most organizational members. This leads to a gap in the literature that even fewer have investigated in the interactions between internal and external imperatives concerning green consumerism and product quality, especially in the food sector. Nonetheless, strategic actions toward external stakeholders, such as the implementations for corporate social responsibilities (hereafter CSR implementation), need to be stimulated by internal drivers (e.g., culture) of the organizations. To fill up the gap, this article sets to conduct an in-depth discussion of (internal) green organizational culture's influences on CSR of organizations in food industry, and food safety. The rationale is elaborated as follows.

Food safety is a result from organizational members' collective beliefs and efforts in environment and stakeholder friendly co-creations. Both collective beliefs and collective actions are necessary to offer high-quality food products/services. Here in our analysis, a green culture represents the collective belief, and CSR implementations represent the collective efforts. Note that the term "CSR" is a very broad concept and a broad field of research too. As Sheehy (2015) noted, CSR can be conceptualized as a "field of study, a management practice and an approach to improving the dialogue concerning the social contribution of business. . ." From such statement, it is necessary to offer a clear definition for CSR before we proceed further. Mainly, we set to talk about the CSR from an action/activity perspective—that is, what does a company do for CSR. There are different views on the concept of the corporate social "responsibility," such as CSR as a philosophy or CSR as an action contributing to an organization's environmental, social, economic, and even political imperatives. While the former is more close to the concept of culture, we wish to take an action perspective of CSR and emphasize that the implemented CSR efforts/actions can be distinctive from, and be influenced by, organizational culture.

Thus, from an inside–outside interaction perspective, on the one hand, companies that operate under a green organizational culture recognize, analyze, solve issue/problems, and develop strategies that uniquely help the company to navigate through the environmental values (McCullough et al., 2016). In such sense, a green organizational culture reflects that the people and organizations need to have a cultural transformation for the collective awareness of their collective actions toward stakeholders and environments (Aliyu et al., 2015). From the market perspective, on the other hand, consumers' choices of food to purchase depend on the marketing features of food enterprises, including word of mouth, which maybe be identified with the enterprise's organizational attributes such as the green culture that stimulates its external, stakeholder-favorable behaviors such as the CSR implementation here, and we wish to clarify the impact of such implementation of CSR (which is thus tangible/visible/communicative to internal and external stakeholders) on food safety as an ultimate collective value generate. In sum, from both perspectives, it is important to elaborate on the collective attribute-action-value nexuses of green culture, CSR implementation, and food safety. Such integration also justifies the central view of the Stakeholder Theory (Freeman, 1984, 1999; Freeman et al., 2010), which relies heavily on integrating resource-based and market-based views (Phillips, 2003) on corporate's attributes and behaviors in influencing (and being influenced by) multiple internal and external constituencies and entities. Based on the discussions above, this article may generate the following contributions. Firstly, it analyzes *why and how* important internal environmental climate (i.e., the green culture) can lead to environmental and public health favored results (i.e., food safety), through effective external environment actions of organizations (i.e., CSR). Secondly, the article discusses the abovementioned issues in a context of a nested, multilevel ecosystem that binds and bonds stakeholders, objects, processes, etc., in nature; the dynamics between green culture, CSR and food safety is embedded in different levels within an organization, which involves a diverse set of stakeholders (Liu et al., 2016). A lot have been said about how those issues are important individually, though, far less have tried to explicate their importance collectively and interdependently. Hence, we set to discuss a cross-level model to generate a broader thought of the phenomenon that might importantly occur at the intersection of green culture, CSR, and food safety in modern organizations. This also constitutes another contribution of this article—to unleash the complex interrelationships between the three main constructs, for which the phenomenological nature is a complex and multilevel system. Third, the article offered an interdisciplinary discussion of the issues. To facilitate our discussions of such topic and correspond the issue's phenomenological natures, this article was positioned from an interdisciplinary perspective. Specifically, green culture is a social-psychologically shared climate among members (Social Psychology), CSR deals with a potential tension between cost (Economics) and good governance (Business Management), and personal and group motivation and conducts in food safety are greatly affected by psychological and ecological concerns (Psychology & Ecology, or Ecological Psychology). A conceptual framework can tentatively facilitate readers' understanding of the core rationale of this article, as the following **Figure 1**.

GREEN ORGANIZATIONAL CULTURE

The terms for describing the concept of a green organizational culture have been diversified, including eco-friendly culture, environment-friendly culture, sustainability-oriented culture, etc., which is mainly based on extending organizational culture to a green oriented context. For instance, Norton et al. (2015) defined a pro-environmental organizational culture as they extended Schein's (1990) organizational culture definition to meet the practical and perceptual criteria of working on business with the premise in environment conservation and protection. It is a widely accepted approach which we followed by defining green organizational culture here as a set of collectively shared beliefs, values, perspectives, norms, and even practices, which guides organizational members to behave properly toward the external environment during economic business processes.

Green organizational culture is one of the most debated topics by both the laymen and elite classes of people in society. The green culture concept is mostly concerned with realizing and obtaining the ecological balance (Mohezara et al., 2016). It involves both environment and people hence the need to carry out green culture since it promotes ecological development and sustainable economic growth based on politics, science and aesthetics (Galpin et al., 2015). Through globalization, different economies have shared the benefits of undertaking green tendencies and incorporating such practices in their organizational culture. Most of the organizations are restructuring their cultures to accommodate new factors on issues such as environmental ones, behavior, and attitude related to environmental problems (Firoz and Abinakad, 2016). Various scholars have identified the theory of reasoned action to establish

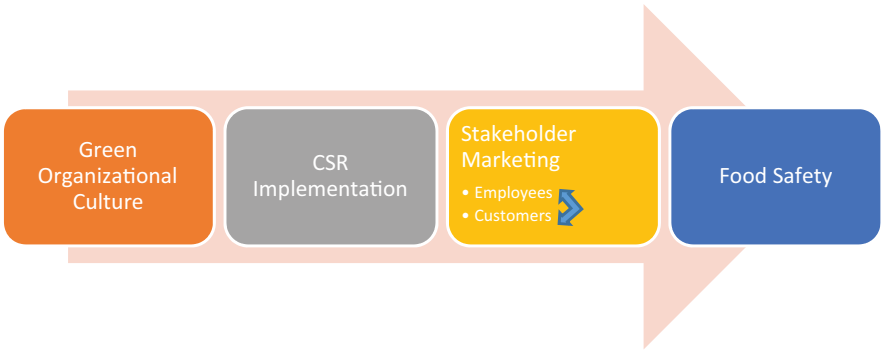

FIGURE 1 | A tentative framework for conceptual analysis.

the relationships between intentions, attitudes, and behavior based on the purchase of green products. A study conducted in Portugal and Brazil identified the influence of mediating variables in the course of purchasing green products. Some of the models used to describe the behavior and need for green purchase included quality and price (Fuentes and Fredriksson, 2016). However, other researches have faulted this finding claiming that price and quality are situational factors and not the chief elements.

The increased demand for green culture across the world has forced specialty stores, departmental stores, and shopping malls to stock up numerous products, both useful and useless. The entire practice has threatened the welfare of people and the ecological balance, with most industries becoming a source of different pollutions to the environment and against the people (Harrison, 2019). The environment is deeply affected by the production, consumption, and disposal of manufactured products. Nature is behaving unnaturally because of the excessive pollution with events such as heavy rains, floods, drought, and global warming. The natural calamities such as earthquakes, cyclones, tsunami, and other epidemics have become more frequent. Green culture is attempting to protect the welfare of consumers and the environment through production, consumption, and disposal of eco-friendly products.

The framework of the administrative culture plays a crucial role in ensuring successful cultural transformations. Every organizational culture has three levels, including values, assumptions, and artifacts, which reflect companies' requirements and desires concerning their environmentally sustainable operations. Generally, green culture is the holistic internal marketing concept involving the production of materials, consumption, and disposal of both products and services. With the detrimental effects the environment is facing today, the production team, dealers, and consumers have become increasingly sensitive to developing and consuming green services and products. Green culture seeks to increase the production of pure products by conservation of energy, pure technology, preservation of the environment, and minimum natural resources in the production process. The use of natural foods in place of processed synthetic foods is the primary campaign in green culture, calling on people to ensure they start consuming natural foods because of the health factor (Bortolotti et al., 2015).

THE GREEN ORGANIZATIONAL CULTURE AND CSR

Corporate social responsibility is a set of self-stimulating and self-regulating organizational affairs that facilitate an organization's reputational and realized capacity to be trusted and accounted by its stakeholders – and thus potentially lead to social values created to generate feedback for the organizations own value. CSRs in organizations encompass a series of facets, including sustainable sourcing, volunteering, ethical labor practices, community outreach, and environmental conservatism. In practices, CSR takes many forms to happen, such as donations for who needed, facilitation of community development, social problem re-solving, etc. Through the CSR programs, businesses not only create economic value but also strengthen communities and create healthy ecosystems. Partially similar with green organizational culture, CSR may also be stimulated when facing the blame for impending the green movement of businesses or when companies consider the sustainability goals (Tang et al., 2016).

As a driver, the green organizational culture is accountable for CSR, as CSR involves managing the social, environmental and economic risks in the process of decision-making (Firoz and Abinakad, 2016). The green organizational culture is made successful by a group of employees who understand the course in supporting environmental management. Hence, an organization with a strong green culture is equal to one that has a supporting workforce for engaging in CSR activities. Under the CSR, companies that bear a green culture thrive in the sustainability business while making strides in protecting the environment and attracting the most talented employees in the process. An organization that practices green culture not only attracts business but talent too. Companies today are gauged as per the CSR aspect with the people waiting to evaluate the activities the company engages in to help the society (Clark et al., 2019). A sustainable business will advocate for recycling of plastic waste, cleaning the water ways from plastic materials or providing solar

panels for households that rely on fossil fuels for lighting. Cultural matrices are conditions that guide the daily lives of humans, integrating them with nature in a community. It is impossible to demystify a separation of the culture from the environment and its people. A green organizational culture will ensure all the practices of the business including the HR practices are in line with the green movement of environmental sustenance (Cordeiro and Tewari, 2015). The HR practices lead to a supply chain that observes the green mandate of the business culture while moderating the relationship of sustainability culture and overall business performance.

EFFECTS ON FOOD SAFETY

Food safety begins from the production process to the packaging, from advertising and marketing to reselling in the local and international markets. Health awareness reflects individuals' thoughts on fitness issues and their willingness to execute actions that will ensure their health is achieved (Liu et al., 2016). For example, nowadays consumers have developed an increasing need to undertake actions that will ensure their health remains intact by considering nutrition. A general belief that consumers possess is that organic food is healthier than inorganic or processed since it is chemical-free and rich in nutrients (Cordeiro and Tewari, 2015). Health consciousness is one of the major factors that result in predictions of constructive attitudes to food safety (Han et al., 2017). Consumption of food is associated with environmental issues, including pollution, water scarcity, and increased greenhouse gas emissions (Kolk, 2016). The consumption of beef, for instance, has a significant effect on the ecosystem since the production of proteins generates a substantial quantity of carbon dioxide. Pain, health problems, and death are some of the effects of consuming high amounts of microorganisms and residues. Food-borne illnesses result in losses and medical costs to the public health sector. It is imperative to adopt more maintainable food deeds with the greatest importance for facilitating conservation sustainability and public well-being. Not just for consumers as a pulling force of food safety, it is equally important for employees in organizations to be conscious in food safety. If the employees, who are generally perceived as "internal customers," do not contribute to food safety, the effects from an organization's food safety strategy and its customers' food safety demands would be weakened, due to the missing efforts from the mediating employees. The psychology and purchase behavior of employees are affected by various factors, including the culture of the organizations and the actions taken under such culture. In such premise, CSR has become an instrument nurtured by the green organizational culture to influence employees' values and commitment in food safety. Such values and commitment in food safety of employees can be seen or felt by customers and thus affect consumers' purchase intentions and behaviors (Bortolotti et al., 2015). For example, in like manner, most organizations have ensured that green initiatives are delivered through corporate social responsibility (CSR) projects to entice buyers (Cordeiro and Tewari, 2015). Thus, the promotion of a company's corporate social responsibility spirit and what has been done frequently by the employees can be saturated into the market through messages displayed on the company's social media platforms.

Initially, engaging in CSR was a feeling-good concept for the organization, but today, it goes beyond that feels. In consideration of food safety, CSR can affect a corporation's bottom line, particularly with the augmented difficulty of supply chains and the importation of yields and ingredients (Firoz and Abinakad, 2016). Social responsibility is directed to food safety in various ways, including snowballing market scope for significant concerns resulting in increased imported merchandises as components for processed nourishments. It leads to contradictory labor laws across countries and their global oversight, which requires vigilance in regards to the safety and rights of people (Clark et al., 2019). The social media impact that s growing significantly has forced consumers to ask food companies to engage in CSR practices. Food companies need to execute CSR practices and provide a safe environment for their employees. Unsafe working environments are likely to result in employees working less to provide a safe processing environment for its customers (Elder and Dauvergne, 2017). Other effects of the unsafe working environment include increased employee turnover rate, presence of increased bloodborne pathogens, heightened employee accidents while at work due to loss of oversight or attention, and other possible safety events. Most of these circumstances directly influence the safety of merchandises, causing an uproar on social media and the company's website.

CSR operations not only show what a company stands for but also show what it stands up for and the efforts it is willing to put. Most of the food processing companies rely on sugars, and generally, the overly used type of sugar is the GMO-sugar because it is readily available. Companies that sought non-GMO sugar have to find other suppliers who, in most cases, are further, and shipping takes longer for the supplies to arrive at the factories (Havinga et al., 2015). Social responsibility means taking the lead in social justice and ensuring that a company will take the risk for the sake of the people. Such companies are mindful of their profits, but above all, they are mindful of their consumers, which is the highest form of CSR.

In the era of social media where everything is reported directly, it is only fair for companies to adopt an accurate measure of dealing with their CSR activities. Consumers have become more aware of products that mean well for them and those that do not. Companies that have made negative comments to the clients have faced severe consequences, including campaigns to turn customers against purchasing from their stalls. A research conducted in 2018 acknowledged that most consumers who purchased food products were guided by the company's social and environmental activities. If a product contributed positively toward an issue a fraction of society cared for, the consumers would spread the word to their peers, parents, and workmates.

Consumers are becoming more vigilant and educated as they realize how the process of food production leads to environmental damage and causes human suffering. Pepsi and Coca Cola were put on the spotlight by Oxfam, which reported issues that communities growing sugar crops endured. Such companies purchased their land without respect for people's

cultural rights. The two companies announced that they would improve their purchase processes. They had to announce the environmental concerns raised about the lands they were acquiring from communities. Besides environmental and health issues, companies need to be careful about other social issues that affect people across the world, such as women's rights. Various companies have been forced to make public announcements to pledge their support for women and align with their interests.

CSR is no longer adjacent but incorporated into the core business practices because of the paramount role in the progress of the company and its growth. CSR efforts are meant to assure the type of food, the process of production, and its safety at a time when most of the people are more aware of their health. CSR is part of today's corporate growth strategy because only the companies that are putting effort to ensure the health and wellness of the people will attract the best talent, build stronger partnerships with employees, manage risks of supply chains and allow transparent conversations with investors and key players in the industry. Companies have paddled back to the suppliers and engaged them for more lessons on how to minimize production costs and make their products more organic. Companies are building platforms for transparency, honesty, and traceability, ensuring sustainable and ethical practices along the entire supply chain.

Correlating CSR positively with competitively is an imperative factor for the consumer perspective because it plays a significant role in mediating between the two to result in increased demand for products (Wei and Huang, 2017). Consumer behavior and perception are concepts that have been studied widely by various scholars to determine the effect of CSR and purchase intention. CSR perception is extensively misunderstood across the world; consumers take it as a company's commitment toward bearing social responsibility (Aliyu et al., 2015). This means that businesses need to pay keen attention to the interests of the immediate community it seeks to serve. With the heightening interest in protecting the environment, consumers link CSR with the mindfulness of a company to protect the environment responsibly. The literature review insists that consumers have different attitudes when exposed to different sources about the same. What stands out in the world today is the need to take care of the environment and manufacture food products in tandem with the current health needs.

A company that seeks to deliver these requirements makes it possible for the consumers to resonate with its products. The attitude and perception of consumers toward the products related to the CSR activities that portray care to the environment and health of its consumers. In contrast, negative information about unethical actions taken by a company sends the wrong message to the consumers, affecting their attitude toward the brand (Clark et al., 2019). Companies are judged, and the merits of their CSR weighed by the public on social media. If the activities are seen as a way of taking advantage of other companies, public criticisms for irresponsible behavior hurts the company.

The CSR of companies across the world is a critical factor that calls for strategic planning. In the 80s, when CSR was introduced in companies, it only involved supplementary activities that would not affect its profits. Currently, CSR is a factor that determines the growth of a company hence calling on the management to choose CSR activities that impact the company positively. The environmental considerations have manifested in ways such as commitments, proclamations, and promises to improve the livelihood of the people it serves. Some of the most prominent activities include providing eco-friendly packaging material, adopting the most sustainable manufacturing modes, and processing. Most companies have initiated a recycling program that allows consumers not to litter but return the packaging material to the company (Liu et al., 2016). The health of every individual is dependent on their surroundings.

Food safety is paramount in the current world because of the increased cases of illnesses associated with manufactured and processed inorganic foods. The public may not be aware of the communicated CSR activities by the company. The retailers and manufacturers have started communicating CSR activities on social media to reach as many consumers as possible (Tang et al., 2016). Retailers distributing food products need to provide candid information to the consumers about the food source, the processing plants, and the entire supply chain. Most companies display this information because of the need to assure the consumers of the quality and safety of foods (Cordeiro and Tewari, 2015). The impact of CSR is felt by companies that are dedicated to supplying foodstuff to the consumers. Most of these retailers have committed continuously toward establishing a framework to help the farmers and help their employees to advance their careers.

CONCLUSION AND THEORETICAL IMPLICATIONS

Social consciousness is one of the factors determining the growth of the company (Yang and Gong, 2020) as companies seek to streamline their online presence, inventory, and distribution management practices, a dedicated framework toward a workable and active CSR. Doing so, economic considerations like cutting costs are still paramount for some company but for food retailers, some have had to acquire plantations to assure the public of their quality and ensure it is constant. Companies are publicizing their CSR activities since they stand a chance to gain support from various NGOs and administrations who find CSR to be a way of improving environmental and social conditions in places that were not attended due to financial capacity (Nouaimeh et al., 2018). When companies use CSR to publicize their efforts to facilitate goodwill to the country, they not only win the support from NGOs to increase their legitimacy but also find public endorsement.

Consumer's perception, behavior, and intention of buying are positively affected by the CSR activities of a company. Most of the consumers are concerned about food safety. Companies that outsource their products from such markets have to contend with unsatisfied and disgruntled customers who assume that the foods are unsafe for their consumption. Consumers are apprehending companies to be transparent about their source of products, the standards of growing the food, packaging, and distribution. As explained above, CSR grounded on a sound green organizational

culture helps companies gain employees supports in action, as well as a broader market from consumers caring about food safety. From this article, one can note that consumers are more assured of food safety when companies have green organizational culture that can lead to CSR activities that engage employee' commitment and actions toward food safety. The internal green culture affects the buying culture of consumers through the CSR activities and engaged employees.

Our discussions generate several theoretical implications for future research reference. First, as a fresh perspective for the interlink between the green culture, CSR, and food safety was proposed, empirical studies can test theoretical models incorporating a part or all of the interrelationships between the major constructs abovementioned. Second, the discussions distinguished and shed light of the potential interactions of internal employees and external customers, on the basis of an organization's green culture and stimulated CSR. Future studies of environmental issues such as the food safety here should also consider the two-folded and interactive influences on and between the two important stakeholder groups. Third, future studies are also encouraged to explore the outcome of CSR that was not in its original purpose. Most studies examine CSR's outcomes that seemed directly and reasonably related (performance, reputation, satisfaction, etc.) This article used food safety to (hopefully) imply the potential of widening the exploration of CSR's influences on outcomes in different phenomenological and research areas. Last but not least, further elaborations/examinations with dimensionalized constructs discussed in this article may further create more opportunities for study. For example, can non-food-related CSR (e.g., ecological or environmental CSR) also increase internal employees' awareness of food safety? What are the comparative effects of food-related versus non-related CSR? Similarly, dimensionalizing the green culture may generate more such opportunities and research questions to explore.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

XL wrote the original manuscript. K-LL revised and edited the drafts. Both authors contributed to the article and approved the submitted version.

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Understanding the Effects of Antecedents on Continuance Intention to Gather Food Safety Information on Websites

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Virtual community websites are one of the applications that provide a platform for people with common interests to extend their social relations in social media. With the proliferation of food safety incidents in recent years, social media has often been a major channel for public engagement in risk communication because of its social networking and immediate interaction. To understand the users' needs and satisfaction, this study proposed a model to develop and evaluate the antecedents of continuance intention toward food safety information from social media. Based on the questionnaire collected from 289 Facebook users, this study assessed the integrated model of the expectation-confirmation theory and technology acceptance model with technology readiness as moderator. The results showed that the perceived ease-of-use, usefulness, and confirmation indirectly affected social media continuance usage intention through satisfaction; perceived ease-of-use, usefulness, and satisfaction were the direct determinants that affected the users' social media continuance intention. Furthermore, positive technology readiness had significant effects on the relationship between the perceived ease-of-use, usefulness, confirmation, satisfaction, and continuance intention toward food safety information. This study contributes some important suggestions and managerial implications for food safety promotion providers, practitioners, and academics in the food industry, and social media environment.

Keywords: food safety, social media, continuance intention, expectation-confirmation theory, technology acceptance model, technology readiness

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INTRODUCTION

Beyond traditional media, such as television, newspapers, and magazines, social media has gained unprecedented popularity in food safety issues and became another major source of food safety information for people today (Rutsaert et al., 2014). Food safety is the focus of public health and people's livelihood, and the succession of food safety incidents in the recent years has caused consumers to distrust food safety, causing huge economic losses. Thus, the inexorable rise of social media to challenge, and even replace, the functions, and roles of traditional media can perhaps be attributed to several obvious innate characteristics. On the one hand, it absorbs users as much as possible and provides an immediate, participatory, continuous, and collaborative mode

of interaction for each user (Ding, 2009). On the other hand, it facilitates rapid circulation and exchange of user-generated content over time (Macias et al., 2009).

Today's so-called media consists of blogs, citizen journalists, Facebook and Twitter users, and traditional media; thus, anyone can participate in the information production process. Such a change has drastically altered the tradition of issue setting, and issues that have received media attention in the past will influence whether the public gives the issue the same attention. However, with the advent of Web 2.0 and social media, the effectiveness of traditional media in influencing public opinion has been greatly affected. Since social media platforms have a much lower barrier to participation than many traditional media platforms, the average person can engage in public dialogue through social platforms. Hence, traditional media must adopt a more flexible business model that adapts to the changing media ecosystem and leverages some of the qualities of social media to gain market and reader attention. Therefore, this study aimed to focus on Taiwanese consumers' perceptions, attitudes, demands, consumption behaviors, and their correlations with organic food, and identify the factors that influence consumers' purchase behavior of organic food.

The so-called "organic food" without chemical residues has gradually became another trend in recent years. Due to the emergence of organic food and the demand for health and safety concepts, consumer acceptance of organic food is gradually increasing. Whether the quality and price of organic food in the market meet the consumers' expectations or needs are a matter of concern. Previous research on Facebook has focused only on user or website characteristics (Acquisti and Gross, 2006; Dwyer et al., 2007; Mazer et al., 2007; Ross et al., 2009). These characteristics included user social experience, motivation, personality, privacy, and self-disclosure. Recently, some studies began focusing on the users' continuance behavior to use Facebook (Lee et al., 2012). Since social media is a type of information system, the success of the system depends on the user's continuance use behavior and thus, understanding the users' needs becomes the most urgent issue. This study composed an expectation-confirmation model (ECM) as a part of the research model. ECM theorized that consumers had expectations before purchasing a product.

Bhattacherjee (2001) believed that the IT users' continuance use intention was like the consumers' repurchase decision-making behavior. Before using social media, users had expectations about their way of interaction, interests sharing, and establishing personal networks. After using social media, users would compare their actual feelings with previous expectations. If their actual feelings were better than their expectations, they would have higher satisfaction and continue to use it. To predict and explain the users' continuance to use the system more effectively, Bhattacherjee (2001) modified the expectation confirmation theory and proposed a post-acceptance model of IS continuance.

Technology readiness measures people's tendency to accept or use new technologies, especially the acceptance of networks or computers. Parasuraman (2000) summarized people's positive and negative feelings toward technology, which were applicable to different groups (consumers, companies, and employees). Liljander et al. (2006) confirmed in his study that technology readiness was crucial for users' acceptance of innovative technology.

Some previous research on social media, such as Facebook, focused only on the users' personal factors or site characteristics. Important factors, such as technology readiness, were ignored. Technology readiness affects not only the users' acceptance of a system but also their acceptance of new products or services (e.g., Yen, 2005; Lin and Hsieh, 2007; Chen et al., 2009, 2013; Chen, 2012; Jin, 2013). However, the technology acceptance model (TAM) only considers the perception of usefulness and ease of use, without considering that personal characteristics will also affect one's willingness to use technology products, that is, whether the user will accept or use the new technology, influenced by his or her accumulated experience and knowledge personality tendency, which ultimately depends on whether the individual has the sufficient technology readiness. Therefore, this study adopted the ECM proposed by Bhattacherjee (2001), TAM proposed by Davis et al. (1989), and technology readiness by Parasuraman (2000) as an antecedent to explain and predict the influence of technology readiness on users' continuance intention to use social media for food safety.

LITERATURE REVIEW

Expectation-Confirmation Model

In the field of studying consumer behavior, the expectation confirmation theory has been widely adopted to assess consumers' satisfaction and repurchase behavior (Oliver, 1980, 1993; Tse and Wilton, 1988; Anderson and Sullivan, 1993; Patterson et al., 1997; Dabholkar et al., 2000). The main concept of expectation confirmation theory was that consumers would confirm their pre-purchase expectation with post-purchase perceived performance to determine their level of satisfaction and then influence their repurchase intention.

Bhattacherjee (2001) suggested that the users' continuance intention of information systems was like the consumers' repurchase decisions. However, the use of information systems was not the same as purchasing behavior in practice. Thus, Bhattacherjee (2001) modified the expectation disconfirmation theory and proposed ECM. The main idea of ECM is that the information system continuance is affected by satisfaction, perceived usefulness, and expectation-confirmation. Lee (2010) applied ECM to explain and predict the e-learning users' continuance intention. Kim (2010) used ECM to forecast mobile data service continuance. Both studies combined ECM with TAM. The results showed that the extension of ECM had a good explanatory power for the continued use of IT. Previous studies have proven that the users' perceived ease-of-use and confirmation affects their level of satisfaction (Hsu et al., 2006; Roca et al., 2006; Limayem and Cheung, 2008; Yu, 2010; Chen et al., 2018; Hsiao, 2018; Kim et al., 2019; Dai et al., 2020; Gupta et al., 2020; Park, 2020; Tam et al., 2020). Furthermore, satisfaction influences the continuance intention to use (Hsu et al., 2006; Roca et al., 2006; Wu et al., 2007; Chen and Zhou, 2008; Chen et al., 2009; Jin et al., 2009; Yu, 2010).

To understand the user behavior of food safety on social media, this study used Facebook fan pages and groups as the main body of research and applied ECM as a theoretical basis to construct the behavior pattern of the food safety community to understand the relevant factors that affect the consumers' intention to continue using it.

Technology Acceptance Model (TAM)

TAM (Davis et al., 1989) used users' attitudes as a major factor for predicting their behavior intention, whether to accept a new information technology. Additionally, the perceived usefulness and perceived ease-of-use were included in this model as determinant factors of attitude. However, TAM investigated human behavior intention only at the cognitive level, ignoring the influences of external factors (Davis, 1989). Davis (1989) suggested that researchers extend TAM with external variables based on different theories to discuss different technology acceptance.

Since TAM was used to predict users' technology acceptance in the working environment, Lin et al. (2007) were concerned about the adoption of TAM in the marketing setting. Rauniar et al. (2014) presented the results for the importance of perceived ease-of-use and usefulness with additional some determinants variables to predict user engagement on social media platforms. Previous studies also provided evidence about the two key influencers (i.e., perceived usefulness and ease-of-use) to understand the impacts of antecedents on behavioral intention toward social media (Ayeh, 2015; Chang et al., 2015; Lin and Kim, 2016; Luo et al., 2019). Therefore, our study revised TAM and added external variables to enhance the interpretive abilities to gather food safety information toward social media.

Technology Readiness

Technology readiness is the tendency of people to accept and use new technologies at home or work to achieve their goals (Parasuraman, 2000). Technology readiness is an individual personality trait, and this concept can be seen as an overall psychological state of an individual's tendency to use new technologies, as determined by the psychological aspects of positive drivers (positive readiness) and inhibitors (negative readiness). Positive drivers encompass optimism and innovativeness while negative inhibitors encompass discomfort and insecurity. Tsikriktsis (2004), in an extended study of technology readiness, also noted that consumers with different levels of technology readiness have different intentions for current and future use of information services.

Later, Parasuraman and Colby (2015) proposed an updated and streamlined TRI 2.0, which is simplified into 16 topics that can be tiered to manage customers with different technology readiness. Since technology readiness is a measure of an individual's psychological inclination and personal characteristics toward new technologies or services, this study considers that the level of technology readiness of an individual will be an important antecedent for consumers to use social media to explore food safety issues.

In the relevant studies regarding technology readiness and other theoretical model, Lin et al. (2007) proposed the Theory of Technology Readiness and Acceptance Model (TRAM), to increase the explanatory power of TAM on the customers' acceptance of innovative technology. Technology Readiness refers to the people's tendency to accept and use new technologies for accomplishing goals at home or work. Thus, technology readiness could be viewed as an individual's psychological tendencies to use new technologies. Prior studies have confirmed that technology readiness could combine other theoretical model to explain the adoption of information systems and technologies (Lin and Hsieh, 2006, 2007; Lin et al., 2007; Walczuch et al., 2007; Chen et al., 2009, 2013; Lin and Chang, 2011; Jin, 2013). It, therefore, seemed reasonable to consider the elements of technology readiness to investigate the adoption of social media to update user's food safety information.

RESEARCH METHODS

Hypotheses Development and Research Model

According to the definition of Parasuraman (2000), technology readiness measures a user's readiness to adopt new technology/system based on four personality traits: optimism, innovativeness, discomfort, and insecurity. Of the four traits, optimism and innovativeness are positive drivers of technology readiness (i.e., positive technology readiness) while discomfort and insecurity are combined as the inhibitors (i.e., negative technology readiness). Jin (2013) validated that the perception of ease-of-use and usefulness were influenced by the users' positive technology readiness in social media usage. Chen et al. (2009) empirically showed that optimism and innovativeness of technology readiness was a strong predictor on satisfaction in self-service technologies. Prior research also examined an integrated model of technology readiness into TAM and found that technology readiness provided the positive linkage with the perceptions of usefulness and ease-of-use (Lin et al., 2007). Furthermore, the positive correlations from technology readiness to perceived usefulness, satisfaction, and continuance intention also were confirmed in mobile service (Chen et al., 2013). Based on the above literature, we proposed the following research hypotheses:

H1: Positive technology readiness positively influences the perceived ease-of-use.

H2: Positive technology readiness positively influences perceived usefulness.

H3: Positive technology readiness positively influences satisfaction.

H4: Positive technology readiness positively influences continuance intention.

H5: Negative technology readiness positively influences the perceived ease-of-use.

H6: Negative technology readiness positively influences perceived usefulness.

H7: Negative technology readiness positively influences satisfaction.

H8: Negative technology readiness positively influences continuance intention.

Davis (1989) illustrated the perceived ease-of-use to the extent to which a user believes that using a particular technology/system would be effortless. Previous studies regarding information technology adoption have found that the higher the perceived ease-of-use, the higher of their perceptions of usefulness (Chen et al., 2009, 2018; Liu and Li, 2011; Mehrad and Mohammadi, 2017; Wu and Chen, 2017; Verma and Sinha, 2018). Information technology acceptance research has consistently indicated that the perceived ease-of-use is the critical influencer of users' satisfaction (Liao et al., 2007; Bienstock et al., 2008; Chen et al., 2009; Recker, 2010; Shin et al., 2011; Joo et al., 2018). Therefore, investigating the perceived ease-of-use and its effect on perceived usefulness and satisfaction seems necessary.

H9: Perceived ease-of-use positively influences perceived usefulness.

H10: Perceived ease-of-use positively influences satisfaction.

Bhattacherjee (2001) proposed the ECM to evaluate the three determinants of information technology continuance intention as follows: the extent of confirmation of expectations, perceived usefulness, and level of individual's satisfaction. Existing empirical evidence on social media has shown that users' continuance intention is mainly determined by their satisfaction with prior social media usage (Chen, 2012). In social media contexts, Oghuma et al. (2016) empirically indicated the fact that satisfaction was predicted by the degree of confirmation and perceived usefulness of mobile instant messaging services. Similarly, other studies have consistently illustrated the positive linkage among confirmation, perceived usefulness, and satisfaction (Thong et al., 2006; Chen et al., 2013; Dai et al., 2020; Tam et al., 2020). Therefore, this study proposed the following hypotheses:

H11: Satisfaction positively influences continuance intention.

H12: Confirmation positively influences perceived satisfaction.

H13: Confirmation positively influences perceived usefulness.

H14: Perceived usefulness positively influences satisfaction.

H15: Perceived usefulness positively influences continuance intention.

The research model of this study is shown in **Figure 1** and research hypotheses are presented in **Table 1**.

Questionnaire Design

The research questionnaire included three segments. The latent variables in this study used a seven-point Likert scale drawn and modified from existing qualified and relevant studies, where 1 meant strongly disagree and 7 meant strongly agree. The measurement scales in the first part were to determine users' perceptions when using Facebook about the issues of food safety information, including perceived usefulness, perceived ease-of-use, and confirmation of expectations. Perceived usefulness and ease-of-use, with four items, respectively, were measured adopting four items modified from Abdullah et al. (2016) and Joo et al. (2018). The second part was to understand users' satisfaction and continuance intention to use Facebook for gather food safety information. Satisfaction and continuance intention were based on Bhattacherjee (2001) and Chen et al. (2013) with four items individually. The third part was to test the users' technology readiness including 18 items from Yen (2005) and Chen et al. (2013). Technology readiness included the positive drivers (optimism and innovativeness) and negative inhibitors (discomfort and insecurity). Furthermore, two university professors and five master students who are well acquainted with social media behavior got together as a focus group to assist to assess the appropriateness of the questionnaire items in this study.

Data Collection

Data was collected online from users who had previously used Facebook in Taiwan. The selected sample in this study is the current potential consumers owned by four famous Facebook Fan Pages and groups about promoting food safety information in Taiwan (i.e., @Learneating[1]; @foodnext.net[2]; @FoodQA[3]; @wayneagrifoodlife[4]). In the four representative Facebook Fan Pages, each fan page has more than 10,000 potential users and consumers in the groups. Recruiting these experienced and potential consumers from Facebook Fan Pages about promoting food safety information would facilitate external validity. For all 318 questionnaires received, 289 were valid. Among them, 44.80% were male and 55.20% were female. Furthermore, 22.93% were aged under 20 years, 61.31% were 21–30 years, 12.35% were 31–40 years, and 3.41% were above the age of 41 years.

RESULTS

Measurement Model Analysis

This study adopted the partial least squares (PLS) method and applied the SmartPLS 3.3.2 software developed by Ringle et al. (2015). PLS is a structural equation model (SEM) analysis technique based on regression analysis. PLS is highly practical and superior to general linear relational model analysis techniques, which can handle both reflective and formative model structures. The requirements for variables to conform to normal distribution, randomness, and sample size are less stringent. In addition, PLS can overcome multicollinearity problems, effectively handle interference, and missing values, and has good predictive and explanatory capabilities. Since the sample size

[1]https://www.facebook.com/Learneating

[2]https://www.facebook.com/foodnext.net

[3]https://www.facebook.com/FoodQA/

[4]https://www.facebook.com/wayneagrifoodlife/

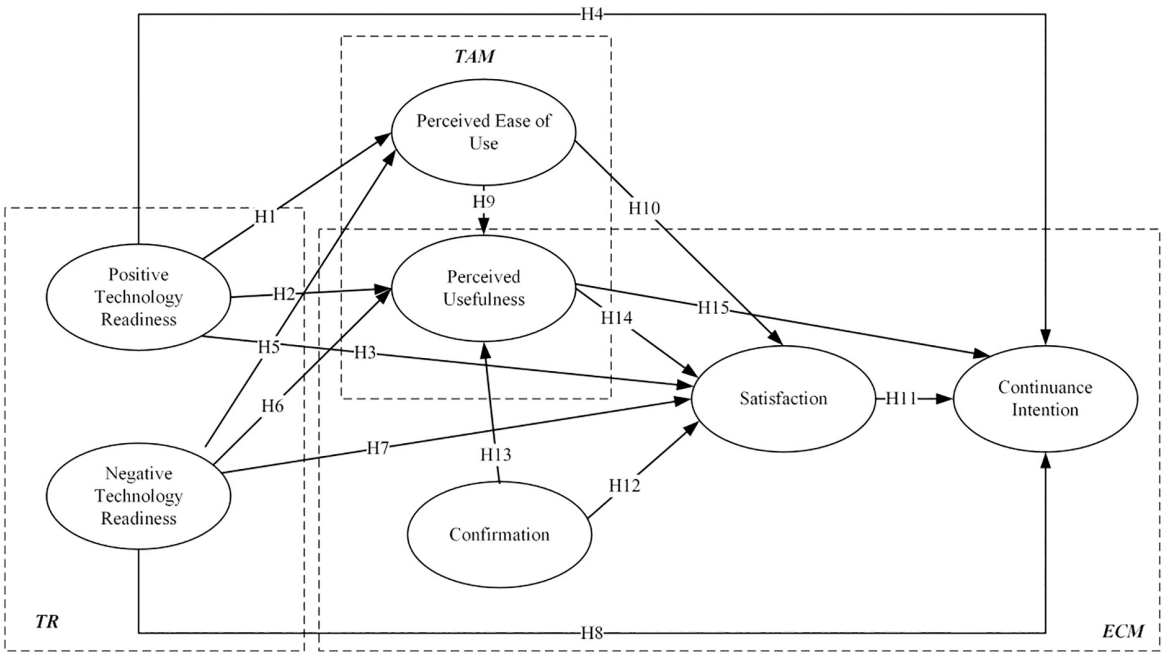

FIGURE 1 | Research model.

of this study is small, the analysis using PLS is not limited by sample size and variable allocation type and has good prediction and interpretation ability. Bootstrap resampling was conducted 5,000 times (Chin, 1998) to ensure the stability of the estimation of each variable.

TABLE 1 | Research hypotheses.

Hypothesis	Hypothesis description
Hypothesis 1	Positive technology readiness positively influences perceived ease-of-use
Hypothesis 2	Positive technology readiness positively influences perceived usefulness
Hypothesis 3	Positive technology readiness positively influences satisfaction
Hypothesis 4	Positive technology readiness positively influences continuance intention
Hypothesis 5	Negative technology readiness negatively influences perceived ease-of-use
Hypothesis 6	Negative technology readiness negatively influences perceived usefulness
Hypothesis 7	Negative technology readiness negatively influences satisfaction
Hypothesis 8	Negative technology readiness negatively influences continuance intention
Hypothesis 9	Perceived ease-of-use positively influences perceived usefulness
Hypothesis 10	Perceived ease-of-use positively influences satisfaction
Hypothesis 11	Satisfaction positively influences continuance intention
Hypothesis 12	Confirmation positively influences perceived satisfaction
Hypothesis 13	Confirmation positively influences perceived usefulness
Hypothesis 14	Perceived usefulness positively influences satisfaction
Hypothesis 15	Perceived usefulness positively influences continuance intention

Petter et al. (2007) argued that the analytical approach to PLS was largely based on the component-based model, while traditional SEM was based on the covariance-based model as a broad alternative to the covariance-based model, and the component-based model was a good alternative to the covariance-based model. The measurement model of the research tool and research variables can be examined simultaneously. The analysis and estimation of PLS were divided into two stages: the first stage was to perform reliability and validity analysis on the measured model and the second stage was to perform path coefficient verification and model prediction capability estimation on the structural model. Such an estimation procedure was used to test the reliability and validity of the variables, that is, to confirm the appropriateness of the explanations of the variables, and then test, and specify the relationships among the variables to validate the assumptions of the research framework (Hulland, 1999).

Convergent validity refers to the measures of constructs that are expected to correlate to a certain degree. This study used composite reliability (CR) and average variance extracted (AVE) to establish convergent validity (Hair et al., 1998). CR assessed the internal consistency of a measure. A higher CR value represented better internal consistency. Fornell and Larcker (1981) suggested that the CR value should be 0.6 or better. AVE refers to the explanatory power of the latent variable to other measured variables. If the corresponding AVE values of the constructs were 0.5 or above, convergent validity existed (Fornell and Larcker, 1981). All AVE values are higher than 0.5, and CR values are higher than 0.7. All

constructs in this study had good convergent validity (as shown in **Table 2**).

Discriminant validity examined the degree of differences among the constructs. Fornell and Larcker (1981) pointed out that the AVE of each construct should be greater than the squared correlation coefficient value of paired constructs. In other words, the AVE's square root should be greater than the correlation value among constructs. As shown in **Table 3**, the empirical results indicated each square root degree of AVE in one of the specific constructs are higher than all the correlation coefficients between the construct and other constructs. Besides, in **Table 4**, all the coefficients of the heterotrait-monotrait ratio of correlations (HTMT) were below the threshold of 0.85 (Henseler et al., 2016). These results provided sufficient evidence of discriminant validity for the proposed model in this study.

This study used a self-reported questionnaire to collect the Facebook users' responses in Taiwan. Since one questionnaire to sample the whole population might have common method bias (CMB), Harman's one-factor test was conducted to examine the data. The basic assumption of Harmon's single factor test was that when one single factor could explain most covariance among all variables, CMB existed. In this study, all variables were subjected to principal component analysis (PCA) for factor analysis. Seven factors with eigenvalues greater than 1 were extracted from 35 questions. The cumulative explained variance for these six factors was 69.53%, and the first factor could explain 18.49% variance, less than 50%. Thus, CMB did not exist significantly in this study.

TABLE 2 | Reliability and average variance extracted.

Variable	Composite reliability	Cronbach's Alpha	Average variance extracted
POS_TR	0.93	0.92	0.56
NEG_TR	0.87	0.83	0.54
PEOU	0.91	0.87	0.73
CON	0.89	0.82	0.74
PU	0.92	0.88	0.73
SAT	0.93	0.89	0.76
CINT	0.92	0.89	0.74

POS_TR, Positive Technology Readiness; NEG_TR, Negative Technology Readiness; PEOU, Perceived Ease-of-Use; CON, Confirmation; PU, Perceived Usefulness; SAT, Satisfaction; CINT, Continuance Intention.

TABLE 3 | Correlation matrix.

	POS_TR	NEG_TR	PEOU	CON	PU	SAT	CI
POS_TR	***0.75***						
NEG_TR	−0.21	***0.73***					
PEOU	0.37	−0.18	***0.85***				
CON	0.45	0.63	−0.08	***0.86***			
PU	0.51	−0.16	0.62	0.64	***0.86***		
SAT	0.50	−0.09	0.64	0.73	0.67	***0.87***	
CI	0.44	−0.14	0.72	0.69	0.69	0.70	***0.86***

POS_TR, Positive Technology Readiness; NEG_TR, Negative Technology Readiness; PEOU, Perceived Ease-of-Use; CON, Confirmation; PU, Perceived Usefulness; SAT, Satisfaction; CINT, Continuance Intention.
The non-diagonal value represents the correlation coefficient of each component. The value of the diagonal represents the square root of the Average Variance Extraction (AVE) value of the component.

TABLE 4 | HTMT for discriminant validity.

	POS_TR	NEG_TR	PEOU	CON	PU	SAT	CI
POS_TR							
NEG_TR	0.23						
PEOU	0.37	0.19					
CON	0.48	0.13	0.74				
PU	0.49	0.17	0.71	0.73			
SAT	0.49	0.10	0.72	0.84	0.75		
CI	0.42	0.14	0.82	0.80	0.79	0.78	

POS_TR, Positive Technology Readiness; NEG_TR, Negative Technology Readiness; PEOU, Perceived Ease-of-Use; CON, Confirmation; PU, Perceived Usefulness; SAT, Satisfaction; CINT, Continuance Intention.

TABLE 5 | Research hypotheses testing.

Hypothesis	Path	Standardized path coef.	Standard deviation	T statistics
H1	POS_TR -> PEOU	0.34***	0.06	5.70
H2	POS_TR -> PU	0.23***	0.05	4.32
H3	POS_TR -> SAT	0.14**	0.05	2.88
H4	POS_TR -> CI	0.03	0.05	0.49
H5	NEG_TR -> PEOU	−0.11	0.06	1.75
H6	NEG_TR -> PU	−0.03	0.05	0.62
H7	NEG_TR -> SAT	0.04	0.04	0.90
H8	NEG_TR -> CI	−0.03	0.04	0.70
H9	PEOU -> PU	0.34***	0.06	5.21
H10	PEOU -> SAT	0.20***	0.06	3.54
H11	SAT -> CI	0.42***	0.06	7.33
H12	CON -> SAT	0.41***	0.06	6.91
H13	CON -> PU	0.32***	0.07	4.77
H14	PU -> SAT	0.22***	0.06	3.91
H15	PU -> CI	0.39***	0.06	6.84

POS_TR, Positive Technology Readiness; NEG_TR, Negative Technology Readiness; PEOU, Perceived Ease-of-Use; CON, Confirmation; PU, Perceived Usefulness; SAT, Satisfaction; CINT, Continuance Intention.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Structural Model

In this study, path analysis was used to examine the substantive relationships among the variables after confirming that the measurement components met the requirements of acceptable reliability and validity. For overall path analysis, PLS was used in this study to examine the relationships between variables, bootstrapping was used to estimate the path coefficients, and re-sampling of the data was used to estimate the value, which was a better approximation than the commonly used limit. Therefore, this study adopted this method to investigate the relationship between variables. The structural model and path analysis results are shown in **Table 5**. The results of the PLS analysis showed that the components of the proposed framework in this study affected the continuance intention including perceived usefulness ($\beta = 0.39$, $p < 0.001$) and satisfaction ($\beta = 0.42$, $p < 0.001$).

However, the effect of POS_TR ($\beta = 0.04$, $P = 0.45$) and NEG_TR ($\beta = 0.00$, $P = 0.93$) on the continuance intention was not significant. In the antecedents on satisfaction of each component, the effect of confirmation ($\beta = 0.41$, $p < 0.001$), POS_TR ($\beta = 0.14$, $p < 0.01$), perceived usefulness ($\beta = 0.22$, $p < 0.001$), and perceived ease of use ($\beta = 0.20$, $p < 0.001$) on satisfaction was significant, but the effect of NEG_TR ($\beta = 0.04$, $p > 0.05$) on satisfaction was not significant. Furthermore, POS_TR had the direct effects on perceived usefulness ($\beta = 0.34$, $p < 0.001$) and perceived ease-of-use ($\beta = 0.23$, $p < 0.001$) were significant. However, the effect of NEG_TR on perceived usefulness ($\beta = -0.11$, $p > 0.05$) and perceived ease-of-use ($\beta = -0.03$, $p > 0.05$) were insignificant.

CONCLUSION

Theoretical Contribution

Social media is the messaging system of today's society at the outbreak of a major food safety crisis and is a forum where public opinion can be expressed in real time. This study analyzed factors (perceived usefulness, perceived ease of use, confirmation, and satisfaction) that affect the continuance intention of social media users. The results indicated that the proposed research model not only passed the examination of convergent validity, discriminant validity, and model fits, but also had a higher explanatory power than the post-acceptance model of IS continuance proposed by Bhattacherjee (2001). That is, by adding the factor of perceived ease of use, the research model had better prediction of perceived usefulness, satisfaction, and continuance intention of social media users. Perceived ease of use had a positive impact on the users' perceived usefulness and continuance intention. This finding is consistent with many extended TAM research (Dabholkar, 1996; Hair et al., 1998; Dabholkar and Bagozzi, 2002; Kleijnen et al., 2004; Lin and Hsieh, 2007; Walczuch et al., 2007; Ross et al., 2009). The ease-of-use user interface of a social media website allows users to accomplish their purposes easily that also increased their perceived usefulness of the website, affecting their continuance intention to use it.

Practical Contribution

Due to the increased accessibility of the Internet in households and the high adoption of Web 2.0 technology in websites, social media has become widespread. Social media is a platform to build social networks or social relations among people who share common interests, activities, backgrounds, or real-life connections. Most social media are run on websites offering different functions for user interactions. The functions include chatting, email, uploading photos, sharing links and videos, blogging, and discussion groups. Through these interactions, social media can connect people or groups with the same interests or activities and then generate a vast personal network. The nature of social media makes it crucial to play a key role in the coverage of key food safety issues, especially in times of major crisis. While traditional media are often criticized for their limited and homogeneous sources, social media is increasingly seen as a platform for conveying opinions and multiple perspectives on social issues (Guo and Saxton, 2014). While social media does operate for commercial gain, it rarely intervenes in the output of content, as it can be difficult for social media to impose its position on its users and further manipulate the winds of public opinion. Moreover, in terms of the operating model, the benefits of social media are most likely to be in the number of users, not in the sale of homemade content. Compared to traditional media, social media seems closer to being a public discourse arena for social crises. Based on the above findings, the researchers made the following suggestions. First, social media providers should take the users' needs into consideration when developing new systems. These needs were enhanced system usefulness/functionality, easier-of-use operation interface, and expectation of the users. Although not everyone has the same requirements for social media, not considering any expectations could result in a lower user satisfaction and decrease the possibility of continuance intention to use social media.

Second, social media providers should provide the functions needed by the target users based on their previous experience of using social networking sites (SNS). When developing a new system, social media providers could have volunteers, especially volunteers with low technology readiness, to test drive the system. This would help providers understand the difficulties faced by users with low technology readiness and adjust the system in terms of user interface or system functionality. Therefore, low technology readiness users would find social media easy to access and love using it. In addition, understanding user expectation of social media is also important because system developers cannot bridge the expectation gap without knowing it. By developing the system functionality that users need, their perceived usefulness would increase, resulting in a positive influence on their satisfaction and continuance intention.

Third, this study suggested that perceived usefulness (functionality) and perceived ease of use (brief user interface) influenced both satisfaction and continuance intention of Facebook users. The survey questions regarding perceived usefulness in this study were Facebook functions related to friend interaction and information sharing. Some of the Facebook users complained about the difficulties in searching for friends' status updates and blogs. Therefore, the researcher suggest that social media providers listen to the needs of the user and upgrade the functionality of the website. When the users' expectations were met, both their satisfaction and continuance intention could be improved.

Future Research Directions and Limitations

This study had a few limitations that are as follows. First, compared with traditional and public websites, social media is related earlier to collect users and citizens to discuss the relevant issues about food safety. Thus, the research model in this study could only be applied to free-of-charge social media websites, but not paid or official services. Second, this study discovered

the effects of users' personal characteristics and feelings on their continuance intention to use Facebook. Factors, such as social identification or innovative marketing, that might impact users' continuance intention could be discussed in future research. The moderating effect of technology readiness was discussed in this study. It is suggested that the other moderating variables can be investigated in a follow-up study. Third, the research objects were drawn from Facebook users in Taiwan; hence, the results were applied in Taiwan only. Because of cultural differences, further research is needed to determine whether the findings in this study are applicable to other countries.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

Ethical review and approval was not required for this study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

HT and Y-PL contributed to research design, empirical analysis, and manuscript writing. AR developed the original idea for the study, proofread, and edited the manuscript. HT, Y-PL, and AR conducted the methodology, data collection, data analysis, and research design. All authors read and approved the final manuscript.

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Conflict of Interest: 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.

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Development and Validation of a Questionnaire on Consumer Psychological Capital in Food Safety Social Co-governance

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Consumers play an important role as one of the main actors in food safety social co-governance. To create a pattern of food safety social co-governance, the active and effective participation of consumers is critical. To encourage consumers to participate in food safety social co-governance voluntarily and positively, we attempted to develop and preliminarily validate a multidimensional questionnaire on consumer psychological capital that could be used to measure the degree of consumer participation in food safety social co-governance. The aim of the initial sample (N = 170) and test sample 2 (N = 204) was to investigate the factor structure of a preliminary measure of consumer psychological capital. A 4-factor model with 23 items explained 61.05% of the total variance in item scores. The aim of test sample 3 (N = 30) was to measure the retest reliability. Test sample 4 (N = 1,076) was randomly allocated to the modeling sample (N = 538) and validation sample (N = 538) to verify questionnaire reliability and validity. Convergent validity, discriminant validity, and the internal inconsistency coefficients of the questionnaire were assessed in the modeling sample. While processing CFA, we deleted 9 items with small standardized factor loadings. The remaining 14 items in the final revised 4-factor model included self-efficacy, resilience, hope, and optimism. The fit indices of the revised four-factor model and second-order factor model in the modeling sample revealed an acceptable model fit. The convergent validity and discriminant validity of the revised model were good and acceptable, respectively. A cross-validation procedure confirmed the appropriateness of the revised four-factor model and second-order factor model in the validation sample. The cross-validation results confirmed that the fit indices of the revised four-factor model fitted the data well and the second-order factor model in the validation sample reached acceptable values. We concluded that the questionnaire developed in this study had good reliability and stable and acceptable construct validity. It could provide a theoretical basis for measuring psychological capital in food safety co-governance.

Keywords: food safety social co-governance, consumers, psychological capital, questionnaire development and validation, reliability test, confirmatory factor analysis

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INTRODUCTION

Food safety is a topic of central interest to almost all members of society as it is particularly pertinent to health. In China, the government previously played a dominant role in regulating and monitoring food safety (Liu et al., 2019). Excessive government intervention suppressed the market's regulatory role, and safety incidents still occur frequently (Wang et al., 2018; Yi et al., 2019). In this circumstance, more effective approaches to food safety governance must be explored. Co-governance, as a transparent and effective approach, is practiced extensively in developed countries (Kelnert and Silva, 1993). Co-governance combines government regulation and social self-governance and is the extension and development of a unitary government governance mechanism (Fairman and Yapp, 2010). Compared with vertical, top-down, one-way government governance mechanisms, co-governance has become the basic form of food safety governance worldwide for guaranteeing food safety with more efficient governance allocation and lower costs (Martinez et al., 2007). To improve the efficiency of food safety governance, reduce governance costs, and reduce or even eliminate food safety risks (Coglianese and Lazer, 2003; Martinez et al., 2007), in June 2013, the government introduced the concept of social co-governance for food safety, which consists of five parts: government supervision, enterprise autonomy, social cooperation, public participation, and legal protection (Wu et al., 2018). The Food Safety Law of China enacted in October 2015 legislated social co-governance as the basic principle of food safety management in China (State Administration for Market Regulation, 2015). The rights and freedom of government, enterprises, and social actors are equal in social co-governance, which is different from traditional governance activities (Martinez et al., 2007). In the food safety social co-governance process, diverse actors cooperate and work together to regulate food safety at a lower cost by the combined and synergetic use of multiple instruments, such as government regulation, market incentives, technical regulation, social supervision, and information dissemination under the framework of laws and regulations, to ensure a higher level of food safety and achieve maximum social welfare (Martinez et al., 2007; Wu et al., 2018).

The fundamental cause of food safety problems lies in the information asymmetry between food manufacturers and consumers, which could lead to market failure (Wu et al., 2018). If the government fails to address the market failure, it probably appears as a "double failure" of government public right and market private right in the process of food safety management (Chen and Wu, 2019). Thus, it is critical for consumers to employ their unique advantages in food safety co-governance actively and effectively. The consumer is one of the main actors of food safety social co-governance. Moreover, consumers are not only the most immediate beneficiaries of food safety but also the most direct sufferers of unsafe food. This means they have strong incentives to address food safety issues and protect their health (Chen and Wu, 2019) and to contribute to the social co-governance of food safety (Rouvière and Caswell, 2012). However, consumers have been criticized for lacking consciousness to voluntarily supervise food safety issues (Mohd Nawi and Mohd Nasir, 2014; Ren et al., 2015) and lacking knowledge of the appropriate channels for making food safety complaints (Cheng et al., 2017). The whistleblowers who reported the food safety issues failed to get timely responses (Yin et al., 2015) or adequate privacy protections and reporting rewards (Zhang, 2013). However, several efforts have been made to mobilize consumer participation in food safety social co-governance. For example, some scholars have recommended the government establish a public interest litigation mechanism similar to that in the United States, which covers penalizing illegal enterprises, rewarding consumers who report illegal activities, and encouraging consumers to participate in food safety co-governance (Yin et al., 2015; Li et al., 2016). Other researchers have argued that the government should provide appropriate rewards and adequate protections for whistleblowers (Moy, 2018) and establish an information disclosure system so that consumers can acquire more food safety information and better understand how to participate in food safety governance (Boumil et al., 2010). Vukatana et al. (2016) urged for improving the transparency and accessibility of the food safety system, which could significantly improve consumers' regulatory capabilities. It seems that these food safety co-governance policies do not work well for consumers, indicating that the value and effectiveness of these food safety co-governance policies need to be demonstrated in future practice. Therefore, the purpose of this article is to explore how to improve consumer eagerness to participate in food safety co-governance from a non-policy perspective, so that consumers can voluntarily play the supervisory role in food safety social co-governance.

Without taking advantage of psychological capital's role in the food safety management process, co-governance alone is not sufficient (Chen and Wu, 2019). Luthans and Youssef-Morgan (2004) proposed the concept of psychological capital consisting of four core components: self-efficacy, optimism, resilience, and hope within the framework of positive psychology (Seligman and Csikszentmihalyi, 2000) and positive organizational behavior (Luthans, 2002). These four structures not only have conceptual independence and empirically based discrimination validity but also promote each other and work synergistically, thereby forming a higher-level construct of psychological capital (Luthans et al., 2007a). The 24-item psychological capital questionnaire developed by Luthans et al. (2007b) is mainly applicable to staff and managers, and its applicable objects are relatively limited. In addition, the questionnaire lacks sufficient evidence of validity, so it is not suitable for measuring consumer psychological capital in the social co-governance of food safety. Chen and Wu (2019) were the first scholars to apply the concept of psychological capital to the social co-governance of food safety. They stated that promoting consumer positive psychological capital enhanced consumer confidence and enthusiasm for participating in food safety co-governance. However, there is a lack of empirical studies investigating the role of consumer psychological capital in food safety co-governance.

To summarize, this paper mainly developed and validated a scale to measure consumer psychological capital in food safety social co-governance from a non-policy perspective and encouraged consumers to play the role of supervisor

voluntarily and positively. Our quantitative study broadens the research scope of psychological capital and provides a novel tool to measure consumer participation in food safety social co-governance.

MATERIALS AND METHODS

Materials

Literature Review

China has long implemented a single governance structure of food safety supervision, which is mainly supervised by government departments and supplemented by the supervision of food categories (Liu et al., 2019). With the transformation of economic and social structures and the development of market economy, the diversity of food types and food supply abundance make food quality and safety a common societal concern and bring great challenges to food safety supervision. A series of food safety scandals in recent years have reflected the inability of traditional regulatory systems to adapt to society's need for safe food (Wang et al., 2018; Yi et al., 2019). The government urgently needs to find more effective approaches to food safety governance in response to public expectations, for public confidence in the government's ability to manage food safety risks was diminished and shaken (Halkier and Holm, 2006).

In the late twentieth century, the government's regulatory capacity lagged behind social development in food safety issues (Wu et al., 2018). At the same time, social organizations and citizen groups greatly promoted the development of social governance. The government had to coordinate and cooperate with social actors in many ways (James, 1992). The co-governance theory was gradually accepted by managers and researchers. By the end of the twentieth century, the theory of social governance emphasizing the construction of a collaborative network that enables multilateral interaction between diverse, decentralized actors began to blossom (Unwin, 1995). A flexible and inclusive concept of social co-governance, which is a new form of co-governance theory in the process of social development, was formed. The theory of social co-governance was one of the most influential theories in the field of public administration at that time. The diversity of participating actors is the core of this theory, which breaks away from the traditional single mode of government governance and thus reflects the publicity in the field of administration. They exercise respective powers according to the provisions of the law to jointly manage public affairs to realize the common interests of the entire society. Given the importance of preventing food safety risks, researchers have extended the concept of social co-governance to food safety governance (Martinez et al., 2007). Food safety social co-governance is the process by which the government and social organizations coordinate and cooperate in setting food safety standards, process implementation, enforcement, and monitoring to provide higher quality and safer food at a lower governance cost (Martinez et al., 2007). Noticeably, actors involved in food safety co-governance are equal partners, unlike in traditional governmental governance activities (Wu et al., 2018).

Psychological capital forms the basis of prosperity and happiness because it ignites positive emotions and feelings of appreciation. Self-efficacy is the self-confidence that an individual is competent for tasks, can face challenges and can strive to succeed (Parker and Sharon, 1998). Optimism is held by individuals who have a positive attribution style and a positive attitude toward the present and the future (Luthans, 2002). Resilience is an individual's ability to quickly recover from adversity, setbacks and failures, and even to actively change and grow (Masten and Ann, 2001). Hope is a state of positive motivation that strives to achieve a predetermined goal through various means (Luthans et al., 2007a). It is necessary to fully recognize the role of psychological capital in stimulating the vitality of consumers and promoting consumer participation in food safety social co-governance (Chen and Wu, 2019). From the perspective of psychological capital, consumers, as beneficiaries of food safety, have a strong motivation to improve food safety and ensure their health. Our quantitative study proposed two hypotheses: (1) Consumer psychological capital set as the second-order factor could explain the four factors including self-efficacy, optimism, resilience, and hope. (2) There are positive correlating relationships between the four factors. If the two hypotheses are true, we can investigate how consumer psychological capital affects consumer participation in future research so that we can make efforts in a more specific direction to improve and encourage consumer enthusiasm to participate in food safety social co-governance.

The Formation of the Initial Questionnaire

The four-dimensional psychological capital concept (Luthans and Youssef-Morgan, 2004)—comprising self-efficacy, resilience, hope, and optimism—was adopted in developing the questionnaire to measure consumer psychological capital. Through a literature search (in Chinese and English), we retrieved questionnaires relating to the four factors of psychological capital, analyzed the dimensions of psychological capital these questionnaires measured, then produced the questions, and finally constructed a pool of items that reflected the four dimensions of consumer psychological capital. Three experts—a psychologist, an epidemiologist, and a biostatistician—and three graduate students in psychology independently evaluated the validity of the items for each dimension in the pool. After a discussion within our research group, three levels of items with evaluations of very effective, effective, and average were selected. The initial questionnaire consisted of 39 items, with 9–10 items for each dimension. For example, "I can positively learn about ways to protect food safety through mobile phones, TV, or offline publicity.", "If I buy expired, spoiled, moldy, or poisonous food, I will inform the people around me in time.", "If I report a problem with food, I hope to receive a timely and fair response from the relevant department.", and "I believe that most of the foods circulating in the market are safe.". The items were scored on a seven-point Likert-type scale (ranging from 1 = strongly disagree to 7 = strongly agree); the higher was the score of the items, the higher the psychological capital.

Quality Control of the Questionnaire

The respondents were required to answer all items in the survey to ensure data completeness. They were allowed to fill

in the questionnaire only once via WeChat to prevent duplicate questionnaire responses. Questionnaires with 20 consecutive identical answers were discarded, as were initial questionnaires with a response time of less than 100 s and formal questionnaires with a response time of less than 300 s.

Methods

Sample and Test Procedure

Our study administered the preliminary and formal questionnaires, using the Questionnaire Star platform, which is an online professional questionnaire survey platform. All surveys were sent to consumers who met the following criteria: (1) they were capable of using the internet to fill in the online questionnaire; (2) they were literate; (3) they could take part in the survey voluntarily; (4) they were 18 or older; and (5) they had experience buying food. Consumers over the age of 18 were informed about the study's purpose, privacy protection and anonymity before completing the electronic questionnaire. Informed consent was given on the first page of the online survey. The ideal sample size for a preliminary survey should be 5–10 times the total number of the items included in the questionnaire (Comrey and Lee, 1992), whereas for the final survey, the sample size should be 40–50 times the total number of items (Cummings et al., 1988; Comrey and Lee, 1992; Price, 1993). The first and second preliminary surveys had sample sizes of 188 and 249, respectively. The final survey had a sample size of 1,307. From the total of 188 consumers surveyed to test the initial questionnaire, 170 valid questionnaires were obtained (initial test sample, effective rate = 90.43%). Items were deleted if they had a discrimination degree of less than 0.4 or their factor loadings did not meet the single-dimension requirement. After adding a few items from the pool and adjusting the presentation of some items, we constructed a retest questionnaire with a total of 30 questions across the four dimensions of psychological capital. The initial 30 items of test sample 2 are presented in **Table 1**.

Subsequently, we surveyed 249 consumers to test the retest questionnaire and obtained 204 valid questionnaires (test sample 2, effective rate = 81.93%). Based on the results of the item analysis and exploratory factor analysis (EFA), items whose factor loadings did not meet the single-dimension requirement were excluded. Finally, we constructed the formal questionnaire consisting of demographic information and 23 questions across four dimensions of psychological capital (**Supplementary Table S1**). To assess the formal questionnaire's retest reliability, 30 consumers were recruited to complete the formal questionnaire twice within 2 weeks (test sample 3). Then, 1,307 consumers were enrolled to complete the formal questionnaire, and 1,076 (test sample 4, effective rate = 82.33%) of them returned valid questionnaires. Test sample 4 included 370 men and 706 women aged between 18 and 76 years old. Confirmatory factor analysis (CFA) was used to test the rationality of the four-factor model, and the test level was defined as alpha = 0.05.

Statistical Analysis

The critical value ratio, correlation, internal consistency, and reliability of the questionnaire were calculated. EFA was carried out by using SPSS version 22 on the initial test sample and on test sample 2 to derive the formal questionnaire. The extreme group method was used to test the identification degree of the items. Items with a determination value of less than 3 and p value greater than 0.05 were deleted (Wu, 2000). If the correlation coefficient between each item score and the total score of all items was less than 0.4, the item was deleted (Giacomin et al., 2008). Items with a factor loading less than 0.4 were also excluded from the questionnaire (Markus, 2012). If deleting an item caused the Cronbach's alpha coefficient to increase significantly (greater than the Cronbach's alpha coefficient of the questionnaire), this item was also removed (Wu, 2000).

In test sample 4, the survey select procedure in SAS version 9.4 was used to ensure random sampling (seed = 1,234). Test sample 4 was randomly separated into a modeling sample and validation sample, each with a sample size of 538. The modeling sample was used to evaluate the factor structure of the CFA, while the validation sample was used for the cross-validation procedure. Cronbach's alpha coefficient (modeling sample) and the retest reliability coefficient (test sample 3) were calculated to assess the questionnaire's reliability. Cronbach's alpha coefficients of the questionnaire greater than 0.80 and 0.70 indicated good, and acceptable internal consistency, respectively (Robinson et al., 1991; DeVellis, 2003; Hair et al., 2010).

CFA was conducted to examine the validity of the model structure formed by EFA. The models were estimated using maximum likelihood estimation. In the basic CFA model, one non-standardized factor loading from each factor and the non-standardized regression coefficients of the 23 residuals were set as 1. The CFA consisted of three steps: (1) evaluating the conceptual factor structure; (2) modifying the factor structure and improving the model fit; and (3) cross-validation. We conducted the CFA on the modeling sample using AMOS version 17.0. To make the model fit the sample data, the items with low standardized factor loadings were deleted in the model modification procedure. We also freed the residual correlation within the same factor according to the modification index (MI). The CFA was then conducted on the validation sample to assess the stability of the factor structure. χ^2/df ratios (Hair et al., 2010), the root mean square error of approximation (RMSEA) (McDonald and Ho, 2002), standardized root mean square residual (SRMR) (Medsker et al., 1994; Hu and Bentler, 1999), comparative fit index (CFI), and Tucker–Lewis index (TLI) (Tucker and Lewis, 1973; Bentler and Bonett, 1980) were used in model selection.

Convergent validity confirms that the scale is correlated with other known measures of the concept. Construct reliability ($CR \geq 0.70$), standardized factor loadings (0.50–0.95 with a significance level of 0.05), and average variance extracted (AVE $\geq$ 0.50) (Bagozzi, 1981) were applied to ensure excellent convergent validity. Discriminant validity ensures that the scale is sufficiently different from other similar concepts. CFA provides two common ways of assessing discriminant validity. First, a square root of AVE for any two constructs is greater than the correlation estimate between these two constructs, indicating high discriminant validity (Hair et al., 2010; Nagase and Kano, 2016). This is a rigorous way to test because even a small correlation between latent constructs would imply a lack of discriminant validity (Segars, 1997). In this exploratory research, the second loose way was referenced, we performed chi-square

TABLE 1 | The initial 30 items in test sample 2.

Self-efficacy	Q4. I can positively learn about ways to protect food safety through mobile phones, TV, or offline publicity.
	Q5. I will pay attention to the food safety incidents released by the news media and take the initiative to stay away from fake and inferior food.
	Q6. If I buy expired, spoiled, mildewed, or toxic food, I can quickly complain and report it to the relevant department by telephone, letter or network, etc.
	Q7. I know how to find online channels and methods for safeguarding consumer rights.
	Q8. I can use QQ, WeChat, Weibo, and other network platforms to play the role of a food safety supervisor better.
	Q9. If I find that illegal businesses have illegal operations, I dare to report it to the relevant departments.
	Q10. If I encounter a serious food safety issue such as food poisoning, I can report it to the relevant department in time.
	Q11. I think I have a strong sense of responsibility for food safety.
Resilience	Q12. I have zero tolerance for unsafe and unqualified food.
	Q13. If I find out that food has expired or deteriorated before buying it, I will take the initiative to submit it to the merchant.
	Q14. If I buy expired spoiled food and look for compensation from businesses but rejected, I will choose to continue to complain, and inform to maintain rights and interests.
	Q15. If someone tells me that I'm meddling when I report food that has expired, gone bad, gotten mildewy, or is toxic, I will still insist on speaking up.
	Q16. If I buy expired, spoiled, moldy, or poisonous food, I will inform the people around me in time.
	Q17. If I buy food that is expired, spoiled, moldy or poisonous, I will learn from experience and improve my food safety awareness.
	Q18. If I eat out or order takeout and eat unhygienic food, I will inform the business and get a reasonable solution.
	Q19. When buying food, I will try to understand its safety as much as possible by checking the shelf life, color, and taste.
Hope	Q20. If I report problematic food, I hope the responsible businesses will be punished accordingly.
	Q21. If I report a problem with food, I hope to receive a timely and fair response from the relevant department.
	Q22. I think participating in food safety co-governance can not only protect your legal rights and health but also protect the rights and health of other consumers.
	Q23. I think that I have a sense of social responsibility, prompting me to participate in food safety co-governance and give full play to food safety supervision.
	Q24. I think that active participation in food safety co-governance and being a good food safety supervisor is beneficial for the food safety social co-governance.
	Q25. I understand that I have the most personal experience of safe food and should actively participate in food safety co-governance.
Optimism	Q26. I believe that most of the foods circulating in the market are safe.
	Q27. I believe that most consumers can play a role in food supervision.
	Q28. I believe that most consumers can positively report, complain about unsafe food that they encounter.
	Q29. For manufacturers or brands that have exposed food safety incidents, I believe they can take corresponding responsibilities and correct them.
	Q30. I believe that most food business operators have an attitude of safety-first and benefit second.
	Q31. I believe that the media can accurately and timely disseminate food safety incidents.
	Q32. I think food regulators will promptly deal with food safety issues reported by consumers.
	Q33. In my opinion, it would be effective for the government, enterprises and society to jointly deal with food safety issues, instead of relying solely on government supervision.

14 items in bold were left in the final questionnaire: self-efficacy (Q6, Q9, Q10, Q11); resilience (Q13, Q16, Q19); hope (Q23, Q24, Q25), and optimism (Q29, Q30, Q31, Q32).

tests on nested models to support the discriminant validity of the revised model, with a statistical significance level of $p < 0.05$.

RESULTS

Item Analysis

A total score of psychological capital items for each consumer was calculated, and all scores were ranked in descending order. Consumers who were ranked in the top 27% (scores: 182–209) and the bottom 27% (scores: 106–151) were defined as having high and low psychological capital, respectively. The t-value of the items ranged from 6.15 to 13.47 in the independent samples T-test, all of which met the statistical significance level of $p < 0.05$. A Kolmogorov–Smirnov normality test on the total score ($p > 0.05$) and the score of each item ($p < 0.05$) suggested that the Spearman's rank correlation should be used to assess the correlation between each item and the total score. The correlations were between 0.50 and 0.71 with a p-value lower than 0.05. The factor loadings were between 0.47 and 0.70. As a result, 30 items in the test sample 2 questionnaire were retained (see **Table 1**). The results of the item analysis are shown in **Table 2**.

Exploratory Factor Analysis (EFA) and Retest Reliability

Bartlett's test of sphericity and a Kaiser–Meyer–Olkin test applied to the remaining 30 items ($\chi^2 = 3606.85$, $p < 0.001$, KMO = 0.90) indicated that factor analysis was appropriate (Jang et al., 2009). Because each dimension of psychological capital was interrelated, a principal component analysis with Promax oblique rotation was employed. Based on the theoretical framework, we deleted items with factor loadings less than 0.50 or those that did not meet the requirements of a single dimension to guarantee that the eigenvalues were above 1. We conducted seven EFAs

TABLE 2 | Item analysis in test sample 2 (N = 204).

	Decision value	Correlation	Cronbach's value after item deletion	Factor loading	Substandard quantity
Q4	6.23**	0.55**	0.94	0.47	0
Q5	10.38**	0.65**	0.93	0.61	0
Q6	13.47**	0.67**	0.93	0.61	0
Q7	8.80**	0.57**	0.93	0.52	0
Q8	11.97**	0.71**	0.93	0.66	0
Q9	12.60**	0.69**	0.93	0.65	0
Q10	11.52**	0.71**	0.93	0.70	0
Q11	10.90**	0.70**	0.93	0.66	0
Q12	11.35**	0.63**	0.93	0.52	0
Q13	7.64**	0.58**	0.93	0.52	0
Q14	12.07**	0.67**	0.93	0.64	0
Q15	12.47**	0.71**	0.93	0.68	0
Q16	7.32**	0.56**	0.93	0.60	0
Q17	8.26**	0.60**	0.93	0.66	0
Q18	8.53**	0.63**	0.93	0.62	0
Q19	9.01**	0.63**	0.93	0.58	0
Q20	6.15**	0.50**	0.94	0.49	0
Q21	7.46**	0.52**	0.93	0.60	0
Q22	7.96**	0.54**	0.93	0.62	0
Q23	8.67**	0.64**	0.93	0.67	0
Q24	9.27**	0.62**	0.93	0.68	0
Q25	10.2**	0.66**	0.93	0.69	0
Q26	7.30**	0.53**	0.93	0.50	0
Q27	10.50**	0.65**	0.93	0.65	0
Q28	11.79**	0.67**	0.93	0.62	0
Q29	8.32**	0.54**	0.93	0.49	0
Q30	7.92**	0.53**	0.94	0.47	0
Q31	9.95**	0.65**	0.93	0.59	0
Q32	11.00**	0.64**	0.93	0.61	0
Q33	7.92**	0.53**	0.93	0.61	0
Standard values	≥3.00	≥0.40	≤0.94	≥0.40	

**$p < 0.01$.

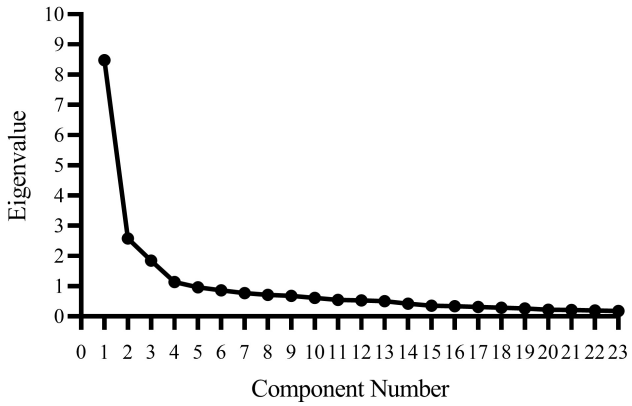

FIGURE 1 | Scree Plot based on EFA of the consumer psychological capital questionnaire.

and obtained the four-factor psychological capital scale with 23 questions shown in **Supplementary Table S1**. The scree plot of the last EFA is provided in **Figure 1**. The results of the EFA are presented in **Table 3**. The four factors had a cumulative variance contribution rate of 61.05%. The variance contribution rates of optimism (Factor 1), self-efficacy (Factor 2), hope (Factor 3), and resilience (Factor 4) were 36.87, 11.21, 8.03, and 4.94%, respectively. The factor loadings of all items were greater than 0.60, indicating that the questionnaire had good structural validity. A total of 30 consumers finished the 23 items retest questionnaire (test sample 3); the retest reliability coefficients of optimism, self-efficacy, hope, resilience, and the total scale were 0.82, 0.91, 0.86, 0.88, and 0.92, respectively, suggesting good retest reliability.

Non-response Bias Analysis and Descriptive Analysis

There is no safe level of response rates below 100%. Particularly for internet surveys, it is difficult to avoid the non-response bias (Alvarez and VanBeselaere, 2005). The study followed up with all 231 consumers who were not included in the final dataset and compared their demographic information with that of 1,076 consumers. The results showed in **Table 4** revealed that no significant differences were identified in age, place of residence, education, income, or marital status. In the survey of 1,076 consumers, the mean of their psychological capital scores ranged from 4.23 to 6.33 (standard deviation: 1.01–1.72), and the median was between 4 and 7. In the Spearman's rank correlation between each item, the largest correlation was found between Q24 and Q25 (correlation = 0.70) while the smallest correlation was between Q29 and Q21 (correlation = 0, see **Supplementary Table S2**).

Confirmatory Factor Analysis (CFA)

Model 1 was a standard four-factor model including self-efficacy, resilience, hope, and optimism. Model 2 was a single-factor model that assumed that all items belonged to one single factor of psychological capital. Model 3 was a three-factor model that combined hope and resilience into one construct, for hope and resilience had a strong positive correlation. The fit indices of models are shown in **Table 5**. The model fit of the single-factor model (Model 2) was unqualified. The fit indices of Model 1 and Model 3 were not even close to the ideal values. For Model 1, although χ^2/df, RMSEA, and SRMR obtained values close to excellent, TLI and CFI were 0.87 and 0.85, respectively, which were below the ideal value of 0.90. Low loadings meant that more of the variance in the measure was error variance than an explained variance. Therefore, we deleted items Q12, Q4, Q7, Q21, Q8, Q26, Q27, Q28, and Q22 successively. Meanwhile, any construct of the model should keep at least three items (Hair et al., 2010). The revised model finally included 14 items, which were self-efficacy (Q6, Q9, Q10, Q11), resilience (Q13, Q16, Q19), hope (Q23, Q24, Q25), and optimism (Q29, Q30, Q31, Q32). We freed the residual correlation between Q29 and Q30, and the correlation coefficient was 0.41, which indicated that consumers have a positive attitude toward food operators or manufacturers.

Model 4 was the final modified four-factor model with 14 items. **Figure 2** shows the final 4-factor model of the consumer

TABLE 3 | Factor loadings of 23 items in test sample 2 (*N* = 204).

	Optimism (factor 1)	Load	Self-efficacy (factor 2)	Load	Hope (factor 3)	Load	Resilience (factor 4)	Load
	Q30	0.84	Q8	0.84	Q24	0.88	Q16	0.77
	Q32	0.82	Q6	0.82	Q22	0.86	Q19	0.75
	Q29	0.80	Q9	0.78	Q25	0.80	Q13	0.64
	Q28	0.77	Q11	0.70	Q23	0.77	Q12	0.64
	Q31	0.76	Q7	0.68	Q21	0.77		
	Q27	0.73	Q4	0.65				
	Q26	0.60	Q10	0.65				
Eigen values	8.48		2.58		1.85		1.14	
Variance contribution rate (%)	36.87		11.21		8.03		4.94	
Cumulative variance contribution rate (%)	36.87		48.09		56.12		61.05	

TABLE 4 | Demographic information in invalid respondents (*N* = 231) and respondents (*N* = 1,076).

	Invalid respondents	Respondents	Statistics	*P*
Age [M (P25, P75)]	27 (24, 30)	27 (24, 38)	$Z = -0.88$	0.38
Place of resident [N (%)]			$\chi^2 = 2.16$	0.14
1 = City	141 (19.03%)	600 (80.97%)		
2 = Rural	90 (15.90%)	476 (84.10%)		
Education [N (%)]			$\chi^2 = 1.12$	0.77
1 = Junior high school and below	17 (15.89%)	90 (84.11%)		
2 = Senior high school or technical secondary school	36 (20.00%)	144 (8.00%)		
3 = Undergraduate or junior college	127 (17.79%)	587 (82.21%)		
4 = Postgraduate and above	51 (16.67%)	255 (83.33%)		
Income [N (%)]			$\chi^2 = 2.11$	0.72
1 = under 3,000	95 (17.50%)	448 (82.50%)		
2 = 3,000–5,000	57 (16.10%)	297 (83.90%)		
3 = 5,000–8,000	45 (19.40%)	187 (80.60%)		
4 = 8,000–12,000	23 (21.10%)	86 (78.90%)		
5 = 12,000 and more	11 (15.94%)	58 (84.06%)		
Marriage status [N (%)]			$\chi^2 = 3.35$	0.34
1 = Unmarried	138 (19.19%)	581 (80.81%)		
2 = Married	89 (16.01%)	467 (83.99%)		
3 = Divorced	2 (9.09%)	20 (90.91%)		
4 = Widowed	2 (20.00%)	8 (80.00%)		

M (P25, P75) indicates the Median and Interquartile Range.
N (%) indicates the number and proportion of different respondents' groups.

psychological capital questionnaire in social co-governance of food safety. The model fit of Model 4 was acceptable (see **Table 5**, χ^2/df = 3.35, RMSEA = 0.07, SRMR = 0.05, CFI = 0.95, and TLI = 0.94). Generally, χ^2/df ratios on the order of 3:1 or less are associated with better-fitting models, except in circumstance with larger samples. χ^2/df smaller than 2.0 is considered very good; between 2.0 and 5.0 is acceptable (Hair et al., 2010). Model 5 was a second-order model based on Model 4; for the correlation coefficients between hope and resilience, hope and self-efficacy were over 0.6. It is necessary to set the psychological capital as a second-order factor to explain efficacy, resilience, hope, and optimism. The model fit of Model 5 was also acceptable (see **Table 5**, χ^2/df = 3.69, RMSEA = 0.07, SRMR = 0.06, CFI = 0.94, and TLI = 0.93).

The internal reliability and convergent validity can be found in **Table 6**. In the modeling sample, the Cronbach's alpha coefficients of optimism, self-efficacy, hope, resilience, and the total scale were 0.86, 0.80, 0.84, 0.74, and 0.88, respectively. The AVE of hope (0.65), resilience (0.50), self-efficacy (0.51), and optimism (0.57) reached the threshold of 0.5. The CR ranged from 0.75 to 0.85, and the standardized factor loadings ranged from 0.67 and 0.85 with statistical significance. The latent variables in the scale had good convergent validity. The correlations between the latent variables and the square root of AVE of four factors are shown in **Table 6**. The inter-factor correlation coefficients in the

TABLE 5 | Fit indices of models in the CFA of the consumer psychological capital questionnaire.

	χ^2(df.)	χ^2/df	RMSEA	SRMR	CFI	TLI	Model comparison	$\Delta\chi^2$	Δdf
Threshold value		≤5.0	≤0.08	≤0.08	≥0.9	≥0.9			
Model 1	1028.5 (224)***	4.59	0.08	0.07	0.87	0.85			
Model 2	2528.9 (230) ***	11.00	0.14	0.11	0.62	0.58	2 vs. 1	1500.40***	6
Model 3	1094.1 (227) ***	4.82	0.08	0.07	0.86	0.84	3 vs. 1	65.60***	3
Model 4′(final)	234.62 (70) ***	3.35	0.07	0.05	0.95	0.94			
Model 5	265.70 (72) ***	3.69	0.07	0.06	0.94	0.93			
Cross-valid.1 ″	209.94 (70) ***	3.00	0.06	0.05	0.96	0.95			
Cross-valid.2 ‴	248.46 (72) ***	3.45	0.07	0.06	0.95	0.93			

****Indicates significance at the 0.001 level.*
Model 1: standard four-factor model consisting of self-efficacy, resilience, hope, and optimism;
Model 2: single-factor model where 23 items were explained by the psychological capital;
Model 3: three-factor model (combined hope and resilience into one factor);
Model 4′ (final) indicates the final modified four-factor model with 14 items;
Model 5 indicates a second-order model where the psychological capital was set as the second-order factor.
Cross-valid1. ″ indicates a cross-validation analysis of Model 4′ (final) using the validation sample (N = 538).
Cross-valid2. ‴ indicates a cross-validation analysis of the second-order factor model using the validation sample (N = 538).

modeling sample were between 0.39 and 0.75. Resilience and hope had a strong correlation, and the remaining dimensions were moderately correlated. **Table 7** shows the questionnaire's discriminant validity. The square root of AVE for optimism, self-efficacy, and hope were 0.76, 0.71, 0.80, respectively, which were greater than the correlation coefficients below the diagonal. The square root of AVE for resilience was 0.71, which was less than the correlation coefficient between resilience and hope of 0.75. A chi-square test was carried out to compare the nested models (see **Table 5**, $\Delta\chi^2 = 1500.40$, $p < 0.05$ between Model 1 and Model 2; $\Delta\chi^2 = 65.60$, $p < 0.05$ between Model 1 and Model 3). The overall results showed acceptable discriminant validity for the model, even though the evidence of discriminant validity was not strong.

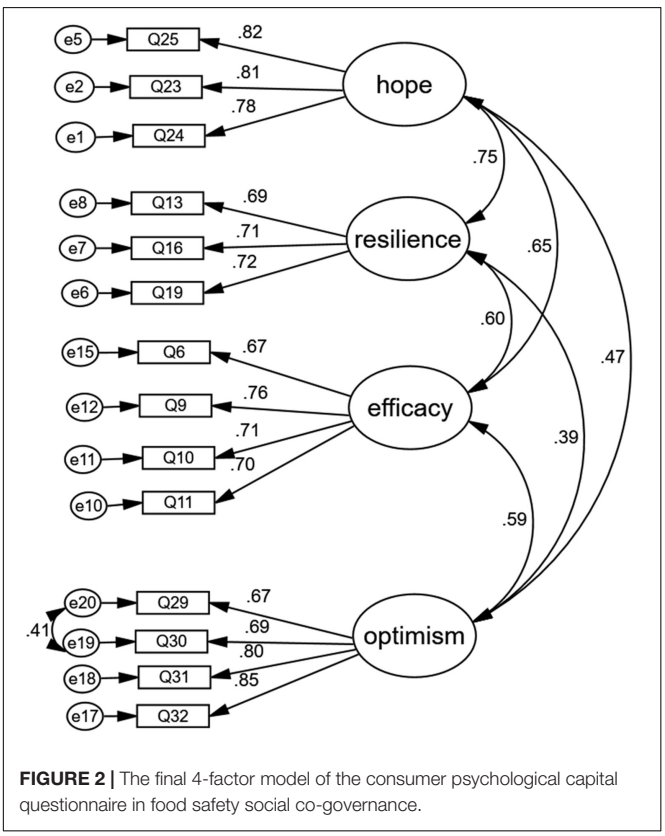

FIGURE 2 | The final 4-factor model of the consumer psychological capital questionnaire in food safety social co-governance.

The modified four-factor model (Model 4) was validated in the validation sample (cross-validation 1 in **Table 5**, χ^2/df = 3.00, RMSEA = 0.06, SRMR = 0.05, CFI = 0.96, TLI = 0.95). The second-order factor model (Model 5) was validated in the validation sample (cross-validation 2 in **Table 5**, χ^2/df = 3.45, RMSEA = 0.07, SRMR = 0.06, CFI = 0.95, TLI = 0.93). All the model fit indices reached the acceptable values, indicating that the four-factor model fitted the sample data. **Table 7** shows descriptive statistics of four-factor with 14 items. The mean and standard deviation of each dimension varied from 4.70 to 6.16 and from 0.92 to 1.32, respectively. This revealed that consumer psychology was relatively positive regarding the social governance of food safety.

DISCUSSION

The study aims to develop a tool for measuring consumer psychological capital in food safety social co-governance, with the aim of better understanding and quantifying consumer psychological capital. This is the first consumer-reported questionnaire designed to measure consumer psychological capital in food safety social co-governance. In the development and validation process, support was provided for the factor structure and construct validity of the consumer psychological capital questionnaire. In particular, factor analysis revealed a four-factor structure consisting of self-efficacy, resilience, hope, and optimism. In this study, item screening helped develop the questionnaire with good reliability and validity. The EFA of the consumer psychological capital questionnaire showed that the statistical results were consistent with the theoretical construct and that the four factors contributed 61.05% of the total variance. CFA revealed that the model had adequate convergent validity and acceptable discriminant validity, which was consistent with

TABLE 6 | Internal reliability and convergent validity results of the skew model of model 4 in modeling sample (*N* = 538).

Factor	Item	Standardized factor loadings	Cronbach's alpha	CR	AVE	$\sqrt{AVE}$
Hope	Q24	0.78***		0.85	0.65	0.80
	Q23	0.81***	0.84			
	Q25	0.82***				
Resilience	Q19	0.72***		0.75	0.50	0.71
	Q16	0.71***	0.74			
	Q13	0.69***				
Self-efficacy	Q11	0.70***		0.80	0.51	0.71
	Q10	0.71***				
	Q9	0.76***	0.80			
	Q6	0.67***				
Optimism	Q32	0.85***		0.84	0.57	0.76
	Q31	0.80***				
	Q30	0.69***	0.86			
	Q29	0.67***				

*CR, Construct Reliability; AVE, Average Variance Extracted (AVE); $\sqrt{AVE}$, the square root of AVE. ***Indicates significance at the 0.001 level.*

TABLE 7 | Descriptive statistics, discriminant validity between latent variables in modeling sample (*N* = 538).

Factor	Mean	SD	Optimism	Self-efficacy	Hope	Resilience
Optimism	4.70	1.32	**0.76**			
Self-efficacy	5.07	1.18	0.59	**0.71**		
Hope	6.04	0.95	0.47	0.65	**0.80**	
Resilience	6.16	0.92	0.39	0.60	0.75	**0.71**
Scale	5.41	0.86				

The values in bold on the diagonal are the square root of AVE for each latent variable.

the construction of consumer psychological capital formed by the EFA. The reliability analysis demonstrated that the dimensions of the questionnaire were highly correlated with items, indicating good reliability of the questionnaire.

Theoretical Implications

The fit indices of the revised four-factor model (Model 4) and the second-order factor model (Model 5) all reached acceptable values. Therefore, the second-order factor model where the psychological capital was set as a second-order factor was accepted in this study. In other words, it is reasonable to use consumer psychological capital to explain self-efficacy, resilience, hope, and optimism, which provided evidence for hypothesis 1. A previous study also supported the second-order model of psychological capital (Luthans et al., 2007a). According to existing studies, the effect variables of psychological capital mainly include job performance (Avey et al., 2006, 2011), work attitude, and work behavior (Luthans et al., 2005, 2007a), and employee happiness (Avey et al., 2010). Our quantitative study broadened the research directions of psychological capital and focused on a different research field of food safety social co-governance. Whether consumer psychological capital has a positive impact on consumer participation in food safety social governance needs to be examined in future research. In addition, this empirical study of the consumer psychological capital questionnaire supported by reliability and validity test was more convincing to fill in the gaps of conceptual research.

Managerial Implications

Our quantitative questionnaire focused on the actual problems faced by consumers in food safety social co-governance and developed questionnaire construction from a realistic perspective to analyze the main problems impacting participation in food safety social co-governance. Unsurprisingly, the correlation between all four factors was positive, which provided evidence for hypothesis 2. This is consistent with the conclusions of previous studies (Luthans et al., 2005; Luthans and Youssef-Morgan, 2017). The self-efficacy dimension captures consumers who have a strong sense of responsibility for food safety and knowledge of how to report food safety issues in a variety of ways. Consumers with high self-efficacy had higher resilience, hope, and optimism in the process of food safety social co-governance. The optimism dimension involves consumers' positive attitudes toward other consumers, food business operators, media, and food regulators. Optimistic individuals always perceive a greater chance for success; most of them trust the food safety department, other consumers, the media, and food enterprises to perform well. Confident consumers have high self-efficacy; it seems that they can deal with challenging food safety incidents. The hope dimension involves consumers knowing the importance of participating in food safety and striving to fully participate in food safety supervision. Having hope helps consumers pursue multiple pathways to achieve their goals. Resilience offers a helping hand to allow for recovery from setbacks when people face food safety problems. Consumers can report food safety issues bravely and learn a lesson from it.

From our questionnaire survey results, the following main recommendations can be made regarding how to strengthen consumer psychological capital. First, food safety departments should publicize basic information about food safety and rights protections through online or offline channels to make consumers more familiar with food safety knowledge and enhance their self-efficacy. Second, according to the severity of the problems reported by consumers, a corresponding incentive mechanism should be established to mitigate the opportunity costs, such as time and money, encountered by consumers in the process of safeguarding their rights. This would have a positive effect on fostering consumer resilience. Third, the government should enhance consumer praise and publicize consumers' reports of food safety issues, encourage consumers to establish a sense of responsibility for food safety, and make consumers understand that actively participating in food safety social co-governance protects not only their rights but also those of other consumers. Thus, consumers will have a higher level of hope for food safety social co-governance. Fourth, severely punishing food operators who are aware of and violate the law would not only improve the government's credibility but also increase consumer trust in the government and enterprises. Consumers' optimistic attitudes are more conducive to promoting social harmony.

Research Limitations

This study has several limitations that should be noted. Although the online survey was convenient, simple, cost-effective, and wide in coverage, the representativeness of the sample could be improved. Further studies are recommended to evaluate the scale's factor structure across varied respondents. In addition, the selection bias and non-response bias are inevitable in an internet survey. We examined whether demographic information was statistically significant between 231 and 1,076 consumers and randomly allocated the 1,076 consumers into the modeling sample and validation sample to validate the questionnaire's validity, but we still need to collect random investigated data to minimize the selection bias and non-response bias. Due to the lack of domestic and foreign research studies on psychological capital enabling consumers to participate in food safety social co-governance, no mature scale is available for reference. Therefore, the criterion calibration validity of the self-compiled scale in this study has yet to be verified.

Suggestions for Further Studies

This research simply provided a reliable tool to measure consumer psychological capital in food safety social co-governance. More quantitative statistical analysis verifying whether psychological capital is positively correlated with consumer participation is still needed in future studies. The questionnaire also motivates us to explore and measure the role of psychological capital in the relationship with government or food enterprises. In other words, cultivating the psychological capital of government or food enterprises is a flexible approach to food safety management. We contend that psychological capital has a positive effect on solving food safety problems for government or enterprises, and will collect more data to confirm this view.

CONCLUSION

In conclusion, the consumer psychological capital questionnaire developed in this exploratory study has good reliability and convergent validity, and acceptable discriminant validity. There were 14 items in the questionnaire, including four factors: optimism, self-efficacy, hope, and resilience. The rationality of this consumer psychological capital questionnaire was supported by the EFA and CFA. This questionnaire can be used as an effective tool to measure consumer participation in food safety social co-governance in further research.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Chongqing Medical University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BP and CM designed this study. LS, XG, MW, LY, and YW constructed the original concepts and assisted in data collection. CM performed the study, analyzed the data, and drafted the manuscript. BP reviewed and revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.584810/full#supplementary-material

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Conflict of Interest: 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.

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An Empirical Study on the Dairy Product Consumers' Intention to Adopt the Food Traceability's Technology: Push-Pull-Mooring Model Integrated by D&M ISS Model and TPB With ITM

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Against the backdrop of frequent food safety problems, the importance of establishing food traceability systems has become increasingly important and urgent to address the contradiction between consumer information on safe food choices and the proliferation of problematic foods. The purpose of this study is to empirically study the influencing factors of Chinese consumers on the food traceability system in the food safety field (hereinafter referred to as FTS). In this study, multiple models—push factor (information system success model), pull factor (ITM theory), mooring factor (TPB), and switching intention—were integrated into the push-pulling-mooring theory (PPM) to form a conceptual PPM comprehensive model framework to study the switching intentions of two-dimensional code traceability technology for dairy products of Chinese consumers. By collecting the questionnaire survey, 305 valid questionnaires were collected from the consumers of middle- and high-end dairy products in China, and the influencing factors of thrust, pull, and mooring force were identified. The results showed that 10 of the 11 hypotheses were positive, but the impact of perceived risk on user satisfaction was negative. The important value of this study is to conduct a comprehensive empirical analysis of the key factors influencing consumer choice of traceable safe food through an integrated multi-model framework to help identify ways to establish and improve consumer willingness to use QR code traceable system products, to increase consumer confidence in the use of traceable and safe food choices.

Keywords: food safety, push-pull-mooring theory (PPM), D&M Information System Successful model (ISS), theory of planned behavior (TPB), initial trust model (ITM)

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INTRODUCTION

In the last 20 years, frequent and recurring food safety problems have plagued people around the world. According to an April 2020 survey by WHO, an estimated 600 million people worldwide have fallen ill as a result of eating contaminated food. Unsafe food containing infectious viruses, damaging bacteria, parasites, or chemicals can cause more than 200 diseases, and approximately

3.3 million people worldwide die each year from diarrhea to cancers (Krishnamurthy, 2020). In low- and middle-income countries, unsafe food costs $110 billion a year in lost productivity and healthcare costs (Hou et al., 2019). Also, some researches have confirmed that similar to SARS-CoV-1 and other eight coronaviruses, the SARS-CoV-2 virus is expected to behave similarly at freezing temperatures, which means it could remain contagious under −20°C for up to 2 years (Rizou et al., 2020). Therefore, perfect food safety measures are critical to controlling viral spread (Uddin et al., 2020).

In fact, consumers around the world are often exposed to different degrees of food unsafety effects. Some notorious food safety news have occurred worldwide, including outbreaks of mad cow disease, African swine fever, the Europe horsemeat scandal, melamine-contaminated milk powder, and other incidents. Food safety events seriously endanger both the people's health and consumer confidence, as well as negatively influence the income of food producers, the development of the food industry, and even the country's international reputation (Yu and Qiao, 2016).

All these highlight the necessity of implementing or improving the food traceability system (FTS). However, a serious information asymmetry between buyers and producers makes the consumers unable to make informed choices on their food consumption, resulting in a lack of food safety trust. FTS, as an important measure to guarantee food safety, provides each necessary information from farm to plate and makes up the information asymmetry. Because FTS is closely related to food safety and consumers' claim for traceability and is an important standard of food safety, it is of vital importance to establish FTS to improve consumers' confidence in food safety (Yu and Qiao, 2016).

Many researches have indicated that traceability awareness and recommendations are issues of specific products and certain countries, and previous work of different researchers mainly focused on analyzing consumers' preferences for FTS and its influencing factors, and evaluating the role of global consumers in the quality assurance characteristics of food traceability systems, including the United States, Canada, and Korea (Qiana et al., 2020).

As a typical framework of switching intention study, PPM (push-pull-mooring model) reveals some factors that drive individuals to leave their original living places and attract them to new destinations (Wei et al., 2019). Essentially, PPM identifies that push elements drive people away from the origin point, while pull elements attract the crowd to the destination point (Fang and Tang, 2017). Moreover, mooring elements represent the additional elements that promote or restrict judgment of migration (Jung et al., 2017). PPM offers scientists with a clear three-dimensional model of switching intention (Zhang et al., 2014).

Generally speaking, research on switch intention has been lacking an overall framework for the study of transfer intention. Only some researchers have attempted the overall framework, but none have been able to fully integrate the two perspectives of promotion and inhibition. The consumer switch intention study is still emerging on the IS field. However, the problem that the theoretical basis is not comprehensive is still as common as in other disciplines.

This research revealed three series of influencing factors that influence Chinese consumers' willingness to switch between different brands of milk under the traditional cold chain and the traceability system, and to empirically analyze the influencing relations among the three types of factors. Therefore, this study integrates ISS model, TPB model, and ITM model into PPM, empirically analyzes the three influencing factors in switching intention, and extends the research on the factors in PPM model to draw the conclusion: ISS model, ITM model, and TPB model to analyze the interaction between different variables and switching intention (Fang and Tang, 2017). The results showed that 10 of the 11 hypotheses are positive, but the effect of perceived risk on customer satisfaction is not significant. The aforementioned empirical analysis results proved that it was beneficial to incorporate these three theoretical models into the PPM model. As far as we know, in the field of food safety traceability, there were few empirical studies using PPM integrated model. This study could fill this knowledge gap.

BACKGROUND AND LITERATURE REVIEW

Frequent food safety incidents have dramatically increased Chinese consumers' appetite for food safety concerns. The melamine milk powder scandal in China's dairy industry has weakened Chinese consumers' confidence in its domestically produced dairy products. With China' economic development and the increasing domestic income level, milk and other dairy products have gradually increased as a proportion of consumer food consumption, which suggests that milk has become a necessity for many Chinese households.

As a result, the dairy products' safety has become an important issue in China. In recent years, Chinese producers have undertaken various technology measures (e.g., FTS of dairy industry) to improve the safety of dairy products and enhance the Chinese milk consumers' confidence (Yin et al., 2016).

From the economic point of view, information asymmetry is one of the problems that contribute to food safety. Obviously, suppliers often utilized information asymmetry between buyers and themselves to engage in opportunistic behavior, such as fraud. If FTS can gain buyers' trust, it will reduce information asymmetry. FTS has become an important solution for producers to demonstrate the food quality to buyers (Yin et al., 2016). With Chinese consumers' attention to food safety, Chinese consumers' demand for FTS has been increasing in recent years (Yin et al., 2016).

Food Traceability System (FTS)

From an economic point of view, information asymmetry becomes the reason of food safety issues. Moreover, suppliers often misused information asymmetry between buyers and suppliers to carry out opportunistic behavior, for example, fraud (Yin et al., 2016). Facing information asymmetry, traceability systems enable food to be tracked and traced at all stages of

production and is regarded by buyers as a vital mechanism to verify the origin of food. Furthermore, it also helps to provide authenticity guarantee for consumers (Kendall et al., 2019).

Food traceability system is a topic that is receiving increasing attention from researchers around the world (Tarjan et al., 2014). The aim of FTS is to determine the food source, protect the food in transit, and reduce the time and cost associated with food recall. A complete FTS, including harvesting, processing, transportation, storage, distribution, and sales, can track products by updating data that are important to the consumers at each stage, such as the product origin, processing mode, storage conditions, and expiration date (Qiana et al., 2020).

To modernize the technical service system, the tools and technologies adopted are continuously developed to realize the progress of the system. Significant advances in information and communication technology (ICT) have promoted the development of FTS both locally and internationally. Barcodes and radio frequency identification (RFID), as identification technologies, have been integrated into FTS to track food products quickly and precisely. Accordingly, FTS has been effectively applied in many different agricultural food industries, including vegetables, fruits, aquaculture, and beef (Qiana et al., 2020).

Facing the information asymmetry, consumers believe that traceability systems that can track and trace food at all stages of production are an important mechanism for verifying the origin of food and also help to provide consumers with assurance of authenticity. Communication with consumers can be facilitated by the development of multiple information delivery mechanisms, including product information linked to the origin of the product and traceability systems. Information technologies consist of barcodes, QR codes, and online material, and can provide more complete information on where products come from and how far along the supply chain they travel.

Barcodes are a perfect choice for speeding up inventory and billing. Barcode is easy to use and is cheap. The Quick Response (QR) code is a two-dimensional bar code that often appears on traceability labels (Qiana et al., 2020). QR code is one of the most commonly used two-dimensional codes. It can store enough data and has very good readability even on small-sized tags, and it is also very readable in the case of physical damage to part of the code (Tarjan et al., 2014). Technological advances in tracking and traceability may further reassure consumers about the authenticity of products, with blockchain technology in particular being seen as a particularly secure and transparent means of ensuring authenticity.

Pull-Push-Mooring (PPM)

Pull-push-mooring was originally suggested as a specific theory of human migration (Moon, 1995; Lee et al., 2001), which was designed for the dominant pattern of migration research, describing why individuals migrate from one land ecosystem to another terrestrial area (Bansal et al., 2005). Essentially, as a comprehensive framework, it studies the different aspects of users' migration intention, including the push factors that promote the users' departure of existing services, the pull factors that attract users to choose an alternative service, and the mooring factor that hinders or promotes the migration decision. PPM derived from migration theory may be a useful conceptual model for analyzing the switching intention because human migration is not just about moving between geographic locations but also extends to a variety of daily activities (Jung et al., 2017).

From the perspective of PPM framework, some researches have solved the switching behavior of the IS sector, such as mobile services (Calvo-Porral and Lévy-Mangin, 2015), travelers' switching intention (Lehto et al., 2015), the switching intention of social network sites (SNS) (Chang et al., 2014), the switching behavior of web browsers (Potter and Ye, 2011), the attitude change of cloud medical services (Hwang et al., 2015), and the users' switching behavior of users' mobile instant messaging (Sun et al., 2017).

Switching intention comes from customers' comments after using the product or service. When customers' evolution results are negative, they tend to show switching behavior. The existing literatures have discussed switching behavior based on marketing disciplines and found out a number of factors affecting switching intentions (Hsieh et al., 2012). Due to the increasing popularity of online service activities, there have been more and more studies on switching behavior in the IT/IS field in recent years (Hsin-Ke et al., 2016). Depending on the application contexts, PPM provides researchers with a clear structure to understand the switching behavior of three dimensions (Keng and Hsin, 2019).

One drawback of PPM is that, although PPM is a perfect model for migration studies (Hsieh et al., 2012), when applied to switching intention for food safety, some key factors related to qualities, TPB, and initial trust may be lost (Fang and Tang, 2017). Therefore, we recommend going beyond the existing PPM framework by referring to the actual characteristics of food safety. To our knowledge, the integrated model between PPM, D&M ISS, TPB, and initial trust has not yet been used to explain user switching intentions in the food safety domain. We believe that an integrated PPM will be a suitable framework for this study.

Push Factors (D&M ISS Model)

DeLone and McLean (2003) suggested a structure for measuring the success of information systems, which has been widely used after its publication. Ten years later, based on the results of empirical tests and theoretical discussions by the academics, they revised their model to measure the information success technologies (DeLone and McLean, 2003). System quality (SYQ), information quality (IQ), and service quality (SEQ) are the key factors, while the results are usage intention, user satisfaction, and net benefit (Chuang and Fan, 2011). For example, SYQ refers to the quality of information automation system, which is manifested as the complete system function. IQ refers to the quality of system output products, including relevance, user-friendliness, adequacy, and accuracy. SEQ refers to the features of the service system that consumers receive from information delivery units and technical supporters, such as friendliness, credibility, and simplicity. User satisfaction is referred as the degree of value produced by IQ (Lee and Lee, 2008).

As one of the popular IS theories to measure the information system technology's success degree, the D&M ISS model has been widely recognized and applied in various research areas. More

than 260 articles have applied this framework to measure the D&M ISS model (Tahar et al., 2013). Particularly, in the context of information system, D&M ISS is applied to many aspects, such as mobile commerce (Lin et al., 2019), mobile banking, and mobile learning (Im et al., 2011).

Even if many evidences have pointed out that ISS can systemically elucidate and predict the factors that influence the usage intention of information system, still few empirical studies on food safety are empirically reported by integrating ISS into PPM.

Perceived risk is generally defined as uncertainty in the possible negative results of utilizing some application or service. Inadequate or unreliable security technologies will enlarge users' risk degree, leading to reduced satisfaction in the context of information technology. In this study, perceived risk is termed as potential losses or uncertain negative outcomes in the process of adopting food traceability systems, including perceived risks that are often encountered, such as platform failures, missing keywords, operating systems incompatibility, and poor IQ (Chen, 2012). Besides, perceived risk means the possibility that students suffer losses in the process of mobile learning. Students often encounter perceived risks like privacy issues, platform faults, and lost keywords (Chao, 2019).

Relationship quality (RQ) is generally conceptually represented as a complex or multidimensional construct (Sun, 2010). It is a higher-order construct consisting of several distinct but related facets in the relationship (Chen, 2012).

Mooring Factors: Theory of Planned Behavior Model (TPB)

Famous "intervention barriers" are associated with factors that facilitate human migration, thereby accelerating it and vice versa. This implies that the relationship between variables and individual environment, psychological factors, values, living standards, and social influences is a complementary factor of PPM's push–pull effect (Kim et al., 2019).

According to the TPB model proposed by Ajzen (1985), certain motivational factors, including attitude toward a certain behavior, subjective norms (i.e., a person's perception of prohibitive and descriptive norms in a specific group), and perceived behavioral control (PBC), will promote the intention to take a certain action. As long as there is a suitable opportunity, consumers will translate this behavioral intention into actual behavior. TPB is very useful for predicting people's food choices and their consumption patterns or food handling practices, and as a tool for analyzing the food-choice behaviors in relation with risk or health-related actions (Chen, 2017).

Theory of planned behavior was used to study influencing elements of usage intention and people's food habits in many areas, for example, a food hygiene intervention, the usage intentions of genetically modified agriculture, and indicators of public perception on risk perception of food additives (Yin et al., 2018).

Pull Factors: Initial Trust Model (ITM)

The pull factors studied in this paper are structural assurance (SA), personal propensity to trust (PPT), and firm reputation (FR) (Matzembacher et al., 2018). Initial trust is often formed during the first interaction between consumers and mobile payment providers, and it has been confirmed that initial trust was the most critical element affecting the first purchase decision of first-time consumers because wireless transactions can only be executed after the initial trust was established (Matzembacher et al., 2018). The factors that affected the initial trust were determined. Those elements can be roughly divided into three factors. The first style of factors was associated with features of websites. Consumers would depend on their initial perceptual knowledge of mobile payment platform to form the usage intention. Structural assurances were effective in affecting usage intention. The second style of factors was closely connected with company. Firm reputation was also an important element influencing usage intention because it decreased the risk from potential price information asymmetry and after-sales guarantee after finishing the process of mobile payment deal. The third style of factors were combined with user behavior. Personal tendency to trust revealed a tendency and had an important influence to usage intention.

Initial trust model has been applied in many fields to determine the switching intention of information technology, such as mobile shopping, mobile banking, e-commerce, and m-payment. Therefore, FTS needs to be explored to improve the level of food safety. For example, the instability of existing supply chains in the fruit and vegetable industry calls for the establishment of an adequate system and the reduction of numerous food safety incidents and fraud. In the dairy industry, there is a need to ensure quality standards and subsequent consumer satisfaction as products are sensitive to changes in processing and system management can effectively control these changes (Matzembacher et al., 2018).

RESEARCH MODEL

Push-pull-mooring model has been empirically tested in different fields and identified as a useful information system research framework, such as switching intention of tourists' hotel booking (Lehto et al., 2015), wireless network websites' willingness to switch (Zhu et al., 2014), switch to web browsers' willingness (Potter and Ye, 2011), and changes in attitudes to cloud health service (Hwang et al., 2015); the aforementioned research conclusions indicated that PPM positively influenced switching intention (Keng and Hsin, 2019).

In the **Figure 1** of this study, RQ was considered as a higher-level construct with two different but related elements: trust and user satisfaction. In the study of RQ, these two factors were widely referred as the determinate components of RQ (Sun, 2010).

The switching intention of consumers is very important to enterprises. This paper will discuss the factors influencing switching intentions from the perspective of FTS. Generally switching behavior refers to the movement from one dwelling place to another. This movement can also be conceptual, such as replacing an existing service provider with an alternative service provider in the context of a service or using a new product to replace a previously used one. This paper will discuss

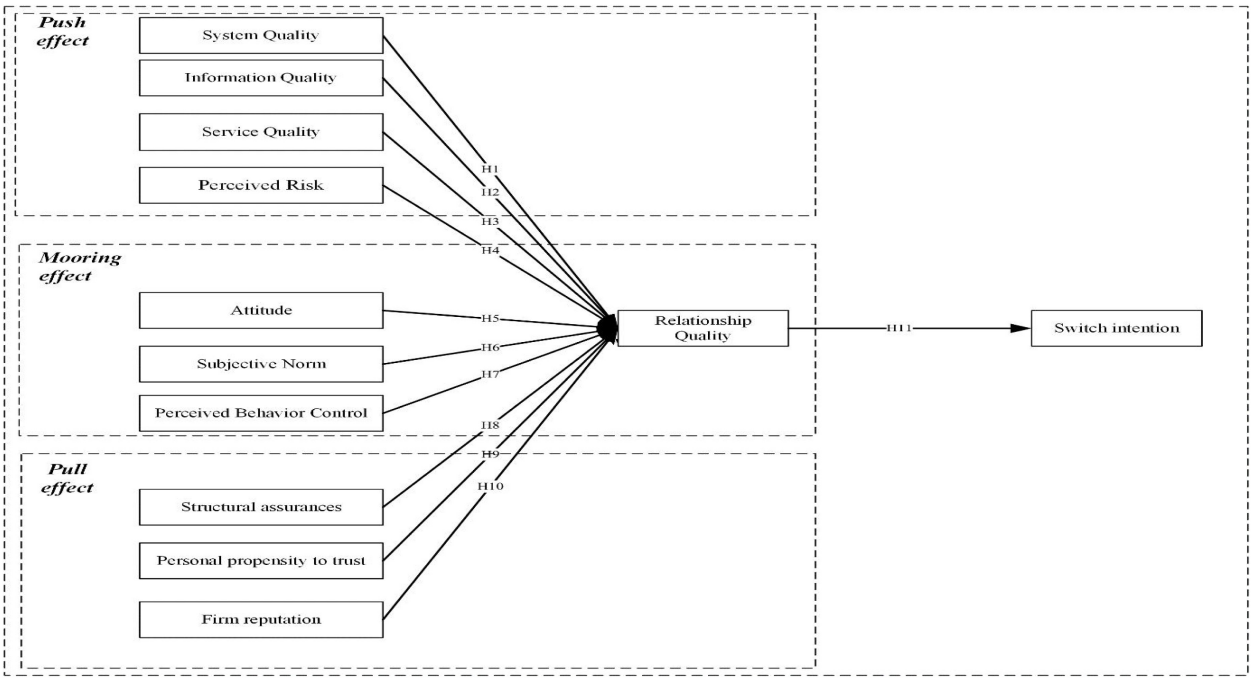

FIGURE 1 | Results of the inner model.

conceptual switching in the context of both products and services. Switching intention and behavior, as a collective representation known as consumer switching behavior, can have a considerable impact on the performance of dairy companies in the form of retention of old customers and acquisition of new customers. Therefore, a comprehensive understanding of the influencing factors of the consumers' switching intention can help product and service designs, so as to further expand the benefit scale of dairy companies.

Push Factors: D&M ISS Model

System quality is referred to as the user's perceived intensity of the system's ease of operation, the intensity of connection and learning, and the degree of pleasure in use (Petter and McLean, 2009). Rizal et al. (2018) pointed out that the perceived SYQ describes the individual's evaluation of the system performance characters based on the user's experience in using the system. Chung et al. (2014) argued that they focused on the influential factors such as the convenience, system reliability, response time, and flexibility of mobile business access terminals in Korea to identify how SYQ has become a key variable in service loyalty. In the absence of these functions (Sharma and Sharma, 2019), users may doubt the ability of mobile payment service providers to provide quality services, which may increase the difficulty of using their devices.

Therefore, SYQ may affect user satisfaction, and we predicted the following hypothesis:

> H1. System quality significantly influences relationship quality.

DeLone and McLean (2003) confirmed the IQ's characteristics, such as integrity, accuracy, pertinence, and accessibility, which are fundamental factors for use and indicate that IQ is a vital element in determining consumers' intention to choose some technology that they will use. Hence, IQ should be considered as the core structure affecting user satisfaction and intention.

Rizal et al. (2018) argued that in an environment mediated by a food safety traceability system, customer's purchasing willingness on some enterprise products and services can be determined by their perceived IQ. Research also suggests that the IQ of dairy products is an important component in building a positive reputation (DeLone and McLean, 2003). Therefore, the hypothesis is suggested as follows:

> H2. Information quality significantly influences relationship quality.

Service quality (SQ) refers to the features (e.g., reaction, trustworthiness, brevity, and technological capability) of the service that consumers receive from the information systems divisions and after-sales service. SQ is often termed as how information service fulfills user needs. Only when it comes to the quality of services can the effectiveness of information systems be correctly evaluated. If the quality of service is not involved, the effectiveness of the information system cannot be evaluated correctly. We believe that confirming all quality factors, including service quality, will help consumers to set up and measure the RQ accurately.

Service quality also influences use satisfaction, perceived quality, and service conversion. For example, customers with high service quality are evaluated to show positive intention.

Contrarily, customers with low service quality will tend to choose a change agent over a new purchase in the next consumer choice situation (Rizal et al., 2018). Considering the aforementioned situations, the following hypothesis is proposed:

H3. Service quality significantly influences relationship quality.

It is believed that perceived risk (PR) refers to a person's perception of the ambiguous and adverse results of an action (Glover and Benbasat, 2014). PR plays an important role in decision-making (Rahman et al., 2019). In this study, PR is defined as the combination of uncertainty and the severity of the results involved. According to risk theory, there is an acceptable range of risk; when the risk perception exceeds that, consumers will take solutions to control the level of risk under an acceptable level. The higher the risk perception is, the more likely consumers are to take actions to reduce the risk.

From the perspective of the PPM model, because many studies have shown that push effects often include negative perceptions of service providers, such as service failures, staff problems, and price problems, leading to low satisfaction and trust, this research attempts to explain how FTS has become an important supplement to food safety push factor. Therefore, we suggest the hypothesis as follows:

H4. Perceived risk significantly influences relationship quality.

Mooring Factors: TPB Model

Theory of planned behavior is in the most significant social psychological theories to predict human activities (Chen, 2017). TPB consists of three components, for example, attitude, subjective norm, and PBC. Taken together, behavioral beliefs produce behavioral attitudes, normative beliefs create subjective norms, and control beliefs lead to perceived behavior control. The combination of all these factors results in a behavioral intention.

Even if TPB has been successfully used to predict switch intention and behavior in a number of fields, it may not gather all the elements of the special behavior, for example, the food choice decision (Chen, 2017). TPB should comprise more components to better predict switch intention and behavior.

Attitude toward a special behavior is an overall evaluation of an individual's goal behavior (Ajzen, 1985). Many researches have confirmed the influence of attitudes on switch intention (Yin et al., 2018).

H5. Attitude significantly influences relationship quality.

Subjective norms are prerequisites for the implementation of social behavioral intentions, including the application of information technology (Ajzen and Fishbein, 2005). Consumers' switch intention is also a function of their cognition of the subjective norms toward switching to the alternative.

The role of subjective norm makes consumers naturally change their habitation based on some norm or majority opinion (Ajzen and Fishbein, 2005). Numerous studies have revealed that mandatory and descriptive norms have an impact on behavioral intention. When the public is faced with reporting dilemmas, the more influence a person or organization has over them, the more pressure they feel to participate in food safety reporting, thus enhancing their intention to participate (Yin et al., 2018).

H6. Subjective norm significantly influences social intention.

Perceived behavioral control is defined as the perception of how easy it is for people to perform an act of interest (Ajzen, 1985) or the degree to which an individual thinks the act is controlled by his or her willingness (Price et al., 2015). PBC determines the degree of difficulty for an individual to perform a certain behavior, which can not only directly affect the behavior but also indirectly affect the behavior through intention. Public food safety reporting behavior can be affected by many objective factors (Yin et al., 2018). Given this situation, this hypothesis can be concluded that:

H7. Perceived behavior control significantly influences switch intention.

Pull Factors

According to the definition of the pull effect in the PPM framework, the pull effect is the positive effect of encouraging potential migrants to travel to a new destination (Keng and Hsin, 2019).

The initial trust model in an individual's perception of the institutional environment is related to differences in security or procedural safeguards. In previous research, institutional trust is a structural guarantee.

Structural guarantees are related to evaluation and success through institutional devices such as regulations and legal guarantees under specific circumstances. They are composed of trustworthy guarantees, regulations, commitments, and legally binding structures. Especially in cross-border e-commerce transactions, the danger of being late is greater because of the strangeness recognized by customers. In a way to reduce the risk of users being late, structural guarantee becomes an important variable. Therefore, the hypothesis postulates:

H8. Structural assurances significantly influence relationship quality.

The personality-based personal trust tendency is the trust that is formed from the small and can be said to be the general tendency of others. Such personal trust tends to be believed to be generally straight and dependent, and the transaction with the trusted person will have a better result before the trusted person takes the opportunistic action.

Therefore, personal trust tends to have no experience with the trustee and depends on trust expectations. Personal trust tends to have a significant impact on initial trust in the initial trust situation.

Research by Wu and Lee (2017) shows that if a company provides a safe and accurate service, the customer's trust tendency will have a significant impact on the usage intention of the service. Therefore, the hypothesis postulates:

H9. Personal propensity to trust significantly influences relationship quality.

Company reputation is one of the important factors that affect early credibility. For mobile applications, two main factors affect reputation: the certification mark and brand recognition. Studies by Wu and Lee (2017) have shown that company reputation has a positive impact on initial trust. Therefore, the hypothesis postulates:

H10. Firm reputation influence significantly influences relationship quality.

Relationship quality plays an important role in exploring the connections that exist between customers and the enterprise. Many academics have researched the influence of the three components of RQ on switching intention. For instance, Sanchez-Franco (2009) researched the effects of satisfaction and trust on loyalty of Internet technology providers. They found that satisfaction significantly affects commitment and trust. In addition, Hennig-Thurau and Klee (1997) studied the impact of RQ dimensions, such as customer satisfaction and trust, on customer's switch intention. Jani and Han (2011) studied the impact of customer satisfaction, trust, and commitment on behavioral intentions, and found that customer satisfaction had a direct impact on intention.

H11. Relationship quality significantly influences switching intention.

DATA COLLECTION AND RESULTS

In the preliminary test, this study referred to relevant literature and expanded various variables and related measurement items according to the theme of this study. We invited 50 Chinese consumers who often use the blockchain QR code for dairy product safety trading and completed the prediction test through face-to-face interview with the designed questionnaire. Then the ambiguous measurement items were modified so that the follow-up consumers could fully understand the content of the questionnaire and improve the credibility of the follow-up survey. In the follow-up questionnaire, we recruited 300 consumers (220 Chinese and 80 South Koreans) who had used the blockchain QR code dairy products. Because the South Koreans in northeast China are more concentrated than those in other parts of China, we can get enough samples quickly. In the large supermarkets of northeast China, we randomly intercepted consumers and identified the right people who have used the blockchain QR code to buy safe dairy products. After receiving the questionnaire, appropriate users filled in the questionnaire according to their own intention.

From the beginning of August to the beginning of September in 2020, the survey conducted a 3-week one-to-one interview on the traceability use intention of dairy products in major supermarket chains in northeast China. Participants who are not involved in QR technology are completely excluded. A total of 350 questionnaires were issued and 330 were recovered, with a response rate of 94.28%. After 25 responses were discarded, 305 samples (92.42%) were used for deterministic analysis due to lack of critical data or experience with QR codes. The final data are sufficient to define the sample. Items were provided on a five-point Likert scale (**Table 1**), ranging from "strongly reject" to "strongly agree." In the subsequent SEM analysis, IBM SPSS 25.0 was used for evaluation to check the element structure and internal correlation of each part. In this study, Cronbach's α was used to evaluate the validity of the structure by examining the factor structure and internal correlation of each structure. To test the study hypothesis, we used IBM Amos 24.0 to determine the causal relationship by means of significance values and standard coefficients. The entire sample is used to analyze the integration model before hypothesis testing.

Reliability, Validity, and Measurement Model Evaluation

We evaluated the measurement item's convergence effect on its related structure. First, the standardized load method is used to measure reliability. Moreover, Cronbach's α and CR scale were used for reliability measurement. Furthermore, AVE is extracted to measure the variance of a variable relative to the variance.

As shown in **Table 2**, Cronbach's α is generally better than 0.60, and CR is also higher than 0.80 (Nunnally, 1978), indicating that the optimal validity measurement explains the structure of the scale and the overall consistency level is high. In addition, the aggregate validity is a measure of three-dimensional factors, that is to say, the standardized load represents the relationship between some basic factors and each indicator is 0.7 statistics, except that the overall reliability of the reliability scale is significantly greater than 0.6 (Nunnally, 1978; Hair et al., 1998); each AVE value is greater than 0.6 (Fornell and Larcker, 1981).

As shown in **Table 3**, discriminant validity refers to the difference between the related indexes of the first principle and those of the second principle (Bagozzi et al., 1991). Fornell and Larcker (1981) found that the discriminant validity test must be carried out by evaluating the square root of AVE in each variable in the correlation coefficient of each construct.

Judged by **Table 3**, for every data, it can be seen that for each data, the square root of the variance between each structure and

TABLE 1 | Sample characteristics.

Characteristics	Description	Frequency	Percentage (%)
Group	China	305	100
Gender	Female	222	72.79
	Male	83	27.21
Age	Below 30	205	67.21
	30–40	45	14.75
	40–50	40	18.04
	Above 50	15	3.04
Occupation	Company employee	155	50.52
	Civil servant	85	27.88
	Self-employed person	40	13.11
	Others	25	8.49
Experience for QR	Yes	305	100.0

TABLE 2 | Convergent validity and reliability (entire samples).

Construct	Indicators	Standardized loading	Cronbach's α	Composite reliability	AVE
SYQ	SYQ 1–4	0.750–0.836	0.862	0.8631	0.6122
IQ	IQ 1–4	0.759–0.814	0.871	0.8551	0.5968
SEQ	SEQ 1–4	0.753–0.879	0.872	0.8649	0.6166
PR	PR 1–4	0.690–0.846	0.851	0.8519	0.5910
AT	AT 1–4	0.824–0.854	0.900	0.9004	0.6932
SN	SN 1–4	0.734–0.788	0.855	0.8552	0.5965
PBC	PBC 1–4	0.762–0.847	0.880	0.8819	0.6516
SA	TP 1–4	0.856–0.910	0.933	0.9344	0.7808
PPT	PPT 1–4	0.797–0.852	0.904	0.9037	0.7013
FR	FR 1–4	0.734–0.876	0.877	0.8800	0.6483
RQ	RQ 1–4	0.811–0.866	0.903	0.9039	0.7019
SWI	SWI 1–4	0.849–0.907	0.930	0.9302	0.7691

TABLE 3 | Discriminant validity (entire sample).

	SYQ	IQ	SEQ	PR	AT	SN	PBC	SA	PPT	FR	RQ	SWI
SYQ	0.782											
IQ	−0.250	0.773										
SEQ	−0.199	0.166	0.785									
PR	−0.147	−0.169	0.054	0.769								
AT	−0.020	0.259	0.301	0.104	0.833							
SN	−0.045	0.221	0.247	−0.053	0.518	0.772						
PBC	−0.061	−0.126	0.166	−0.034	−0.501	−0.391	0.807					
SA	0.163	0.087	0.082	−0.104	−0.254	−0.244	0.186	0.884				
PPT	0.132	0.128	0.203	−0.108	0.336	0.197	0.252	0.502	0.837			
FR	0.071	0.146	0.231	−0.114	0.271	−0.222	0.172	0.341	0.461	0.805		
RQ	0.134	0.342	0.348	−0.175	−0.524	0.461	0.381	0.420	0.491	0.453	0.877	
SWI	0.055	0.181	0.337	−0.100	0.491	0.360	−0.392	0.495	0.519	0.464	0.745	0.838

each AVE is greater than any correlation coefficient between the relationship structure between the structure and another, and the meeting's good discriminative validity criterion. The correlation between constructs exceeds the diagonal value, which proves that the construct validity of our measurement tool is satisfactory.

The two-process method (Anderson and Gerbing, 1988) was used to evaluate the selected data. First, we examined the convergence and effectiveness of the algorithm. The second step was to evaluate the integration framework between the portfolio models. Third, to test the fitting degree and structure of the measured values, the data of Chinese consumers were applied to test the overall structure. The following model fitting indexes were recommended by Hooper et al. (2008).

The AMOS 24.0 program was used to assess this study's measurement and structural framework. The χ^2/d.f. are 1.156 and 1.108, GFIs are 0.850 and 0.845, AGFIs are 0.820 and 0.826, NFIs are 0.894 and 0.894, CFIs are 0.988 and 0.978, IFIs are 0.988 and 0.978, RFIs are 0.882 and 0.853, PGFIs are 0.840 and 0.758, PCFIs are 0.888 and 0.907, PNFIs are 0.803 and 0.796, RMRs are 0.040 and 0.060, and RMSEAs are 0.019 and 0.025. Our results support this relationship of each model.

The 11 hypotheses of this research were examined by SEM. For the contraction fitness index, it exceeds the acceptable minimum fitness value, which is a standard value. The fitting indexes show that the fitting results of the analytical sample and the comprehensive model are satisfactory.

Hypothesis Verification

After examining measurement suitability and integrated framework's organization, the structure's path coefficient was estimated. According to the *p*-value in **Figure 2**, one path (H4; *p*-value of >0.05) was rejected, and the remaining nine paths were confirmed as positive.

The Chinese consumers' switch intention that was influenced by SYQ (β = 0.17), IQ (β = 0.187), SEQ (β = 0.196), PR (β = −0.051), AT (β = 0.148), SN (β = 0.162), PBC (β = 0.126), SA (β = 0.145), PPT (β = 0.186), FR (β = 0.146), and RQ (β = 0.826) jointly explained 68.2% intention of switch variance.

The test results and structural model were given, and the model of FTS experience is analyzed. Judged by **Table 4**, the existence of the comprehensive model is verified. **Table 4** verifies the correlation path coefficient, lists the causal path characteristics, and verifies the results of the combined framework. The basic assumptions' path coefficients of the synthesis model were well measured. According to the respective p values, one path (H4; $p > 0.05$) was not supported, and the remaining paths were significantly lower than 0.05 level.

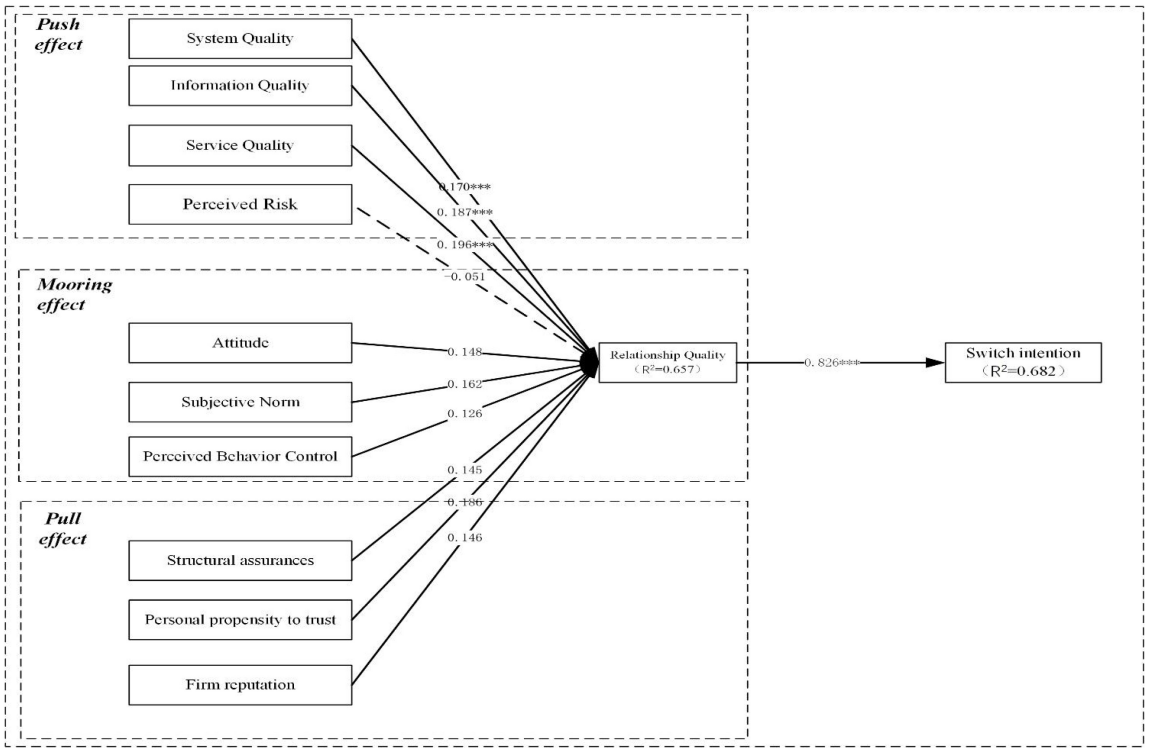

FIGURE 2 | Research model.

TABLE 4 | Results of hypotheses tests.

Hypothesis	Route	Estimate	SE	*T*-value	*P*	Path coefficients
H1	SYQ→RQ	0.183	0.054	3.413	***	0.170
H2	IQ→RQ	0.166	0.044	3.798	***	0.187
H3	SEQ→RQ	0.196	0.050	3.917	***	0.196
H4	PR→RQ	−0.052	0.047	−1.114	0.265	−0.051
H5	AT→RQ	0.138	0.061	2.268	0.023	0.148
H6	SN→RQ	0.152	0.056	2.722	0.006	0.162
H7	PBC→RQ	0.122	0.053	2.3	0.021	0.126
H8	SA→RQ	0.113	0.041	2.794	0.005	0.145
H9	PPT→RQ	0.171	0.055	3.103	0.002	0.186
H10	FR→RQ	0.136	0.049	2.794	0.005	0.146
H11	RQ→SWI	0.979	0.07	13.947	***	0.826

**p < 0.05; **p < 0.01; ***p < 0.001. RQ, relationship quality; SYQ, system quality; IQ, information quality; SEQ, service quality; PR, perceived risk; AT, attitude; SN, subjective norm; PBC, perceived behavior control; SA, structural assurances; PPT, personal propensity to trust; FR, firm reputation; SWI, switch intention.*

Judged by the previous analysis results, we can draw the following conclusions: (1) SYQ is a key factor determining RQ and has a significant positive impact on RQ. So H1 is valid. (2) In the concept of a user-friendly interface, navigation convenience, response time, and reliability are the most important variables. There is also a significant positive relationship between IQ and RQ, among which security, integrity, correlation, and privacy protection are the most important variables. Therefore, H2 is valid. (3) Service quality has a significant positive effect on RQ. Therefore, H3 holds. Ability to complete transactions and after-sales service, and meet customer's demands are most critical to service quality. (4) Perceived risks have no positive influence on RQ. Thus, H4 failed.

Relationship quality plays a critical role in fully mediating variables between SYQ, IQ, SEQ, and switching intention. The SYQ, IQ, and service quality of dairy sellers using the blockchain QR code can enhance customers' trust in the enterprise's ability, integrity, and goodwill, and promote dairy consumers to enhance their purchase intention. Thus, H11 is established.

Moreover, our combined TPB model with PPM theory also shows that RQ is a major factor in influencing the switching intention of choosing dairy products. This conclusion

TABLE 5 | Mediating effect analysis.

Independent variable	Mediating variable	Dependent variable	Mediation effect	SE	LLCI	ULCI	*P*-value
SYQ	RQ	SWI	0.14	0.046	0.053	0.23	0.002
IQ	RQ	SWI	0.155	0.046	0.065	0.241	0.002
SEQ	RQ	SWI	0.162	0.046	0.07	0.249	0.001
PR	RQ	SWI	−0.042	0.037	−0.116	0.029	0.269
AT	RQ	SWI	0.122	0.059	0	0.233	0.05
SN	RQ	SWI	0.133	0.052	0.033	0.24	0.014
PBC	RQ	SWI	0.104	0.051	0.006	0.21	0.033
SA	RQ	SWI	0.12	0.045	0.035	0.214	0.016
PPT	RQ	SWI	0.153	0.048	0.06	0.247	0.001
FR	RQ	SWI	0.12	0.046	0.028	0.206	0.009

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

is consistent with other researches which have found that RQ is a vital motivational driver in the intention-switching procedure (Glaeser et al., 2000; Hobbs and Goddard, 2015). Thus, H5–7 are established.

In addition, as an additional variable to explain the intention of Chinese dairy consumers, our measurements of structural guarantees, PPT tendency, and firm reputation are statistically significantly positive. Our results confirm that H8–10 are true: initial trust variables in QR code positively affects RQ.

Mediation Model Verification

The mediating effect was analyzed with Bootstrap and Amos 25.0 software, and the results are shown in **Table 5**.

In **Table 5**, when the independent variable is PR, the mediating effect results is −0.042, and the CI is −0.116 to 0.029, concluding 0. The significance $p = 0.269 > 0.05$, indicating that the independent variable PR cannot influence SWI through RQ.

Through the aforementioned SEM tests, we concluded that PR negatively influenced switch intention because significance $p = 0.269 > 0.05$. This conclusion indicates that FTS providers should increase other quality factors (SYQ, IQ, and SEQ) to influence QR and decrease ITM (SA, PPT, and FR) to stimulate users' usage intention, to retain the old consumers, which will drive online service providers to generate more competitive features to attract new consumers.

In addition, we have tested the relationship among PPM, ISS, ITM, and dairy consumers' intention to buy, and the significant direct effect of the causal relationship has been proved. The RQ plays a critical and sufficient mediating role among PPM, ISS, ITM, and dairy consumers' switching intention.

CONCLUSION

Discussion

With the passage of time, the importance and relevance of FTS become more and more obvious. Our result shows that traceable dairy products benefit Chinese consumers. Chinese consumers influenced by traceability food information are willing to pay the extra price for the traceable information. Chinese consumers' lack of information on traceable dairy products may be seen as an obstacle to the development of the traceable dairy industry. Therefore, further task is needed to raise consumer awareness of the potential advantages of traceability systems in the dairy product systems.

In this paper, it is necessary to use the PPM model in the migration theory to explain the switching intentions of customers on the dairy products. Second, according to the common characteristics among the first-order dimensions that influence the customer's switching intentions, this study classified factors into three and validates the usefulness of second-order construct framework to conceptualize the model more concisely. In this study, we focus on the factors that can influence and promote consumers' switching intention to increase or decrease the use of FTS. Therefore, like Hoffman and Novak (2009), we combined TPB and ITM with ISS and PPM as the prerequisite of the framework. In particular, we identify the significant factors influencing push–pull. This study shows that all the other 10 hypotheses are valid except PR.

Theoretical Contribution

This study is of great significance to researchers and practitioners. To address the deficiencies in both the theoretical structure and empirical analysis in food safety FTS, three series of factors (i.e., the D&M ISS model, the TDB model, and the ITM theory) are combined with the PPM to form a complete integrated model as a conceptual framework. The conceptual framework enhances the explanatory deficiencies of the three separate models and further clarifies the subjective and objective factors that influence conversion intentions. This study builds a complete multidimensional framework for food safety FTS (shown in **Figure 1**). It is proposed that SYQ, IQ, SEQ, PR, AT, SN, PBC, SA, PPT, and FR are 10 important determinants to measure the switching intention of FTS. By emphasizing the validity of integrating the three established theories of ISS, TPB, ITM, and PPM, this study provides a holistic approach for future researches using the new FTS technology, namely blockchain two-dimensional code technology.

Our results show that the proposed model has strong explanatory power and is robust in several cases. The integration framework has not only theoretical appeal but also important

empirical significance. The following inspirations can be obtained from this study:

Push Effects

Some enlightenments are obtained from this study. First of all, our research develops the previous researches. The research results take IQ, SYQ, and SEQ as a whole and provide support for the research on information SYQ. (1) SYQ: research shows that SYQ is the key factor determining trust. Only in all transactions where the system promotes a quality process at all times can high-quality operations be produced. The quality of blockchain QR code technology can enhance customers' experience of these activities. (2) IQ: it is found that quality of information has a significant impact on the quality of relationships. Previous studies have also confirmed that security, privacy, relevance, and integrity are important for establishing RQ (Liu and Arnett, 2000; Lee and Turban, 2001; Gefen, 2002; Gefen et al., 2003). (3) SEQ: research shows that service quality is also a key factor determining the quality of relationships. If the quality of service provided by milk product operators adopting blockchain two-dimensional code technology can meet the expectations of customers, it can cultivate customers' trust. Milk product operators adopting blockchain two-dimensional code technology should pay attention to customers' needs, provide follow-up service support for customers, and present the realization of promises in an efficient way, which will increase customers' trust belief and ultimately encourage purchase intention.

According to our results, there is an insignificant relationship between perceived risk and RQ. Risk is the probability distribution of the outcome of an event, the gain or loss of which is uncertain. As consumers cannot timely and accurately understand the impact of food on their own health, the uncertainty of food safety risks is relatively high. This information asymmetry challenges the users' perceived risks conception. Because of the information asymmetry, ordinary users will only count on feelings and experience to make judgments instead of depending on scientific details. This is often at variance with the actual situation of food safety. For example, consumers may exaggerate to treat food safety emergencies like bird flu and mad cow cases, even though the frequency of that is rather low, and the risk is low. However, some serious and high-risk food safety events are overlooked, for example, the long-term consumption of many fried foods that are carcinogenic. As a result, there is a large discrepancy between consumer perceptions and facts.

Mooring Effects

First of all, attitude positively affects the switching intention of dairy consumers. Obviously, the dairy products providers should foster positive attitudes toward food safety RQ among dairy consumers and raise their awareness of the importance of reporting food safety RQ. This measure can cultivate dairy consumers' high sense of social responsibility and enhance their food safety awareness.

Second, PBC also positively affects the switching intention of dairy consumers in choosing safety food. Therefore, the dairy product providers should focus on decreasing difficulty in choosing safety dairy products. The dairy product providers should develop innovative, effective use of the Internet and big data to streamline the food safety reporting process, smooth the multiplicity of reporting channels, and ensure that public food safety reporting is simple, convenient, and feasible.

Third, subject norm is a major determinant whether a consumer participates in food safety report, which leads to the emphasis that participating in food safety report is an individual's social ideal behavior and moral obligation. This need reinforces their personal perception that it is morally right to participate in food safety reporting.

Pull Effects

From the dairy product consumer's perspective, a perceived benefit of traceability, which can impact all stages of the supply chain, is that it provides additional product-related information and enhances the consumers' RQ. In addition, these systems can respond quickly in the event of a food safety incident, helping to keep dairy products' trust. In the event of an incident, traceability information can shift responsibility to the source of the safety issue and avoid reputational damage due to the mistakes of different actors.

The emergence of new technologies in the food system reduces consumers' understanding and familiarity with food production and separates them from the food producers and processors. It is necessary to provide structural assurances such as "transparent information that marks its quality and safety."

If a dairy company's consumer-facing communication is easy and honest, combined with blockchain QR code technology, it will be able to create a positive image for the brand and the company's products will be perceived as high quality, thus generating a positive reputation for the company's products. In fact, a brand that includes transparent information about its quality and safety can be perceived as a high-quality and safe food product. When dealing with traceability systems, firm reputation is important to retain the same customer base, and corporate goodwill offers the possibility of gaining a unique position in the marketplace.

Consumer propensity to trust tends to pay more for traceability information on labels, and the characteristics most willing to pay a premium are those of open, serious, outgoing consumers, and those with material and physical needs. Structural assurance, firm reputation, and PPT positively influence RQ, which positively influences switching intentions.

Managerial Implications

The management significance of this study is shown in the following aspects. First, it is helpful for FTS platform designers to recognize the major influencing factors for maintaining existing users and attracting new learners. Second, the conclusion can systematically and empirically explain the main elements affecting the switch intention, and also help the government to fill the gaps in the FTS's theory and practice when strengthening food safety. Third, the main factors obtained from the results will help the food industry to accelerate the construction of digital FTS and improve the efficiency of food traceability practice, so as to strengthen the systematic loopholes in food safety and the prevention and control of problematic food by using high-tech teaching methods.

Based on the aforementioned conclusions, we propose the following suggestions. First of all, after the occurrence of food safety incidents, the government and relevant regulatory authorities should promptly start the emergency plan, control the development of the situation, remove, recall, and seal the problem products. At the same time, manufacturers should also explain the truth to consumers and put forward remedial measures, and implement them, to eliminate consumers' panic psychology and enhance consumer confidence.

Second, the QR code should provide clear and detailed information about food, such as its natural nature, brand, origin, packaging, price, nutrition, ingredients, safety, sustainability, environmental effects, and other information. The information provided by the QR code should be richer and more detailed than what consumers expect, thus reducing uncertainty and strengthening consumers' buying intentions.

Third, to improve consumers' awareness of domestic products and make use of consumers' brand preference, manufacturers should produce products in strict accordance with national regulations to eliminate food safety problems. This is the most fundamental way to solve the problem of food safety, but it requires effective supervision by the government and consumers.

Fourth, it is worth noting that the only unsupported hypothesis refers to the fact that the effect of perceived risk on RQ is not significant. We should further investigate some uncertainty factors that may be involved in the research model. For example, information timeliness and information privacy issues should be considered in the future.

Limitations and Future Work

Even if we have made the theoretical and managerial contributions, there are three limitations that warrant further research, but the future study directions remain to be discovered. First, considering the limited sample range, future research could incorporate factors such as the age and experience of food traceability consumers as moderators in the theoretical model and examine whether there are differences between different consumer samples based on these characteristics. Therefore, follow-up study is needed. Second, we only researched the Chinese and South Korean consumers in the field of food safety. To strengthen the systematic nature of this study, we would like to compare the results from different countries. Third, we integrated D&M ISS and TPB into PPM to identify the factors that influence the willingness to identify the factors that influence the willingness to use FTS. Future studies could use UTAUT, UTAUT2, TTF model, etc. to test the role of other factors in influencing FTS users' willingness to switch. Future SEM studies should test the willingness to switch FTS in the field of food safety from a more comprehensive perspective.

Most of the previous studies focused on the traceability of the food chain to retail outlets, so they did not trace the consumer part of the food chain. The consumer component is also important in terms of food safety, so future traceability should be extended to consumers in more countries. If market forces, consumer demand, and government regulations all converge to push supply chain traceability to a new level, food traceability from farm to table will become a reality.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because "It can only be used when publishing in journals that have the basic or share upon reasonable request data policy." Requests to access the datasets should be directed to linxin@neepu.edu.cn.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

XL contributed to research design, empirical analysis, article writing; and conducted the methodology, data analysis, and research design. R-ZW developed the original idea for the study. Both authors read and approved the final manuscript.

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Co-opetition Relationships and Evolution of the World Dairy Trade Network: Implications for Policy-Maker Psychology

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This study conducted a social network analysis of the evolutionary characteristics of the world dairy trade network based on the overall trade pattern. In addition, the evolution of trade blocs and the co-opetition relationships involving dairy products in major countries were analyzed in terms of supply and demand. The results show that continuous and complex changes have taken place in the world's dairy trade network since 2001. The number of trade entities in dairy products has stabilized since 2012. At present, approximately 94% of countries (regions) are involved in dairy product trade, such that the world dairy trade network exhibits the small-world effect and scale-free property. The world import pattern for dairy products has changed. While export centers have not changed, import centers have shifted from Europe, America, and East Asia to North America, East Asia, and the Middle East. The world dairy trade network consists of the EU trade bloc headed by Germany, the former Soviet Union–Brazil trade bloc, and the Asia–Australia–America trade bloc. The trade blocs have evolved due to geographical positions, historical cultures, and political relations. In a trade bloc, the diversification of import sources is more prominent in demand countries. European and Asian markets have become the main markets of the major exporters. In this study, the evolutionary characteristics of the world dairy trade network and the co-opetition relationships were analyzed to provide scientific support to inform the development of dairy trade policies. The results can provide technical and psychological support to policy-makers in various countries in their dairy trade decision-making.

Keywords: dairy trade network, topological structure, dairy product supply, dairy product demand, co-opetition relationship, policy-maker psychology

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INTRODUCTION

Dairy trade, as a key component of international trade, is an important link between areas that are rich and poor in dairy resources. In addition to effectively guaranteeing the supply of dairy products and food safety, dairy trade can also ensure mutual complementarity in the dairy industry. With the increasing demand for dairy products and the continuous promotion of dairy integration processes around the world as well as the gradual increase in trade, the contribution of dairy trade to international trade has gradually increased. In 2017, dairy product trade accounted for 4.39% of the total trade (USD 156.79 billion), playing an important role in international trade. Rabobank

predicted that the global dairy supply would stop increasing in 2020 and that dairy supply would be insufficient for different reasons in different countries. These reasons can be summarized as follows: poor economic performance, high milk prices, sluggish retail, geopolitical disputes, and bad weather. Therefore, an in-depth analysis of the world's dairy trade network may have a profound impact on the world's dairy trade pattern as well as on the psychology and behavior of decision-makers.

Current studies mainly discuss dairy trade based on a single country (Kurata and Ohe, 2020; Liu et al., 2020) or on two countries (Guo et al., 2020; Mao et al., 2020). In terms of content, literature has mainly focused on the following areas: the competitiveness of dairy trade (Khan et al., 2020), trade potential analysis (Sánchez-López et al., 2020), influencing factors (Bogadóttir, 2020), countermeasures (Zhao et al., 2020), and the impact on industry and market development (Peng and Cox, 2006; Zhang et al., 2020). In terms of methods, dairy trade studies have mainly employed mature models such as constant maturity swap, the technological gap model, trade competitiveness, revealed comparative advantage, international market share, and the Global Trade Analysis Project model (Wen et al., 2010; Ohlan, 2014; Dolin et al., 2020; Meyer et al., 2020; Wijaya et al., 2020).

Generally speaking, existing studies have explored the characteristics of global dairy trade in great depth, but few have addressed its overall status, structural characteristics, and evolution. For example, does the dairy trade network exhibit the small-world effect and power law characteristics? How will the complex game relationships between countries (regions) change under the domination of trade network evolution according to supply and demand powers? Are relationships between supplier countries necessarily competitive? For dairy trade powers, it is particularly urgent to resolve such problems, as clarifying trade network relations can help countries adjust industry policies and promote the sustainable development of the global dairy trade. Focusing on the above problems, this study constructed a global dairy trade network to analyze the network's structural characteristics in terms of network connectivity and centricity. Based on the time nodes of 2001 and 2017, the evolutionary characteristics of dairy trade blocs and their influencing factors were studied using the complex network community detection algorithm. Finally, the co-competition relationship between supply and demand powers was studied from the perspective of supply and demand to more thoroughly understand the function and structure of the world dairy trade network, thus providing a useful reference for countries (regions) with a high demand for dairy products that are also highly dependent on imports.

On the whole, dairy product trade network analysis can reveal the current international dairy product trade pattern, enabling policy-makers to recognize competitive advantages and disadvantages for their domestic dairy products. This recognition can help those who are formulating policies related to dairy product trade to be more level-headed by reducing psychological pressure and improving their rational decision-making. Of course, our paper serves as a reference and highlights the significance of policy-makers in different countries.

METHODS AND DATA HEADINGS

Methods

First, a descriptive analysis of the basic trade conditions was conducted and the trade trend for dairy products was analyzed based on changes in total and specific trade. Second, a social network analysis was carried out. Following Schmitz and Helmberger (1970) and Han and Xu (2020), a social network was adopted to analyze changes in density, average shortest path length, centricity, out-degree and in-degree, closeness centricity, betweenness centricity, and trade blocs to reveal the evolutionary characteristics of the world dairy trade network. The specific study methods are described in the literature by Schmitz and Helmberger (1970) and Han and Xu (2020).

Subjects and Data

In this study, the countries (regions) participating in global dairy trade were abstracted as nodes, and 60 countries (regions), including China, the United States, and France, were selected as subjects[1]. The duration was set from 2001 to 2017 for the following reasons:

(1) From 2001 to 2017, the import and export volume of dairy products in these countries (regions) accounted for 97% of the total trade, with high representativeness.
(2) In order to minimize the impact of the 2008 financial crisis, the study period was extended 7 years before and 9 years after 2008. This approach of using a longer study period served to minimize the impact of any 1 year while ensuring the quality of data.

A 60 × 60 matrix of the dairy trade network was constructed based on trade flows of the 60 countries (regions), and the characteristics of the network were analyzed by ucinet. In addition, Gephi was used to visualize the network. The types of dairy products included in this study were unconcentrated milk and cream, solid milk and cream, yoghurt, whey and modified whey, butter, and cheese, with the corresponding customs HS codes 0401–0406.

As shown in **Figure 1**, the total trade of dairy products was only USD 55.104 billion in 2001 and then reached USD 179.878 billion in 2014. It gradually declined in 2014 before dropping sharply in 2015 due to the impact of dairy import construction in China and import bans in Russia (Zhong et al., 2014). In addition, increasing trade and entities in the world dairy market would inevitably change total dairy trade. In 2001, only 188 countries (regions) participated in global dairy trade, while in 2010, the number exceeded 200. In 2012, approximately 94% of countries (regions) participated in global

[1]Germany, Netherlands, France, New Zealand, Italy, Belgium, United Kingdom, United States, Denmark, Spain, Ireland, Australia, China, Saudi Arabia, Poland, Russian Federation, Austria, Mexico, Belarus, Greece, Japan, Hong Kong, Czech Republic, Sweden, Algeria, Switzerland, Singapore, United Arab Emirates, Malaysia, Indonesia, Portugal, Argentina, Finland, Philippines, Egypt, Luxembourg, Lithuania, Thailand, Canada, Nigeria, Oman, Slovakia, North Korea, Hungary, Iran, Brazil, Vietnam, Venezuela, Uruguay, Ukraine, Kuwait, Taiwan, Kuwait, Romania, Chile, Lebanon, Latvia, Slovenia, Bahrain, and Kazakhstan.

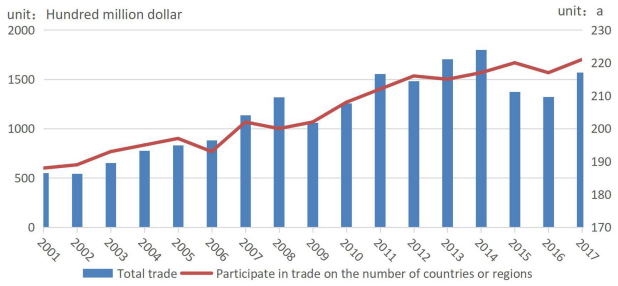

FIGURE 1 | Evolution of total trade of global dairy and participants from 2001 to 2017.

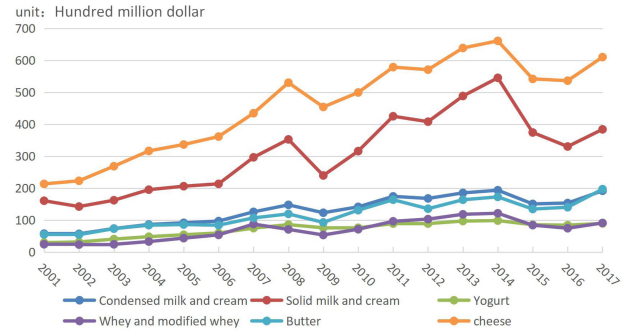

FIGURE 2 | Evolution of types of global dairy trade from 2001 to 2017.

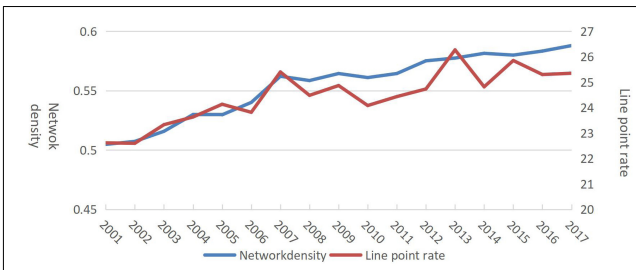

FIGURE 3 | Evolution of network density and line point rate from 2001 to 2017.

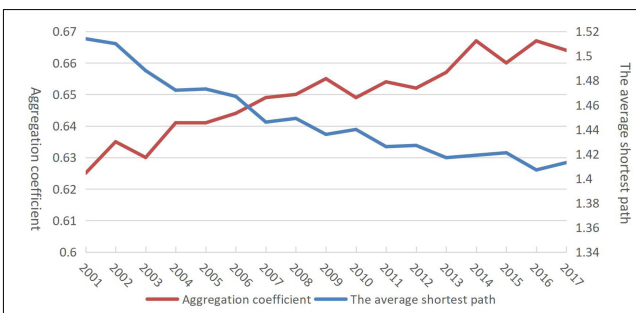

FIGURE 4 | Evolution of aggregation coefficient and average shortest path from 2001 to 2017.

dairy trade, and the number of participating countries (regions) was approximately 215.

Dairy trade can be divided into three stages according to volume changes in various types of dairy trade (**Figure 2**). In Stage 1 (2001–2007), total trade and the trade of all types of dairy products gradually increased, with the trade of cheese being slightly higher than that of solid milk and cream and the trade and increment of whey and modified whey being the lowest. In Stage 2 (2008–2013), the trade of unconcentrated milk and cream, yoghurt, whey and modified whey, and butter maintained relatively stable growth while the trade of cheese, solid milk, and cream fluctuated like a "roller coaster," while total trade also fluctuated. In Stage 3 (2014–2017), the trade of unconcentrated milk and cream, yoghurt, whey and modified whey, and butter continued to grow. Meanwhile, the trade of cheese, solid milk, and cream dropped sharply from 2014 to 2016 and then rose again in 2017.

The complexity of the network increased, exhibiting the small-world network effect.

EVOLUTION OF CONNECTIVITY AND NODE CENTRICITY IN THE WORLD DAIRY TRADE NETWORK

The Complexity of the Network Increased, Exhibiting the Small-World Network Effect

First, the trade linkage between countries (regions), network density, complexity, and network line point rate were directly proportional. The changes in network density showed that the density of the dairy trade network increased year by year, with a minimum value of 0.50 in 2001 and a maximum value of 0.59 in 2017. From 2001 to 2017, the network density fluctuated but gradually increased. After 2012, the network density stabilized between 0.57 and 0.58. The changes in the line point rate showed a minimum value of 22.60 in 2002, with it gradually increasing in later years. A comprehensive comparison of network density and line point rate showed that both indicators had basically the same trend (increase) after 2001 (**Figure 3**), indicating that dairy trade relationships was becoming more complicated as network connectivity gradually improved.

Second, the evolution trend of the aggregation coefficient and the length of the average shortest path (**Figure 4**) showed that, although the two indicators changed in opposite directions, the aggregation of the network became tighter after 2010. In particular, it can be observed that the aggregation coefficient was 0.63 in 2001 and 0.67 in 2014 before dropping slightly in 2015.

Third, under normal circumstances, a higher aggregation coefficient and shorter average shortest path length may suggest the small-world effect in the network. The longest average shortest path length was 1.44 and highest aggregation coefficient

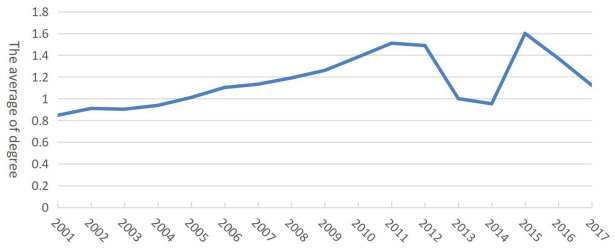

FIGURE 5 | Evolution of the average of degree of global dairy products from 2001 to 2017.

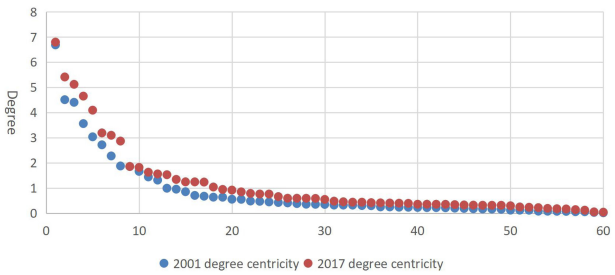

FIGURE 6 | Evolution of degree of global dairy products from 2001 to 2017.

was about 0.62, indicating that the dairy trade network exhibited the small-world effect.

For policy-makers, the advantage of a complex and relatively concentrated dairy product trade network is that it enables them to concentrate on formulating more targeted import and export policies. However, the disadvantages are also relatively obvious. Affected by complex cooperation methods and small-scale cooperation, decision-makers need to be more cautious when facing collaborators, which covertly increases the psychological burden.

The Network Showed the Scale-Free Property, Changing the Import Pattern

Centricity, as an important indicator of the role of nodes in the network, can reflect the relative importance of countries (regions) in the dairy trade network. The time series showed that the average degree was only 0.85 in 2001 but reached 1.60 in 2015, increasing by two times (**Figure 5**). Although centricity fluctuated greatly after 2012, the changes showed that the impact and role of countries (regions) in the world dairy trade network were gradually increasing. As shown in **Figure 6**, the degree curve of the world dairy trade network conformed to the characteristics of the power-law distribution in 2001 and 2017, indicating that the dairy trade network was a scale-free network. Since the degree curve of 2001 was under that of 2017, the scale-free property of the dairy trade network gradually strengthened over time.

In the trade network, the weighted degree can represent the diversification of import and export of dairy products and

TABLE 1 | Top 10 countries with respect to weighted degree, in-degree, and out-degree.

2001					
Country	**Degree centricity**	**Country**	**Out-degree**	**Country**	**In-degree**
Germany	6.69	Germany	5.34	Germany	3.96
France	4.51	France	4.18	Italy	3.14
Netherlands	4.40	Netherlands	3.93	France	2.58
Italy	3.56	New Zealand	3.02	Netherlands	2.36
New Zealand	3.03	Belgium	1.98	Belgium	2.36
Belgium	2.72	Australia	1.68	United Kingdom	2.11
United Kingdom	2.27	Denmark	1.64	Spain	1.32
United States	1.87	Ireland	1.30	United States	1.24
Australia	1.85	Italy	1.26	Japan	0.98
Denmark	1.66	United Kingdom	0.94	Mexico	0.95
2017					
Germany	6.80	Germany	5.48	Germany	4.59
Netherlands	5.41	Netherlands	5.09	Mainland China	3.18
New Zealand	5.12	New Zealand	5.04	Netherlands	2.57
France	4.65	France	3.86	France	2.55
United States	4.09	Belgium	2.06	Belgium	2.29
Mainland China	3.19	Italy	2.05	Italy	2.29
Italy	3.09	United States	2.04	United States	2.09
Belgium	2.86	Ireland	1.55	Saudi Arabia	1.37
Saudi Arabia	1.86	Denmark	1.53	Sweden	1.16
Ireland	1.82	Belarus	1.22	Uruguay	1.10

the distribution diversification of import and export regions (**Table 1**). Over time, the top 10 countries (regions) with respect to weighted degree, out-degree, and in-degree changed greatly. In 2001, the top three countries for out-degree were Germany, France, and the Netherlands, and the top three countries for in-degree were Germany, Italy, and France. Meanwhile in 2017, the corresponding countries were Germany and the Netherlands (in-degree) and Germany, mainland China, and the Netherlands (out-degree). It should be noted that mainland China did not reach the top 10 with respect to weighted degree, out-degree, and in-degree before 2017, but in 2017, it ranked sixth in average degree and second for in-degree. The geographical distribution characteristics of the top 10 countries (regions) for weighted degree, out-degree, and in-degree in 2001 and 2017 showed that the import pattern of dairy products changed with the diversification of import and export countries (regions) as well as the diversification of products. The import focus of dairy products was transferred from Europe, America, and East Asia to North America, East Asia, and the Middle East, while the export focus did not change greatly. Policy-makers in various countries should adjust their psychological goals to correspond to this evolution of the trade network center to minimize inaccurate decision-making that arises from psychological expectations being too high or low.

The Network Had a "Point-to-Point" Model, Manifesting as Dependence and Competition Between Countries (Regions)

Closeness centrality refers to the level at which a node is not controlled by the sending and receiving of another node, while betweenness centrality refers to the control level of resources by node countries (regions) in the network. These two indicators can reflect the pattern of dairy trade to a large extent. From 2001 to 2017, despite fluctuations, the closeness centrality steadily increased. The results in 2001 and 2017 showed that the top 10 countries (regions) in 2001 were Denmark, France, the Netherlands, Germany, Italy, the United Kingdom, the United States, Canada, Belgium, and Spain, while in 2017, they were France, Germany, Italy, the Netherlands, Spain, Denmark, Poland, the United Kingdom, the United States, and Slovakia (**Table 2**). It was found that more than half of the above countries (regions) were listed in the top 10 in-degree or out-degree 10 countries (regions), demonstrating the "point-to-point" characteristic of the trade mode in the world dairy trade network.

As shown in **Table 2**, the betweenness centrality was maintained between 0.38 and 0.40. The sizing analysis on betweenness centrality in 2001 showed that the top 10 countries (regions) were Denmark, France, the Netherlands, Germany, Italy, the United Kingdom, Spain, Belgium, the United States, and Switzerland. Meanwhile, in 2017, they were France, Germany, Italy, the Netherlands, Spain, the United States, the United Kingdom, Denmark, Poland, and Switzerland. The comparison of betweenness centrality and out-degree showed that six countries (Germany, the Netherlands, France, Italy, the United States, and Denmark) were still included in the top 10 countries (regions) in 2017, showing that the control strength of the relationship between dairy products directly corresponded to dependence between the exporting countries (regions) and their vulnerability to one another.

In general, decision-makers should focus on strengthening interaction and communication with partners outside the network in a strong control trade network. Conversely, in a weak control trade network, they should emphasize strengthening interaction and communication with partners inside the network.

BLOC CHARACTERISTICS OF EVOLUTION OF THE DAIRY TRADE NETWORK AND CO-COMPETITION RELATIONSHIPS BETWEEN SUPPLY AND DEMAND POWERS

Bloc Detection of Evolution of the Dairy Trade Network

Under normal circumstances in dairy trade, the path dependence of countries (regions) would promote the formation of trade blocs. The characteristics, trade connections, and scale of dairy trade blocs (**Figure 7**) showed that three trade blocs coalesced in 2001. First, there was the trade bloc consisting of European and Middle Eastern countries (regions), with Germany as the core node and the Netherlands and France as important nodes. These countries had relatively close trade linkages and a large scale of trade with the other countries (regions) in the bloc. Second, there was the trade bloc of the former Soviet Union countries (led by Russia), with the Russian Federation as the absolute core node and Poland and Ukraine as the important nodes. Lastly, there was the Asia–Australia–America trade bloc, which had relatively close internal connections, with New Zealand and Australia as the core nodes and the United States and Japan as the important nodes.

In 2017, there were still three trade blocs but with an obvious overlapping trend. The trade bloc for the former Soviet Union countries and that of the European countries became one bloc in 2001. This was because in countries (regions) such as Russia, external dependence on dairy products increased gradually, and these countries relied on dairy products from European countries (regions). In this trade bloc, the importance of the Netherlands increased, second only to Germany. Moreover, the original Asia–Australia trade bloc expanded to include Middle Eastern countries (regions). Meanwhile, the importance of China and the United States was lower than that of

TABLE 2 | Distribution of top 10 countries with respect to closeness centrality and betweenness centrality.

2001				2017			
Country	**Closeness centrality**	**Country**	**Betweenness centrality**	**Country**	**Closeness centrality**	**Country**	**Betweenness centrality**
Denmark	100.00	Denmark	1.59	France	100.00	France	0.81
France	100.00	France	1.59	Germany	100.00	Germany	0.81
Netherlands	100.00	Netherlands	1.59	Italy	100.00	Italy	0.81
Germany	98.33	Germany	1.44	Netherlands	100.00	Netherlands	0.81
Italy	96.72	Italy	1.33	Spain	100.00	Spain	0.81
United Kingdom	96.72	United Kingdom	1.33	Denmark	98.33	United States	0.80
United States	96.72	Spain	1.25	Poland	98.33	United Kingdom	0.77
Canada	95.16	Belgium	1.23	United Kingdom	98.33	Denmark	0.74
Belgium	93.65	United States	1.21	United States	98.33	Poland	0.74
Spain	93.65	Switzerland	1.15	Slovakia	95.16	Switzerland	0.69

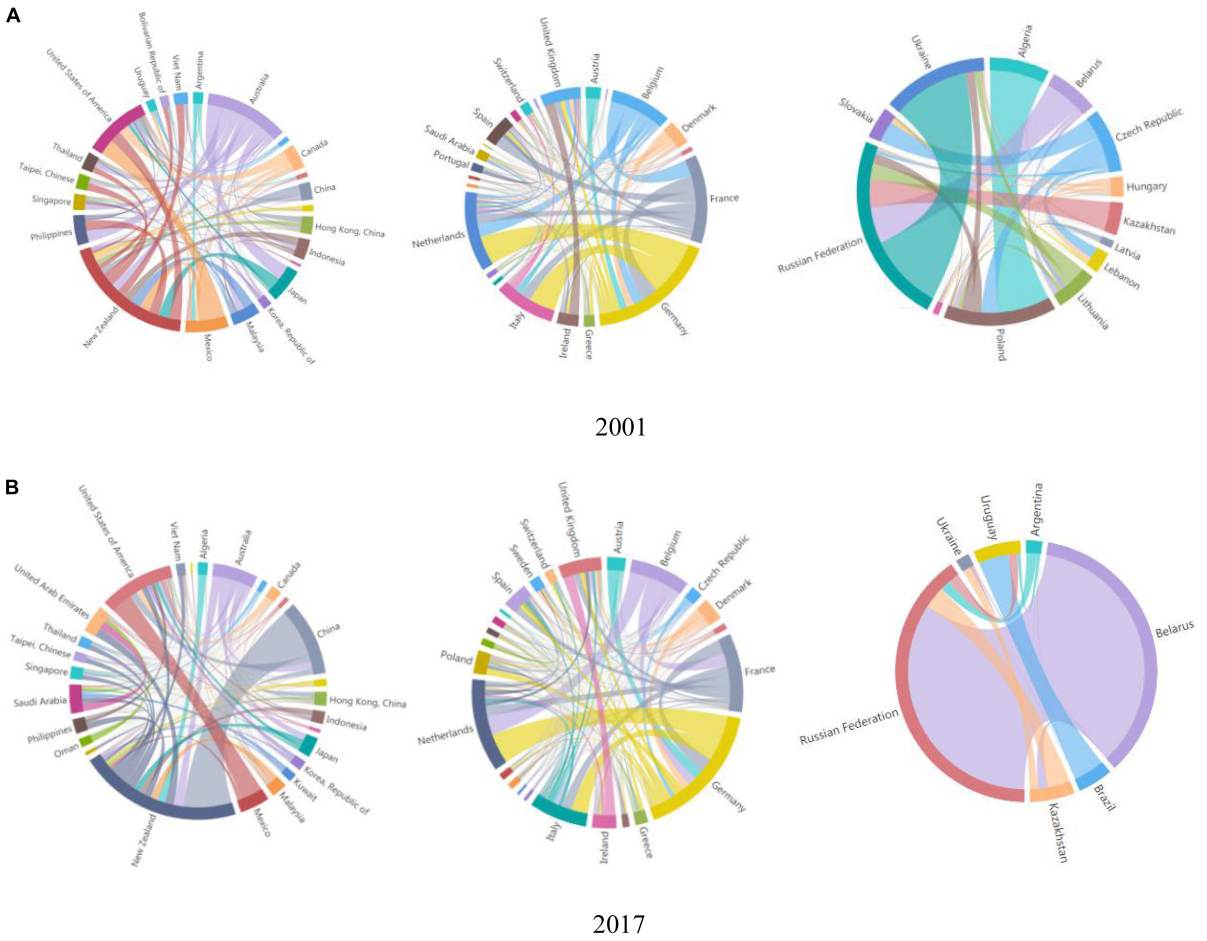

FIGURE 7 | Network structure of world dairy trade blocs. **(A)** 2001, **(B)** 2017.

New Zealand, and the status of Australia declined. Third, the trade bloc of the former Soviet Union countries started shrinking and formed a new bloc with South American countries, with the Russian Federation remaining as the absolute core node of the bloc.

The variation trend in trade blocs from 2001 to 2017 showed that geographical location played an important and fundamental role. For example, internal relations between East Asian and South Asian countries have always been close. In addition, historical and cultural factors are key factors in the formation of a trade bloc. As another example, although the Soviet Union collapsed, the former Soviet Union countries still had close relationships with European countries under the guidance of Russia.

Import Sources of Major Supply and Demand Powers Were More Diversified From the Perspective of Cooperation

Regarding the number of import sources, Russia had the least (two sources) among all the dairy demand powers. Belgium and Netherlands also had relatively fewer import sources, with three and four, respectively. Italy, mainland China, and France had five import sources, and Spain had six import sources. Germany, the United Kingdom, and the United States had seven import sources, the most among all countries. The import and export concentration rates of the top 10 supply powers showed that the export concentration of the four countries reached 80%, while that of the other six countries was 70–80%. In comparison, only two of the top 10 demand powers had import concentrations above 80%, while five countries had import concentrations of 40–80% and three countries had import concentrations less than 40%, with an average import concentration of 55.4% and average export concentration of 79.78%. In addition, dairy product supply countries had 2.4 exporting countries (regions), while demand countries had 5.1 source countries (regions). From this, it is evident that the import sources of demand power were more diversified than the supply sources of exporting countries. The import concentration rate was far lower than that in the supply countries, further confirming the importance of a diversified development strategy in dairy importing countries.

A Competitive Relationship Between Supply Countries Did Not Necessarily Exist

In 2017, the export powers for dairy products were New Zealand, Germany, the Netherlands, France, the United States, Belgium, Italy, Denmark, Ireland, and Belarus. As for Belarus, 94.91% of its dairy products were exported to the Russian Federation, and regarding Denmark, 49.83% of its dairy products were exported to three major targets. The Netherlands and New Zealand had three major export targets, with export concentration rates of 59.48 and 50.97%, respectively. Belgium had five export targets, with an export concentration rate of 76.10%. France, Germany, Ireland, and the United States had six export targets each, with Ireland and the United States being more diversified in exports having export concentration rates of 78.16 and 74.04%, respectively.

The competitive relationship between major supply powers for dairy products may rest on export targets. Based on experience, supply powers would have a competitive relationship if they had the same export direction. However, in actual situations, due to differences in export targets and directions, competitive relationships could not be generalized. For example, New Zealand and the Netherlands had different export directions and targets. New Zealand mainly exported to Australia, mainland China, Malaysia, and the United Arab Emirates, while the Netherlands mainly exported to Belgium, France, Germany, and Hong Kong. Therefore, a non-competitive relationship existed between New Zealand and the Netherlands. Meanwhile, Belgium and France engaged in large-scale dairy trade with Germany, Italy, and the United Arab Emirates; thus, there was a competitive relationship between them. In sum, a competitive relationship did not necessarily exist between dairy supply countries. In general, competitive relationships existed among Belgium, France, and Germany, which mainly competed with each other in Europe and Asia.

CONCLUSION AND POLICY IMPLICATION

Since 2001, the world dairy trade network has been subject to continuous and complex changes. After 2012, the number of entities in dairy trade stabilized, and presently, approximately 94% of countries (regions) participate in dairy trade. The dairy trade network exhibits the typical small-world effect and scale-free property, which may become more obvious over time. The import focus of dairy products has shifted to North America, East Asia, and the Middle East from Europe, South America, and East Asia, while the export focus remains unchanged. The trade model of the world dairy trade network shows a "point-to-point" characteristic. The control strength of trading countries depends on their mutual dependence and vulnerability. In dairy trade, a country (region) generally has a certain path dependence, and a trade bloc is the embodiment of such dependence from the perspective of colony characters. At present, there are three trade blocs in the world dairy trade network: the Asia–Australia–America trade bloc, the former Soviet Union–Brazil trade bloc, and the EU trade bloc, which is led by Germany. The exchange between these blocs has gradually deepened, and the blocs have evolved based on their geographical locations, historical cultures, and political relations. In a trade bloc, demand powers are more diversified in import sources than are supply powers. A competitive relationship does not necessarily exist between supply powers. In general, competitive relationships exists among Belgium, France, and Germany, which compete with each other mainly in Europe and Asia.

First, there is mutual dependency and vulnerability between supply and demand countries. The corresponding countries (regions) can explore potential import and export markets based on trade agreements, further adjusting the market and product structures for dairy products. Second, the demand and import powers should continue to deepen and stabilize trade relationships with supply countries and strengthen the macro-control of dairy products by meeting demand for these products. Third, large producing countries should strengthen the competitiveness of their dairy industries by continuously improving the quality of dairy products, supporting export of dairy companies, expanding export markets, and accelerating the promotion of multilateral trade cooperation mechanisms.

In relation to existing studies, network analysis was adopted in this study to discuss dairy trade networks between countries. In addition, the structures of networks were also analyzed in terms of network connectivity and centrality. Our findings can provide technical and psychological support to various countries in their dairy trade decision-making processes. In addition, the dairy product trade network analysis reveals current patterns in international dairy product trade, the understanding of which can enable policy-makers to recognize competitive advantages and disadvantages of their domestic dairy products. This understanding can help these policy-makers to be more level-headed when formulating policies related to dairy product trade by reducing psychological pressure and improving rational decision-making abilities. However, the impact of the current dairy trade network on the internal dairy industry development in each participating country (region) was not discussed in this study due to data accessibility limitations. Subsequent studies should focus on this topic.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors undertook research, writing, review tasks throughout this study, read, and agreed to the published version of the manuscript.

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Conflict of Interest: 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.

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CONCEPTUAL ANALYSIS
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Well-Designed Food Governance as Psychological Mechanism of Consumer Perceptions in the Context of Tourism Poverty Alleviation

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Poverty is a challenge leading to food insecurity in people's minds. This article discusses food governance as a psychological mechanism to facilitate the sense of wellness in people's minds in the context of tourism poverty alleviation. Mainly, we argue that, when a government is implementing tourism poverty alleviation, not only are economic efforts, but also positive psychological feelings are required. We, thus, argue that sound food governance may increase the sense of wellness in the minds of people as food consumers by increasing food safety and security. This perspective paper contributes by explicating the influences of macrolevel governance design of safer and more secure food systems on people's psychological wellness, especially against the background of tourism poverty alleviation in developing countries.

Keywords: food governance, tourism poverty alleviation, psychological remedy, developing countries, micro-foundation

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INTRODUCTION

Poverty is a critical challenge that leads to food unsafety and insecurity in both developing and the least developed nations. Globally, food insecurity/unsafety as a direct product of poverty leads to malnutrition and low quality of life. Accordingly, existing food security interventions targeting tourism poverty alleviation are discussed in the context of practical actions and positive measures. In this regard, research studies consistently point out environmental management, increased farm yields, youth engagement in agricultural production, and investment in job creation. Based on this, biological, chemical, and economic aspects of food security/safety for tourism poverty alleviation have dominated governance discourses.

However, psychological concerns cannot be ignored beyond those important perspectives above. In addition to the resulting problems mentioned above, poverty may also challenge the government and people by impeding significant cognitive and psychological development (e.g., less chance for intelligence training or low self-esteem) (OOO). Put differently, when designing and implementing governance mechanisms for poverty intervention via food security/safety improvements, psychological mechanisms and logics should also be discussed systematically.

Consumer psychology and behaviors should also be incorporated as a central issue to solve problems of poverty and food insecurity through enhanced food governance [for details, see Wu et al. (2018), Chen and Wu (2019)]. Despite their existence, less is said about how a better "food" governance at enterprise/industry/national levels is a remedy for tourism poverty alleviation through psychological mechanisms that alter consumer perceptions and behaviors. For this reason, this is a conceptual paper that addresses the relationships of the chain of food governance at

enterprise/industry/nation levels through psychological interventions that remedy poverty levels in developing economies.

Against this background, every interventional level is tackled independently while also looking at existing linkages that explain the psychological mechanisms that can alter consumer perceptions/behaviors for improved food governance. In **Figure 1**, a comprehensive schema is sketched to lead our following discussions. The study's aim and angle is 2-fold: (a) to delineate and investigate the interplay between industry, enterprise, and the national food governance framework and (b) to delineate and investigate the impact of the interplay between industry, enterprise, and the national food governance framework on consumers' perception and, thus, consumer behavior.

LITERATURE REVIEW

Correlation Between Poverty and Food Security

Poverty is directly connected to food insecurity, especially in a down time such as the COVID-19 pandemic period. Källestål et al. (2020) analyze poverty-related problems in four municipalities in Northern Nicaragua using the Unsatisfied Basic Needs (UBN) index. The study explores multiple dimensions of poverty based on the capability approach using data mined from the Cuarto Santos Health and Demographic Surveillance database using the K-means algorithm. The capability approach gives beneficiaries the right to determine an alternative life they would prefer subject to interventions. Accordingly, the study finds that fairly rich households, based on the UBN index, had modern lifestyles based on subjective choice, but poor households were food insecure. In this regard, this study establishes a direct connection between poverty and food insecurity.

In sub-Saharan Africa, food security and agricultural productivity among small-scale farmers determine food security and the livelihoods of rural households. With reference to the aforementioned, Mutea et al. (2019) find that solving food security challenges in rural agro-dependent communities requires an appreciation of the link between food insecurity and livelihood. In particular, the study relies on the food security index to determine food security and livelihood drivers. The aforementioned include variables, such as food consumption score, household dietary diversity score, coping strategies index, household food security access index, and months of adequate household provisioning. Upon analysis, they find that 32% of households under the survey were food secure, and the rest were insecure. Food security was dependent on household productive tool ownership, off-farm incomes, own-food consumption, and agro-ecological factors as well as pest destruction. Notably, semi-humid and semi-arid conditions contribute to food security with all factors constant although humid and semi-arid ecological climatic circumstances negate food security.

To stress the point further, studies demonstrate that agro-ecological conditions impact food security and malnutrition in children under the age of 5 years from low-income backgrounds. Chakona and Shackleton (2018) investigate the connection between malnutrition risks in children under 5 years old from poverty-stricken households as a result of problems related to food insecurity. Using the Household Dietary Diversity Score (HDDS) and Household Food Insecurity Access Scale (HIFAS), the study finds that dietary diversity increases with agro-ecological potential. On the other hand, HIFAS measurements increase with a low agro-ecological gradient. Based on this study, enhanced food production enhances food security through dietary diversity, which then reduces malnutrition risk among children under the age of 5 years old.

Cognitive maladjustments and attitude toward poverty depend on childhood food security experiences. In this regard, Hermida et al. establish that low socioeconomic status directly impacts rural poor children compared to their urban counterparts. As such, the study finds that children in poverty perform poorly in "executive functions and non-verbal communication intelligence." As such, they posit that policy interventions should target childhood cognitive development among children from poor backgrounds. Moreover, Lipina and Evers (2017) argue that cognitive development in children is dependent on the biological, psychosocial, and socio-cultural factors related to poverty. Consequently, they suggest that neuroscience can play a critical role in understanding cognitive development in children and their susceptibility to poverty.

Food Security and Tourism Poverty Alleviation Interventions

Government policy geared toward vulnerable portions of the population is an immediate intervention to stave off food insecurity across the world, and the quality thereof, as well as health, is equally integral. Accordingly, Philip et al. sought to investigate the long-term implications of food aid on health and well-being with a specific focus on the quality of affluent Israel food pantries. Based on the Healthy Portions Score, the study sampled 105 beneficiaries of food aid from 16 food baskets across the country. The study finds that social intervention through food aid in terms of quality of the recipient diet is critical in policy making. Notably, interest in this regard is on the consideration of diet and quality in the food security policy.

Low socioeconomic status increases food consumption compared with food secure individuals when provided with free provisions. Accordingly, Godsell et al. induced low socioeconomic status among 123 adult participants and a control group. They then subjected them to the availability of free snacks, and food-secure participants consumed less compared with the food-insecure participants. As a result, the sense of deprivation in poor food consumption leads to unhealthy eating habits and consequences, such as obesity. Based on such example, consumer perceptions can be manipulated because they make food-consumption choices based on subjective utility depending on scarcity or abundance situations.

Commercialization of agriculture has been suggested as a viable means for addressing farmer's welfare in urban and peri-urban areas of the developing world. In this regard, Mutsami and Karl (2020) argue that the commercialization of crops and

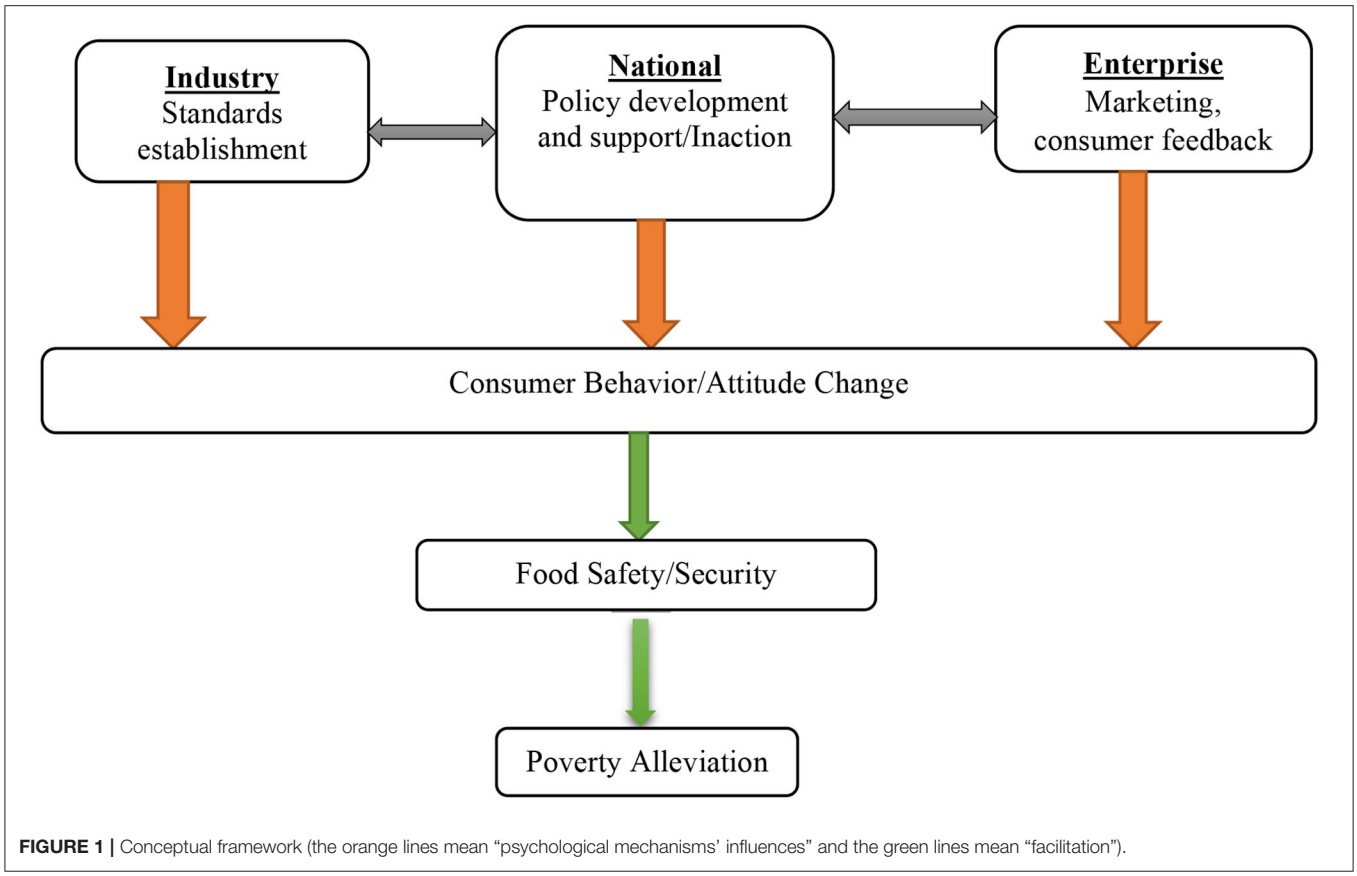

FIGURE 1 | Conceptual framework (the orange lines mean "psychological mechanisms' influences" and the green lines mean "facilitation").

large livestock is an established intervention to solve problems of poverty and food security. Critically, this study focuses on the commercialization of rabbits with a focus on other underlying factors, such as education, health, and micro-credit access, and its implication on tourism poverty alleviation. It finds that rabbit commercialization in urban and peri-urban communities reduces poverty, reduces family size, and enhances education attainment and access to credit. Having looked at studies that establish the relation between food security and poverty, the former enhances individual general well-being, such as health, academic achievement, and financing options for growth.

Global governance mechanisms under the auspices of the United Nations Sustainable Development Goals (UN SDG) focus on the eradication of hunger through food security and safety measures.

According to Vågsholm et al. (2020), the balance between sustainability, food security, and safety as well as prudent utilization of available food is vital in sustainable food production and consumption. Strategies in this regard involve intensive food production, enhanced cycle production, recycling, and reuse of food. In addition, they argue that increased consumption of plant as opposed to animal proteins and reduction of antibiotic use in animal and plant husbandry is key to promoting food safety. They further acknowledge that product labeling is a way forward to increase consumer choice depending on their sensitivity to food wastage.

Psychological Capital in Food Governance

Social and psychological capital is key to transforming poor migrant communities from penury to self-sustaining individual development. Modesti et al. (2020) carried out a study on the role of social and psychological capital concerning social enterprises with a migratory background (SEMB) in Italy. According to the study, migrant-led social enterprises have a direct contribution to refugee integration in host communities. In this regard, they conclude that social and psychological capital is significant internal capital that facilitate refugee settlement and the ability to turn their adversity into resources for their development. Despite these findings, the role of SEMB in enhancing a migrant community's social integration and effectiveness was left for future research. As such, this study notes gaps in social and psychological capital as a transformative force in food governance concerning security and safety.

In the era of climate change, a policy environment that supports climate-smart options has been promoted as an intervention in reducing global warming. For Lewis and Rudnick, smart agriculture is based on three key concerns, namely (a) contributions to greenhouse gas emissions; (b) susceptibility to anthropogenic effects of climate change; and (c) the nexus between agricultural production, incomes, and food security. Drawing from California state climate-smart policies and programs, that policy must offer sufficient trade-offs between the three concerns for prioritization

or reconciliation of the same. California's Climate Smart Agriculture (CSA) allows for mitigation, adaptation, and production agricultural productivity measures depending on resource usage and sustained productivity. Through stakeholder participation, farmers in California have adopted climate action farming practices based on state-sponsored incentive programs.

Social co-governance involving diverse stakeholders is a very crucial component of food security vulnerabilities. Chen and Wu (2019), therefore, define the collaboration between "government, industry, and society" (p. 1) as social co-governance. In this regard, they argue that collaboration between the three must be built on positive psychological capital. Giving the example of pork production in China, they propose four approaches for positive psychological capital–based food safety governance: (a) manufacturers instilling food safety and security values in employees, (b) the government appealing to the sensibilities of food producers and social actors for efficacy toward this regard, (c) the state also publishing food safety standards and guidance for producers, and (d) social persuasion of social actors through participatory approaches in policy formulation.

CONCEPTUAL FRAMEWORK

Globally, the human population is growing, creating demand for sustainable food safety, security, and health. Accordingly, the UN SDG acknowledges the challenge of hunger and the need to sustainably feed 10 billion people with nutritious and healthy food (Hunter et al., 2016). Presently, food governance systems fall short of enhancing food security at a time when more than 750 million people are hungry and malnourished. According to studies, the global population will hit the 10 billion mark by 2050, generating an urgent need for global and national food security. Against this background, consumer-oriented policies and standards aimed at sustainable consumption are significant.

Notably, the social co-governance model based on stakeholder positive psychological capital is an approach suitable for analyzing food security and tourism poverty alleviation drawing on lessons from China (Wu et al., 2020). In this regard, the four ingredients of the social co-governance model are transplanted into the study of the food governance relationship chain involving national, industry, and enterprise practice seeking to alter consumer behavior and perception toward sustainable consumption for tourism poverty alleviation.

In sum, this conceptual note addresses psychological social co-governance in the developed world, citing examples from China and other developing countries. For this reason, the structure of this study explores industry, enterprise, and national food governance levels separately and as inter-relationships. Specifically, it explains how food governance stakeholders in the developing world may alter consumption patterns toward food security and, subsequently, tourism poverty alleviation. Here below is a diagrammatic representation of the concept applied for the study.

Psychological capital psychological Capital.

National Food Security Governance

Successful economies build their quest for socioeconomic development policy on food security for its population as well as the safety of the same. China built its economic prosperity on the back of ensuring a food-secure nation with policies derived from experiences from past famine (Browning et al., 2019). Governments play a significant role far as national food governance in terms of sustainable consumption (Beveridge et al., 2019). Consequently, the 1950's famine inspired President Deng Xiaoping's food sufficiency policy in the 1980's, which focused on quantity. Moreover, China has social welfare and pension policies that cushion the poor and vulnerable, hence, sustaining quantity food consumption (Browning et al., 2019). Through this approach, the government takes a welfare approach to the alleviation of the effects of poverty in rural and urban China.

China's socio-cultural orientation as a product of ethical traditional systems influence a consumer clean meat–eating preference; nonetheless, the national policy is centered on safety and economics. Overall, China's government prioritizes agricultural technology, food safety, and security (Garcia et al., 2020). As a result, such policy approaches arouse a Chinese middle-class preference for clean and plant-based meat (Garcia et al., 2020). With food safety incidents on the rise, there is a rising interest in organic food among the aforementioned socioeconomic groups in urban areas. This can be attributed to policy gaps upon which consumer cognition influences market demand for organic food. Similarly, policy lacunas drive unsustainable procurement of endangered sea-cucumber consumption (Fabinyi et al., 2017). As such, both policy action and inaction may sanction consumer cultural orientation even if consumer preference ignores sustainability.

China's practice and policies target small farms with vaccination programs against swine fever, which can decimate small pig farms economically and dent supply of its important pork market. With China being the largest global largest pork producer and consumer, the African swine flu pandemic threatened smallholder farmer incomes and raised consumer safety concerns (Garcia et al., 2020). As a result, a local animal immunization policy targeting small- and medium-scale pig farms sustains an economic sector and consumer safety perceptions to support uptake. The internal market negative psychological concerns on food safety in the largest global pork consumer will, in turn, reduce poverty.

Sustainable interventions modeled on behavioral research guide policy formulation. Behavioral science has been identified as an approach for construing climate change adaptation with regard to sustainable management of scarce environmental resources, such as food, energy, and water (Moore and Boldero, 2017). Eradication of this threat to a critical sector of the Chinese economy calls for development of vaccines with the help of the scientific community and sound government policy. Notably, swine fever is a threat to China's food security being the largest pork producers and

consumers, meaning it is a critical part of the country's dietary needs (Garcia et al., 2020). The immunization policy is a safety guarantee that is critical to pork consumption, food security, and small-scale farmers' incomes and, hence, tourism poverty alleviation.

Tourism poverty alleviation strategies through food security policy measures entail the development of standards for land use and small farmers' entrepreneurship perceptions. With regard to food production, a rural land use policy within a local and socioeconomic context relieves the extremes of food pressure and the anthropogenic effects of climate change (Reay et al., 2020). The aforementioned is achievable if the focus is trained on policy-driven lifestyle changes that are based on cognition. Studies have shown that in China's positive spillover effects on environmental sensitivity are fluid compared to Brazil and Denmark (Capstick et al., 2019). A good example is China's agricultural entrepreneurship policy, which transforms cognition of the value of agriculture as a business. As a result, about 4.5 million farmers moved back to start their businesses to diversify income sources (Kong et al., 2019). Being an established agricultural economy with near sufficient food resources, an entrepreneurship approach is suitable for stabilizing incomes and reducing poverty.

Overall, evidence-based policy initiatives based on education and cultural interventions are critical for tourism poverty alleviation and sustainable consumption. Although China's consumption practices are largely market-driven, Western perceptions of reducing health and environmental consequences of consumption are education and prevention programs (Carrus et al., 2018). Certainly, China can draw lessons from the West for evidence-based policy options for its intervention against environmental and health problems of consumption. Some consumption and tourism poverty alleviation efforts can be induced through policies that induct learners on conserving cues to influence behavior (Watson et al., 2017). Consequently, the policy has the potential to influence consumption through the evidence-driven interventions for healthy consumption, environmental safety, and food security, which, in turn, alleviates poverty.

Policy inaction directly influences market-driven consumption based on developing individualist cultures in developing China with an impact on the market value chain. A rising urban population's cumulative demand preferences create a chain of producers, middlemen, transportation, and other sectors whose productivity is a critical poverty cushion. Social norms and cultural practices are directly linked to food choices, which then impact well-being and health outcomes (Carrus et al., 2018). In addition, long-held cultural dietary needs also contribute to a generic effect in organic food consumption, which sustains the economic sector. Despite the benefits of a non-regulated food security environment, widely held practices may only expand sustainably through policy support.

Industry Initiatives

National policy standards with a safety focus may also be part of corporate social responsibility (CSR) or industry safety and health standards practice to influence consumer choice. For the Chinese pork industry, the China Brand Name Association certifies products as voted trust brand (VTB) to assure consumers of their safety, reliability, quality, and affordability (Wu et al., 2020). Generally, this is dependent on internal and external factors that influence consumer decisions on food purchase behavior (Martínez-Ruiz and Gómez-Cant, 2016). Factors that producers may use to attract consumer attention include product farming practices, production methods, and nutrition (Wu et al., 2020). When these values are instilled in employees in the production process, they affect consistency and consumer behavior as far as choice is concerned.

Industry labeling practices for food safety and security promote consumer confidence in products if sustainable consumption key messages are embedded in. Shifts in socio-cultural practices toward individualism increase consumer psychological orientation toward healthy and sustainable choices (Carrus et al., 2018). In China, the organic food industry in big cities is a response to the increasing concern about the use of pesticides and antibiotics (Liu and Zheng, 2019). Consequently, the industry categorizes organic and inorganic food, traditional, and pollution-free, among others, to win consumer trust in the food's safety and nutritional value (Liu and Zheng, 2019). The market-generated responses to food safety and sustainable consumption through classification alters consumption patterns in response to their safety concerns.

Organic farming initiatives in the face of increasing demand for dairy products in China increase crop yields to meet emerging consumer choices and incomes for dairy farmers. As evidence shows, dairy farming is an alternative organic solution to increasing crop yield and replaces synthetic and environmentally unsustainable synthetic fertilizers (Fang et al., 2020). Organic food classification labeling not only distinguishes organically produced products to influence the growing consumer preference, but also provides additional income to dairy farms to play a role in organic food production (Liu and Zheng, 2019). Here, consumer trust and attitudes toward organic foods is a key support system for small and medium-scale dairy farmer recycling efforts (Lazaroiu et al., 2019). Importantly, the industry in China is responding to new and modern consumer interest in sustainable organically produced foods, which creates a value chain for organic fertilizer for the benefit of small-scale dairy producers.

Industry plays a critical role in encouraging organic food consumption through consumer cognition and urban affordance. Research has demonstrated that individuals respond to cues that sometimes lead to obesity or healthy weight consciousness (Watson et al., 2017). Pavlovian cues in response to advertising is a learning mechanism that differs between obese and healthy-weight individuals (Watson et al., 2017). The industry may capitalize on the effects of external influences on consumer decisions on food attributes and consumption. China's nascent organic industry may capitalize on its specific social context with regard to healthy production and consumption and the value chain it supports (Martínez-Ruiz and Gómez-Cant, 2016). All this may be captured on industry standards of advertising to divert people to organic food production and consumption

for food security and tourism poverty alleviation among organic farmers.

Industry practices geared toward sustainable food production also draw from government regulatory initiatives on sustainable consumption. Japan's conservative government policy on whaling supports industry efforts toward sustaining its internal whale meat market (Butler-Stroud, 2016). Forces driving its consumption derive from the national government, diet, and the general society. The government subsidizes the industry to meet the demands of traditional whale meat consumers and commercialize the industry (Butler-Stroud, 2016). The fact that it has withdrawn from multilateral governance structures influences national consumption to create jobs in the whaling industry.

Fundamentally, Communist government policy support and industrial practice toward food security have the potential to alter poverty and sustainable consumption. For this to take effect, it requires significant staff and organizational change, which then cascades to collective industry practice toward sustainable practices (Lee et al., 2017). Practical lessons in this regard are pro-environmental value orientations that determine collective action (Lee et al., 2017). The same standards may be applied with regard to changing attitudes in urban areas toward organic foods in urban China. As such, an increased consumption of an organic food industry standard may extend their practices in the organic food production sectors. Most definitely, the concentration of production to meet a rising and expanding urban behavior–driven demand has the potential to increase employment and, thus, poverty reduction.

Enterprise Initiatives

The role of enterprise may combine with industry standards through collaborative approaches to climate-sensitive use of marine food resource management, such as fish stocks. Climate change effects such as rising sea levels and other anthropogenic effects threaten fish stocks and, hence, cause food security of small-scale farmers (Butler et al., 2020). In Indonesia and Papua New Guinea, small-scale farmers' contribution to food security in the isolated Asia Pacific Islands depend on integrated systems that rely on the distributor and consumer feedback that inform policy (Butler et al., 2020). In particular, co-governance mechanisms at the village level bring together consumers and fisheries in a bottom-up approach to policy making and consumption practices (Butler et al., 2020). Participatory approaches, inculcate ownership, and responsible consumer choices that are directed toward sustainable consumption safeguard the future food security generations.

Entrepreneurs play a pivotal role in influencing dynamics of consumer preferences and the procurement chain from producers. Supermarkets in Vietnam have increased variety and choice and spending habits on food items depending on incomes (Trinh et al., 2020). Accordingly, regions with high consumption of fat and processed carbohydrates experience an impact quality with negative impacts on health. In this regard, noted evidence of household consumption of high-fat and high-protein foods contribute to healthy eating habits among consumers. Similarly, India's policy bars biofortification of rice, which affects any dietary consumption among predominantly poor consumers. Once again, government policy constrains enterprise efforts to wean societies of dependence on native rice (Bashir et al., 2013). Under such circumstances, the pursuit of health outcomes among rice farmers through fortification constrains the role of enterprises.

Bold and inclusive measures are capable of making bold collective interventions for sustainable food consumption and tourism poverty alleviation. In this context, one finds the complex interplay of interests between food security and mitigating the effects of climate change (Ziervogel and Ericksen, 2010). India's approach of cash transfer safety nets to vulnerable households mitigates against the food security effects of climate change. Unfortunately, the cost of maintaining household asset-building programs are exorbitant and unsustainable (Ziervogel and Ericksen, 2010). Consequently, there is a combination of formal and informal components of food security and tourism poverty alleviation. An appropriate informal solution for a developing economy capitalizes on social rather than technical innovations to generate a self-sustaining micro-economy. On the other hand, the formal sector may address the capital needs against the backdrop of policy supported micro-loans to enhance food production and consumption among the poor (Ziervogel and Ericksen, 2010). This is tantamount to investment in already existing local economies through state and enterprise efforts.

Enterprises founded on goal-oriented frameworks are critical in creating environmentally sustainable food consumption for tourism poverty alleviation. They do this through the promotion of background knowledge and provision of information on sustainable consumption cues at the point of sale, which have been identified as possible interventions (Vermeir et al., 2020). The challenge with consumption cues is that they are usually ignored at the point of purchase although sometimes climate-sensitive food products may be costly. Industry, government, and enterprise may collaborate to alter consumer perception toward sustainable consumption (Vermeir et al., 2020). Perhaps developing economies need to complement this effort with the policies that make sustainable production cost-effective and key messaging to stimulate green consumption behavior. This will go a long way in promoting goal-oriented behavior through collective policy, industry, and enterprise to influence the same and increase incomes among organic producers and the value chain it supports.

CONCLUSION

This paper interestingly uses the concept of food governance as poor people's psychological "healing" mechanism when shopping for food with a purpose of safety. Conceptual analyses from different levels and aspects of people's livelihood governance and poverty remedies offer logical and evidenciary supports for the authors' arguments and call for more governmental efforts. The good thought is that food safety governance can bring psychological safety and, thus, generate a feeling of

wellnesse. This is a piece that offers hints for governmental units to go "in deep" to the governed people's minds in a context of livelihood consumption—a piece that utilizes micro-psychological dynamics to generate implications for macro-governmental policies.

To sum up, food governance mechanisms in developing nations have a direct implication on consumer preferences. So far, the concept reveals that there are competing needs that fall short of the trade-offs required to balance food safety, security, and sustainable consumption thereof. National policies establish standards and procedures that alter consumption for tourism poverty alleviation. Similarly, coordinated efforts between industry and enterprise facilitate linkages with national systems in implementation and regulatory standards geared toward consumer preferences. For instance, China's clean meat and pork consumption habits are a reflection of its evolution of middle-class consumer choices with a focus on organic consumption. In this regard, immunization and recycling are critical components in food governance measures to safeguard the small scale farmers' economic interests.

Developing countries are hardly aligned to capitalize fully on positive psychological capital. Most developing countries exist in evolving food markets with divergent consumer preference toward organic foods, bio-fortification, and sustainable marine resource exploitation. Primary indications show that total consumer total preference creates a need for research on consumer safety and policy for tourism poverty alleviation. Despite these concerns, positive psychological capital can facilitate interaction between national systems, industry, and enterprise. Consumer-driven systems, such as in China, addressing food security and safety are the fulcrum around policies and market practices that safeguard the majority of small farmers who are critical in enhancing food governance. As the production chain emphasizes safety and health factors, consumers trust. Future studies can expand the discussions in this article to a variety of sub-contexts under tourism poverty alleviation, such as tourism. For example, tourists' psychological capital facilitated by food safety through well-designed governance may lead to more consumption to stimulate economics and partially contribute to tourism poverty alleviation.

AUTHOR CONTRIBUTIONS

GH collected the data set, wrote the original paper, and analyzed for the results. KL-L conceptualized the main theme, reviewed and edited the manuscripts, and is responsible for the interactive review process.

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ORIGINAL RESEARCH
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Does the Price Support Policy Drive a Balanced Distribution of Profits in the Chinese Dairy Supply Chain? Implications for Supplier and Consumer Psychology

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Evaluating the price policy of raw milk is of great significance to the sustainable development of an industry supply chain. In this context, our study used the multi-period difference-in-difference method to systematically examine the impact of the policy implementation on product price and profit distribution in the supply chain. The results showed the following: (1) the price of raw milk in the implementation area of the price support policy is 13.54% higher than that of the unimplemented area; (2) the effect of price increase in the western region (15.5%) is higher than that in the eastern region (13%), and the central region (10.73%); (3) furthermore, the purchase price guidance policy of raw milk drives price increase or price suppression in the links of the supply chain to promote a balanced distribution of profits among the participants in the chain. These conclusions all have good stability and have reference significance for further improving and adjusting the price support policy of raw milk to realize the sustainable development of the Chinese dairy industry. This will enhance the production confidence of Chinese raw milk producers and improve Chinese consumers' expectations and consumer psychology regarding domestic dairy products.

Keywords: dairy supply chain, price policy effect, profit balance, multi-period DID, supplier psychology, consumer psychology

INTRODUCTION

The dairy supply chain includes multiple links, such as forage cultivating and processing, dairy animal feeding, dairy processing, and sales. Therefore, promoting the sound development of the dairy industry is beneficial to realizing income increase for dairy farmers, improving the dietary structure of residents, driving the development of enterprises, and local economy (Tinbergen, 1964; Schmitz and Helmberger, 1970). After 10 years of reflection and adjustment, the development mode and product quality of the Chinese dairy industry has improved significantly. For example, the casual inspection pass rate of raw milk in 2018 was 99.8%,

the melamine index has been 100% qualified for 10 successive years[1]. In 2018, the number of cows reached 14,300,000, and the annual single yield was over 6,350 kg, which was 1.5 times of that of 2012[2]; and in the period of 2012–2018, the total value of output of dairy enterprises above the state-designated scale increased from 246.9 billion yuan to 309.5 billion yuan, realizing successive growth for 5 years[3]. However, it is undeniable that the profit distribution in the whole dairy supply chain in China is imbalanced, which means that the profit of dairy retailers and dairy processing enterprises is far greater than the profit of raw milk suppliers. Under the influence of dual price transfer from downstream dairy enterprises and retailers to dairy farmers, the raw milk selling price is always being squeezed. This imbalance has been widely recognized by scholars in the field.

Based on the provincial research data of Heilongjiang Province, Qian et al. (2011) analyzed the costs and profits of each link, including production by dairy farmers, processing by dairy enterprises, and retail by supermarkets, and the results have shown that the profit added value of dairy products is mostly distributed in the retail link, which is followed by the finished dairy product processing link, while the raw milk production link has the least profit added value, which suggests that the profit distribution in the dairy supply chain is arbitrary. Zhong et al. (2014) discussed the differentiation of profit among the subjects of the dairy industry from the perspectives of production costs, and the results have shown that the ratio of dairy cow feeding cost, product processing cost, and selling cost is approximately 7.5: 1.5: 1 and the dairy farmers are facing higher production risks than dairy enterprises and retailers. Hu et al. (2020) discussed the market price transmission mechanism from the perspective of a reorganization of the dairy supply chain, and by adopting the impulse response function and error correction method, demonstrated that there is asymmetric price transmission among the production links of the dairy supply chain. This means that the probability of cost shift from production link to retail link is far lower than that from retail link to production link. In addition, other studies on the current status of profit distribution in the dairy supply chain have also proved that there is an imbalanced profit distribution in the chain.

A balanced profit distribution will bring more economic benefits to producers. When production costs remain the same, producers will be more able to resist external risks and more confident in increasing production and R&D investment while improving product quality (Bryant and Dillard, 2019; Dutta et al., 2019). For consumers, the enrichment of product categories and the improvement of product quality will strengthen their confidence in domestic products (Carmen et al., 2016; Jimenez-Delgado and Reina-Paz, 2020). For both producers and consumers, their increased psychological expectations will be more conducive to the development of the dairy industry and price stability, thus forming a virtuous cycle (Silva et al., 2017; Kniffin et al., 2018; Dutta et al., 2019).

The import flow of raw milk in China has been increasing annually, and the production profits of dairy farmers have been "double-squeezed" by dairy companies and retailers, which has severely affected the enthusiasm of dairy farmers in production. The fundamental goal of the price support policy is to solve the problem of unfair transactions in the raw milk market and increase the production confidence of dairy farmers. Furthermore, the increase in producer confidence is conducive to the improvement of product quality, which helps consumers overcome psychological barriers in resisting domestic dairy products and stimulating their consumption vitality.

The balanced profit distribution among the production links of the dairy supply chain is vital for the sustainable development of the industrial development mode (Alvarez and Arias, 2004; Hu et al., 2019). This is because a balanced profit distribution among the production links stimulates the vitality of producers and the potential of consumers, making the producer prefer to emphasize quality over quantity of products, and making the consumers prefer domestic dairy products, thus forming a sustainable virtuous cycle. To further correct the market inequalities in the industry and promote a balanced profit distribution, the state governments issued *Opinions of the State Council on Promoting the Sustainable and Healthy Development of the Dairy Industry* (hereinafter, referred to as "*Opinions*"), *Dairy Products Quality and Safety Supervision and Administration Regulations* (hereinafter, referred to as "*Regulations*") in 2007 and 2008, respectively, according to which the local governments shall formulate raw milk purchase guide prices in case of raw milk market failure, and timely implementation of a guide price policy in the areas in which the purchase price of raw milk is relatively low. The purpose of such a policy is to protect the minimum guaranteed profit of farmers and fundamentally eliminate imbalance in the purchase and selling price of raw milk. However, there is no literature verifying the actual effect of raw milk price support policy. In fact, the effects of the raw milk price support policy should be systematically assessed for policy adjustment and for bridging the mentioned theoretical gap. For these reasons, this paper discusses the actual effect of the price support policy on subjects in the dairy supply chain, aiming to answer the following questions: whether the raw milk purchase guide price policy drives an increase in the average selling price of such products, and whether it promotes balanced profit distribution among the subjects in the dairy supply chain.

Since the issuance of *Opinions* and *Regulations*, 19 provinces and municipalities directly under the central government have issued raw milk purchase guide price policies, with the purpose of improving raw milk price management measures, standardizing product transactions, and therefore eliminating the unfairness in the purchase and selling price of the dairy supply chain. As shown in **Table 1**, such policies were implemented at different dates in these provinces. For example, Hebei, Shanxi, and Shaanxi issued related local industry policies such as *Agricultural-related Price (Charge) Policy in Hebei Province, Opinions of the People's Government of Shaanxi Province on the Implementation*

[1]Data source: *China Dairy Industry Quality Report* (www.dac.org.cn)

[2]Data source: Annual statistics of *Dairy Information Website* on http://www.ryzxw.com/Data/article/list-105-1.html

[3]Data source: Annual statistics of *Dairy Information Website* on http://www.ryzxw.com/Data/article/list-105-1.html

TABLE 1 | Price support policy formulation and policy launch time by province.

Area	Province	Policy proposal time	Related content
Eastern region	Hebei	November 13, 2008	"...calculate the price of raw milk, based on which, propose and publish the raw milk purchase guide price for the peak season (May–October), off season (November to April of following year), and the cases that the price of principal elements affecting raw milk fluctuate significantly."
	Guangdong	November 26, 2009	"...Guangdong Province Department of Agriculture, the Bureau of Industry and Commerce, the Price Bureau, and Guangdong Dairy Association jointly issued a guide price policy for raw milk purchases. The purchase price per kilogram of milk is 3.83¥(+- 10%). The guide price is expected to be officially implemented in early December. It is reported that this is the first time that Guangdong Province has unified the purchase price of raw milk"
	Fujian	September 30, 2010	"...popularize and promote the *Dairy Farm Hygiene Regulations* and *Raw Milk Production Technical Regulations (Trial)*, and strengthen the guidance and supervision of the local establishment of raw milk price coordination mechanisms."
	Shanghai	January 16, 2011	Due to the large content of relevant policy documents, we will not list them one by one here.
	Zhejiang	December 29, 2011	
	Shandong	January 29, 2015	
	Beijing	January 3, 2016	
	Jiangsu	November 16, 2018	
Central region	Shanxi	December 18, 2008	
	Hubei	November 27, 2009	
	Heilongjiang	January 16, 2010	
	Henan	May 24, 2012	
	Jiangxi	December 18, 2018	
Western region	Shaanxi	December 18, 2008	
	Xinjiang	January 22, 2009	
	Sichuan	May 14, 2009	
	Ningxia	July 9, 2009	
	Neimenggu	December 27, 2012	
	Qinghai	February 16, 2015	

The policy launch time is based on the information published on the official websites of the provinces and municipalities. For example, Shandong raw milk purchase price policy information comes from the Departmental Regulatory Documents published by Shandong Provincial People's Government Official Website (http://www.shandong.gov.cn/).

of the "Regulations on the Supervision and Administration of Milk Quality and Safety" immediately after the issuance of the regulations; while provinces such as Jiangsu, Jiangxi, and Qinghai issued the raw milk purchase guide price policy around 2018, lagging behind Hebei and other provinces; the reason for this is that the issuance of a policy may be affected by two factors. On the one hand, the production cost and selling price of raw milk vary from area to area, resulting in differences in benefit coordination among subjects of the dairy supply chain; on the other hand, under the effect of the orientation of industry, market, and policy, the dairy industry is not given priority for development in some areas. That is to say, issues such as imbalanced profit distribution among subjects of the dairy industry and imbalanced development in the supply chain will not become the focus of policy in the short term.

In general, after the implementation of the raw milk purchase guide price policy, the selling price of raw milk and dairy products in the 19 provinces, and in the municipalities directly under the central government showed an upward trend to a varying extent, as shown in **Figure 1**. In the figure, with three provinces randomly selected from the eastern region, central region, and western region for the policy effect test, the raw milk purchase price index of nine areas such as Beijing, Shanxi, and Sichuan showed an obvious upward trend in the right side of the dividing vertical line (representing the moment of the policy implementation). For example, the raw milk selling price index in Shanghai increased from 0.994 in 2010 to 1.248 in 2011; the raw milk selling price index in Heilongjiang increased from 0.894 in 2009 to 1.155 in 2010; the raw milk selling price index in Ningxia increased from 1.179 in 2009 to 1.412 in 2010. It should be noted that the raw milk purchase guide price policy was issued in 2008 in the Hebei Province, but the raw milk price showed an obvious upward trend in 2009. This was because policies are usually issued in November and December in Hebei, Shanxi, and other areas, and it takes a certain time to implement them in organizations at the municipal and county level. Thus, the policy effect will be shown in the following year. The above-mentioned preliminary test seems to suggest a synchronization between the issuance of policies and the rise of raw milk purchase price, but it cannot demonstrate that the rising price is not the result of other factors. Furthermore, even if the policies have indeed caused an increase in the price, the actual effect should be assessed.

MATERIALS AND METHODS

Model Construction

Is the policy effective? In his study on the influences of post-school education on resident incomes, Ashenfelter (1978) mentioned that temporal and regional characteristics and other

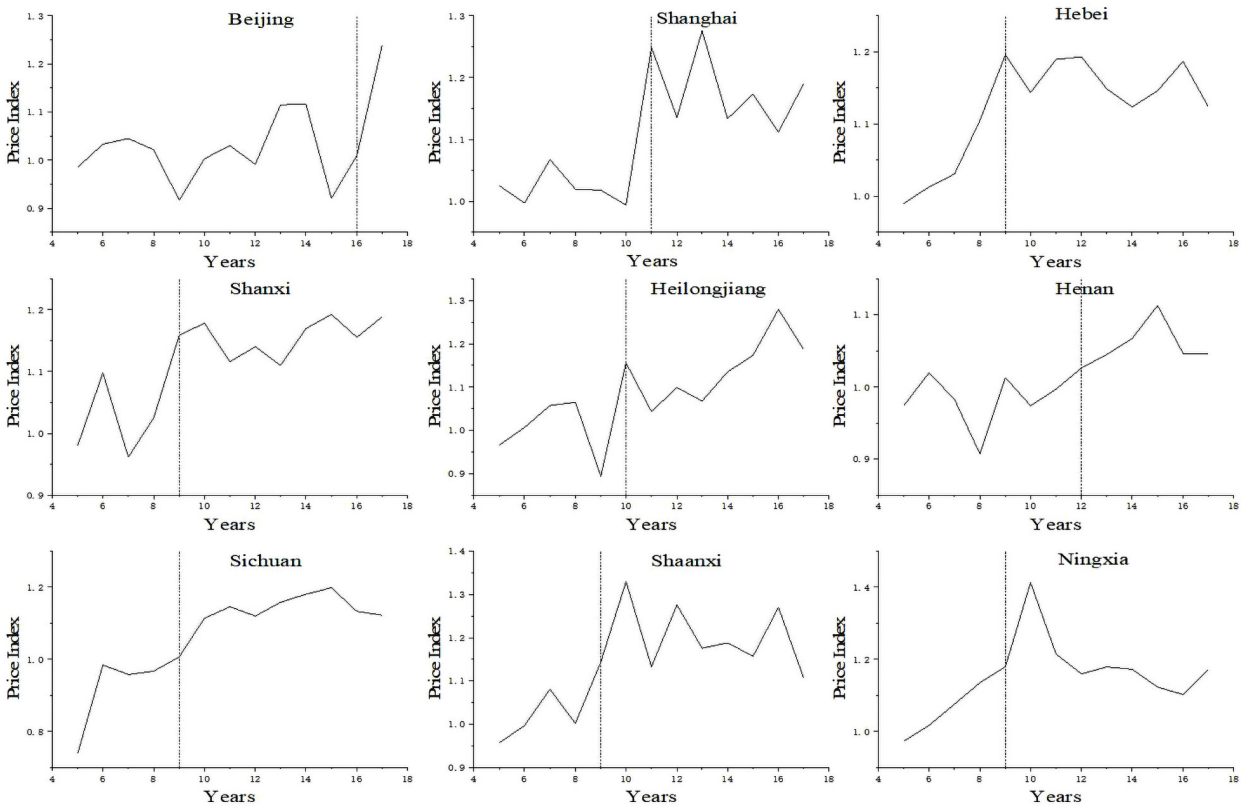

FIGURE 1 | Raw milk purchase price index trends in regions that implemented the policy.

random interference factors should be considered to analyze the difference caused by the implementation of a policy. This is because some characteristics of the same area may vary around the time when a policy is implemented, and some characteristics of the area in which the policy is implemented may differ from those of other areas (in which the policy is not implemented). This means that, to assess the actual effect of a policy, it is necessary to exclude other factors that influence the object analyzed as far as possible. Like Ashenfelter, we adopted the difference-in-difference (DID) method, which has been widely applied to evaluate policy effects (Abadie, 2005; Grafova et al., 2014; Wijaya et al., 2020). The expression of the method is shown in Formula (1):

$$Y_{it} = C + \alpha Period_t + \beta Treated_i + \gamma(Period_t \times Treated_i) + \delta X + \mu_{it} \quad (1)$$

$Period_t$ refers to the policy implementation dummy variable, which should be assigned 0 before policy implementation, and 1 after policy implementation. $Treated_i$ refers to the grouping dummy variable, which will be assigned 1 if area i is a policy implementation area or organization, that is, in the experimental group, or assigned 0 if the area i is an unimplemented area or organization, that is, in the control group. $Period_t \times Treated_i$ refers to the dummy interaction variable, and its coefficient γ refers to the policy net effect (for specific reasons, please refer to Ashenfelter's relevant research results, which will not be illustrated here). Finally, X refers to the control variable group and μ_{it} refers to the random error term.

The raw milk purchase guide price policy in China has two characteristics: first, it is a local policy formulated by each province and municipality according to the actual situation and based on the overall institutional policy issued by the central government. Of course, its implementation is not necessary or urgent for areas in which the profit distribution among subjects of the dairy supply chain is relatively balanced; thus, as shown in **Table 1**, it has not been issued in some areas, providing a control group for continuous reference. Second, local raw milk purchase guide price policies were issued at different times, from 2008 to 2018, which means that the experimental group and control group show a dynamic variation. The first characteristic indicates that the experimental group and control group can be set up in the test of raw milk purchase guide price policy, and the number of observation periods of the research object is greater than 2, which fits in the DID method. However, it should be noted that the traditional DID method requires a consistent implementation time of policies in the experimental group, while the actual implementation time of policies in the 19 areas considered varies to different extents. Thus, raw milk purchase guide price policies cannot meet the condition fully.

To solve the inconsistency in the implementation time of policies, a multiple periods DID was adopted in this study (Dolin et al., 2020; Zhang et al., 2020; Zhao et al., 2020), in which the grouping is based on the policy implementation time instead of

whether the area is ultimately affected by the policy. This means that, even if all provinces and municipalities have implemented the raw milk purchase guide price policy, the areas in which such a policy had not been implemented in the study period can be regarded as the control group. The inclusion of this adjustment in Formula (1) is that the interaction variable of the experimental group is no longer the same. In addition, the value variation among the policy implementation dummy variable, grouping dummy variable, and interaction variable remain the same. Thus, Formula (1) can be adjusted to Formula (2):

$$Y_{it} = C + \gamma(Period_t \times Treated_i) + \delta X + \eta_t + \varepsilon_i + \mu_{it} \quad (2)$$

The difference between Formula (2) and Formula (1) is that the separate policy implementation dummy variable $Period_t$ and grouping dummy variable $Treated_i$ were excluded; the time fixed effect η_t and regional fixed effect ε_i were added to eliminate the time effect affecting the estimation of the coefficient of the interaction variable and the regional factors that do not change over time. In addition, the control variable group was retained in Formula (2) to control time-varying variables with regional characteristics, including per capita GDP, population, and some natural environmental factors of each area (Grafova et al., 2014; Khan et al., 2020). Y_{it} refers to the raw milk selling price index of area i in t (year). The other indicators were as defined in Formula (1).

Data Description

In addition to Beijing, Shanghai, Hebei, and other areas in which the policies were implemented, the sample areas for this research also included 11 areas in which the policies were not implemented, such as Tianjin, Hainan, Guizhou, and Liaoning. It should be noted that in addition to Hong Kong, Macau, and Taiwan, the Tibet Autonomous Region and Jiangxi were excluded from empirical tests, as no source data of the raw milk selling price index were available for reference; thus, 29 sample areas were left out. In addition, considering data availability and the policy implementation time of each area, the research time series was set as 2005–2017. After determining the areas and time series of study, the following indicator data were collected in this paper: first, we defined the core explanatory variable $Period_t \times Treated_i$ (a dummy variable), which indicates that Province i was an area where the raw milk purchase guide price policy was implemented in year t when $Period_t \times Treated_i = 1$, and that Province i was not an area where the raw milk purchase guide price policy was implemented in year t if $Period_t \times Treated_i = 0$. Second, the raw milk selling price index was expressed as the ratio of the raw milk selling price index of each year to the commodity price index of the year, whose data were derived from the "Price Index" Column of the *China Economic and Social Big Data Research Platform*.[4] The ex-factory price index of the finished dairy product was expressed as the ratio of the ex-factory price index of the finished dairy product to the commodity price index of that year, whose data were derived from the 2005–2017 *China Price Statistics Yearbook*.[5] The retail price index of dairy products was expressed as the ratio of the retail price index of dairy products to the commodity price index of that year, whose data were derived from the same data source used for the ex-factory price index of finished dairy products. Third, the per capita GDP was expressed as the ratio of per capita GDP of each province or municipality to national per capita GDP of that year. The population was expressed as the ratio of the population size of each area to the national population size of that year, whose data were derived from the General Column and Population Column of the *China Economic and Social Big Data Research Platform*.[6] The data of temperature and precipitation of each area were derived from statistical data from the 2006–2018 *China Meteorological Yearbook*,[7] and were expressed as the annual mean temperature and precipitation in the main areas of each province. The descriptive statistics of the indicator data are shown in **Table 2**.

RESULTS

Regression Result Analysis

The test results of the overall policy effect are shown in **Table 3**, in which the time fixed effect, regional fixed effect, weather control variables, and regional (time-varying) control variables were added gradually (see columns 1–5). The reported results show that all coefficient values of the interaction variable were positive and were of significance at the 1% level. Thus, the results obtained with Model 5, the most explanatory model, were regarded as the reference standard. In Model 5, the coefficient value of the interaction variable was 0.1354. This showed that, from a holistic perspective, the implementation of a guide price policy in an area could make the raw milk selling price index increase by 0.1354 units, suggesting that the raw milk selling price of that time was 13.54% higher than that of the previous period. Then, does the effect of guide price policy on product selling price remain the same in different areas?

The results shown in **Table 4** answer this question. In **Table 4**, Models 6 and 7 represent the policy effect in the eastern region,

[4]Data source: http://data.cnki.net/YearData/Analysis

[5]Data source: http://data.cnki.net/yearbook/Single/N2018110002

[6]Data source: http://data.cnki.net/YearData/Analysis

[7]Data source: http://data.cnki.net/yearbook/Single/N2018060291

TABLE 2 | Variables for descriptive statistics.

Variable name	Obs.	Mean	Standard error	Minimum	Maximum
Raw milk selling price index	377	1.05381	0.09448	0.70828	1.41269
Ex-factory price index of finished milk	377	1.01625	0.03882	0.93372	1.13077
Retail price index of dairy products	377	1.00932	0.04868	0.85814	1.17676
$Period_t \times Treated_i$	377	0.31034	0.46324	0	1
GDP per capita index	377	0.03552	0.02734	0.00290	0.12213
Population index	377	0.03301	0.02026	0.00415	0.08034
Temperature (log)	377	2.58812	0.41707	1.45861	3.23474
Precipitation (log)	377	6.62352	0.65759	4.31615	8.68491

TABLE 3 | Influence of the raw milk purchase guide price policy on the product price index.

Model	1	2	3	4	5
$Period_t \times Treated_i$	0.1437*** (0.0084)	0.1438*** (0.0102)	0.1398*** (0.0116)	0.1405*** (0.0117)	0.1354*** (0.0131)
Time fixed effect	No	Yes	Yes	Yes	Yes
Regional fixed effect	No	No	Yes	Yes	Yes
Weather control variables	No	No	No	Yes	Yes
Regional (time-varying) control variables	No	No	No	No	Yes
Obs.	377	377	377	377	377
R2	0.4006	0.4644	0.4645	0.4659	0.4694

**** indicate significance at the 1% levels, respectively, the values in parentheses indicate standard errors. Weather control variables include temperature and precipitation. Regional (time-varying) control variables include per capita GDP and population.*

Models 8 and 9 represent the policy effect in the central region, and Models 10 and 11 represent the policy effect in the western region. Specifically, the guide price policy implemented in the eastern region increased the local raw milk price by 13%, the guide price policy implemented in the central region increased the local raw milk price by 10.73%, and the guide price policy implemented in the western region increased the local raw milk price by 15.5%. Based on this, we can conclude that this policy has a positive driving effect on the raw milk selling price in the eastern, central, and western regions, and the policy effect in the western region is greater than that in the eastern and central regions. The possible reason is that the western region includes the provinces such as Inner Mongolia and Xinjiang, in which the policy orientation and support are more significant than those in the eastern and central regions, and are set to ensure a stable development of animal husbandry.

Robustness Test

Parallel Trend Test

An important prerequisite for the validity of the DID method is the convergence hypothesis (Bogadóttir, 2020; Khan et al., 2020; Sánchez-López et al., 2020). In our study, this means that, if the raw milk purchase guide price policy was not implemented, the price trend in the province or municipality of the experimental group should have been equal to that of the control group. Considering the multiple execution nodes of the guide price policy, the event analysis method was adopted in this study to conduct a parallel trend test. The formula is as follows:

$$Y_{it} = C + \sum_{\Delta=-12}^{\Delta=8} \gamma' D_{i,t_0+\Delta} + \eta_t + \varepsilon_i + \mu_{it} \quad (3)$$

In Formula (3), $D_{i,t_0+\Delta}$ refers to the time dummy variable, covering 12 years before and 8 years after policy implementation. The reason for this was that the time span of the samples in this study was 2005–2017, the issuance time of policy of the first area in the experimental group was 2008+1, and the issuance time of policy of the last area in the experimental group was 2017. In addition, the coefficient of the time dummy variable γ' refers to the difference in the raw milk purchase price of the areas where the policy was implemented and that of the control group regions in the Δ ($-12 < \Delta < 8$) year after policy implementation. The criteria for this test were as follows: if γ' showed a relatively stable variation during the period with $\Delta < 0$, the policy test conformed to the criteria of the parallel trend test. On the contrary, if γ' showed large fluctuation during the period with $\Delta < 0$, there was a significant difference in the raw milk selling price variation of the experimental group and that of the control group before the implementation of the policy, which did not conform to the criteria of the parallel trend test.

The parallel trend test results are as shown in **Figures 2–5**. From a holistic perspective and regional heterogeneous perspective, γ' showed a relatively stable trend before the issuance time ("current" in the mentioned figures), demonstrating that there was no significant difference in raw milk selling price variation of the areas where the policy is currently implemented and the areas where the policy is not implemented before the issuance of the purchase guide price policy. After the issuance ("current") time, the value of γ' increased significantly, showing that the guide price policy had a significant effect on raw milk purchase price. The trend variation of γ' with the critical value of "current" verified the validity and reliability of the DID results again.

Placebo Test

In fact, the parallel trend test was just a necessary precondition for the application of DID. The conformance of the study object

TABLE 4 | Testing under conditions of regional heterogeneity.

Model	6	7	8	9	10	11
$Period_t \times Treated_i$	0.1367*** (0.0193)	0.1300*** (0.0220)	0.1193*** (0.0185)	0.1073*** (0.0202)	0.1532*** (0.0210)	0.1550*** (0.0196)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Weather control variables	No	Yes	No	Yes	No	Yes
Regional (time-varying) control variables	No	Yes	No	Yes	No	Yes
Obs.	143	143	91	91	143	143
R2	0.5403	0.5512	0.4250	0.4443	0.5169	0.5335

**** indicate significance at the 1% levels, respectively, the values in parentheses indicate standard errors. Weather control variables include temperature and precipitation. Regional (time-varying) control variables include per capita GDP and population.*

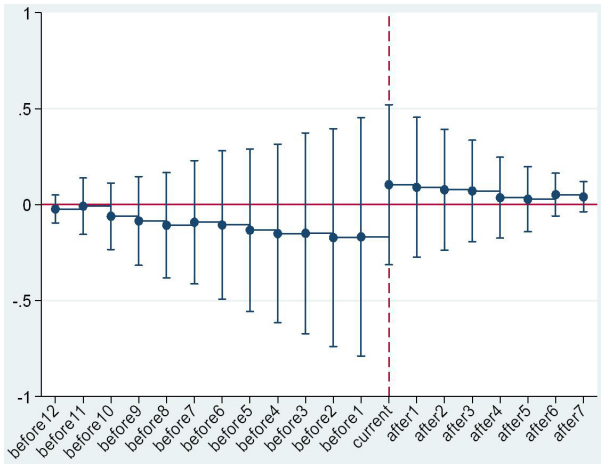

FIGURE 2 | Overall parallel trend test.

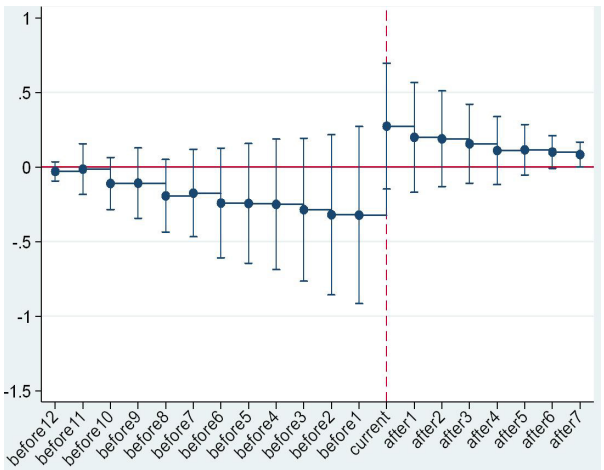

FIGURE 3 | Parallel trend test in the eastern region.

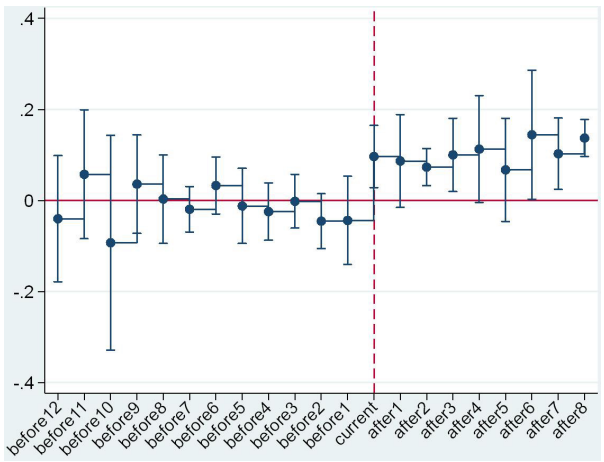

FIGURE 4 | Parallel trend test in the central region.

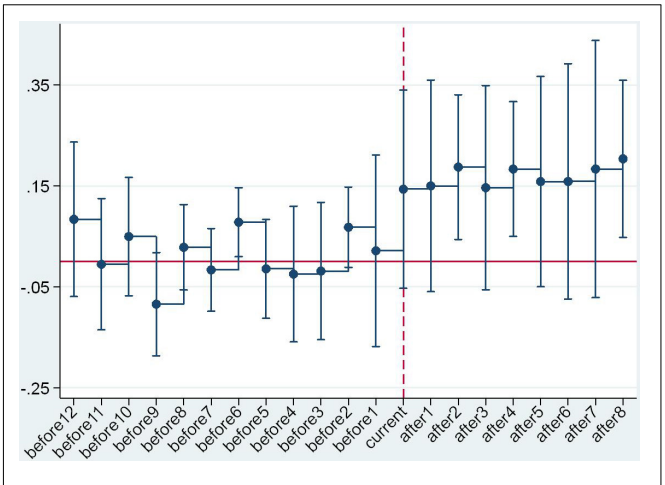

FIGURE 5 | Parallel trend test in the western region.

to the postulated condition did not mean that the results of the coefficient of the interaction variable reflected the policy effect more than other effects (Guo et al., 2020; Liu et al., 2020; Mao et al., 2020). One important consideration regards the influence of uncontrolled regional time-varying characteristics and undetected factors on estimation results. In this study, all regional characteristic factors that do not vary over time were included by adding a regional fixed effect, and all regional characteristic factors varying over time were included by adding regional time-varying variables, and the regional heterogeneity analysis also showed that regression results were not affected by area selection. However, the time-varying characteristics that were not examined in this study and other undetected factors may have caused bias in results. For this reason, in this study, 19 experimental groups were generated randomly in a fictional way to assess the effect of the guide price policy again, which was repeated 1,000 times, and no significant difference was expected in the experimental group and control group generated randomly.

As shown in **Figure 6**, under the condition of the fictitious experimental group, the t values were distributed in an inverted U-shaped curve with an axis of symmetry of 0, suggesting that the random test results were consistent with expected results, that is, under the condition of experimental groups generated randomly, the guide price policy had no treatment effect on product price in the areas where the policy was implemented. This indirectly indicated that the purchase guide price policy had a positive driving effect on raw milk selling price, which did not change with variation in area and time; this proving a certain robustness.

Other Robustness Tests

To further verify the reliability of the research results, a series of robustness tests were conducted based on Formula (2), mainly involving the lag effect and expectation effect of the policy. This was because each area may adopt different expectations and preparations for the purchase guide price policy, and the local

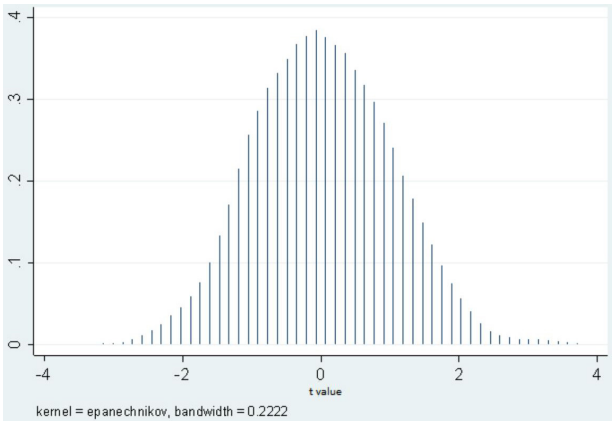

FIGURE 6 | Kernel density estimation of placebo test.

market price of raw milk may rise accordingly, generating an expectation effect. In addition, in some cases, the policy may not have a significant influence on the product price of that period, the policy will keep the market in a wait-and-see attitude or in the regulation state, generating a lag effect of the policy. It is certain that the expectation and lag effects can cause bias in conclusions. To avoid the expectation effect or lag effect, in this study, the dummy variables of Lag Phase 1, Lag Phase 2, Expectation Phase 1, and Expectation Phase 2 were added gradually in the model to assess the policy effect again. The results are shown in **Table 5**. In **Table 5**, regardless of the lag or expectation effect, the effect of the policy implementation of the current period should be of significance at the 1% confidence level, and the coefficient value should be close to the results shown in **Table 3**. However, the regression coefficient results of lag and expectation effect were small and not significant, suggesting that the expectation and lag effect of the raw milk purchase guide price policy can be ignored.

TABLE 5 | Expectation and lag effect test of policy implementation.

Model	12	13	14	15
$Period_t \times Treated_i$	0.1271*** (0.0217)	0.1274*** (0.0220)	0.1098*** (0.0231)	0.1086*** (0.0230)
$Period_t \times Treated_{i-1}$	0.0019 (.0199)	0.0004 (0.0245)	0.0062 (0.0239)	0.0031 (0.0259)
$Period_t \times Treated_{i-2}$		0.0018 (0.0215)	−0.0010 (0.0214)	−0.0001 (0.0235)
$Period_t \times Treated_{i+1}$			0.0088 (0.0172)	0.0101 (0.0191)
$Period_t \times Treated_{i+2}$				−0.0014 (0.0177)
Time fixed effect	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes
Weather control variables	Yes	Yes	Yes	Yes
Regional (time-varying) control variables	Yes	Yes	Yes	Yes
Obs.	348	319	290	261
R2	0.4156	0.3772	0.3573	0.3500

**** indicate significance at the 1% levels, respectively, the values in parentheses indicate standard errors. Weather control variables include temperature and precipitation. Regional (time-varying) control variables include per capita GDP and population.*

FURTHER ANALYSIS

The balanced profit distribution among dairy farmers, dairy enterprises, retailers, and consumers is an important precondition for the sustainable development of the dairy industry (Kurata and Ohe, 2020). In other words, although the direct purpose of the raw milk purchase guide price policy is to protect the benefits of dairy farmers, it should fundamentally promote balanced profit distribution in the whole dairy supply chain. The foregoing contents showed that the purchase guide price policy had a positive driving effect on raw milk selling price, that is, the principal purpose (protecting the minimum guaranteed profit of dairy farmers) of the policy was achieved. However, has the profit distribution along the domestic dairy supply chain become more balanced with an increase in the profit of dairy farmers? It is difficult to obtain an intuitive, comprehensive answer by conducting tests only from the producers' perspective: the test on the policy effect should be conducted from the perspective of processing enterprises and consumers.

Prior to the analysis, it is necessary to clearly specify the kind of profit distribution that is deemed relatively reasonable and balanced. In this paper, the research results of Latruffe et al. (2017) were referenced. A Shapley-value approach was adopted to calculate a relatively reasonable profit distribution scheme, according to the contributions of each subject of the chain. The results showed that the balanced profit distribution ratio among dairy farmers, dairy processing enterprises, and retailers should have been 24.5: 23.7: 51.8. However, the actual profit distribution ratio was 10: 35: 55, calculated by using the average price indexes of production, processing, and selling link of dairy products in 2005–2013, as shown in **Figure 7**. This suggested that the profit in the raw milk supply link was far lower than the reasonable value, and the profit in the processing link and retail link was far higher than the reasonable value. The raw milk purchase guide price policy has increased the selling price of raw milk, resulting in an increase in the profit of dairy farmers; however, has the overall equilibrium level of the supply chain increased? In the following part of this paper, the test and analysis will be conducted using the "ex-factory price index of finished dairy product" and "retail price index of dairy commodities."

Table 6 shows the effect of the guide price policy on the intermediate processing link and terminal retail link from a holistic perspective, where Models 16 and 17 represent the effect of the raw milk purchase guide price policy on dairy processing enterprises. Models 18 and 19 represent the effect of the policy on retailers. Specifically, the implementation of local raw milk purchase guide price policies had an insignificant inhibiting effect on the product selling price of dairy processing enterprises, which was manifested as a decrease in the finished dairy product price

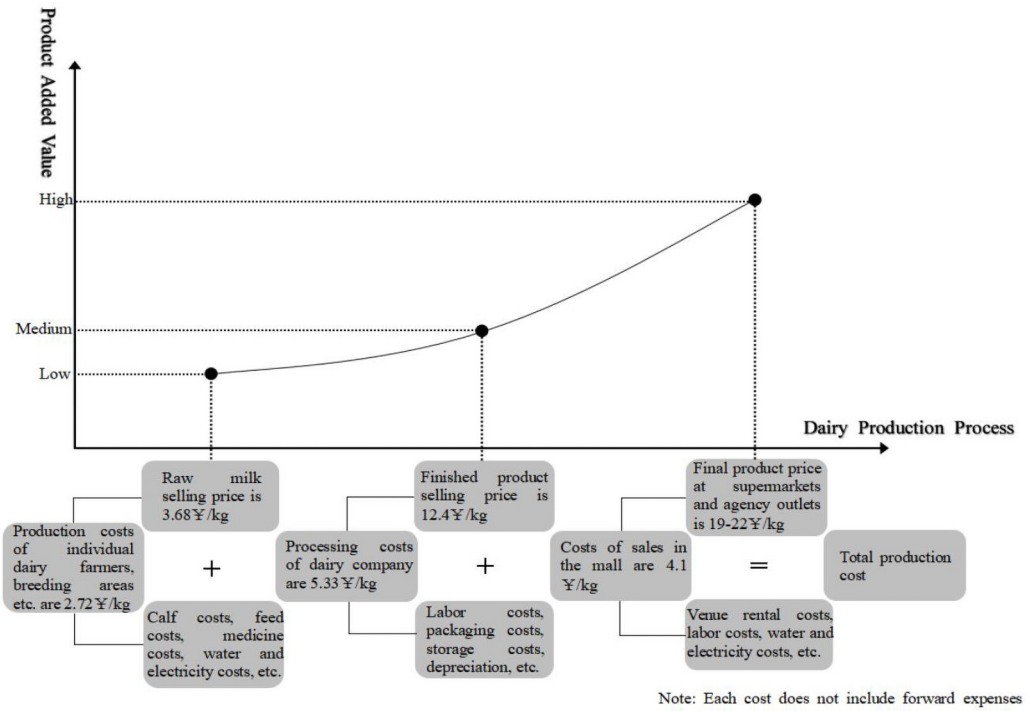

FIGURE 7 | Dairy production cost breakdown.

TABLE 6 | Analysis of policy effects from the perspective of milk processing enterprises and retailers.

Model	16	17	18	19
$Period_t \times Treated_i$	−0.0047 (0.0104)	−0.0032* (0.0011)	0.0003 (0.0084)	0.0011* (0.0003)
Time fixed effect	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes
Weather control variables	No	Yes	No	Yes
Regional (time-varying) control variables	No	Yes	No	Yes
Obs.	377	377	377	377
R2	0.5088	0.5135	0.8274	0.8292

** indicate significance at the 10% levels, respectively, the values in parentheses indicate standard errors. Weather control variables include temperature and precipitation. Regional (time-varying) control variables include per capita GDP and population.*

by 0.32% of the unit caused by the policy implementation. On the contrary, the issuance of the guide price policy made the selling price of products in supermarkets and sales commission agencies increase, although the effect was manifested as an increase of 0.11%. Why did the policy have a driving effect on the retailers' product selling price and the opposite effect on the product selling price of processing enterprises? The possible reason is that, on the one hand, some dairy processing enterprises have established supporting farms, and the price support policy decreased the breeding cost, resulting in a decrease in the selling price of finished dairy products. On the other hand, the price support policy increased the number of cows, resulting in an excessive supply of finished dairy products, thus decreasing the price. However, for retailers, the price support policy could release a market signal, and to prevent the shifting of the production cost of dairy enterprises to themselves, the terminal subjects will reduce profit loss by lifting the price.

DISCUSSION AND CONCLUSION

This paper investigated the effect of the raw milk purchase guide price policy, including the effect on the product selling price of dairy farmers, dairy processing enterprises, and retailers. The effect of the price support policy on the balance of profit distribution in the dairy supply chain was calculated: first, based on the existing profit distribution ratio of 10: 35: 55 among the subjects of the dairy industry, the policy effect was integrated into the ratio and brought through a normalization process to obtain the final profit distribution ratio of 11.35: 34.20: 54.45, which is closer to the balanced profit distribution ratio of 24.5: 23.7: 51.8 than the ratio of 10: 35: 55. The results suggested that the raw milk purchase guide price policy could not only promote an increase in the income of dairy farmers, but also promote a balanced profit distribution among subjects of the dairy supply chain, thus promoting the healthy, stable development of the entire dairy supply chain.

The subjective aim of the dairy product purchase guide price policy is to protect the minimum guaranteed profit of dairy farmers and promote a balanced profit distribution in the dairy industry. This will enhance the production

confidence of Chinese raw milk producers and increase Chinese consumers' expectations and consumer psychology for domestic dairy products. Under the circumstance that production costs remain the same, producers will be more able to resist external risks and more confident in increasing production and R&D investment while improving product quality. Enriching product categories while improving product quality will strengthen consumer confidence in domestic products. In other words, the fundamental goal of the price support policy is to solve the problem of unfair transactions in the raw milk market and increase the production confidence of dairy farmers. Furthermore, the increase in producers' confidence is conducive to the improvement of product quality, which helps consumers overcome psychological barriers to resisting domestic dairy products and stimulating their consumption vitality. Our study proved that the price support policy is beneficial to improving the production psychology of raw milk suppliers and consumer psychology of consumers.

What then is the actual effect? In this paper, the DID was adopted to test the effect of the price support policy, and the research conclusions include three parts. First, the price support policy generally ensures a minimal guaranteed income of farmers through setting a minimum purchase price, and the actual effect is that the raw milk selling price in the areas where the policy is implemented is 13.54% higher than that in the areas where such a policy is not implemented. The price driving effect is most significant in the western region (15.5%), followed by the eastern region (13%), and the central region (10.73%). Second, the price support policy has an opposite effect on dairy processing enterprises and retailers, although the effect is not obvious. Third, by integrating the effect of the price support policy on subjects of the dairy industry into the current actual profit ratio of the dairy supply chain, the raw milk purchase guide price policy could promote a reasonable revolution in profit ratio among subjects of the chain.

The implications of the policy discussed in this paper are as follows: first, the raw milk purchase price is determined by dairy enterprises, dairy farmers, and industry associations, through negotiation and under the leadership of governments, and is conducive to standardizing the transactions among the subjects of the dairy industry and to establishing a fair and reasonable market structure of raw milk, and thus to protect the income of upstream dairy farmers. This suggests that it is necessary to set it using sustainable institutional regulations. Second, the price support policy may promote sustainable cooperation among the nodes constituting the whole dairy supply chain, and its internal mechanism is giving full play to advantages and bond functions of policy and coordinating profit distribution among subjects in the upstream and downstream portions of the chain. Third, based on the results of the empirical test, it can be derived that, to standardize the market structure of raw milk, it is necessary to handle and publish behaviors not complying with raw milk purchase and selling contracts, creating a list of dishonest dairy processing enterprises, establishing a forced exit mechanism, and strengthening the supervisions by public opinion, thus improving the stability of dairy production, processing, and selling. Scientific and comprehensive evaluation of the raw milk purchase guide price policy can, in the short term, provide theoretical support for the formulation, adjustment, and implementation of relevant policies. In the long term, this will ensure the sustainable development of the dairy supply chain.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

All authors undertook research, writing, and review tasks throughout this study, read and agreed to the published version of the manuscript.

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Conflict of Interest: 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.

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Fitnesser's Intrinsic Motivations of Green Eating: An Integration of Theory of Planned Behavior and Hedonic-Motivation System Adoption Model

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Global climate change arouses people's attention to environmental protection and, therefore, changes consumption habits. Food overconsumption not only produces extra waste but also pollutes the environment. Therefore, it is important to understand the factors that motivate people to eat green, an eco-friendly way to consume food. To keep the body in good shape, the fitnessers concern more about diet than the general people. This study explored intrinsic motivations, such as social recognition, environmental ethics, curiosity, joy of purchase, perceived usefulness, subjective norm, and perceived behavior control as constructs that affect fitnesser's green eating intention. All constructs except curiosity have significant impacts on behavior intention. The results demonstrate that social recognition and environmental ethics have significant effects on curiosity, joy of purchase, perceived usefulness, subjective norm, and perceived behavior control. The mediation effects between social recognition and behavior intention are not supported. The mediators between environmental ethics and behavior intention are joy of purchase, perceived usefulness, subjective norm, and perceived behavior control.

Keywords: intrinsic motivation, green eating, theory of planned theory, hedonic-motivation system adoption model, social recognition, environmental ethics

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INTRODUCTION

With the rapid growth of the world's population and the increasing consumption of energy, environmental pollution caused by energy consumption has attracted wide attention. China has a population of 1.3 billion, accounting for 18.57% of the world's population. Also, China is the world's second largest economy (Barboza, 2010), and its food consumption and role in environmental protection cannot be ignored. Food is a basic need for human life and cannot be substituted. Food consumption accounts for 20–30% of the environmental impact in the West (Tukker and Jansen, 2006).

Fast economic development not only brings people a better life but also causes the environment a heavy burden. To prevent the environment from being destroyed by increasing pollution, the government supported various green industries and encouraged people's green behaviors (Steg and Vlek, 2009). One of the behaviors is green eating, which is consuming food in an eco-friendly

way. Key elements about eating green include eating locally grown foods, choosing organic foods if possible, limiting intake of processed or fast foods, and consuming meatless meals weekly (Weller et al., 2014). Green eating behavior can reduce energy consumption by not buying food in a distance and lessen waste production by eating fresh or organic food instead of processed food. For sustainable development, it is important to implement environmental protection education to the society, so as to understand the factors that influence green eating intention (Muposhi and Dhurup, 2017; Kim and Kim, 2018; Dalvi-Esfahani et al., 2020; Lacroix and Gifford, 2020).

Fitness has a broader meaning in Eastern countries. Not limited to bodybuilding, a fitness center could provide aerobics, sports, group classes, pools, steam rooms, Jacuzzis, saunas, or even massage rooms or lounge areas for social interaction. To maintain their body figure, fitnessers believe exercise can prevent aging, and selected diet can increase physical strength or even enhance immunity. For example, they tend to cut down on high sugar or starchy foods and eat high-fiber or low-calorie foods. Therefore, their awareness of food selection is more cautious than the general public. This study adopted the theory of planned behavior (TPB) to find out the determinants including social recognition, environmental ethics, curiosity, joy of purchase, perceived usefulness, subjective norm, and perceived behavior control to understand the impacts on fitnesser's intention of green eating.

Theory of planned behavior is an extensively applied research model in the intention for green eating (e.g., Mundorf et al., 2018; Ahmad et al., 2020; Canova et al., 2020; Carfora et al., 2020; Dalvi-Esfahani et al., 2020; Malan et al., 2020; Ruangkanjanases et al., 2020). However, prior studies have adopted or extended TPB in several aspects for predicting intention toward green eating, and there are still two major limitations that remain to be solved. First, few of the studies have elaborated on how antecedents affect the key components for green eating. These limitations drive the possibilities for further exploration in green behaviors. Therefore, this research applied TPB as a basic framework and further attempted to include a cognitive construct (i.e., social recognition, environmental ethics, curiosity, joy of purchase, and perceived usefulness) to measure its effect on intention toward green eating. Second, because intrinsic motivation has a greater impact on human behavior than extrinsic motivation (Csikszentmihalyi, 1990; Thomas and Velthouse, 1990), unlike the other scholars who apply only TPB in their studies, this study explored TPB, the hedonic-motivation system adoption model (HMSAM), and intrinsic constructs including social recognition and environmental ethics in the proposed model to examine fitnesser's acceptance of green eating.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Theory of Planned Behavior

According to the theory of reasoned action (TRA), one's behavior is based on his behavior intention, and one's behavior intention is affected by his attitude and subjective norm (Fishbein and Ajzen, 1975). Originating from the TRA, TPB extends the TRA with perceived behavioral control as an antecedent variable of behavioral intention (Ajzen, 1991). TPB has been extensively adopted in explaining human behavior intention, not to mention environmental protection issues.

A number of studies agreed that TPB predicted different behaviors *via* external variables and antecedents (e.g., Chen and Hung, 2016; Paul et al., 2016; Hsu et al., 2017; Al-Jubari, 2019; Sun et al., 2019; Hoque and Hossan, 2020; Parash et al., 2020; Si et al., 2020; Uzun and Kilis, 2020). A meta-analysis conducted by Hagger et al. (2002) confirmed that the three aforesaid factors can be used to predict behavioral intentions and behavior. Therefore, this study hypothesized H_1 and H_2 as follows:

Hypothesis 1 (H_1). *Fitnesser's subjective norm is positively correlated with their intention to eat green.*

Hypothesis 2 (H_2). *Fitnesser's perceived behavior control is positively correlated with their intention to eat green.*

Hedonic-Motivation System Adoption Model

van der Heijden (2004) proposed his research result regarding hedonic-motivation system (HMS) by adding joy in the technology acceptance model (TAM) as a mediator between perceived ease of use and behavioral intention to use. Prior research indicated the influence of perceived usefulness on behavioral intention (e.g., Chen et al., 2009, 2013; Tsai et al., 2020). Moreover, empirical evidence also supported the relationship between perceived usefulness and purchase intention (e.g., Jamal and Sharifuddin, 2015; Moslehpour et al., 2018).

Grounded in flow-based cognitive absorption (CA), Lowry et al. (2012) improved the HMS by integrating intrinsic motivations, such as curiosity and joy in the HMSAM. Oluwajana et al. (2019) found that curiosity, joy, and perceived usefulness have a direct impact on behavior intention based on HMSAM. Past studies also provided empirical evidence linkages between behavioral intention intrinsic motivations (i.e., curiosity, joy, and perceived usefulness) (e.g., Koo and Choi, 2010; Shu, 2014; Mohammadi, 2015). According to the above discussion, this study proposed H_3, H_4, and H_5 as follows:

Hypothesis 3 (H_3). Fitnesser's curiosity is positively correlated with their intention to eat green.

Hypothesis 4 (H_4). Fitnesser's joy of purchase is positively correlated with their intention to eat green.

Hypothesis 5 (H_5). Fitnesser's perceived usefulness is positively correlated with their intention to eat green.

Social Recognition

Social recognition is about public acknowledgment of people's status, merits, or personality (Susewind and Walkowitz, 2020). Maslow's (1970) hierarchy of needs classifies human needs into five levels to motivate human behavior. Social recognition serves as a postconsumption feedback on the viability of this

social function (Fischer et al., 2010; McPhail et al., 2011; Stead et al., 2011). Thus, fitnessers use environmentally friendly products, and the sense of society can satisfy their need for status, achievement, recognition, and self-esteem. Similarly, in prior empirical evidence, social recognition is one of the influential antecedents in the formation of individual perceptions (e.g., Chuang and Dellmann-Jenkins, 2010; Kim et al., 2016). Therefore, this study proposed the following hypotheses:

Hypothesis 6 (H_6). Fitnesser's social recognition is positively correlated with the subjective norm to eat green.

Hypothesis 7 (H_7). Fitnesser's social recognition is positively correlated with the perceived behavioral control to eat green.

Martella et al. (2015) identified various human needs including social recognition and curiosity based on the gamification framework. To develop a successful constructivist-based learning environment, several issues including curiosity and social recognition that motivate students were the top priority (Herring, 2004).

As mentioned in the social attraction theory, society members who reflect the collective group standard may appear more attractive by other group members (Hogg and Hardie, 1991) and, hence, be beneficial from higher levels of social recognition, in which their subjective well-being is positively affected. Likewise, in a cross-country study regarding religious people, social recognition has a positive impact on happiness (Stavrova et al., 2013). Besides, prior research also found the linkage between social recognition and perceived usefulness (Wu and Chen, 2017). Therefore, our study proposed the following hypotheses:

Hypothesis 8 (H_8). Fitnesser's social recognition is positively correlated with the curiosity to eat green.

Hypothesis 9 (H_9). Fitnesser's social recognition is positively correlated with the joy to eat green.

Hypothesis 10 (H_{10}). Fitnesser's social recognition is positively correlated with the perceived usefulness to eat green.

Environmental Ethics

Environmental ethics ensures a healthy man–nature relationship (Misra, 1995). In the beginning, the importance between humans and nature has been ignored, but now, humans have a new understanding of ecosystems and of keeping the balance of the cultural and biological diversity of humans and other forms of life (Leopold, 1949; Ellis and Ramankutty, 2008; Leopold et al., 2010). Including the extent of human decent obligations to the environment, environmental ethics focuses on the collective action of human beings on nature (Holden, 2005). Humans and other creatures form an interdependent system on Earth, and humans are not superior to other creatures (Taylor, 1986). Rolston (2020) refers to the basis of environmental ethics as natural love of an individual, and the original experience might be hedonic.

In a recent study in the United Kingdom regarding small and medium enterprise (SME) owners, North and Nurse (2014) discovered that they have strong moral and environmental ethics in running "normal" businesses while having curiosity about the problem of climate change and its solutions. Therefore, the concerns of environmental issues have been prevailed to the "normal" citizen. McShane (2007) stated that environmental ethics should not give up on intrinsic value, like joy. On the enjoyment of life, Chinese fitnessers have become more and more concerned about the impact of ecological degradation, and advertisement emphasizing eco-friendliness appears to having significant impact on their perception of perceived usefulness and credibility (Chan, 2004). Therefore, this study proposed the following hypotheses:

Hypothesis 11 (H_{11}). Fitnesser's environmental ethics is positively correlated with the curiosity to eat green.

Hypothesis 12 (H_{12}). Fitnesser's environmental ethics is positively correlated with the joy to eat green.

Hypothesis 13 (H_{13}). Fitnesser's environmental ethics is positively correlated with the perceived usefulness to eat green.

In the study of food consumption (Kim, 2014), ecological concern refers to the concern about doing the right thing for animal welfare, the environment, and the ecosystem, which can be regarded as moral norms. Human should respect the environment *via* environmental ethics and beliefs and ensure the ethical connection between humans and the environment. These should also dominate the mind, as well as attitudes and behaviors (Chen and Hung, 2016). In this context, similar to the viewpoints of Leopold (1949), Taylor (1986), and Arvola et al. (2008), environmental ethics is significantly related to the three aforementioned factors in the TPB. Studies on ethical consumerism like Shaw and Shui (2002) used the TPB to explain customers' behavioral intentions to purchase ethically produced goods. Therefore, the study proposed the following hypotheses:

Hypothesis 14 (H_{14}). Fitnesser's environmental ethics is positively correlated with the subjective norm to eat green.

Hypothesis 15 (H_{15}). Fitnesser's environmental ethics is positively correlated with the perceived behavior control to eat green.

According to the literature review and the hypotheses development, this study proposed a research model as shown in **Figure 1**.

RESEARCH METHOD

Measurement scales for all constructs in this study were designed based on previous studies and were scored on a seven-point Likert scale, with higher scores indicating higher agreement with the question. Behavioral intention, subjective norm, and perceived behavioral control were adapted from Ajzen (1991), Paul et al. (2016), and Yadav and Pathak (2016). Perceived usefulness with three items was adopted from Chen et al. (2013) and Wu et al. (2015). Curiosity and joy with three items, respectively, were modified from Agarwal and Karahanna (2000) and Lowry et al. (2012). Social

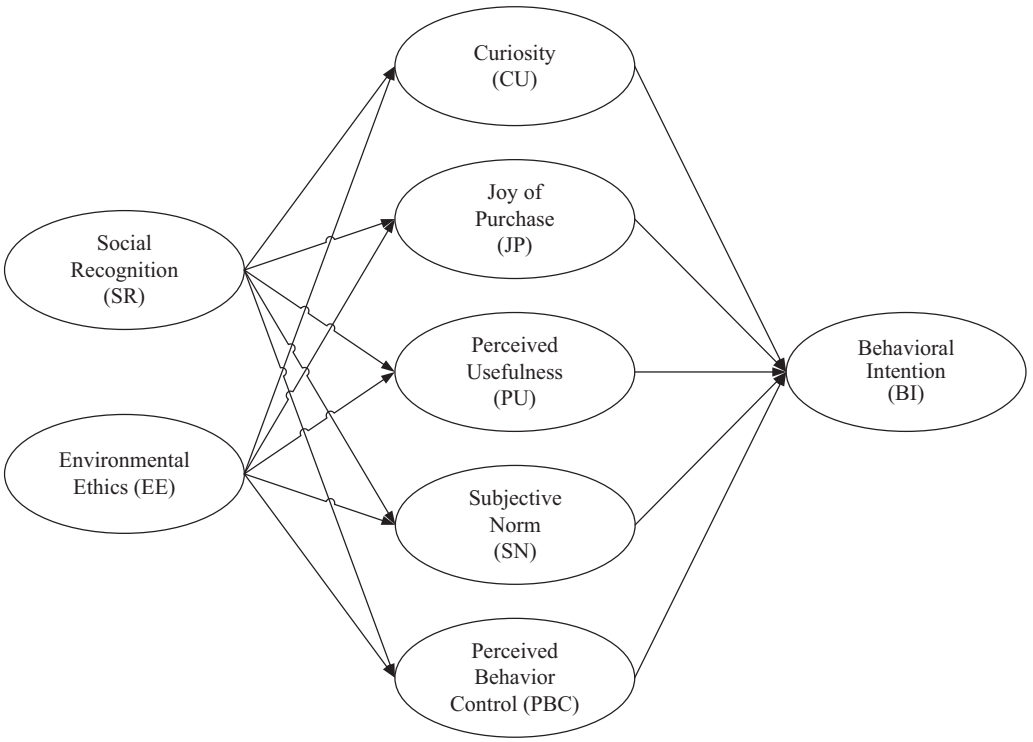

FIGURE 1 | The research model.

recognition with three scales was developed from Fischer et al. (2010) and McPhail et al. (2011). Finally, environmental ethics had three items adopted from Henriques and Sadorsky (1999). Before the formal questionnaire was sent out, a pilot test was conducted in order to revise the content of the questionnaire to avoid any discrepancies. Therefore, the content validity of this research could be improved, eliminating the occurrence of ambiguous words and inappropriate questioning through the pilot test.

The questionnaire was made available at a professional and famous online survey website[1] and announced to the public in four major cities—Beijing, Shanghai, Guangzhou, and Shenzhen in China. The beginning of the questionnaire briefly explains the definition of green eating, and the first question determines whether the respondent has the experience of green eating. Only fitnessers with green eating experience were invited to participate in the survey and were instructed to answer all questionnaire items.

Beginning in early July 2020, the data collection process lasted for 3 weeks. To improve external validity, we collected data only from active fitnessers, rather than from the general public. After removing seven invalid questionnaires, 786 valid responses were analyzed by AMOS 24. Among the samples of this study, 47.80% were male and 52.20% were female. Furthermore, 16.93% were aged under 25 years, 61.31% were 26–45 years, 18.35% were 46–65 years, and 3.41% were above the age of 66 years.

[1]https://www.wjx.cn/

ANALYSIS RESULTS

Measurement Model

Construct Validity

This study followed the two-step approach of structural equation modeling (SEM) proposed by Anderson and Gerbing (1988) to estimate the measurement and structural model. We chose SEM as the statistical method and AMOS as the analysis tool for two reasons. First, SEM is a family of statistical procedures that could handle the confirmatory factor analysis (CFA) and path analysis. Particularly, CFA is an important procedure to measure construct validity and the path analysis is adopted to evaluate the research hypotheses (Byrne, 2001; Kline, 2011). Second, AMOS is one of the recommended analysis tools to perform the results of SEM (Babin et al., 2008). The first step examined construct reliability and validity of the measurement model using CFA, and the second step checked the path effects and their significance of the structural model. The measurement model was assessed by using the maximum likelihood estimation (MLE) in terms of factor loadings, reliability of measurement, convergent validity, and discriminant validity.

As shown in **Table 1**, all standardized factor loadings of questions are from 0.699 to 0.894. All composite reliability of the constructs ranging from 0.839 to 0.913 and Cronbach's alpha ranging from 0.828 to 0.913 exceed 0.7 as recommended by Nunnally and Bernstein (1994), indicating that all constructs have internal consistency. Lastly, the average variance extracted (AVE) of the constructs ranging from 0.633 to 0.777 exceed

TABLE 1 | Results of the measurement model.

Construct	Item	Standardized factor loading	Construct reliability		Convergent validity
			Alpha	CR	AVE
SR	SR1	0.867	0.902	0.921	0.756
	SR2	0.894			
	SR3	0.847			
EE	EE1	0.803	0.828	0.837	0.633
	EE2	0.699			
	EE3	0.875			
CU	CU1	0.805	0.850	0.850	0.655
	CU2	0.813			
	CU3	0.809			
JP	JP1	0.833	0.872	0.872	0.695
	JP2	0.828			
	JP3	0.839			
PU	PU1	0.816	0.843	0.844	0.644
	PU2	0.764			
	PU3	0.826			
SN	SN1	0.847	0.876	0.877	0.704
	SN2	0.861			
	SN3	0.809			
PBC	PBC1	0.808	0.838	0.839	0.635
	PBC2	0.826			
	PBC3	0.755			
BI	BI1	0.886	0.913	0.913	0.777
	BI2	0.887			
	BI3	0.872			

Alpha, Cronbach's alpha; CR, composite reliability; AVE, average variance extracted; SR, social recognition; EE, environmental ethics; CU, curiosity; JP, joy of purchase; PU, perceived usefulness; SN, subjective norm; PBC, perceived behavioral control; BI, behavioral intention.

TABLE 2 | Discriminant validity of the measurement model.

	SR	EE	CU	JP	PU	SN	PBC	BI
SR	**0.869**							
EE	0.589	**0.796**						
CU	0.569	0.648	**0.809**					
JP	0.660	0.748	0.704	**0.834**				
PU	0.562	0.691	0.719	0.797	**0.802**			
SN	0.634	0.640	0.559	0.746	0.662	**0.839**		
PBC	0.616	0.704	0.633	0.694	0.668	0.702	**0.797**	
BI	0.566	0.748	0.551	0.683	0.622	0.604	0.622	**0.881**

The items on the diagonal in bold represent the square roots of the AVE; off-diagonal elements are the correlation estimates.
SR, social recognition; EE, environmental ethics; CU, curiosity; JP, joy of purchase; PU, perceived usefulness; SN, subjective norm; PBC, perceived behavioral control; BI, behavioral intention.

0.5 as suggested by Fornell and Larcker (1981) and Hair et al. (2010), showing that all constructs have adequate convergent validity. These results demonstrated that all measurement items had convergent validity.

As shown in **Table 2**, the bold numbers in the diagonal direction represent the square roots of AVEs and the off-diagonal numbers are correlations among constructs. Most of the numbers in the diagonal direction are greater than the off-diagonal numbers, and all the correlations are lower than 0.85; therefore, discriminant validity appears to be adequate for this study.

Detection of Common Method Bias

Preventive measures in this research were taken in order to reduce the common method bias (CMB) that may result from sample collection of a single respondent's cognitive information by self-reported measurement items and decrease the impact of CMB. In addition to anonymous surveys, this research attempted to hide the meaning of each question and separate measurement items for different constructs as much as possible. The variable results in **Tables 1**, **2** had an appropriate degree of construct validity, which also indicated that the results were not largely affected by CMB. In addition, this study adopted Harman's single-factor test to evaluate the severity of CMB (Podsakoff et al., 2003). The model fit of the CFA for the 24 measurement items in this study was better than the single-factor model of CFA significantly. This result could be seen that the impact of CMB was not serious in this research.

Structural Model Analysis

By using the maximum likelihood method, this study performed structural model testing to estimate the hypothesized relationships of the proposed model. Model fit indicators determine the degree of whether the sample data fit the structural equation model. Schumacker and Lomax (2010) and Kline (2011) recommended a variety of criteria to determine the model fit of a structural model. Jackson et al. (2009) suggested that the commonly used model fit reporting guidelines are χ^2, *df*, χ^2/df ratio, GFI, RMSEA, SRMR, CFI, and TLI.

Table 3 demonstrates several model fit indicators and the thresholds recommended by previous studies. Except for χ^2, all model fit indicators exceed the recommended levels suggested by Schumacker and Lomax (2010). Because χ^2 is very sensitive to a large sample, the ratio of χ^2 to its degree of freedom was computed. For a good model fit, the ideal ratio should be below three. Instead of evaluating each index independently, Hu and Bentler (1999) proposed that more strict combination rules should be applied to model fit indices so the type I errors could be controlled. The model fit indicators satisfy most of the independent level of recommended fits and the combination rule. Thus, it has been proven that the proposed model of most of the constructs has a good fit.

The results support the research hypotheses regarding the validity of the research model (as shown in **Table 4**); 54.3% of CU can be explained by SR and EE constructs, 74.2% of JP can be explained by SR and EE constructs, 64.7% of PU can be explained by SR and EE constructs, 62.8% of SN can be explained by SR and EE constructs, 62% of PBC can be explained by SR and EE constructs, and 54% of BI can be explained by CU, JP, PU, SN, and PBC constructs.

Mediation Effects

Bootstrapping mediation analysis can provide confidence intervals to examine the indirect effects. One of the preferred bootstrapping mediation analysis methods is bias-corrected

TABLE 3 | Model fit.

Model fit	Criteria	Measurement model	Structural model
Chi-squared/*df*	<5	2.848	3.914
GFI	>0.9	0.934	0.903
CFI	>0.9	0.969	0.948
TLI	>0.9	0.962	0.940
NFI	>0.9	0.953	0.932
IFI	>0.9	0.969	0.949
RMSEA	<0.08	0.049	0.061
SRMR	<0.08	0.029	0.039

Chi-squared/df, chi-squared divided by degrees of freedom; GFI, goodness-of-fit index; CFI, comparative fit index; TLI, Tucker–Lewis index; NFI, normed fit index; IFI, incremental fit index; RMSEA, root-mean-square error of approximation; SRMR, standardized root-mean-square residual.

TABLE 4 | Structural model analysis.

DV	IV	Unstd. regression weight	SE	*t*-Value	Std. path coefficient	R^2
CU	SR	0.145	0.042	3.447	0.163***	0.580
	EE	0.689	0.057	12.166	0.648***	
JP	SR	0.191	0.040	4.746	0.202***	0.783
	EE	0.840	0.056	14.893	0.744***	
PU	SR	0.082	0.045	1.848	0.065	0.685
	EE	0.859	0.062	13.844	0.769***	
SN	SR	0.261	0.043	6.030	0.275***	0.613
	EE	0.659	0.056	11.795	0.580***	
PBC	SR	0.183	0.041	4.454	0.206***	0.650
	EE	0.699	0.054	12.896	0.660***	
BI	CU	0.036	0.048	0.741	0.036*	0.549
	JP	0.332	0.063	5.252	0.357***	
	PU	0.126	0.055	2.278	0.134*	
	SN	0.105	0.046	2.274	0.114*	
	PBC	0.200	0.054	3.712	0.201***	

DV, dependent variable; IV, independent variable; SR, social recognition; EE, environmental ethics; CU, curiosity; JP, joy of purchase; PU, perceived usefulness; SN, subjective norm; PBC, perceived behavioral control; BI, behavioral intention.
**p-value < 0.05.*
****p-value < 0.001.*

bootstrapping (Williams and MacKinnon, 2008), which is used in this study. As shown in **Table 5**, the total effect SR→BI, $p > 0.05$, bias-corrected confidence interval (CI) does include zero [CI of SR→BI = (−0.051, 0.448)]. The existence of total effect was not supported. It was not necessary to test the mediation effect. The total effect ER→BI, $p < 0.05$, bias-corrected CI does not include zero [CI of ER→BI = (0.281, 0.919)]. The existence of total effect was supported. The indirect effect EE→CU→BI, $p > 0.05$, both bias-corrected CI includes zero [CI of EE→CU→BI = (−0.036, 0.163)]. Consequently, the hypothesis of the existence of indirect effect was not supported. The indirect effect EE→JP→BI bias-corrected CI does not include zero [CI of EE→JP→BI = (0.094, 0.652)]. Thus, the hypothesis of the existence of indirect effect was supported. The indirect effect ENV→PU→BI bias-corrected CI does not include zero [CI of EE→PU→BI = (0.007, 0.405)]. Therefore, the hypothesis of the existence of indirect effect was supported. The indirect effect ENV→SN→BI bias-corrected CI does not include zero [CI of ENV→SN→CU = (0.007, 0.25)]. Consequently, the hypothesis of the existence of indirect effect was supported. The indirect effect ENV→PBC→BI bias-corrected CI does not include zero [CI of ENV→PBC→BI = (0.037, 0.401)]. Accordingly, the hypothesis of the existence of indirect effect was supported.

TABLE 5 | Analysis of mediation effects.

Parameter	Estimate	Lower	Upper	*p*-Value
SR→CU→BI	0.005	−0.008	0.046	0.373
SR→JP→BI	0.063*	0.009	0.177	0.015
SR→PU→BI	0.010	−0.006	0.076	0.216
SR→SN→BI	0.028*	0.000	0.088	0.043
SR→PBC→BI	0.036*	0.005	0.111	0.014
EE→CU→BI	0.025	−0.049	0.148	0.464
EE→JP→BI	0.279**	0.114	0.633	0.001
EE→PU→BI	0.010	−0.006	0.076	0.216
EE→SN→BI	0.028*	0.000	0.088	0.043
EE→PBC→BI	0.016	−0.015	0.086	0.224

SR, social recognition; EE, environmental ethics; CU, curiosity; JP, joy of purchase; PU, perceived usefulness; SN, subjective norm; PBC, perceived behavioral control; BI, behavioral intention.
**p-value < 0.05.*
***p-value < 0.01.*

CONCLUSION

Theoretical Contributions

Due to the complex nature of sustainability, it is common for researchers to focus only on the economic aspect of environmental solutions and implications. However, this study explored fitnesser's intrinsic motivations of green eating. Most of the environmental studies suggested to address the extension of TPB in interpreting human behavior in ecological protection issues (e.g., Bagheri et al., 2019; Suki and Suki, 2019; Si et al., 2020). Therefore, integrating only one theory is not sufficient to explain complicated human behavior. This study proposed a research model incorporating TPB and HMSAM to discuss the compact of social recognition and environmental ethics on fitnesser's green eating intention. In addition, the mediation effects of curiosity, joy, perceived usefulness, subjective norm, and perceived behavior control were investigated. The results supported hypotheses H_1 to H_{10}. Both fitnessers' social recognition and their environmental ethics are positively correlated with the HMSAM constructs such as curiosity, joy of purchase, and perceived usefulness and the TPB constructs like subjective norm and perceived behavior control.

Social recognition refers to the positive response of society to individual social behavior. The praise and recognition of others is helpful to promote one's social status. In this study, fitnessers with a higher level of social recognition tend to have a higher curiosity in understanding how green eating can protect environment, have greater pleasure when eating green, and have

a better understanding of the usefulness of green eating in ecological protection.

Environmental ethics is the study of environmental issues from an ethical perspective. Since environmental protection has become a manifestation in today's society, many fitnessers are committed to environmental protection initiatives and are proud of being environmentalists. They are eager to learn more about environmental protection and hope to protect the environment better. They "feel better right now" when they have hedonic goals (Lindenberg and Steg, 2007). They feel that they are doing their part for environmental protection when they eat green and, therefore, feel happy inside.

Fitnessers with a rich knowledge of environmental protection may gain social recognition from their friends. On the other hand, to obtain social recognition, they want to know more or be curious about the mechanism between green eating and environmental protection. When they are involved in these issues, they have full understanding about what green eating can do to the environment. Consequently, they feel that eating green is useful for ecological protection and they are happy to do it in their daily lives. This explained the correlation between social recognition and joy of purchase. Similarly, fitnessers with higher environmental ethics have no doubt in their mind that green eating is useful for environmental protection.

Subjective norm is the perception of the social pressures that individuals experience when they take a particular behavior. It is not surprising that a consumer with a higher social recognition has a higher subjective norm. Fitnessers are possible to cater to their friends to gain higher social recognition, so they will not perform a certain behavior. In other words, they will comply with their friends, to follow the subjective norm, because it is important to raise their social recognition.

As mentioned above, people with higher social recognition have the tendency to cope with their friends better. That is, they have better control of themselves whether or not to perform a particular behavior. Similarly, if fitnessers have higher environmental ethics, they expect to be able to master their behavior and will not do anything that is harmful to the environment. This explained why fitnessers with a higher level of environmental ethics tend to have a higher joy of purchase. Therefore, both social recognition and environmental ethics have a positive impact on perceived behavior control.

This study not only explores the influence of social recognition and environmental ethics on behavior intention, but also discusses the mediation effects of curiosity, joy of purchase, perceived usefulness, subjective norm, and perceived behavior control. Based on the mediation effect analysis, since the total effect of social recognition to behavior intention is not significant, constructs between social recognition and behavior intention are not discussed. However, the total effect of environmental ethics to behavior intention is significant, and the mediation effects of joy of purchase, perceived usefulness, subjective norm, and perceived behavior are supported. In other words, except for the H_{11} that fitnesser's curiosity is positively correlated with their intention to eat green being not supported, H_{12}–H_{15} dealing with environmental ethics having impacts on the behavior intention through the four abovementioned mediators are all sustained.

Intrinsic value is the degree to which an activity is considered to be personally enjoyable (Chiu and Wang, 2008; Jiang et al., 2020). Straume and Vittersø (2012) claimed that the individuals' feelings of joy or pleasure could affect their behavior. A number of empirical studies have also confirmed the positive effect of hedonic values on consumer behavior intention. Hedonic perception influenced fitnesser's intentions of adoption significantly (Song, 2014). Choi and Kim (2016) found that both enjoyment and perceived usefulness affected behavioral intention positively. Similarly, in this study, perceived usefulness mediated behavior intention. This result is supported by Chang et al. (2005) in their search of quality antecedents. In a web learning tools study, Lai (2017) found that perceived behavior control mediated behavior intention, and so did the subjective norm. In a study of genetically modified foods, Kim et al. (2014) pointed out that subjective norm and perceived behavior control are positive determinants of behavior intention, though this research proves that both subjective norm and perceived behavior control are mediators between environmental ethics and behavior intention.

Managerial Implications

There are four theoretical contributions of this article. First, this research combines TPB and HMSAM to extend the research on green eating and to build up the research model from social recognition, environmental ethics, and the two aforesaid models. Second, there is no prior research using the HMS adoption model in discussing fitnesser's intention in green eating. This study proves that joy of purchase and perceived usefulness positively affect fitnesser's behavior intention that has filled up the research gap. Third, this study indicates that the relationship between environmental ethics and behavior intention is mediated by joy of purchase, perceived usefulness, subjective norm, and perceived behavior control. Fourth, arousing fitnesser's social recognition and environmental ethics is helpful in increasing their intention of green eating. Unlike many previous studies that only focused on interpreting consumer behavior with TPB, this research raises the research domain to a different level by integrating social recognition and environmental ethics into the research model.

There are three practical contributions of this study. First, this study validates that increasing fitnesser's social recognition and environmental ethics can not only raise their joy of purchase, perceived usefulness, subjective norm, and perceived behavior control but also improve their behavioral intention toward green eating. If manufacturers want to increase their sales on green eating, other than increase fitnesser's social recognition and environmental ethics, they have to enhance fitnesser's abovementioned four elements to change fitnesser's behavior intention to eat green.

Second, fitnesser's joy of purchase, perceived usefulness, subjective norm, and perceived behavior control should be promoted so their intention to eat green will be influenced. Because the mediation effects of the said four constructs are significant in this study, companies can change the fitnesser's behavior intention to eat green if their aforesaid variables can be improved.

Third, this study demonstrates that fitnesser's social recognition and environmental ethics are positively associated

with joy of purchase, perceived usefulness, subjective norm, and perceived behavior control and are also positively associated with fitnesser's behavior intention. Both fitnesser's social recognition and environmental ethics indirectly affect fitnesser's behavior intention to eat green positively *via* joy of purchase, perceived usefulness, subjective norm, and perceived behavior control.

Research Limitations and Future Work

Although this study provided some useful insights and viewpoints, it had several limitations and should be addressed in further research. First, the aim of this study was to determine the constructs that influence fitnesser's behavior intention of green eating. Future research could try to integrate different theories and constructs to better interpret fitnesser's behavior intention in comparison with this study. Second, the sample collection and research design of this study were undertaken in China. Future research could broaden the sample collection by adding samples from other countries or areas. Multiculture comparison of consumer behavior intention could be explored if possible. Finally, this study deployed a questionnaire survey that only provided cross-sectional data. The concept of environmental protection and the innovation of green eating may change over time; therefore, future research should try to conduct a longitudinal study to reveal the different effects of social recognition and environmental ethics on fitnesser's behavior intention in different time periods.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Study on Consumer Preference for Traceable Pork With Animal Welfare Attribute

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We determined consumer preferences for traceable pork attributes in 328 consumers in Wuxi City, Jiangsu Province, China, based on a traceable pork attribute system composed of traceability, animal welfare, place of origin, and price attributes. Preference was studied using a Choice Experiment and Bayesian inference analysis. Results showed that the marginal utility of health welfare was lower than that of high-level traceability information and similar to that of place of origin but was higher than that of middle-level traceability information. A complementary relationship existed between dietary animal welfare and high-level traceability information and between health welfare and non-indigenous production. A substitution relationship existed between health welfare and indigenous production and between environmental animal welfare and non-indigenous production. The marginal utilities of health welfare and dietary welfare were higher than those of all price levels, and consumers accept a higher price as a result of increased production costs due to the inclusion of animal welfare information. Due to the harsh realities of COVID-19, China has recently approved the animal welfare attribute to be integrated into traceability market systems of new animal-derived food. The government should encourage manufacturers to produce diverse traceable animal-derived food not only to protect animal welfare and promote the construction of an ecological civilization, but also to develop new animal-derived food markets to satisfy different levels of consumer demand.

Keywords: traceable pork, animal welfare, origin, food safety, bayesian inference

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INTRODUCTION

Since March 2020, COVID-19 has rapidly spread worldwide, resulting in incalculable losses to humans. The COVID-19 pandemic has also triggered global reflection on animal welfare protection, including the consumption of wild animals as food, and more deeply, the impact of animal health on human health. For example, according to the Ministry of Agriculture and Rural Affairs of the People's Republic of China, since the initial outbreak of African Swine Fever (ASF) in August 2018 to January 2020, China has reported 162 outbreaks and culled nearly 1.2 million infected pigs, resulting in huge economic losses to the pork industry. However, although the government has taken strict action against ASF prevention, ASF-infected pork is still present in the market, thus disturbing normal market order and threatening pork quality and safety, and consequently human health and safety. For example, the Public Security Bureau of Rui'an,

Wenzhou, Zhejiang, as disclosed in the Top Ten Food Crime Cases in the First Half of 2019 issued by the Zhejiang Provincial Public Security Department, investigated and uncovered the production and sale of food that did not meet safety standards, leading to the seizure of nearly 7 tons of ASF-infected pork and an illegal profit of more than two million yuan.[1] Although ASF is not a zoonotic disease, nor is it considered infectious or harmful to humans, ASF-infected pork in the market has once again aroused widespread public concern about pork safety issues. Beltrán-Alcrudo et al. (2017) showed that the emergence and spread of ASF is largely caused by non-standard behavior of stakeholders in the pork supply chain system, as well as poor environment and management in pig farming, so that the physical well-being of pigs cannot be guaranteed. For example, swill, domestic waste, and other pollutants are often used illegally to feed pigs and the farming environment is often unhygienic, resulting in disease and cross-infection due to bacterial proliferation.

In 1976, the American researcher Hughes introduced the concept of animal welfare for the first time. He defined farm animal welfare as a state of complete mental and physical health, where the animal is in harmony with its environment, advocating that humans should consider animal welfare while using animals humanely (Ren, 2006). Gavinelli et al. (2007) pointed out that animal-derived food safety will be impacted if basic animal welfare is neglected or cannot be guaranteed, which poses long-term potential threats to human health through the food chain. Iannetti et al. (2019) showed that poor animal welfare can lead to an increase in the probability of animal diseases and their potential transmission to humans. Among infectious diseases that threaten human health, there are more than 200 infectious zoonoses. Grace et al. (2012) defined zoonosis as an infectious disease transmissible among animals and humans. Grace et al. (2011) also reported that approximately 20% of human diseases and deaths in less developed areas are caused by zoonoses. As of 2019, an average of 12 million people worldwide die from zoonoses each year (Li et al., 2019). Iannetti et al. (2019) found that zoonoses have accounted for more than 70% of emerging infectious diseases in the past 30 years. The European Food Safety Authority (ESFA) (2019) emphasized that the susceptibility of animal-derived food to disease, including zoonoses, will increase if animal welfare cannot be guaranteed. Therefore, many European and American countries have established clear regulations regarding the protection of animal welfare in the process of farming, slaughter, and transportation from the perspective of food safety and social ethics. At present, the international community has adopted the basic definition given by the British Farm Animal Welfare Council (FAWC). The Farm Animal Welfare Council: Five Freedoms (2009) holds that animals should be entitled to five freedoms: i.e., freedom from hunger and thirst by ready access to fresh water and a diet to maintain full health and vigor (i.e., dietary welfare); freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area (i.e., environmental welfare); freedom from pain, injury, and disease by prevention or rapid diagnosis and treatment (i.e., health welfare); freedom to perform normal behavior by providing sufficient space, proper facilities, and adequate company of the animal's own kind (i.e., behavioral welfare); and freedom from fear and distress by ensuring conditions and treatments that avoid mental suffering (i.e., mental welfare). The World Health Organization has further stated that if animals are healthy, comfortable, fed, safe, able to express their nature freely, and free from pain, fear, and pressure, then the basic requirements of animal welfare have been met (Office International Des Epizooties (OIE), 2015). However, there is almost no legislation safeguarding animal welfare in China, and consumers know very little about animal welfare, which is the main cause of livestock meat quality and safety issues in China (Wang and Gu, 2016).

Many studies have shown that food traceability systems with both ex ante quality assurance (also known as ex ante warning) and ex post traceability can help eliminate information asymmetry between producers and consumers, prevent food safety problems, and reduce the impact of food safety incidents through traceability (Opara, 2003; Kher et al., 2013; Hou et al., 2019). Therefore, if an animal welfare information attribute with the function of ex ante quality assurance is added to pork traceability systems, it will help guide farmers to safeguard pig welfare in the farming process and prevent swine fever and other safety incidents, thereby achieving ex ante quality assurance (Alfnes et al., 2018). Furthermore, once an incident similar to ASF-infected pork entering the market occurs, pork that fails the required standard can be recalled in a timely manner, and those responsible can be held accountable, thereby achieving ex post traceability. However, adding an animal welfare information attribute to a pork traceability system will inevitably increase the production costs of pork (Weerd and Day, 2009), which will certainly be reflected in market prices. Therefore, whether consumers are willing to pay a certain premium for traceable pork with an animal welfare information attribute will affect the willingness of producers to produce traceable pork with this attribute. As illustrated by the literature review below, consumers in different countries are willing to pay a certain premium for animal welfare at different levels. However, similar research remains scarce in China. Based on the actual market situation in China, we carried out a case study on consumers in Wuxi City, Jiangsu Province, which incorporated an animal welfare information attribute into a traceable pork attribute system as ex ante quality assurance information. Thus, we built a traceable pork attribute system that integrated traceability information, animal welfare, place of origin, and price attributes. In addition, a Choice Experiment was employed to collect experimental data and Bayesian inference was used for data analysis to study the perceptions and preferences of consumers for traceable pork with the animal welfare information attribute. This provides a theoretical basis for the construction of a pork traceability system that includes an animal welfare attribute in China. Ultimately, it is hoped that this will enhance pork traceability systems to improve pork safety and ensure food safety and consumer health in China.

[1] Protection of Food Safety! Top Ten Food Crime Cases in the First Half Uncovered by Zhejiang Provincial Public Security Department, source: China.com.cn (http://zjnews.china.com.cn/yuanchuan/2019-07-03/178907.html).

LITERATURE REVIEW

As the food supply chain becomes increasingly complex, insufficient consumer knowledge on food safety information attributes can have a negative impact on the feedback loop of the supply chain (Reardon and Timmer, 2012). Regattieri et al. (2007) showed that food traceability systems provide consumers with quality and safety information and are an essential tool to prevent food safety risks. Based on the theory of consumer demand put forward by Lancaster (1996), the value of a commodity is created by the combination of its attributes. Therefore, the utility of consumers' consumption of food can be regarded as coming from a combination of attributes, including traceability. Food attributes can be divided into three categories, i.e., search, experience, and trust attributes (Wu et al., 2015a). Hobbs (2004) stated that a food traceability system is designed to provide two basic functions, i.e., ex ante quality assurance and ex post traceability. The main function of ex post traceability is that sub-standard food can be effectively recalled through the traceability system (Ubilava and Foster, 2009). Ex ante quality assurance presents consumers with trust attributes, such as food quality and safety, place of origin, and animal welfare, in the form of a label. This transforms the trust attribute of food safety into a search attribute, thereby reducing the time to search for desirable traceable foods (Golan et al., 2003) and playing a pre-warning role (Wu et al., 2015a). Various studies have shown that ex ante quality assurance plays a far greater role than ex post traceability in eliminating information asymmetry (Hobbs, 2004; Loebnitz and Loose, 2015).

Considerable research has been conducted on consumer preference for food traceability information with the function of ex post traceability. Loureiro and Umberger, 2007 adopted a Choice Experiment to study the preference of American consumers for safety attributes of meat products and found that such consumers pay more attention to products with food safety labels issued by the USDA, which prove that the meat is fresh and traceable, compared to products without safety labels. Abidoye et al. (2011) adopted the Choice-Based Conjoint approach to study American consumer preference for quality attributes of beef and concluded that such consumers are most concerned with and willing to pay a certain premium for traceability information. Bai et al. (2013) used the same method to study Chinese consumer preference for traceable milk and found that urban consumers prefer milk with traceability information. Using a Real Choice Experiment (i.e., real exchange of goods and money), Wu et al. (2015b) found that Chinese consumers have significantly heterogeneous preferences for traceable pork, and they are willing to pay a certain premium for traceability information on slaughter, processing, distribution, and sales. Furthermore, based on a Choice Experiment, Yin et al. (2017) showed that Chinese consumers prefer the traceability information attribute in the purchase of baby milk, for which they are willing to pay a certain premium. Wu et al. (2018) also studied the willingness of Chinese consumers to pay for pork with different levels of traceability information, confirming that consumers have the highest willingness to pay for complete traceability information that covers farming, slaughter, processing, distribution, and sales. Based on an Experimental Auction, Nguyen et al. (2018) studied Vietnamese consumers' willingness to pay for rice and found that the premium paid by consumers for rice gradually increased from 9% to 33% when the certified sustainably produced rice contained traceability information.

Scholars have also studied consumer preferences for place of origin and animal welfare attributes with the function of ex ante quality assurance. In terms of the place of origin attribute, Chang et al. (2013) found that American consumers prefer indigenous ground beef to ground beef from different origins. Lim et al. (2014) reported that American consumers have greater trust in the safety of domestic beef than imported beef and have a higher willingness to pay for beef with a domestic production label. In terms of the animal welfare attribute, Yuta et al. (2018) showed that nearly 90% of Japanese consumers are willing to pay a certain premium for beef with an animal welfare label. Markova-Nenova and Wätzold (2018) found that German consumers have a higher willingness to pay for milk with an animal welfare attribute. Lemos Teixeira et al. (2018) found that consumers in Brazil and Chile prefer eggs provided by farms that can guarantee animal welfare in terms of favorable diet, living conditions, and health. Merlino et al. (2018) confirmed that Italian consumers strongly consider animal welfare factors, second only to price factors, when purchasing beef. Spain et al. (2018) reported that 78% of American consumers believe that a fair and objective third party is required to ensure the reliability of animal welfare certification, and they are willing to pay a 32% premium for eggs under reliable animal welfare certification. Lai et al. (2018) also found that Chinese consumers in economically prosperous cities prefer pork with animal welfare labels, and are willing to pay a premium for them, but at a lower level than for food safety attributes.

The penetration rate of traceable pork in China is still low and the different types of traceable pork studied in this paper do not actually exist in the market (i.e., a virtual traceable pork profile). This makes it difficult to obtain actual purchase data on consumers' market behavior. Thus, consumers must be asked directly about their stated preferences and willingness to pay for traceable pork. Several basic methods can be applied to study stated preference, including Choice Experiment, Contingent Valuation, and Conjoint Analysis. According to Louviere et al. (2010), a Choice Experiment can be conducted with random utility theory as a starting point and have a mature practical basis, and thus has become a key tool to study consumer preferences.

In summary, various studies have investigated consumer preferences and have consistently reported that consumers generally pay attention to traceability, animal welfare, and place of origin. However, most previous studies on animal welfare have been conducted in developed countries, with studies on Chinese consumers and the incorporation of animal welfare into traceability systems with ex ante quality assurance remaining relatively scarce. Moreover, most earlier studies have used latent class modeling analysis tools to highlight group differences in consumers, while neglecting differences in consumers' individual preferences for different attributes. In the present study, we investigated the perceptions and preferences of consumers in Wuxi, Jiangsu Province, China, for an animal welfare attribute of traceable pork in a system composed of traceability, animal

TABLE 1 | Attributes and levels of traceable pork.

Category	Attribute	Level and definition
ex post traceability	1. Traceability information	1. Information about farming, slaughter, and sales (HITRACE) 2. Information about farming and slaughter (METRACE) 3. Information about farming (LOTRACE) 4. No traceability information (NOTRACE)
ex ante quality assurance	2. Animal welfare	1. Dietary welfare (PHYSICAL) 2. Environmental welfare (ENVIR) 3. Health welfare (HEALTH) 4. No animal welfare (NOWELFARE)
	3. Origin	1. Indigenous (LOCORIGIN) 2. Non-indigenous (OTHORIGIN) 3. NOORIGIN
	4. Price	1. 14 yuan/500 g (PRICE1) 2. 15.4 yuan/500 g (PRICE2) 3. 16.8 yuan/500 g (PRICE3) 4. 18.2 yuan/500 g (PRICE4)

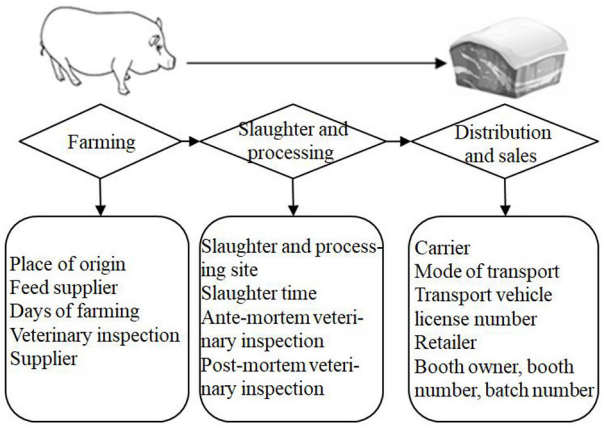

FIGURE 1 | Schematic of traceability information in each link of the traceable pork supply chain.

welfare, place of origin, and price attributes using a Choice Experiment and Bayesian inference analysis. Moreover, animal welfare and place of origin were classified as ex ante quality assurance attributes and traceability information was classified as an ex post traceability attribute according to Hobbs (2004). The results of this study should provide guidelines for the development and popularization of the traceable pork system that incorporates animal welfare in China.

EXPERIMENTAL DESIGN AND INVESTIGATION

Based on the assumption that traceable pork can be regarded as a combination of traceability information, animal welfare, place of origin, and price attributes according to the utility theory proposed by Lancaster (1996), the experiment was designed and conducted as follows.

Traceable Pork Attribute Setting

As the most frequently consumed meat in China, pork also has the most quality and safety incidents (Wu et al., 2015c). In 2018, pork output and consumption in mainland China amounted to 54.04 and 55.398 million tons, respectively, accounting for 47.82% and 49.25% of the world's total pork output and consumption, respectively. Moreover, traceable pork is one of the earliest traceable food types in the Chinese market. Therefore, we investigated traceable pork as a case study in this paper. Given the different consumer preferences for different parts of traceable pork of the same variety, pork hindquarters, a pork part widely consumed in China (Wang et al., 2011), were selected as the experimental product to eliminate the possible impact of non-intrinsic factors on research conclusions. For simplicity, traceable pork hindquarters are referred to as traceable pork hereinafter. The specific attribute settings are shown in **Table 1**.

First, the traceability information attributes and levels were set as follows. Wu et al. (2015c) found that food safety issues in China, including those of pork, are predominantly caused by human factors, such as improper behavior, failure to implement or strictly implement existing technical specifications and standard systems for food, and other violations related to production and business. From the perspective of the whole pork supply chain in China, and based on Wang et al. (2017), feed suppliers, farmers, butchers, dealers, and retailers are important stakeholders in the pork supply chain system, and their behaviors directly affect pork quality and safety. Due to information asymmetry on pork safety attributes, it is difficult for consumers to have full access to all relevant information, which thus leads to market failure (Wu et al., 2017). Therefore, information on traceable pork was set to cover three key links, i.e., farming, slaughter and processing, and distribution and sales. Moreover, the traceability information was displayed graphically to facilitate consumer understanding (**Figure 1**). Specifically, the traceability information attributes were designed with reference to the four levels shown in **Table 1**.

Second, animal welfare was introduced as an ex ante quality assurance attribute. Inspired by the Farm Animal Welfare Council: Five Freedoms (2009), three forms of animal welfare, i.e., dietary, environmental, and health welfare, were selected as attribute levels. In the design of the study questionnaire, the specific connotations of the three kinds of animal welfare were described clearly, and the following items were established accordingly, i.e., "how important is providing pigs with ready access to a satisfactory diet"; "how important is providing pigs with a well-ventilated pigsty that allows comfortable rest and activity"; "how important is providing pigs with access to immediate treatment when sick", to ensure that surveyed consumers (hereinafter referred to as participants) had a direct perception of animal welfare. Five response options were included, i.e., "very unimportant", "unimportant", "neither important nor unimportant", "important", and "very important".

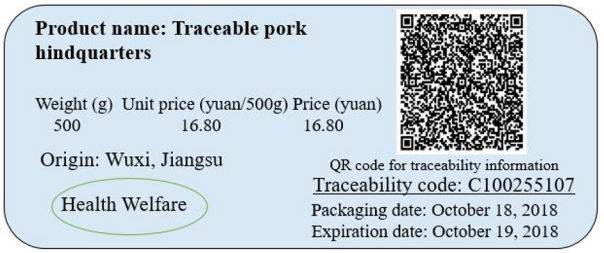

FIGURE 2 | Experimental sample label of traceable pork hindquarters.

Third, the place of origin attribute was introduced into the traceable pork attribute system and separately listed in the label as an ex ante quality assurance attribute. Strictly speaking, the farming information in the traceability attribute established in this paper contains information on place of origin. However, Zhong and Wu (2018) showed that the scale of pig farming in China is still small at present and decentralized small-scale farming prevails, and thus the existing traceability system is unable to trace every small-scale pig farmer in the farming link. Although it is difficult for the place of origin information, as an independent attribute, to trace specific pig farmers, it can reflect the characteristics of the region where small-scale pig farmers are located. Moreover, it is necessary to include place of origin as an independent attribute of traceable pork in the context of China. Specifically, food safety in China is often associated with region and is closely related to regional natural environments (e.g., soil, water, and atmosphere) and social integrity.[2] For example, heavy metal pollution in rice exhibits regional distribution in China (Wu et al., 2014). According to the Chinese definition, the place of origin of products includes regional space and geographical indication. Therefore, according to Wu et al. (2017), place of origin was considered an independent attribute of traceable pork in this study[3] to provide consumers with producer-identifying information and thus with ex ante warning (Lim et al., 2014). In this paper, "LOCORIGIN" is defined as pork produced in Wuxi, where the experiment was conducted; "OTHORIGIN" is defined as pork produced in Lu'an City, Anhui Province, which is commonly available in the Wuxi market according to our local survey; and "NOORIGIN" is defined as pork without a specified place of origin. The place of origin attribute was labeled separately, as shown in **Figure 2**.

Fourth, properly setting the price of traceable pork profiles with different attributes and attribute levels is critical for Choice Experiments as all traceable pork products set in this paper do not exist in the actual market. As the site of the experiment and the selection of participants were from downtown Wuxi, consistent with those in Wu et al. (2018), and the time interval between these experiments was short, the price of pork set by Wu et al. (2018) was adopted here (see **Table 2** for specific price levels).

Experimental Design

Each traceable pork attribute shown in **Table 1** has a different number of levels. Therefore, the Choice Experiment followed a full factorial design (Louviere et al., 2000). The traceable pork attributes and attribute levels in **Table 1** resulted in $4 \times 3 \times 3 \times 4 = 144$ virtual traceable pork profiles. Generally speaking, choice tasks that take more than 30 min will exhaust consumers (Allenby and Rossi, 1989); as such, profiles must be limited in order to eliminate choice fatigue in participants. At the same time, based on the principle of random design, the attributes and attribute levels of traceable pork were randomly combined to ensure balanced attribute level distribution while reducing choice fatigue. The Choice Experiment was designed as follows: Firstly, the 15 main effects of the four traceable pork attributes shown in **Table 1** to be studied were identified. In addition, 16 two-way interactions could be obtained between the different levels of each information attribute, which, together with the above-mentioned 15 effects, require a total of 31 degrees of freedoms. Secondly, 10 different versions of questionnaires were developed, with 10 tasks in each version. Each task contained two traceable pork profiles and a no-choice option. Thus, participants needed to compare 20 traceable pork profiles, which did not exceed the maximum quantity of profiles to avoid choice fatigue and satisfy minimum requirements for degrees of freedom. The final Choice Experiment design is shown in **Figure 3**. At the end of the experiment, each participant was asked demographic questions, such as gender, age, marital status, and educational background, as well as about weekly household consumption, to investigate the possible impact of such factors on consumption preferences.

Organization and Implementation

This experiment was conducted by trained postgraduates from a well-known local university through direct one-on-one interviews with participants. To ensure the randomness of the respondents, every third person coming into view was selected as the respondent (Wu et al., 2015b). It should be noted that if consumer surveys were to be carried out in a city where traceable food pilot projects have not been implemented, the investigator would need to explain relevant concepts in detail as consumers may be unfamiliar with the concept of traceable food. This would not only increase the time cost of investigation, but also the dependence of the survey results on the concept explanation of the investigator, which may lead to biased research findings. Here, the survey was carried out in Wuxi, Jiangsu. Wuxi is one of the earliest pilot cities for a traceable pork system, and thus residents have a certain understanding of traceable pork. Moreover, its per capita GDP reached 174 600 yuan in 2018, one of the highest in China and indicating a high level of economic development. The experiment was carried out in all five administrative regions of

[2]In China, many food safety and quality incidents are caused by dishonest acts of food producers and operators, e.g., food fraud and adulteration. Therefore, the integrity of food producers and operators in a region directly affects consumer expectations of food safety in that region. The term "place of origin" here not only indicates a geological range, but also covers consumer assessment of the integrity of food producers and operators in that region.

[3]"Place of origin" included in the traceable information system in this study refers only to the location of pig farming.

TABLE 2 | Demographics of participants.

Demographic	Category	Sample size (person)	Proportion (%)
Gender	Male	155	47.26
	Female	173	52. 74
Age	18–25 years old	155	47.26
	26–35 years old	89	27.13
	36–45 years old	29	8.84
	46–55 years old	33	10.06
	56–65 years old	18	5.49
	66–72 years old	4	1.22
Marital status	Married	144	43.90
	Unmarried	184	56.10
Education background	Junior high school and below	39	11.89
	Senior high school (including vocational high school)	47	14.33
	Junior college (including higher vocational college)	64	19.51
	Bachelor's degree	143	43.60
	Master's degree or above	35	10.67
Children under 18 years old in the family	N	219	66.77
	Y	109	33.23
Pregnant or breast-feeding women in the family	N	308	93.90
	Y	20	6.10
Health condition	Very good	126	38.41
	Good	153	46.65
	Moderate	48	14.63
	Poor	1	0.31
	Very poor	0	0
Personal annual income	36 000 yuan and below	128	39.02
	36 000–50 000 yuan	64	19.51
	50 000–80 000 yuan	51	15.55
	80 000–100 000 yuan	38	11.59
	Above 100 000 yuan	47	14.33
Annual household income	50 000 yuan and below	33	10.06
	50 000–80 000 yuan	56	17.08
	80 000–100 000 yuan	62	18.90
	100 000–150 000 yuan	53	16.16
	Above 150 000 yuan	124	37.80
Number of family members	1	3	0.91
	2	30	9.15
	3	144	43.90
	4	79	24.09
	5 and above	72	21.95
Household pork consumption per week	500 g and below	43	13.11
	500–1 000 g	121	36.89
	1 000–1 500 g	92	28.05
	1 500–2 000 g	30	9.15
	Above 2 500 g	42	12.80

Wuxi, including Liangxi, Binhu, Huishan, Xishan, and Xinwu, with 70 participants aged 18∼65 recruited face-to-face in a large supermarket[5] in each administrative region. The entire experiment was conducted during 18–21 October 2018, resulting in 328 valid questionnaires.

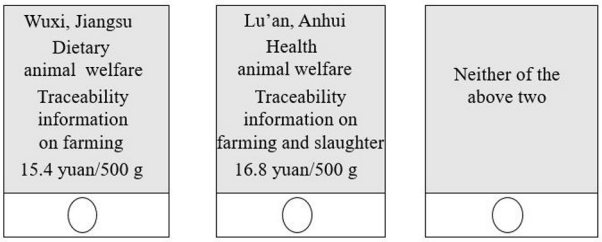

FIGURE 3 | Single task sample of choice experiment.[4]

Demographics of Participants and Their Understanding of Animal Welfare in Pig Production

Table 2 shows the demographics of the 328 participants recruited in the study. Among all participants, women accounted for 52.74% of total samples, which accords with the actual situation in China, i.e., more women are responsible for food purchases in Chinese families. In total, 74.39% of participants were aged between 18 and 35 years, 56.10% were unmarried, and 54.27% had a bachelor's degree or above; 66.77 and 93.90% of participants had no children under 18 years old and no pregnant or breast-feeding women in their families, respectively; 85.06% of participants had a good or very good health condition; 53.96% of participants had an annual household income of more than 100 000 yuan; and 43.90, 24.09, and 21.95% of participants had three, four, and five or above family members, respectively. In addition, 64.94% of participants had a household pork consumption of 500–1 500 g per week. However, it should be noted that as the sample was limited to consumers in Wuxi, it may not be representative of all cities in China.

Table 3 shows the perceptions of the 328 participants regarding animal welfare in pork production. In general, participants were basically satisfied with pork quality and safety in the current market. Specifically, 66.16% of participants expressed no knowledge of animal welfare. However, 43.60, 51.52, and 77.13% of participants considered "ready access to a satisfactory diet", "living in a well-ventilated pigsty that allows comfortable rest and activity", and "access to immediate treatment when sick" to be very important, respectively. Moreover, 53.35 and 77.74% of participants believed that it was completely necessary to safeguard pig welfare and that safeguarding pig welfare helped improve pork quality, respectively.

[4]The investigator prepared three samples of pure lean pork with "fresh, moderate, and unattractive" appearance by adding food coloring and showed them to the participants during the experiment for comparison.

[5]The selected supermarkets were Carrefour in Liangxi, Auchan in Binhu, Tesco in Huishan, RT-Mart in Xishan, and Hualian in Xinwu. All have a business area larger than 3 000 m^2 and average annual flow of 1.5 to 2 customers/m^2.

TABLE 3 | Participants' perceptions of animal welfare in pork production.

Item	Category	Sample size (person)	Proportion
Satisfaction with current pork quality and safety (1 = total dissatisfaction, 10 = total satisfaction)	1	7	2.13
	2	7	2.13
	3	24	7.32
	4	16	4.88
	5	69	21.04
	6	63	19.21
	7	67	20.43
	8	50	15.24
	9	12	3.66
	10	13	3.96
Knowledge of animal (e.g., pig) welfare	No knowledge	217	66.16
	Low knowledge	76	23.17
	Medium knowledge	20	6.10
	High knowledge	13	3.96
	Very high knowledge	2	0.61
Ready access to a satisfactory diet	Very unimportant	4	1.22
	Unimportant	2	0.61
	Neither important nor unimportant	45	13.72
	More important	134	40.85
	Very important	143	43.60
Living in a well-ventilated pigsty that allows comfortable rest and activity	Very unimportant	4	1.22
	Unimportant	2	0.61
	Neither important nor unimportant	47	14.33
	More important	106	32.32
	Very important	169	51.52
Access to immediate treatment when sick	Very unimportant	2	0.61
	Unimportant	1	0.31
	Neither important nor unimportant	21	6.40
	More important	51	15.55
	Very important	253	77.13
Whether or not it is necessary to safeguard the welfare of pigs and other animals	Completely unnecessary	5	1.53
	Unnecessary	12	3.66
	Uncertain	17	5.18
	Slightly necessary	119	36.28
	Completely necessary	175	53.35
Whether or not it helps improve pork quality and safety by safeguarding pig welfare	Unhelpful	6	1.83
	Slightly helpful	37	11.28
	Uncertain	30	9.15
	Helpful	147	44.82
	Very helpful	108	32.92

MODEL ESTIMATION

Model Building

According to the Independence of Irrelevant Alternatives (IIA) hypothesis proposed by Luce (1959), U_{imt} is the utility obtained by participant i in situation t by selecting the m_{th} traceable pork profile from subset J of choice space C, and includes the deterministic term V_{imt} and stochastic term ε_{imt}, that is:

$$U_{imt} = V_{imt} + \varepsilon_{imt} \quad (1)$$

$$V_{imt} = \beta_i' X_{imt} \quad (2)$$

where β_i is the marginal utility vector of participant i, and X_{imt} is the attribute vector of the m_{th} traceable pork profile. The m_{th} traceable pork profile is chosen when $U_{imt} > U_{int}$ is true for any $n \neq m$. Therefore, the probability that participant i selects the m_{th} traceable pork profile in situation t can be expressed as follows:

$$\begin{aligned} P_{imt} &= prob\left(V_{imt} + \varepsilon_{imt} > V_{int} + \varepsilon_{int}; \forall n \in C, n \neq m\right) \\ &= prob\left(\varepsilon_{int} < \varepsilon_{imt} + V_{imt} - V_{int}; \forall n \in C, n \neq m\right) \end{aligned} \quad (3)$$

If it is assumed that ε_{imt} follows a type I extreme value distribution, then the model determined by (1) and (2) is known as the conditional logit model, so that the conditional probability in (3) can be converted into the following form (Train, 2003):

$$P_{imt} = \frac{\exp\left(\beta_i' X_{imt}\right)}{\sum_n \exp\left(\beta_i' X_{int}\right)} \quad (4)$$

In theory, each participant knows their own β_i and ε_{imt}, but they cannot be directly observed, so researchers can only give the unconditional probability by observing X_{imt} as follows:

$$P_{imt} = \int \frac{\exp\left(\beta' X_{imt}\right)}{\sum_n \exp\left(\beta' X_{int}\right)} f(\beta)\, d(\beta) \quad (5)$$

where $f(\beta)$ is the probability density of β. Equation (5) is the general form of the logit model, which is known as the random parameters logit or mixed logit model. If it is assumed that participant preferences for traceable pork are homogeneous, that is, when $\beta_i = b$, $f(\beta) = 1$; and when $\beta_i \neq b$, $f(\beta) = 0$, then Equation (5) can be converted into a fixed parameters logit model. As heterogeneous consumer preferences for traceable pork are more in line with reality, and the fixed parameter logit model may not meet the IIA assumption, the random parameters logit model is commonly used to assess consumer preferences in the field of food safety.

Model Estimation

Based on the Choice Experiment, Y_i is the vector of the traceable pork profile chosen by participant i in different situations, that is, $Y_i' = (Y_{i1}, Y_{i2}, \cdots, Y_{iT})$. In this study, participants had a total of 10 tasks, representing their choices in 10 periods. Assuming that participants' preferences will not change in a short period of time, the conditional probability of selecting Y_i is as follows:

$$P(Y_i|X_i, \beta_i) = \prod_{t=1}^{10} \frac{\exp\left(\beta_i' X_{iY_{it}t}\right)}{\sum_{j=1}^{4} \exp\left(\beta_i' X_{ijt}\right)} \quad (6)$$

The unconditional probability is the integral of all β values in Equation (6), and can be specified as follows:

$$P(Y_i|X_i) = \int P(Y_i|X_i, \beta) f(\beta)\, d\beta \tag{7}$$

As Equation (7) is non-linear, maximum-likelihood estimation is a common estimation method. However, maximum-likelihood estimation can only be used to estimate the fixed parameters logit model, and whether its iteration is convergent is closely related to the setting of the initial value. More importantly, it is difficult to determine whether the result is globally or locally optimal (Train, 2003). Bayesian inference can be used to estimate group preferences. It provides better consistency and validity than maximum-likelihood estimation and does not require the calculation of an optimal solution, so that the related maximum-likelihood estimation defects can be avoided (Train, 2003). Therefore, hierarchical Bayesian inference was adopted in this paper.

If β_i is the score vector of participant i, which is in line with random effects distribution, then expectation is the function of covariant ω_i, that is:

$$\begin{aligned} \beta_i &= \Gamma' \omega_i + \varepsilon_i \\ \varepsilon_i &\sim MVN\left(0, V_\beta\right) \end{aligned} \tag{8}$$

where Γ is the regression coefficient matrix. If the covariant is not considered, namely, to make $\Gamma = 0$, then $\beta_i \sim MVN\left(0, V_\beta\right)$. In this paper, we assumed that V_β follows the inverse Wishart distribution, that is:

$$\left(V_\beta\right)^{-1} \sim W(\nu_0, V_0) \tag{9}$$

Based on the Bayesian rule, the posterior distribution of β_i is expressed as:

$$h\left(\beta_i|Y_i, X_i, \bar{\beta}, V_\beta\right) \propto P(Y_i|X_i, \beta_i)\, \pi(\beta_i) \tag{10}$$

where $\pi(\beta_i)$ is the prior distribution of β_i.

Iterative Process

Hierarchical Bayesian inference can be expressed in hierarchical form as:

$$Y|X, \beta \tag{11}$$

$$\beta|\omega, \Gamma, V_\beta \tag{12}$$

$$\Gamma|a, A \tag{13}$$

$$V_\beta|\nu_0, V_0 \tag{14}$$

where Equations (13) and (14) are the hyper-parameters of prior distribution. The iterative Markov chain process in Equations (11)–(14) is as follows: (1) For each participant, extract β after obtaining Y and X, and then repeat for all participants; (2) extract Γ after obtaining β and V_β at the individual level; (3) extract V_β after obtaining β and Γ; (4) repeat the above process.

TABLE 4 | Variable assignment.

Variable	Variable assignment
HITRACE	HITRACE = 1; METRACE = 0; LOTRACE = 0
METRACE	HITRACE = 0; METRACE = 1; LOTRACE = 0
LOTRACE	HITRACE = 0; METRACE = 0; LOTRACE = 1
NOTRACE	HITRACE = −1; METRACE = −1; LOTRACE = −1
PHYSICAL	PHYSICAL = 1; ENVIR = 0; HEALTH = 0
ENVIR	PHYSICAL = 0; ENVIR = 1; HEALTH = 0
HEALTH	PHYSICAL = 0; ENVIR = 0; HEALTH = 1
NOWELFARE	PHYSICAL = −1; ENVIR = −1; HEALTH = −1
LOCORIGIN	LOCORIGIN = 1; OTHORIGIN = 0
OTHORIGIN	LOCORIGIN = 0; OTHORIGIN = 1
NOORIGIN	LOCORIGIN = −1; OTHORIGIN = −1
PRICE1	PRICE1 = 1; PRICE2 = 0; PRICE3 = 0; PRICE4 = 0
PRICE2	PRICE1 = 0; PRICE2 = 1; PRICE3 = 0; PRICE4 = 0
PRICE3	PRICE1 = 0; PRICE2 = 0; PRICE3 = 1; PRICE4 = 0
PRICE4	PRICE1 = 0; PRICE2 = 0; PRICE3 = 0; PRICE4 = 1

Model Results and Analysis

Table 4 shows the assignment of the main variables. Here, we used effect coding for the assignment of the level variables of the four attributes of traceable pork, i.e., traceability information, animal welfare, place of origin, and price. We also assumed that the coefficients of the no-choice option, interaction terms, and price were fixed, and the parameters of other attributes were stochastic and normally distributed (Ubilava and Foster, 2009). The parameter estimation results of the model are shown in **Table 5**.

As seen in **Table 5**, the regression results showed that the no-choice option was significant at the 1% level and the estimated coefficient was negative. In addition, the estimated coefficients of HITRACE, METRACE, PHYSICAL, ENVIR, HEALTH, LOCORIGIN, and OTHORIGIN were significant at the 1% level and were positive. As also shown in **Table 5**, HITRACE had the highest marginal utility (1.0323) among all traceable pork attributes, followed by LOCORIGIN (0.7888) and HEALTH (0.7801), which showed similar marginal utility. In addition, the order for marginal utility of other attribute levels was METRACE, PHYSICAL, OTHORIGIN, and ENVIR, i.e., 0.6193, 0.4429, 0.3943, and 0.2496, respectively. Therefore, the order of consumer preferences for traceable pork attributes was HITRACE, LOCORIGIN, HEALTH, METRACE, PHYSICAL, OTHORIGIN, and ENVIR.

The regression results of the price variable in **Table 5** show that the estimated coefficients of all four price levels were positive but non-significant. This may be because the set price attributes had a relatively small effect on the marginal utility of traceable pork consumption compared with traceability information, animal welfare, and place of origin in the context of the four attributes and attribute levels set in the paper. Moreover, the marginal utilities of the four price levels reveal that the coefficients of the price attribute were not monotone. The marginal utility of the price attribute was not highest

TABLE 5 | Hierarchical Bayesian iteration results.

Main effect and interaction	Estimated coefficient	Standard error
PRICE1	0.1663	0.4437
PRICE2	0.3177	0.4412
PRICE3	0.2595	0.4486
PRICE4	−0.3518	0.4536
HITRACE	1.0323**	0.0821
METRACE	0.6193**	0.0718
LOTRACE	−0.0002	0.0662
PHYSICAL	0.4429**	0.0709
ENVIR	0.2496**	0.0656
HEALTH	0.7801**	0.0780
LOCORIGIN	0.7888**	0.0697
OTHORIGIN	0.3943**	0.0654
HITRACE × PHYSICAL	0.3549**	0.1165
HITRACE × ENVIR	−0.1069	0.1180
HITRACE × HEALTH	−0.1878	0.1343
HITRACE × LOCORIGIN	0.1812	0.1021
HITRACE × OTHORIGIN	−0.0378	0.1018
METRACE × PHYSICAL	−0.0917	0.1210
METRACE × ENVIR	0.0650	0.1170
METRACE × HEALTH	−0.0716	0.1349
METRACE × LOCORIGIN	0.0097	0.1022
METRACE × OTHORIGIN	−0.0538	0.1005
LOTRACE × PHYSICAL	−0.0076	0.1199
LOTRACE × ENVIR	0.1981	0.1268
LOTRACE × HEALTH	−0.1115	0.1425
LOTRACE × LOCORIGIN	−0.1228	0.1015
LOTRACE × OTHORIGIN	−0.0995	0.1028
PHYSICAL × LOCORIGIN	0.0300	0.1092
PHYSICAL × OTHORIGIN	−0.0011	0.0994
ENVIR × LOCORIGIN	0.0573	0.1056
ENVIR × OTHORIGIN	−0.3082**	0.1002
HEALTH × LOCORIGIN	−0.2313*	0.1179
HEALTH × OTHORIGIN	0.3230**	0.1084
No-Choice Option	−1.6463**	0.4448
log likelihood	−2 763.1703	
AIC	5 618.3	

*** and * represent coefficients significant at 1 and 5% levels, respectively.*

when the price was lowest (*PRICE1* = 14 yuan/500 g), but was highest at 15.4 yuan/500 g. However, when the price was higher than 15.4 yuan/500 g, marginal utility decreased with the increase in price, consistent with the Law of Demand in classical economics, that is, consumer demand decreases with the increase in commodity prices. The marginal utility not being highest when the price of traceable pork was lowest is probably because participants paid more attention to pork quality and safety. Better pork quality and safety can be safeguarded by a higher level of traceability information, which means a higher price. Comparatively speaking, it is difficult to safeguard the quality and safety of traceable pork at the lowest price, and thus its marginal utility was lower than that at 15.4 yuan/500 g. By further calculating the difference between the maximum and minimum marginal utility of each attribute of traceable pork divided by the sum of the corresponding differences of all attributes, we obtained the relative importance of each traceable pork attribute (Xu et al., 2019): i.e., traceability information, 39.30%; price, 25.49%; animal welfare, 20.19%; and place of origin, 15.02%.

In terms of interactions, the interactions HITRACE × PHYSICAL and HEALTH × OTHORIGIN were significant at the level of 1%, with positive coefficients. Thus, a complementary relationship existed between HITRACE and PHYSICAL and between HEALTH and OTHORIGIN. When the label only shows dietary welfare of pigs, that is, information on food and drinking water in the farming process, the addition of high-level traceability information that covers farming, slaughter and processing, and distribution and sales as a supplement can reduce consumer concerns about the risk of pork. Thus, there is a complementary relationship between HITRACE and PHYSICAL. When the label shows that traceable pork is non-indigenous, pigs cannot be guaranteed treatment when they are sick in the farming process, so the health welfare label is also required to ensure the safety of such pork. Thus, there is also a complementary relationship between HEALTH and OTHORIGIN. In contrast, the HEALTH × LOCORIGIN interaction was significant at the 5% level, with a negative coefficient. This suggests that the indigenous label guarantees access to medical treatment, which is the information contained in the health welfare label, resulting in a strong relationship between HEALTH and LOCORIGIN. Lastly, the ENVIR × OTHORIGIN interaction was significant at the 1% level, with a negative coefficient, indicating that a substitutional relationship exists between ENVIR and OTHORIGIN. The ex ante risk assessment carried out by participants on traceable pork based on the non-indigenous label already covered information about the habitat environment of pigs in the farming process, so OTHORIGIN can substitute ENVIR.

MAIN CONCLUSIONS AND PROSPECTS

In this study, consumer preferences for traceable pork attributes, including traceability information, animal welfare, place of origin, and price, at different levels, were examined in 328 consumers in downtown Wuxi, Jiangsu Province, China, using a Choice Experiment and Bayesian inference. The main conclusions are as follows:

Firstly, when asked directly, 77.74% of participants claimed that safeguarding pig welfare was helpful or very helpful for improving pork quality and safety. The Choice Experiment results also showed that although the marginal utility of health welfare was lower than that of high-level traceability information, it was similar to that of place of origin, and higher than that of middle-level traceability information and other attribute levels. Consumer preference for health welfare was lower than that for traceability information. This may be due to their perceptions of higher traceability information than of health welfare as perception determines behavior. The calculation

results showed that the relative importance of animal welfare to consumers was higher than that of place of origin among traceable pork attributes with the function of *ex ante* quality assurance. Therefore, including the animal welfare attribute in the form of a label may better meet consumer demand for pork safety and quality information than including the place of origin attribute. This conclusion accords with that of Yuta et al. (2018), i.e., most consumers prefer to purchase animal-derived food with an animal welfare label. This is because the animal welfare label provides more information than the place of origin label. For example, the health welfare attribute reflects information on disease treatment in the farming process of pigs, which is more helpful for consumers to determine pork quality and safety.

Secondly, we found a complementary relationship between high-level traceability information and dietary welfare. This finding suggests that the risk of pork with an animal welfare label only is still uncontrollable, and traceability information that covers farming, slaughter and processing, and distribution and sales should be included as a supplement. Therefore, to ensure the function of the animal welfare label, a label system that combines the traceability information attribute, which enables ex post traceability, and the animal welfare attribute, which enables ex ante quality assurance, may better meet market demand. This conclusion is consistent with that of Wu et al. (2015b). This is because complete traceability information covering farming, slaughter and processing, and distribution and sales ensures that sub-standard food can be effectively recalled, thereby safeguarding pork safety and quality. Thirdly, although the importance of the animal welfare information attribute was lower than that of the price attribute, the marginal utilities of health welfare and dietary welfare were higher than those of all price levels. This indicates that consumers accept a higher price as a result of increased production costs due to the inclusion of animal welfare information. This is mainly because consumers are highly concerned about food safety. This conclusion accords with that of previous studies in other countries. For example, Yuta et al. (2018) reported that nearly 90% of Japanese consumers are willing to pay a certain premium for beef with an animal welfare label. Spain et al. (2018) found that American consumers are willing to pay a premium of 0.79 US dollars (32%) for eggs with animal welfare information. Thus, consumer demand already exists for the setting of an animal welfare attribute for traceable animal-derived food in the context that consumers are highly concerned about the safety of animal-derived food in China. Due to the COVID-19 pandemic, China has recently approved the integration of an animal welfare attribute into traceability market systems of new animal-derived foods. The government should encourage manufacturers to produce diverse traceable animal-derived food not only to protect animal welfare and promote the construction of an ecological civilization, but also to develop new animal-derived food markets to satisfy different levels of consumer demand.

There are some study limitations to mention. The current experiment was a hypothetical experiment, which did not include actual payment by consumers. Given the characteristics of stated preference, consumers tend to exaggerate or falsely express their consumption behavior, which may differ from their behavior under a real market environment. Therefore, non-hypothetical experiments should be used in future studies. In addition, as the sample was limited to consumers in Wuxi, Jiangsu Province, further research with a wider scope is required to confirm the universality of our findings.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Jiangnan University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LW: conceptualization and validation. EH: data curation and writing—review and editing. LK: formal analysis. MC: writing—original draft.

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Influence of Loss Aversion and Income Effect on Consumer Food Choice for Food Safety and Quality Labels

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Food safety and food quality are two closely related aspects of the food management system. The difference between the two is that one keeps consumers safe while the other keeps consumers satisfied. This study examined the differences in how consumers value food safety and food quality with a focus on the influence of loss aversion on one's psychological level and of income effect on one's socio-demographic level. Our findings indicate that loss aversion and income effect significantly influence the way consumers value food safety vs. quality labels when considering potential health risks and food price. High risk-averse and low-income consumers with strong loss aversion and a weak income effect show a higher demand for food safety labels as a way to ensure easy access to safety indications. Low risk-averse and high-income consumers with weak loss aversion and a strong income effect show a higher demand for food quality labels because they hope to gain more health benefits from high-quality food at good prices. This study provides insights that will assist public authorities and food industry in balancing food safety control and food quality improvement in order to meet the heterogeneous market demand changing alongside the transition of China's food consumption and production.

Keywords: food choice, difference, food safety, food quality, loss aversion, income effect

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INTRODUCTION

Since the food safety scandal of excess melamine residues broke out in China in 2008, the overwhelming majority of consumers with high risk aversion have been in a panic over the issue of food safety (Ortega et al., 2012; Chen et al., 2015; Lai et al., 2018; Liu et al., 2020). Competent Chinese authorities have stepped up food monitoring and supervision along the entire food supply chain from production to consumption (Kang, 2019; Zhou et al., 2021). Since the scandal, food safety risks have been kept under effective control, ensuring that safe food is widely accessible to the public. As incomes rise and the availability of food becomes more diversified, Chinese consumers are beginning to pursue higher quality, more nutritious, and healthier food products (Yu and Abler, 2009; Yu, 2018). In an effort to achieve high-quality improvement in agricultural production, the national rejuvenation initiative has been promoted with the purpose of overhauling the agricultural supply side system and constructing the competitive market order for better quality

food to be offered at a good price (Nie et al., 2020; Nie et al., 2021). However, the ongoing COVID-19 pandemic presents an exceptional and unprecedented challenge for the world. Cold-chain food is seen as being one of the major mediums of virus breeding and dissemination, as it carries the virus and raises the risk of infection through food production, processing, storage, packaging, and distribution (Godoy et al., 2021; Han et al., 2021). The outbreak of epidemic disease has a huge impact on public health (Djekic et al., 2021; Marti et al., 2021); thus, food safety issues have resurfaced as a global critical problem along with an increase in consumers' concern about food safety (Kitz et al., 2021). In fact, consumers' food safety concerns and food quality demands have clearly transformed their food choices, resulting in changes in the economic structure and food production behavior (Grunert et al., 2015; FAO, 2017). At the current crossroad, whether public authorities and the food industry prioritize food safety control or food quality improvement should be based on the heterogeneous market demand for food safety vs. quality (Choi et al., 2018a,b). After all, consumers with varying levels of risk aversion and income are the primary beneficiaries of the market.

Food safety and food quality are two of the most important aspects of the food management system. Although closely related, there are differences between food safety and food quality regarding the requirements in a food-handling environment (Haas et al., 2021). Food safety refers to practices and conditions that preserve food quality by avoiding contamination and food-borne illnesses during preparation, processing, and storage (Grunert, 2005). Food quality refers to the features and characteristics of a food product that conform to the required specifications, are acceptable and cost-effective to consumers, and are profitable for the company (Naspetti and Zanoli, 2009). The difference between food safety and food quality lies in the fact that one keeps consumers safe and the other keeps consumers satisfied (Rijswijk and Frewer, 2008; Kealesitse and Kabama, 2012). In general, it is difficult for consumers to distinguish the specific attributes of food safety and food quality when making food choices (Dulleck et al., 2011). Food safety is perceived as a credence attributes, as it cannot be ascertained before or after purchase unless through safety indication (e.g., safety certificates, traceable information) (Grunert, 2005). Some quality cues are either search attributes (e.g., brand reputation, quality grades) or credence attributes (e.g., geographical production) (Akdeniz et al., 2013; Grunert et al., 2015; Marek et al., 2020), which can be ascertained prior to consumption (Nelson, 1970; Grunert, 1997). In response to the rising concern over food safety and quality issues as well as differentiated consumer demand for these issues, China has integrated a multilevel food-labeling scheme into the food market in order to help consumers identify the safety and quality levels of food products. The food labeling scheme consists of certification, traceability, brand, grading, geographical indication, etc. Food with certified and traceable labels are primarily consumed out of concern about food safety issue (Nie et al., 2018; Liu et al., 2019; Wu et al., 2020). Brand, quality grade, and geographical indication are introduced to identify the quality levels of food products (Lim and Hu, 2016; Choi et al., 2018b; Ding and Veeman, 2019).

However, much of the previous literature confused the distinction between the concepts of food safety and food quality, and others primarily focused on consumers' food demand choice for either food safety or food quality. To the best of our knowledge, no published study has integrated food safety and food quality into a comprehensive framework, compared the differences of how consumers value food safety vs. quality labels, and even evaluated how socio-demographic and psychological characteristics influence consumers' food demand choice. This study addresses the knowledge gap that exists in the current literature of behavioral economics and psychology. Our empirical analysis aims to (1) estimate whether consumers' food demand choice differs significantly when it comes to food safety vs. quality labels and to compare the extent of those differences in their food choices, and to (2) investigate how loss aversion [i.e., losses loom larger than gains (Koan et al., 2021)] and income effect influence consumers' food choice for food safety vs. quality labels.

The major objective of this study is to estimate the differences in consumers' food choice for food safety vs. quality labels. Specifically, we first use the mixed logit model to explore the heterogeneities in consumers' valuations of food safety vs. quality labels. Second, we categorize respondents into subsamples based on different levels of risk aversion and income in order to identify the differences in their valuations of food safety vs. quality labels. Third, we examine the impacts of loss aversion and income effect when making food choices based on food safety vs. quality labels. The results will provide valuable information to help the food industry decide whether to increase the publicity of safety or quality information labels, help distributors develop effective marketing strategies to meet consumer demand for food safety and quality, and assist policymakers in setting attribute priorities on food safety vs. quality when formulating food policies.

RESEARCH FRAMEWORK

Research Hypotheses

Utility is a term in economics that refers to the total satisfaction or dissatisfaction that consumers experience when consuming a good or service. Economic theories based on rational choice usually assume that consumers will strive to maximize their utility, from the perspective of psychological expectations. Utility is also a subjective measure of satisfaction or dissatisfaction that varies from person to person according to each personal preference. Although consumer utility is impossible to quantify, utility losses or gains that a consumer obtains from different goods and services can be compared (Lancaster, 1966; Louviere et al., 2000). Consumers make food purchasing choices based on the comparison of self-assessed utility losses and gains in order to maximize their psychological expectations. The utility tradeoff between loss aversion and income effect, directly affected by each individual's risk aversion and income level, determines whether a consumer will choose safe food that is above the minimum quality standard or high-quality food at a high price. Accordingly, we propose and validate hypothesis H1 about the heterogeneity in consumers' valuations of food safety and quality labels.

H1: Consumers with varying levels of risk aversion and income place heterogeneous valuations for food safety and quality information labels.

For consumers with a high safety concern and strong budget constraint, the potential health risk of consuming food without official or third-party safety-certified labels would significantly reduce consumer utility. At the same time, the cost savings that come with relatively low prices of safe food would increase consumer utility. Loss aversion, whereby the impact of losses overweighs gains, is typically examined in relation to decisions about anticipated outcomes (Boyce et al., 2013; Iwasaki et al., 2019; Koan et al., 2021). In general, probable utility losses in potential health risk have a larger negative impact on consumer well-being than equivalent utility gains in low food price. This implies that the negative utility caused by the insufficient food safety information would be larger than the positive utility created by the relatively low food price. Under this condition, the loss aversion for health risk would be amplified due to a high level of risk aversion and would outweigh the income effect created by low food prices. When consumers have a high level of risk aversion and a low level of income, they are likely to care more about the safety of what they eat than the quality of the food. These high risk-averse and low-income consumers tend to pay a premium for additional safety information and to choose safer food with safety-certified labels in order to reduce utility loss resulting from potential health risks. Accordingly, we propose and validate hypothesis H2 regarding the influence of loss aversion and income effect on consumers' demand for food safety labels, as indicated by the upper half of **Figure 1**.

H2: When the utility losses from loss aversion outweighs the utility gains from income effect, consumers with high risk aversion and low income prefer safe food with safety information labels.

In another case, for consumers with low safety concern and weak budget constraint, the potential health benefit from consuming more nutritious and healthier food with higher quality would certainly increase consumer utility, while the relatively higher food prices would reduce consumer utility. However, because consumers have a low risk aversion for food safety, the loss aversion regarding potential health risks related to unsafe food would be weakened and the negative utility of loss aversion approaches 0. Similarly, the high price – which includes the labeling cost of high-quality food – has no apparent negative impact on high-income consumers' utility. Here, the negative utility of income effect is also close to 0. In general, utility gains in health benefit have a larger positive impact on consumer well-being than the minimal utility losses in high food price and health risk. This implies that the positive utility created by high-quality food with sufficient quality information is the main factor driving low risk-averse and high-income consumers' demand for food quality labels. Under this condition, the income effect for potential health benefit from high-quality food with high price far outweighs the loss aversion for potential health risk. Accordingly, we propose and validate hypothesis H3 about the influence of loss aversion and income effect on consumers' valuations of food quality labels, as indicated by the bottom half of **Figure 1**.

H3: When the utility losses from loss aversion is less than the utility gains from income effect, consumers with low risk aversion and high income prefer high-quality food with quality information labels.

Choice Experiment

Choice experiment is a quantitative technique that is used to elicit consumer preferences. It helps researchers to uncover how consumers value selected attributes of food products by asking them to state their preferences among a series of choice sets of hypothetical alternatives. Each alternative is described by several attributes, and consumers' responses are used to infer the value placed on each attribute. Comparing with other standard contingent valuation techniques that require respondents to rank or rate alternatives, choice experiment presents a reasonably straightforward task, which more closely resembles a real-world decision. The theoretical foundation of choice experiment is conceptually based on Lancaster's consumer utility theory, which postulates that consumers obtain utility from the attributes of a product rather than from the product itself (Lancaster, 1966).

Our choice experiment was carefully designed to specify five product attributes, including two food safety attributes (certification and traceability system), two food quality attributes (brand reputation and grading system), and the prices of rice products. The five specifications of food-specific attributes are summarized in **Table 1**. In our choice experiment, the rice products with safety-certified labels are mainly referred to as organic or green rice. Three cases of certification were considered; i.e., governmental certification label, third-party certification label, and no certification label. For simplicity, we considered two cases of traceability, brand, and grade: with and without traceability label, with and without brand, and with premium or standard grade. The traceability label in our survey is a QR code that can be scanned by cellphone to track food safety information about where the rice product comes from. Gold Arowana is a well-known rice brand in China and is highly regarded by consumers. Rice is graded into premium and standard grades mainly according to content of broken rice, length of rice, and milling degree, as specified in the National Standard Rice (No. GB 1354-2009). Brand is commonly specific to high value-added products, and by contrast, grading system applies to bulk agricultural products with low added values. The rice price takes three values, with a base price of 3 yuan/500g, a middle price of 5 yuan/500g, and a ceiling price of 7 yuan/500g.

The five selected attributes can produce as many as 72 ($3^2 \times 2^3$) combinations under a full factorial design. To minimize respondents' response difficulties, a fractional factorial design orthogonally generated 16 combinations, each two of which were randomly split into one group. A respondent was presented with 8 simulated choice scenarios that each contained two alternatives

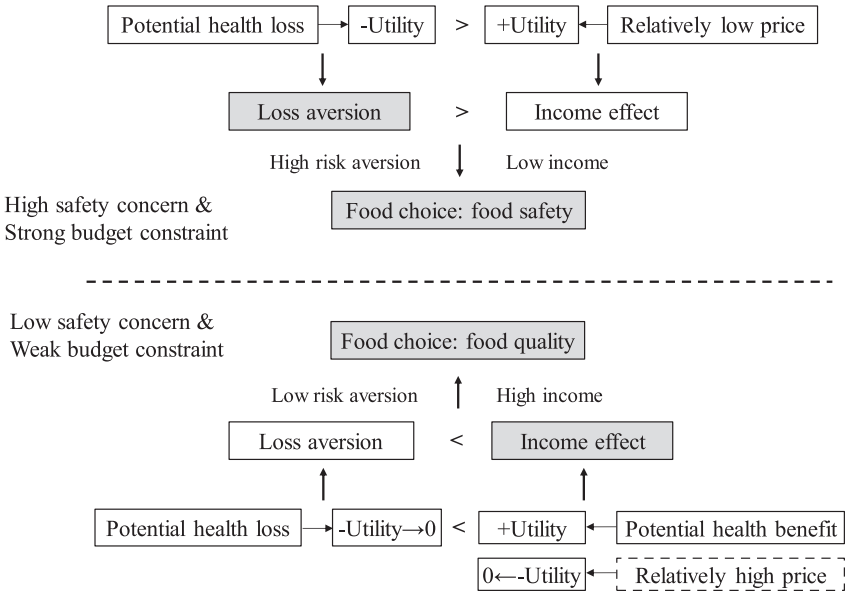

FIGURE 1 | The influence of loss aversion and income effect on consumer food choice.

characterized by the combinations of different levels of five attributes. The "do not buy" alternative was included to simulate a real shopping market where respondents were allowed not to purchase rice products. A choice scenario is illustrated in **Figure 2**.

Since the choice experiment does not provide incentives for respondents to invest sufficient cognitive effort when thinking about their valuation decisions, the WTP values may be overstated in the hypothetical situation because of the lack of real economic commitment. At the beginning of our survey, we use some *ex ante* methods to mitigate hypothetical bias. Specifically, hypothetical questions include the "do not buy" alternative (as an explicit option to adjust uncertainty), an objective cheap talk (designed to remind respondents to behave in the same way that you would if you really had to pay for the product), and honesty priming treatment (used to increase respondents' honesty and to unconsciously manipulate their perception, appraisal, and behavior priming). Overall, de-Magistris et al. (2013) found some evidence that WTP values both in honesty priming treatment and cheap talk were the two closest to the WTP derived from non-hypothetical treatment. The hypothetical choice experiment, modified by these *ex ante* methods, would result in reasonable and robust valuation measures.

TABLE 1 | Information labels of rice products in choice experiment.

Information labels		Level 1	Level 2	Level 3
Food safety	(1) Certification	Governmental	Third-party	None
	(2) Traceability	QR code	No	
Food quality	(3) Brand	Gold Arowana	No	
	(4) Grade	Premium	Standard	
(5) Price (CNY/500g)		3	5	7

Our choice experiment was carried out across China's western, middle, and eastern regions from May to July 2018. A group of well-trained enumerators were recruited to investigate three major capital cities: Chongqing (municipality), Changsha (capital of Hunan province) and Nanjing (capital of Jiangsu province), and six developing cites: Xinyang (Henan province), Luan and Bengbu (Anhui province), Xuzhou, Changzhou and Suzhou (Jiangsu province). These nine cities covered in our survey were selected from major Chinese rice consumption areas. In all, approximately 41% of experimental observations were derived from fresh markets, 46% from domestic supermarkets, and 13% from international supermarkets. This was done to better capture the heterogeneity of consumers' purchasing behaviors in various purchasing contexts.

Data Description

Table 2 shows the summary statistics based on selected demographic information from consumer surveys. The average age of the sampled respondent is 40 years old and acts as a primary shopper for her three family members. About 54 percent of respondents acquire a 4-year college degree. Nearly 60 percent of respondents' household income level is between 6000 CNY to 15000 CNY. Furthermore, consumers' perception of food safety risk and their attitude toward food safety risk are captured with the five-point Likert scales. On a 1-to-5 scale the median average risk perception is approximately 2.43, similar to the value reported by Lim et al. (2014). Respondents have a negative attitude about consuming food without safety labels, with an average risk attitude of 3.84 on 1-to-5 scale. A majority of respondents believe that the local regulatory system is efficient, and they have high confidence in the authenticity of food inspection information disclosed by the government.

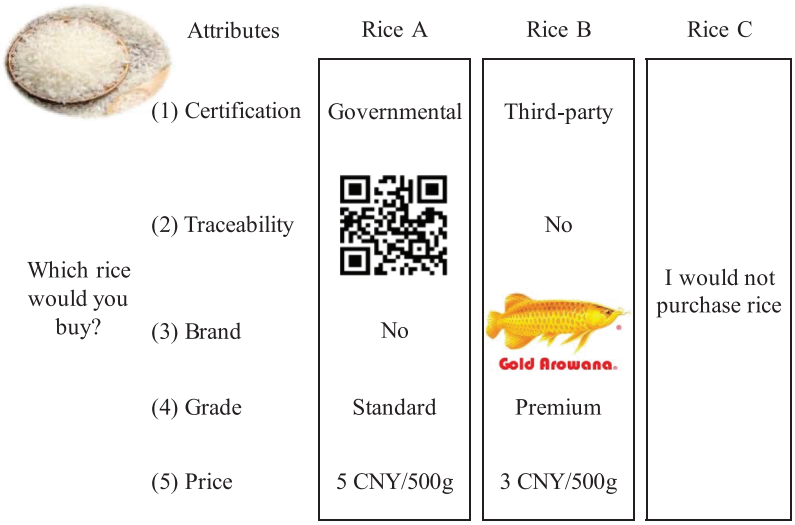

FIGURE 2 | A rice choice set sample.

MATERIALS AND METHODS

Mixed Logit

Mixed logit is a highly flexible model that can approximate any random utility model (Mcfadden and Train, 2000). Generally speaking, it obviates the three limitations of standard logit by allowing for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time. Following the consumer theory (Lancaster, 1966) and the random utility theory (McFadden, 1974), the utility that decision maker n obtains from choosing alternative j in choice situation t is given by

$$U_{njt} = \beta_n' x_{njt} + \varepsilon_{njt} \quad (1)$$

where U_{njt} is a function of observable attributes of the alternatives, x_{njt}, and of the decision maker n. The random term μ_{njt} is assumed to be iid type I extreme value distributed. The mixed logit model extends the standard conditional logit model by allowing heterogeneous coefficients β_n in the model to vary across decision makers. The decision maker n knows the value of his own β_n for all alternatives J and will choose the alternative i that provides the highest level of utility, if and only if $U_{nit} > U_{njt}, \forall j \neq i$.

To estimate consumers' unobserved heterogeneous preferences for informational attributes, we select the mixed logit model, which is specified to include a combination of non-random coefficients and multivariate normal random coefficients (Hole, 2007). The mixed logit probability can be viewed as a weighted average of the logit formula evaluated over a density function of coefficients. By assuming that utility is linear in parameters β_n, the choice probability of mixed logit model under density function $f(\beta_n)$ can be expressed in the form of

$$P_{nit} = \int \frac{exp(\beta_n' x_{njt})}{\sum_{j=1}^{J} exp(\beta_n' x_{njt})} f(\beta_n) d\beta_n \quad (2)$$

Willingness to Pay

The WTP for an attribute is interpreted as the level of compensation or discount for consumers relative to the utility without that attribute, which would be needed to make them indifferent to the two situations. To calculate mean WTP values for all consumers, a ratio is taken in which the numerator is the parameter on that attribute and the denominator is the negative price coefficient, which can be perceived as the marginal utility of money. The WTP for attribute k is represented by

$$WTP_k = -\frac{\beta_k}{\beta_{price}} \quad (3)$$

where β_k and β_{price} are all decision makers' mean coefficients for attribute k and for the price of rice product, respectively.

For the statistical properties of the WTP for attribute k, the Monte Carlo method developed by Krinsky and Robb (1986) is used to measure standard deviation and 95% confidence intervals. This simulation procedure of a parametric bootstrapping technique requires a large number of random draws (1000 draws in our case) for a parameter vector from a multivariate normal distribution utilizing a variance–covariance matrix and the means of estimated parameter vectors.

RESULTS AND DISCUSSION

Table 3 shows the mixed logit model estimation results for both the full sample and the subsample. To categorize consumers as low or high risk aversion, we aggregate the scores for each

TABLE 2 | Socio-demographic statistics.

Variable	Description	Mean (SD)
Age	Years	39.64 (15.08)
Household size	Persons	3.13 (1.30)
Gender	Female = 1, male = 0	0.62 (0.49)
Child	Child in household = 1, No child = 0	0.42 (0.49)
Shopper	Chief shopper in household = 1, Not = 0	0.60 (0.50)
Education	Junior school or below = 1	13.01%
	Senior school = 2	23.79%
	College graduate = 3	53.91%
	Graduate degree = 4	9.29%
Monthly family Income	Less than 3,000 = 1	4.83%
(unit: yuan)	3,000–6,000 = 2	18.77%
	6,000–10,000 = 3	33.84%
	10,000–15,000 = 4	23.98%
	15,000–20,000 = 5	10.22%
	More than 20,000 = 6	8.36%
Risk perception[1]	Strongly agree = 1, . . ., Strongly disagree = 5	2.43 (0.99)
Risk attitude[2]	Strongly willing = 1, . . ., Strongly unwilling = 5	3.84 (1.42)

China census data is the weighted mean based on 1% National Population Sample Survey 2015 and China Statistical Yearbook 2017.
[1]Consuming rice without safety-certified labels is not risky at all.
[2]You are strongly willing to accept the risk of consuming rice without safety-certified labels.

consumer, measuring individual risk perception and risk attitude as shown in **Table 2**. Consumers with a total value of 2 to 5 are categorized as "low risk aversion" subsample, while consumers with a total value of 6 to 10 are categorized as "high risk aversion" subsample. Similarly, the classification of consumers into the two groups of low and high income depends on their monthly family income. Consumers with monthly family income of less than 10000 CNY are classified as "low income" subsample, while consumers with an income of more than 10000 CNY are classified as "high income" subsample. **Table 4** shows the mean values of consumers' WTP for each food safety and quality label. Based on the mixed logit model estimation, each consumer's WTP is derived from Krinsky and Robb (1986) parametric bootstrapping simulation by 1000 random draws for a parameter vector from a multivariate normal distribution and utilizing a variance-covariance matrix and the means of estimated parameter vectors.

For the analysis, the coefficients of food safety and quality labels were assumed as random and normally distributed. As shown in **Table 3**, the coefficients of price and optout for rice consumers are negative and significant, indicating that consumers are sensitive to rice price and that they would experience dissatisfaction from not buying the staple food. As expected, consumers strongly prefer food safety and quality labels that positively impact their utilities. Rice products with certificated, traceable, grade, and brand labels could provide detailed safety and quality information to help them make well-informed purchasing decisions and reduce the time cost of purchasing. As to the full sample, the first two columns of **Table 3** indicate that the coefficients of three food safety attributes – governmental certification, third-party certification, and traceability – are significant and positive, which means consumers prefer rice with safety-certified and traceable labels. Consumers' mean WTP values for price premium to achieve government-certified and traceable information are higher than third-party certification; however, as found in **Table 4** the 1000 non-parametric bootstrap simulations show that consumer preferences for governmental certification and traceability are significantly heterogeneous while preferences for third-party certification is not. This implies that consumers are more divergent about the food safety labels on government-certified and traceable information, because they both guarantee a certain level of food safety. Moreover, consumers' preferences for the other two food quality attributes, i.e., grade and brand, are also highly significant with similar magnitudes of estimated coefficients and WTP values, as indicated by **Tables 3**, **4**. There exists heterogeneity in consumer preference for brand reputation, while they express more consensus about the role of quality grade label, which improves the level of food quality. The heterogeneities in the full sample's valuations of food safety labels on governmental certification and traceability, as well as in their valuations of food quality labels on brand reputation, show a statistical significance of 1%, which validates the hypothesis H1 that was proposed in the second part of this paper. The next four columns of **Tables 3**, **4**, respectively, compare the estimated results for the mixed logit model and WTP between various subsamples. While consumers' preferences for food safety and quality labels are qualitatively similar across subsamples in terms of scales and directions (as evidenced by **Table 3**), the WTP values estimated in **Table 4** notably differ compared to their preference coefficients.

The estimated WTP for food safety vs. quality labels within and between subsamples are compared in **Table 5**. The results are intuitive, showing that as consumers become increasingly concerned about the safety of food, and as their income grows, the WTP values either for food safety or quality labels both significantly increase. It implies that consumers with a higher income and a greater awareness of what they eat are more motivated to identify the level of food safety and quality. They are willing to pay a higher price for obtaining that inherent and unobvious food-related information. It shall be noted that whether consumers belonged to the high vs. low risk-averse group or the high vs. low income group, both groups were willing to pay a higher price for the cost of food safety labels than food quality labels, because food with a safety-certified information label can minimize consumers' risk perception and risk attitude.

The WTP differences between subsamples are statistically significant, as the *t*-test statistics indicated in **Table 5**. Consumers in the high risk-averse group are willing to pay 0.716 CNY/500g more for food safety labels and 0.557 CNY/500g more for food quality labels than the low risk-averse group. The WTP difference value of 0.159 CNY/500g between safety and quality labels in the high vs. low risk-averse group implies that compared to low risk-averse consumers, food safety is considered a more preferable attribute for consumers who are highly risk-averse about the safety of what they

TABLE 3 | Results of the mixed logit model.

	Full sample	Low risk aversion	High risk aversion	Low income	High income
Estimated coefficients in utility function					
Price	−0.423***(0.020)	−0.417***(0.027)	−0.430***(0.031)	−0.469***(0.027)	−0.370***(0.032)
Governmental certification	1.072***(0.051)	0.945***(0.069)	1.225***(0.077)	1.038***(0.065)	1.149***(0.084)
Third-party certification	0.207***(0.045)	0.168***(0.060)	0.260***(0.071)	0.221***(0.058)	0.192***(0.075)
Traceability	0.771***(0.040)	0.615***(0.053)	0.959***(0.063)	0.783***(0.052)	0.769***(0.067)
Grade	0.677***(0.038)	0.578***(0.050)	0.807***(0.059)	0.609***(0.048)	0.793***(0.063)
Brand	0.752***(0.039)	0.600***(0.050)	0.927***(0.063)	0.721***(0.053)	0.807***(0.062)
Optout	−2.990***(0.126)	−3.011***(0.168)	−2.982***(0.194)	−2.962***(0.161)	−3.077***(0.207)
Distributions of standard deviations of estimated coefficients					
Governmental certification	0.373***(0.077)	0.437***(0.094)	0.213(0.173)	0.275**(0.126)	0.489***(0.107)
Third-party certification	−0.014(0.140)	0.012(0.141)	−0.143(0.298)	−0.012(0.153)	−0.104(0.370)
Traceability	0.297***(0.066)	0.298***(0.087)	−0.208(0.138)	0.210*(0.115)	−0.414***(0.085)
Grade	0.007(0.115)	−0.004(0.123)	0.017(0.261)	0.002(0.129)	0.035(0.164)
Brand	0.394***(0.053)	0.332***(0.077)	0.431***(0.077)	0.450***(0.066)	0.314***(0.091)
Optout	0.967***(0.081)	0.884***(0.115)	1.102***(0.120)	0.959***(0.100)	0.874***(0.138)

*Notes: ***, **, * denotes statistical significance at 1%, 5%, 10% levels, respectively. Standard errors are in parentheses.*

TABLE 4 | Estimated WTP (CNY/500g) of full sample and subsamples.

	Full sample	Low risk aversion	High risk aversion	Low income	High income
Governmental certification	2.532***	2.265***	2.846***	2.214***	3.102***
	[2.289, 2.782]	[1.947, 2.603]	[2.488, 3.247]	[1.957, 2.487]	[2.617, 3.667]
Third-party certification	0.488***	0.402***	0.605***	0.472***	0.519***
	[0.268, 0.720]	[0.107, 0.717]	[0.261, 0.988]	[0.215, 0.746]	[0.101, 0.986]
Traceability	1.821***	1.473***	2.228***	1.670***	2.077***
	[1.638, 2.023]	[1.246, 1.728]	[1.936, 2.568]	[1.468, 1.898]	[1.722, 2.499]
Grade	1.598***	1.384***	1.875***	1.299***	2.141***
	[1.436, 1.791]	[1.172, 1.638]	[1.634, 2.188]	[1.120, 1.518]	[1.839, 2.540]
Brand	1.776***	1.437***	2.154***	1.537***	2.180***
	[1.601, 1.987]	[1.223, 1.702]	[1.877, 2.511]	[1.340, 1.776]	[1.843, 2.621]

*Notes: ***, **, * denotes statistical significance at 1%, 5%, 10% levels, respectively. 95% confidence intervals are in brackets.*

TABLE 5 | WTP differences for food safety vs. quality labels within and between subsamples.

Group	High vs. low risk aversion			High vs. low income		
	I Low	II High	Δ High vs. low aversion: II-I	III Low	IV High	ΔHigh vs. low income: IV-III
(1) Food safety labels	1.729***	2.445***	0.716***	2.043***	2.110***	0.067***
(2) Food quality labels	1.178***	1.734***	0.557***	1.330***	1.599***	0.268***
ΔSafety vs. quality: (1)-(2)	0.552***	0.710***	0.159***	0.712***	0.511***	−0.201***

*Notes: ***, **, * denotes statistical significance at 1%, 5%, 10% levels, respectively.*

eat. Conversely, consumers in the high-income group are willing to pay 0.067 CNY/500g more for food safety labels and 0.268 CNY/500g more for food quality labels than the low-income group. The WTP difference value of −0.201 CNY/500g between safety and. quality labels in the high vs. low-income group implies that compared to low-income consumers, high-income consumers give more attention to higher quality in more healthy and nutritious food that far exceed safety requirements.

Such WTP differences show that stronger loss aversion would produce a higher demand for food safety labels and a stronger income effect would produce a higher demand for food quality labels. The *t*-test statistics of WTP differences significantly validate the hypotheses H2 and H3 at the 1% level. It was expected that loss aversion and income effect would jointly influence differences in consumer reactions to the availability of food safety vs. quality labels. In terms of loss aversion, high risk-averse consumers experience a greater loss aversion when posed with potential health risks, making them more willing to pay a premium price to ensure that the rice product is safe enough. Low risk-averse consumers who present a weakening loss aversion correlated with psychologically perceived health

risks tend to prefer food quality labels over food safety labels. In terms of income effect, high-income consumers show a strong willingness-to-pay when it comes to the cost of food quality labels in order to achieve more health benefits from high-quality food at a good price. For low-income consumers with a strong budget constraint, they are more likely to choose safe food that is above the minimum quality standard and with a relatively low price as opposed to higher priced high-quality food.

CONCLUSION AND IMPLICATION

China is now at a critical juncture in the transformation of food consumption and production. The decision on the part of public authorities and the food industry to prioritize food safety control or food quality improvement should center on market demand for either safe food that is above the minimum quality standard, or high-quality food held to a high quality standard. Although food safety and food quality are closely related in the food management system, there are significant differences between the two in that the former keeps consumers safe and the latter keeps consumers satisfied. However, to our knowledge there is no study in the current literature that integrates food safety and food quality into a comprehensive framework while evaluating the influence of consumers' socio-demographic and psychological characteristics on preferences for food safety and food quality. Taking rice as a case study, this study employs choice experiment survey data and the mixed logit model in order to estimate the differences in consumers' food choice for food safety vs. quality labels, and to uncover the influence of loss aversion and income effect on their valuations of food safety vs. quality labels.

The mixed logit model results show that Chinese consumers have heterogeneous preferences and WTP for a price premium to cover the cost of food safety and quality labels, with more divergent valuations of food safety labels on governmental-certified and traceable information, and food quality label on brand reputation. The density estimates of WTP differences indicate that although high-risk averse consumers express a higher WTP both for food safety and quality labels than low risk-averse consumers, the density distributions of high-risk averse consumers' WTP for food safety labels and that of low risk-averse consumers' WTP for food quality labels both exhibit a high degree of convergence. Similarly, although high-income consumers have a nearly equivalent WTP for food safety labels as low-income consumers, they have a higher WTP for food quality labels on average.

The WTP differences between subsamples indicate that loss aversion would produce a high demand for food safety labels and that income effect would produce a high demand for food quality labels. It was expected that consumers with various socio-demographic and psychological characteristics would react differently to the availability of food safety vs. quality labels in the food market. For high risk-averse and low-income consumers, they experience a greater loss aversion regarding potential health risks and a weaker income effect for high food prices, so that they tend to pay a price premium for easy access to safety indications assuring the safety of food. For low risk-averse and high-income consumers, the weaker loss aversion and greater income effect would result in a stronger willingness-to-pay for food quality labels that will bring them many health benefits from high-quality food at a good price.

Overall, our findings indicate that consumers with varying levels of risk aversion and income would be influenced by the loss aversion and income effects on their food choice for food safety vs. quality labels. This finding strongly suggests that the Chinese government and food industry should implement a multilevel food labeling scheme that integrates food safety and quality management systems. From the perspective of public policy, although ensuring food safety and improving food quality are two different policy objectives, with the government and food industry as the driving forces behind each, respectively, the two objectives should coexist within the common framework of China's food management system. The modified food labeling scheme implemented jointly by the government and food industry would provide consumers more useful information to help them identify the inherent food safety and quality attributes, which cannot be easily identified otherwise. Such a fully information-asymmetric market can facilitate well-informed food choices and maximize consumer welfare.

Ensuring food safety is an important task that forms an integral part of the national planning strategy for building a healthy China and enhancing people's well-being. The primary purpose of governmental food management is to guarantee that the food available to the public on the market meets the minimum quality standards, which is now being achieved over the last decade through a variety of initiatives including a modified food labeling scheme, rigorous random food inspection, and enhanced penalty severity. As governmental regulatory capacity is continuously strengthened, food safety risk will be effectively kept to an acceptable level, and consumers' safety concern and their loss aversion regarding potential health risks will be weakened in terms of psychological expectations. Meanwhile, with the rapidly rising income levels, the current food market and policy climate overly focused on food safety control would not provide more valuable food quality information, nor would it satisfy the growing market demand for high-quality food among high-income consumers. Thus, the original policy objective of prioritizing food safety control over food quality improvement should be revised accordingly to keep up with the changing market demand for food safety vs. food quality. On the contrary, if the revised policy objective of food quality improvement is placed ahead of food safety control, an overemphasis on food quality improvement by the food industry would not only result in a sufficient safe food supply that far exceeds safety requirements, it would also result in increased production costs, higher food prices, and heavy expenditure burdens on low-income consumers who can hardly afford high-quality food at good prices and have a higher demand for safe food with relatively low prices.

Therefore, in the transition process from safe to high-quality food production and consumption, the government and food industry should balance the tradeoff between food safety control and food quality improvement. A multilevel labeling system contributes to a good market containing different levels of food

quality with competitive prices, where consumers with varying levels of risk aversion and income would make appropriate food choices for safe food or high-quality food. Our findings provide the government with an effective labeling strategy for ensuring the safety of public diet, especially for the health interest of low-income and high risk-concerned groups. It also provides policy incentives for producers, processors, and distributors to collaborate and create a quality-differentiated food market with comprehensive food information in order to enhance the food industry's competitiveness and to meet heterogeneous market demand for food safety vs. food quality.

This study identifies the dual effects of loss aversion and income on consumer food choice for food safety and food quality, but it is unclear whether the effects of education, cognitive performance, and other variables, particularly those affecting consumers' valuations and choices, are at least as important for their food choices. Because the costs of promoting a modified labeling system are partially covered by food prices, the level at which the price increase should be limited relative to the current price in order to gurantee consumers' benefit is of interest for future research. Furthermore, a further study comparing consumers' valuations of mandatory vs. voluntary labeling systems could also establish valuable findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Nanjing Agricultural University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

WN: conceptualization, methodology, and writing original draft. HB: methodology and data collection. JL: manuscript preparation, supervision, and editing. TL: conceptualization and writing original draft and editing. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: 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.

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Decoy Effect on Consumers' Purchase Behaviors in Relation to Meat Products: Comparison of Pork and Chicken

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Few studies have analyzed the behaviors of consumers in relation to their purchase of meat products produced with animal welfare in consideration under different decoy scenarios; thus, it is difficult to accurately understand consumer behaviors and to reduce the bias in the conclusions of this study regarding consumption preferences in relation to meat products that had been produced with animal welfare in consideration. With the frequent occurrence of cases connected with the quality and safety of meat in China, the welfare conditions of livestock and poultry urgently need to be improved. We used 810 consumers in Wuxi City, Jiangsu Province, China as our study sample, chose pigs and chickens, i.e., the two common species of livestock and poultry, as study cases, and set four types of decoy scenarios based on breeding time, breeding model, diet cleanliness label, and price attributes, to explore the purchasing options of consumers for meat produced with high levels of animal welfare, under different decoy conditions. A decoy effect was observed in a bounded rational consumption situation in relation to the purchasing behaviors of both chicken and pork. In a situation of chicken purchase, the decoy effect of the breeding model was the strongest, followed by that of price, diet cleanliness label, and breeding time. In the case of pork purchase, the decoy effect of the diet cleanliness label was the strongest, followed by price, breeding model, and breeding time. In a comprehensive comparison between the two types of consumption experiments, price decoy constantly played a significant role, while the decoy effect of breeding time was the weakest. Accordingly, we proposed that in addition to strengthening the knowledge of people in the welfare of livestock and poultry, designing a breeding model decoy or price decoy in the process of chicken sales and designing a diet cleanliness label decoy or price decoy in the process of pork sales can guide the demand of consumers for meat produced with high levels of animal welfare. The welfare of livestock and poultry should thus be improved.

Keywords: livestock and poultry meat products, food safety, animal welfare, decoy effect, bounded rationality

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INTRODUCTION

Scientific research has confirmed that among the infectious diseases that threaten human health, more than 200 infectious diseases are zoonoses and can be transmitted from animals to humans (World Health Organization, 2020), and among these zoonotic diseases, more than 130 have been found in China. In this study, live pigs were chosen as an example. The WHO and The Food and Agriculture Organization (FAO) have pointed out that there are six major infections in pigs, namely, swine fever, transmissible gastroenteritis, swine influenza, piglet paratyphoid, piglet colibacillosis, and swine pneumonia. Although swine fever can only infect pigs, anthrax can infect almost all mammals, including humans (Sheng, 2009). In recent years, outbreaks of new infectious diseases worldwide have become more frequent. These new infectious diseases have a common feature, in that they are related to animals to varying degrees and 70% of them are zoonotic (Iannetti et al., 2019). Although the causes of emerging zoonotic diseases are very complex, the disregard of people for animal welfare is a leading reason. A typical case is the influenza A (H1N1) global epidemic, which started in Mexico and the United States in 2009. In that year, the WHO confirmed a total of 29,080 cases of H1N1 in 79 countries and regions; 226 cases were confirmed in mainland China. The virus emerged from a pig farm in Mexico, where sewage flowed and where pigs were close-packed. Poor pig welfare contributed to the tragedy of the global pandemic (Wu, 2020). Thus, food quality and food safety are often linked to the food production methods (Harper and Henson, 1999), and poor animal welfare treatment, such as crowded environment and unclean diet, greatly increases the probability of animal diseases and the risk of their spreading from animals to humans through the food chain (European Food Safety Authority (EFSA), 2019; Iannetti et al., 2019). On the contrary, in the process of animal breeding and slaughtering, giving good animal welfare treatment can reduce the probability of animals suffering from diseases, enhance animal immunity, and improve the quality and safety of the meat (Gavinelli et al., 2007; Hartung et al., 2009; Velarde et al., 2015; Xu et al., 2019).

To suppress zoonotic diseases, reduce food safety issues, and improve the quality of meat products, animal welfare should be effectively protected in the process of livestock and poultry breeding, transportation, and slaughter (Zhao, 2010; Yang and Hong, 2019). However, improving the welfare of livestock and poultry would inevitably have an impact on the production costs and benefits for producers (Gocsik et al., 2016; Vissers et al., 2019). These measure whether to implement the production that takes welfare into account based on the economic feasibility of animal welfare plans and special market needs (Nocella, 2009; Mulder and Zomer, 2017). In China, consumers generally have low awareness of animal welfare, not realizing the internal connection between animal welfare protection and human health, and the market demand for meat produced meeting animal welfare needs is not sufficient to stimulate the welfare-related production behaviors among livestock and poultry producers (Gu, 2017; Ma, 2019). Thus, most livestock and poultry farmers generally ignore animal welfare issues in their pursuit of production efficiency and profit maximization, resulting in frequent outbreaks of quality and safety issues in relation to various meat products (Hartung et al., 2009; Deng and Xiao, 2017). To improve the welfare of livestock and poultry animals in China, it is thus necessary to scientifically formulate the marketing strategies that would expand the market demand for livestock and poultry products with animal welfare attributes taken into consideration based on the consumer preferences to stimulate the welfare production behaviors among livestock and poultry producers.

Using the traditional rational choice theory, scholars have studied the preferences of consumers and their willingness to pay for animal welfare-related attributes in the production of livestock and poultry products, i.e., whether consumers would choose animal welfare-friendly livestock and poultry products with maximum utility under their budget constraints. However, the context effect based on the modern decision-making theory overturns the traditional rational choice theory, indicating that the context has a systemic influence on the preferences and choices of consumers, thus leading to the bounded rationality of the decision-making behaviors of consumers (Bettman et al., 1998; Novemsky et al., 2007; Sun et al., 2017). The decoy effect is a context effect, i.e., after adding new options to a commodity selection set, the probability of an alternative option in the commodity selection set being selected by consumers will increase (Huber et al., 1982; Brenner et al., 1999; Park and Kim, 2005). Heath and Subimal (1995) found that the decoy effect is pervasive in consumer preference. Analyzing the decoy effect can help us understand consumer behaviors more accurately and reduce the deviations in consumer preference in study conclusions (Trueblood et al., 2014; Noguchi and Stewart, 2018). However, few studies have analyzed the decoy effect in the consumption behavior of consumers in relation to livestock and poultry products that had been produced with animal welfare attributes in consideration from the perspective of decision-making under bounded rationality. To better assist companies market livestock and poultry products with animal welfare attributes that were taken into account, this study used yellow-feathered broilers and pork hindquarters as cases and introduced decoy scenarios based on the animal welfare attributes to analyze whether there exists a decoy effect in the consumption behaviors of consumers in relation to livestock and poultry products with animal welfare attributes taken into account and to compare the decoy effect strength of animal welfare attributes of different products.

LITERATURE REVIEW AND HYPOTHESES

The emergence of decoy products highlights the pros and cons of options in a selection set (Brenner et al., 1999), which can help decision-makers reduce cognitive load and simplify decision-making (Nowlis et al., 2010). From the perspective of value transfer, decoy products change the attribute ranking of selected products, making the target products has a comparative advantage (Pettibone and Wedell, 2000). As shown in **Figure 1**, in the core set containing products *A* and *B*, a decoy product D_C with a subjective value similar to product

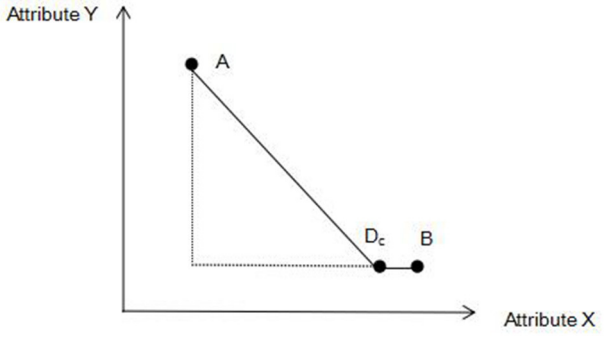

FIGURE 1 | Schematic diagram of the mechanism of decoy effect.

B is set. Compared with product B, if the decoy product D_C has utility benefit on the attribute *Y* but has utility loss on the attribute *X*, consumers may choose product *B* based on simplified decision-making and loss aversion. Thus, when the optimal decoy product is designed, the high-quality performance of the main product can be significantly highlighted (Herweg et al., 2017), and scholars have carried out studies on how the decoy effect affects the purchasing decision of consumers and its strength.

Many factors affect the decoy effect, but Müller et al. (2014) believed that the most basic condition for the occurrence of a positive decoy effect is the ability of a decoy product to trigger consumer trade-offs and comparisons with the target products. Therefore, consumers who rely on intuitive reasoning (Mao and Oppewal, 2012) and who use the intuitive information processing mode (Mourali et al., 2007) are more likely to generate a decoy effect. Hamilton et al. (2007) found that when the number of product attributes is large, the consideration of consumers for all attributes would be difficult, and a few attributes with higher utility would have a stronger decoy effect. Scarpi (2008) focused on analyzing the strength of the attraction effect under the situations of background information, real decoy[1], and phantom decoy[2] and also found that when the decoy situation and the background situation contrasted in guiding consumer behaviors, the decoy effect was more effective, and the attraction effect of the phantom decoy was stronger than that of the real decoy. Frederick et al. (2014) used lottery games and television purchases as examples and found that when the product attributes were represented as graphics, shaded areas, and other perceptions that could be directly experienced, the decoy effect might be reduced, eliminated, or even reversed, while only when the product attributes were represented by numbers, grades, and other similar concepts, the decoy effect was relatively obvious. Zhang and Liu (2017) used fitness packages as an example and found that increasing a fixed fee decoy for deterministic payment and an extra fee decoy for uncertain payment in a package service increases the probability of the target alternative being selected, but the fixed fee decoy for deterministic payment had a stronger attracting effect. Schumpe et al. (2020) found that setting text prompts as a decoy before shopping advertisements can divert the resistance of consumers to shopping advertisements, which is manifested as a greater willingness to purchase. Wu et al. (2020) used traceable pork hindquarters as a study case and found that when consumers made consumption choices in a non-induced situation and then made choices in a situation with inductive information, the decoy effect was relatively stronger, while the direct creation of the decoy situation had a relatively small impact on the purchase selection behaviors of consumers.

Nonetheless, some studies have shown that decoys may fail and even have a resistance effect in the process of the purchases of consumers. For example, when consumers are more knowledgeable about a product, or purchase products based on the experience rather than product descriptions, they are less affected by the decoy situation (Dhar and Glazer, 1996; Putrevu and Lord, 2001; Mourali et al., 2007; Hadar et al., 2018). Costanigro and Lusk (2014) used food labels that indicated ethylene ripening in food as decoys to explore the acceptance of consumers of food labels that indicate the genetic modification. The results showed that prior exposure to such labels did not lead to significant differences in consumer aversion to genetically modified foods. Attwood et al. (2020) used high-priced vegetarian food as a disadvantage decoy to induce consumers to choose a sustainable vegetarian diet. Their findings showed that the addition of the high-priced vegetarian decoy did not significantly change the number of consumers who chose the target vegetarian food and competitive meat. The reason for this may be that the price decoy set in the experiment failed to inspire and induce the utility weighing mechanism of consumers. Similarly, Ohlhausen and Langen (2020) compared the attractiveness of descriptive dish labels with that of decoy options and found that labels can positively affect the sustainable consumption of consumers, while decoy dishes reduce the probability of choosing target dishes. A possible reason for this may be that the decoy attributes failed to make consumers perceive the utility differences between the target and competing dishes. In addition, Rogers et al. (2020) have also attempted to use decoy programs to encourage smokers to participate in a specified number of smoking cessation meetings, but the time decoy failed to guide smokers to increase their choice of target programs. It could be that the decoy strength was too low or that quitters saw "attendance time" not as an opportunity cost but as a benefit. Evidently, successful decoys should be able to influence the relative value judgment of consumers on the attributes of selected products and induce them to choose appropriate target products based on the value judgment mechanism.

In summary, for consumer purchase behaviors, decoy products may trigger a positive decoy effect or cause decoy failure. So far, there have been few studies on consumer behaviors in relation to livestock and poultry products with animal welfare taken into consideration under different decoy scenarios; thus, it is difficult to provide a scientific basis

[1]The realistic and available products set in the decoy experiment.

[2]The products whose attributes are superior to those of the target product but are temporarily unavailable, so, in theory, consumers will shift their desire to target products.

for the marketing of livestock and poultry produced with animal welfare in consideration. Hence, this study took two common meat products, namely, yellow-feathered broilers and pork hindquarters, as examples and designed decoy products according to different attributes (including three attributes related to animal welfare, namely, the breeding time, breeding model, and diet cleanliness label, as well as price attributes). The purpose was to explore whether these four types of attributes have a decoy effect on the purchase behavior of consumers concerning livestock and poultry meat products and to compare the value difference of the decoy effect of the same attribute in different purchase situations of livestock and poultry products. Based on the above considerations, the assumptions were made as follows:

H1a: The attribute of breeding time does not have a positive decoy effect on the chicken purchase of consumers.
H1b: The attribute of breeding time does not have a positive decoy effect on the pork purchase of consumers.
H2a: The attribute of breeding model does not have a positive decoy effect on the chicken purchase of consumers.
H2b: The attribute of breeding model does not have a positive decoy effect on the pork purchase of consumers.
H3a: The attribute of diet cleanliness label does not have a positive decoy effect on the chicken purchase of consumers.
H3b: The attribute of diet cleanliness label does not have a positive decoy effect on the pork purchase of consumers.
H4a: The price attribute does not have a positive decoy effect on the chicken purchase of consumers.
H4b: The price attribute does not have a positive decoy effect on the pork purchase of consumers.

EXPERIMENTAL DESIGN, IMPLEMENTATION, AND SAMPLE CHARACTERISTICS

We applied the following experimental design and launched a specific implementation plan to achieve our experimental goal.

Experimental Design

Setting of Experimental Subjects

Among livestock and poultry products, Chinese consumers generally prefer pork and chicken. According to the US Department of Agriculture (USDA), in 2019, the pork and chicken production in China reached 42.55 million tons and 13.80 million tons, respectively, accounting for 43 and 14% of the total global pork and chicken production, respectively. Therefore, we chose chicken and pork as our experimental products. In addition, to avoid the interference of different meat sources, types, and parts of livestock and poultry on the experimental results, we chose domestic yellow-feathered broilers and domestic pork hindquarters as our specific varieties for our experiment and informed the interviewees before the experiment.

Attribute Setting of Livestock and Poultry Meat Products

Considering that the current welfare problems concerning livestock and poultry in China are mainly concentrated on excessively fast breeding times, high breeding densities, and unclean feeding (Yang et al., 2016; Deng and Xiao, 2017; Zhang et al., 2018), we set breeding time, breeding model, diet cleanliness label, and price as four attributes for yellow-feathered broilers and pork hindquarters, as shown in **Table 1**. According to our preliminary investigation, the growth time of yellow-feathered broilers ranges from 2 to 4 months, and the growth time of live pigs ranges from 6 to 10 months. A very short growth time can easily burden the heart and lungs of livestock and poultry, which is not conducive to animal welfare (Carlsson et al., 2007; Mulder and Zomer, 2017). Therefore, the breeding time levels of yellow-feathered broilers were set as *fast* (2 months) and *slow* (4 months), and those of pork hindquarters were set as *fast* (6 months) and *slow* (10 months). A relaxed environment where animals can eat, drink, and move freely also reduces the risk of depression and lameness (Carlsson et al., 2007; de Graaf et al., 2016; Wolf and Tonsor, 2017). Thus, the breeding model levels of yellow-feathered broilers were set as *cage breeding*[3] and *free-range breeding*[4], and those of pork hindquarters were set as *limited-fence breeding*[5] and *free-range breeding*[6]. To ensure the diet-related health of livestock and poultry, drinking water, and feed should comply with the China GB 5749 and NY/T 5027 standards. Thus, the levels of diet cleanliness label for yellow-feathered broilers and pork hindquarters were set as *with diet cleanliness label* and *without diet cleanliness label*. Referring to the average retail prices in large supermarkets and e-commerce platforms in 2019, the price of ordinary domestic yellow-feathered broilers was about 15 yuan per catty, while their price can reach 30 yuan per catty if they meet a slaughter time of more than 4 months and are raised freely. Thus, the price attribute levels for yellow-feathered broilers in this study were set at 15 yuan/catty, 22.5 yuan/catty, and 30 yuan/catty. In the same period, the retail price of ordinary domestic pork hindquarters was about 22 yuan per catty, while their price can reach 40 yuan per catty if they satisfy the welfare breeding conditions such as slaughter for more than 10 months and moderate free-range breeding. Thus, the price attribute levels for pork hindquarters in this study were set at 22 yuan/catty, 31 yuan/catty, and 40 yuan/catty.

Experimental Design

As shown in **Table 2**, in the chicken consumption experiment, to explore the choice of consumers of high welfare chicken under

[3]This involved the adoption of closed small cages to raise chickens; the size of the cages was about 33 cm (length) × 30 cm (width), and each cage could fit about three chickens. The chickens could not move freely.
[4]This involved the adoption of a free-range, mixed indoor and outdoor breeding mode. About 150 chickens could be raised per 100 square meters. The chickens could go in and out and eat freely.
[5]Live pigs were raised separately; the size of the limit fence was about 2.2 meters (length) × 70 cm (width), which was only slightly larger than the size of the pigs. The pigs could not move freely.
[6]This was adopted to raise ecological white pigs; about five to eight pigs could be raised per 100 square meters. The pigs could eat freely.

TABLE 1 | The setting of the attributes and their corresponding levels.

Attributes	The levels for chicken (yellow-feathered broiler)	The levels for pork (pork hindquarter)
Breeding time	*Fast* (2 months)	*Fast* (6 months)
	Slow (4 months)	*Slow* (10 months)
Breeding model	*Cage breeding*	*Limited-fence breeding*
	Free-range breeding	*Free-range breeding*
Diet cleanliness label	*Without*	*Without*
	With	*With*
Price (yuan/catty)	*15*	*22*
	22.5	*31*
	30	*40*

TABLE 2 | Consumption options of livestock and poultry products.

Types	Options
Yellow-feathered broiler	Fast (2 months), cage breeding, without diet cleanliness label, 15 yuan/catty (a)
	Fast (2 months), cage breeding, with diet cleanliness label, 22.5 yuan/catty (b)
	Slow (4 months), free-range breeding, with diet cleanliness label, 30 yuan/catty (c)
	Fast (2 months), free-range breeding, with diet cleanliness label, 30 yuan/catty (d)
	Slow (4 months), cage breeding, with diet cleanliness label, 30 yuan/catty (e)
	Slow (4 months), free-range breeding, without diet cleanliness label, 30 yuan/catty (f)
	Slow (4 months), free-range breeding, with diet cleanliness label, 33 yuan/catty (g)[o]
Pork hindquarter	Fast (6 months), limited-fence breeding, without diet cleanliness label, 22 yuan/catty (h)
	Fast (6 months), limited-fence breeding, with diet cleanliness label, 31 yuan/catty (i)
	Slow (10 months), free-range breeding, with diet cleanliness label, 40 yuan/catty (j)
	Fast (6 months), free-range breeding, with diet cleanliness label, 40 yuan/catty (k)
	Slow (10 months), limited-fence breeding, with diet cleanliness label, 40 yuan/catty (l)
	Slow (10 months), free-range breeding, without diet cleanliness label, 40 yuan/catty (m)
	Slow (10 months), free-range breeding, with diet cleanliness label, 44 yuan/catty (n)[p]

To compare the decoy effect of the price attributes of the two types of livestock and poultry products, the price decoy was set to be 10% higher than the price of the target product; thus, o: 30 × (1 + 10%) = 33; p: 40 × (1 + 10%) = 44.

decoy conditions or not, we referred to the study by Wu et al. (2020) and set three welfare levels for yellow-feathered broilers as low, medium, and high, respectively, represented by *a*, *b*, and *c*, which constitute the core set $U\{a,b,c\}$, in which option *c* is the target product[7], and options *a* and *b* are competitive products[8]. Four types of decoy options were separately set up based on the attributes of breeding time, breeding model, diet cleanliness label, and price, which are represented by *d*, *e*, *f*, and *g* and form the extension set $U_1\{a,b,c,d\}$, $U_2\{a,b,c,e\}$, $U_3\{a,b,c,f\}$, and $U_4\{a,b,c,g\}$. Among these, chicken *c* is superior to chickens *d*, *e, f*, and *g* in terms of breeding time, breeding model, diet cleanliness label, and price, respectively. In the same way, in the pork hindquarter consumption experiment, we set three welfare levels for pork hindquarters as low, medium, and high, represented by *h*, *i*, and *j*, which constitute the core set $V\{h,i,j\}$, in which option *j* is the target product, and options *h* and *i* are competitive products. We set up four types of decoy options based on the attributes of breeding time, breeding model, diet cleanliness label, and price, which are separately represented by *k*, *l*, *m*, and *n* and form the extension sets $V_1\{h,i,j,k\}$, $V_2\{h,i,j,l\}$, $V_3\{h,i,j,m\}$, and $V_4\{h,i,j,n\}$. Among these, pork *j* is superior to pork *k*, *l*, *m*, and *n* in terms of breeding time, breeding model, diet cleanliness label, and price, respectively (**Table 2**).

In the yellow-feathered broiler consumption experiment, observing the purchase share of consumers for *c* in the core set *U* and the four extension sets, compared with the purchase share of *c* in the core set, if the relative purchase share of target product *c* to competing products *a* and *b* does not increase in the extension set, which includes a certain decoy based on the corresponding attribute, then the decoy product set based on this attribute does not have a positive decoy effect on consumer purchase behavior; the hypotheses H1a to H4a are then tested accordingly. In the same way, in the pork hindquarter consumption experiment, observing the purchase shares of consumers for *j* in the core set *V* and the four expansion sets, compared with the purchase share of *j* in the core set, if the relative purchase share of target product *j* to competing products *h* and *i* does not increase in the extension set, which includes a certain decoy based on the corresponding attribute, then the decoy products set based on this attribute do not have a positive decoy effect on consumer purchase behavior, and the hypotheses H1b to H4b are tested accordingly. On this basis, the decoy effect strength of the same attribute in the purchase process of different livestock and poultry meat products is compared.

[7]For products that we hoped consumers would buy, the attributes of this product were used as reference points in the study to set decoy products.

[8]The remaining products in the core set except for the target product.

Organizational Implementation and Sample Characteristics

Experimental Organization and Questionnaire Survey

The experimental and questionnaire investigation was conducted in Wuxi, Jiangsu Province, China. According to the data from the National Bureau of Statistics in 2019, Wuxi, a city with an area of 4,627.46 square kilometers and a permanent resident population of 6.59 million, is one of the most densely populated cities in the Yangtze River Delta region (>1,400 permanent residents/square kilometers). The per capita gross domestic product of Wuxi ranks second among Chinese cities, its overall level of economic and social development is in the lead, and both the awareness of food safety consumption of the residents and the demand for food safety information are relatively strong. In addition,

Wuxi has one of the largest meat distribution centers (Tianpeng Food City) in East China; hence, it is also a key city for food marketing and food safety supervision. Wuxi thus provides a good foundation to carry out studies such as the present study. To ensure the representativeness of the experimental sample, trained postgraduate students from a local university acted as investigators and randomly recruited participants in large supermarkets and butcher markets from all five administrative areas of urban Wuxi. During recruitment, every third consumer participated as experiment participants (Wu et al., 2012). For the sake of simplicity, an equal number of adults (162 in total) aged between 18 and 65 years were recruited from each administrative area: 81 participants for the chicken consumption experiment and 81 participants for the pork consumption experiment. The experiments were completed in five batches from June 1 to June 20, 2020. In addition to the consumption experiment part of the questionnaire, the participants also need to answer questions such as individual characteristics in the questionnaire. Finally, a total of 810 questionnaires were obtained: 405 for the yellow-feathered broiler experiment and the pork hindquarter experiment, respectively. To improve their enthusiasm to participate, each participant who completed the experiment was given a small gift as compensation for their time.

Sample Characteristics

The sample characteristics are shown in **Table 3**. The proportion of women in the sample was 55.3%, which is consistent with the fact that women are more likely to buy food in Chinese families. Of the participants, 77.8% aged below 40 years, 66.2% had a college- or university-level education, and 62% were urban residents. The monthly personal income of them was mainly concentrated in the two levels of 3,000–6,000 yuans and 6,000–8,000 yuans, accounting for 27.5 and 37.2% of the total consumers, respectively. Among the 810 respondents, only 2.6 and 0.3% of them had a "high" or "very high" knowledge of animal welfare, and the knowledge of most respondents of animal welfare was "low" or "very low," indicating that the understanding of animal welfare among Chinese consumers is inadequate.

ANALYSIS FRAMEWORK, RESULTS, AND DISCUSSION

Analysis Framework

For the yellow-feathered broiler consumption experiment, based on the calculation method of Mourali et al. (2007), we set $P(c; U)$ as the absolute purchase share of target product c in the core set, while $P(a; U_1)$, $P(b; U_1)$, $P(c; U_1)$, and $P(d; U_1)$ refers to the absolute purchase share of competitive products a and b, target product c, and decoy product d in the extension set $U_1\{a, b, c, d\}$, respectively. $P_d(c; a, b)$ refers to the relative purchase share of competing products a and b in the expansion set $U_1\{a, b, c, d\}$ after adding the decoy product d.

$$P_d(c; a, b) = \frac{P(c; U_1)}{P(a; U_1) + P(b; U_1) + P(c; U_1)} = \frac{P(c; U_1)}{1 - P(d; U_1)} \quad (1)$$

The value of the decoy effect is represented by ΔP as follows:

$$\Delta P = P_d(c; a, b) - P(c; U) \quad (2)$$

When $\Delta P > 0$, a positive decoy effect occurs; when $\Delta P < 0$, a negative decoy effect occurs. The formula for the strength coefficient of the decoy effect is as follows:

$$K = \frac{P_d(c; a, b)}{P(c; U)} \quad (3)$$

The greater the K value, the greater the strength of the decoy effect.

Results of the Chicken Experiment With Different Welfare Levels

As shown in **Tables 4**, **5**, in the yellow-feathered broiler core set $U\{a, b, c\}$, the absolute shares of consumers that chose yellow-feathered broilers a, b, and c were 10.1, 37.8, and 52.1%, respectively, among which c refers to the target product; thus, $P(c; U) = 52.1\%$. In the expansion set $U_1\{a, b, c, d\}$, after adding the breeding time decoy d, the absolute share of consumers that chose yellow-feathered broiler c was 59.8%. According to formulas (1)–(3), the relative purchase share $P_d(c; a, b) = 62.2\%$, $P(c; U) < P_d(c; a, b)$, the ΔP value of the decoy effect of the breeding time attribute was 10.1%, and the strength K was 1.19. Therefore, hypothesis H1a is rejected, and the attribute of breeding time has a positive decoy effect on the chicken purchase of consumers. In the expansion set $U_2\{a, b, c, e\}$, after adding the breeding method decoy e, the absolute share of consumers that chose yellow-feathered broiler c was 62.5%, $P_e(c; a, b) = 65.6\%$, $P(c; U) < P_d(c; a, b)$, the ΔP value of the decoy effect of the breeding time attribute was 13.5%, and the strength K was 1.26. Therefore, hypothesis H2a is rejected, and the attribute of the breeding model has a positive decoy effect on the chicken purchase of consumers.

Similarly, in the extension set $U_3\{a, b, c, f\}$ with the diet cleanliness label decoy f and the extension set $U_4\{a, b, c, g\}$ added with the price decoy g, the absolute shares of consumers that chose yellow-feathered broiler c were 59.5 and 62.0%, $P_f(c; a, b) = 62.4\%$, $P_g(c; a, b) = 65.2\%$; $P(c; U) < P_f(c; a, b)$, $P(c; U) < P_g(c; a, b)$, the ΔP values of the decoy effect of the breeding time attribute were 10.3 and 13.1%, and the strength K were 1.20 and 1.25, respectively. Therefore, hypotheses H3a and H4a are rejected: diet cleanliness label and price have a positive decoy effect on the chicken purchase behavior of consumers.

It can thus be noted that in the yellow-feathered broiler consumption experiment, all the four attributes we investigated could trigger a decoy effect, with the order of strength as follows: breeding model > price > diet cleanliness label > breeding time. A possible reason is that the traditional way of raising chickens in China is pasture-rearing, and Chinese consumers are more satisfied with the nutritional value and taste of free-range chickens (Zhu et al., 2019); thus, the decoy of the breeding model had the strongest effect. The decoy effect of the price attribute was also relatively strong. Whether

TABLE 3 | Demographic characteristics of respondents.

Statistical indicator	Category	Yellow-feathered broiler	Pork hindquarter	Total	
		Frequency	Frequency	Frequency	Effective percentage (%)
Gender	Male	187	175	362	44.7
	Female	218	230	448	55.3
Age (year)	18–30	191	213	404	49.9
	31–40	116	110	226	27.9
	41–50	79	69	148	18.3
	51–65	19	13	32	3.9
Level of education	Primary school and below	10	8	18	2.2
	Junior high school	40	37	77	9.5
	Senior high school (including technical secondary school)	66	67	133	16.4
	College	89	105	194	24.0
	University	173	169	342	42.2
	Postgraduate and above	27	19	46	5.7
Address	Urban	259	243	502	62.0
	Rural	146	162	308	38.0
Personal monthly income	≤3,000 yuan	54	45	99	12.2
	3,001–6,000 yuan	114	109	223	27.5
	6,001–8,000 yuan	154	147	301	37.2
	8,001–12,000 yuan	58	79	137	16.9
	>12,000 yuan	25	25	50	6.2
Knowledge of animal welfare	Very low	98	108	206	25.4
	Low	193	229	422	52.1
	Medium	101	58	159	19.6
	High	12	9	21	2.6
	Very high	1	1	2	0.3

the decoy strength of the effective attribute or price of the products is prominent depends on the value comparison of each attribute and target attribute in the consumer choice set (Herweg et al., 2017), which shows that consumers are of great concern to the price of high-welfare meat products. For Chinese consumers, compared with the free-range raising model, the cleanliness of the diet has a lower impact on the taste of broilers and the level of animal welfare. Therefore, the decoy effect of the cleanliness label attribute was not high, ranking third. The decoy effect of the breeding time attribute was the weakest, possibly because there have been few reports of chicken safety incidents related to broiler breeding time; hence, the attribute may have not yet been attracted the attention of consumers.

Results of Pork Hindquarter Experiment With Different Welfare Levels

As shown in **Tables 6**, **7**, in the core set $V\{h,i,j\}$, the absolute shares of consumers that chose pork hindquarters h, i, and j were 10.6, 31.9, and 57.5%, respectively, where j is the target product, so $P(j;V)$ was 57.5%. In the expansion set $V_1\{h,i,j,k\}$, after adding the breeding time decoy k, the absolute share of consumers that chose pork hindquarter j was 64.0%. Thus, the relative purchase share $P_k(j;h,i)$ was 67.5%, $P(j;V) < P_k(j;h,i)$, the ΔP value of the decoy effect of the breeding time attribute was 10.0%, and the strength K was 1.17. Therefore, hypothesis H1b is rejected, and the attribute of breeding time has a positive decoy effect on the pork purchase of consumers. In the expansion set $V_2\{h,i,j,l\}$, after adding the breeding time decoy l, the absolute share of consumers that chose pork hindquarter j was 64.9%, $P_l(j;h,i) = 68.0\%$, $P(j;V) < P_l(j;h,i)$, the ΔP value of the decoy effect was 10.5%, and the strength K was 1.18. Therefore, hypothesis H2b is rejected, and the attribute of the breeding model has a positive decoy effect on the pork purchase of consumers.

Similarly, in the extension set $V_3\{h,i,j,m\}$ with the diet cleanliness label decoy m and the extension set $V_3\{h,i,j,n\}$ with the price decoy n, the absolute shares of consumers

TABLE 4 | The absolute purchase share in the yellow-feathered broilers experiment.

Product options	Core set U	Extension set			
		U_1	U_2	U_3	U_4
a	41 (10.1%)	24 (5.9%)	22 (5.4%)	21 (5.2%)	25 (6.2%)
b	153 (37.8%)	123 (30.4%)	111 (27.4%)	124 (30.6%)	109 (26.9%)
c	211 (52.1%)	242 (59.8%)	253 (62.5%)	241 (59.5%)	251 (62.0%)
d	–	16 (3.9%)	–	–	–
e	–	–	19 (4.7%)	–	–
f	–	–	–	19 (4.7%)	–
g	–	–	–	–	20 (4.9%)

TABLE 5 | ΔP and K of decoy effect in the yellow-feathered broilers experiment.

Variables	Extension set			
	U1	U2	U3	U4
ΔP	10.1%*	13.5%*	10.3%*	13.1%*
($\chi^2(3)$)	(25.83)	(35.21)	(30.48)	(34.73)
K	1.19	1.26	1.20	1.25

*Significant at 1% significance level.

TABLE 6 | The absolute purchase share in the pork hindquarter experiment.

Product options	Core set V	Extension set			
		V_1	V_2	V_3	V_4
a	43 (10.6%)	39 (9.6%)	39 (9.6%)	33 (8.1%)	32 (7.9%)
b	129 (31.9%)	86 (21.2%)	85 (21.0%)	79 (19.5%)	81 (20.0%)
c	233 (57.5%)	259 (64.0%)	263 (64.9%)	277 (68.4%)	273 (67.4%)
d	–	21 (5.2%)	–	–	–
e	–	–	18 (4.5%)	–	–
f	–	–	–	16 (4.0%)	–
g	–	–	–	–	19 (4.7%)

TABLE 7 | ΔP and K of decoy effect in the pork hindquarter experiment.

Variables	Extension set			
	V1	V2	V3	V4
ΔP	10.0%*	10.5%*	13.7%*	13.2%*
($\chi^2(3)$)	(31.17)	(29.06)	(33.13)	(34.75)
K	1.17	1.18	1.24	1.23

*Significant at 1% significance level.

that chose pork hind leg j were 68.4 and 67.4%, respectively. $P_m(j; h, i) = 71.3\%$, $P_n(j; h, i) = 70.7\%$, $P(j; V) < P_m(j; h, i)$, $P(j; V) < P_n(j; h, i)$, the ΔP values of the decoy effect were 13.8 and 13.2%, and the strengths were 1.24 and 1.23, respectively. Therefore, hypotheses H3b and H4b are rejected: the diet cleanliness label and price have a positive decoy effect on the pork purchase of consumers.

It can be noted that in the pork hindquarter consumption experiment, all four attributes had a decoy effect, and the order of strength was as follows: diet cleanliness label > price > breeding model > breeding time. In the traditional livestock and poultry breeding models of China, pigs are generally raised in captivity. Thus, the strength of the decoy effect of the breeding model of pigs did not rank first but ranked third. The outbreak of African swine fever in recent years has caused Chinese consumers to panic about the safety of meat. Swill feeding can spread mycotoxins in pigs. It is one of the inducements for African swine fever, and Chinese consumers find it disgusting. Hence, the attribute of diet cleanliness labels could trigger a stronger decoy effect. This point is similar to the conclusion that Liu and Chen (2019) made in their study on the decoy effect in traceable pork hindquarters, i.e., the attribute that reflects the quality and safety information of pork has a stronger decoy effect. The decoy strength of price ranked second in the results of the yellow-feathered broiler consumption experiment, indicating that the impact of price on consumer buying behavior is always relatively important. This shows that in the promotion of animal welfare meat products, the price factor constantly plays an important role. Compared with the decoy effects of other attributes, the decoy effect of breeding time ranked last. A possible reason is that compared with the clean diet and breeding model, the attribute of breeding time has a relatively small impact on the welfare of pigs and pork quality or safety, thus reducing the intensity of the decoy.

Comparison and Discussion of the Results of the Two Types of Livestock and Poultry Product Consumption Experiments

As illustrated in **Figure 2**, it can be noted that there are differences in the value of the decoy effect of different attributes in the two experiments. The ΔP value of the price decoy ranked second, i.e., 13.1 and 13.2% for the chicken and pork experiments, respectively; that is, in the process of guiding consumers to purchase livestock and poultry meat products with the high-level animal welfare, it is effective to set decoy products based on the price attributes. The effect of the breeding time decoy was relatively lower and ranked at the bottom, i.e., 10.1 and 10.0% for the chicken and pork experiments, respectively. The premise of the existence of the decoy effect is that the properties can trigger the trade-off of target products of consumers. Thus, consumers pay less attention to the growth time of livestock and poultry in their purchase decisions of livestock and poultry produced with

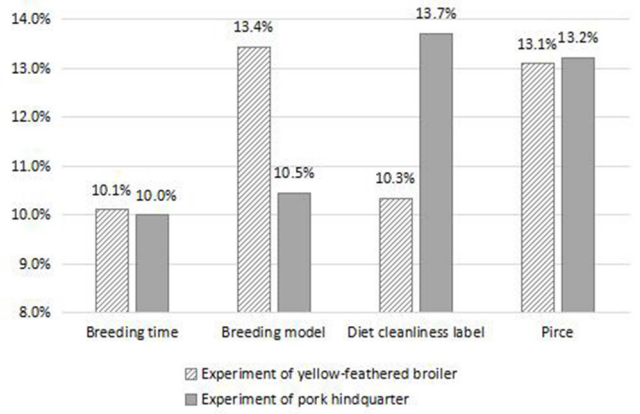

FIGURE 2 | ΔP of decoy under different attributes in the two experiments.

animal welfare in consideration. The difference is that first, in the yellow-feathered broiler consumption experiment, the decoy effect of the breeding model was the largest, reaching 13.4%, while in the pork hindquarter consumption experiment, the decoy effect of the breeding model was not high, only 10.5%. It may be that in Chinese traditional livestock and poultry farming models, chickens are mostly raised freely, and pigs are mostly raised in captivity; hence, the value of the decoy effect of the broiler breeding model is significantly higher than that of live pigs. Second, in the yellow-feathered broiler consumption experiment, the value of the decoy effect of the diet cleanliness label was only 10.3%, while that in the pork hindquarter consumption experiment reached up to 13.7%. This may be that due to the frequent exposure of negative news regarding "swill pigs" and "clenbuterol pigs" and the negative impact of African swine fever, consumers are more concerned about the cleanliness of the diet of pigs.

CONCLUSION AND IMPLICATIONS

This study took yellow-feathered broilers and pig hindquarters, i.e., the two common meat products, as specific experimental products, and set three attributes connected with animal welfare (i.e., breeding time, breeding model, and diet cleanliness label) and price attributes to discuss whether each attribute has a decoy effect in the purchase behaviors of livestock and poultry products of the consumers, and compared the difference between the decoy effects of the same attribute in different products. The main conclusions are as follows: In the yellow-feathered broiler and pig hindquarter consumption experiments, setting decoy products based on the four types of attributes can all trigger positive decoy effects on the purchasing decisions of consumers. In the chicken consumption experiment, the order of effectiveness of the four types of attribute decoy was as follows: breeding model > price > diet cleanliness label > breeding time. In the pork consumption experiment, the order of effectiveness of the four types of attribute decoy was as follows: diet cleanliness label > price > breeding model > breeding time. It can be noted that in the chicken purchase decisions, the attributes that reflect cultural traditions and habits of raising broilers were more likely to trigger consumer comparison and trade-offs of decoy chicken and target chicken, while in pork purchase decisions, attributes connected to pork quality and safety were more likely to trigger consumer comparisons and trade-offs between decoy pork and target pork. Correspondingly, the breeding model of broilers and the diet cleanliness of live pigs had the highest decoy effects on consumption behaviors in relation to yellow-feathered broilers and pig hindquarters, respectively.

Accordingly, we put forward the following suggestions for government departments and related enterprises: (1) In promoting animal welfare-friendly livestock and poultry products, government departments should strengthen the promotion of the concept and levels of livestock and poultry welfare and the relationship of animal welfare to promote meat quality and safety, so that consumers can better understand the connotation and function of animal welfare attributes, such as breeding time, breeding model, and clean diet, and guide consumers not only to judge based on the price attributes when purchasing livestock and poultry meat but also to make choices based on the attribute level of animal welfare. (2) When promoting broiler products and pork products with animal welfare attributes, sellers can combine the finesse of decoy strategies to design a reasonable marketing plan for the livestock and poultry meat market. For example, appropriately setting up the chicken products with inferior breeding model attributes or inferior price attributes, and pork products with inferior diet cleanliness label attributes or price attributes, and utilizing the sensitivity of consumers to target attributes and the deviation of information processing mechanisms to guide the purchase choices of consumers for high-welfare meat products and encourage producers to improve the welfare of livestock and poultry.

The study also has certain limitations. First, the expansion set in this experiment contained four types of products, compared with the expansion sets containing three types of products in the studies of Sellers-Rubio and Nicolau-Gonzalbez (2015), Liu and Chen (2019), and Rogers et al. (2020), which may limit the identification of consumers of dominant products and limit the strength of the decoy effect. In addition, the method of comparative choice experiment adopted in this study is a hypothetical experiment without real monetary delivery behavior, and the stated preference of consumers for products may deviate from the actual consumption choice. Finally, our study was based on a representative city in China. The validity and applicability of our findings can be verified against a larger variety of geographical and cultural settings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethics committee of Jiangnan University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LX proposed the research direction, designed the structure of the study, and wrote the manuscript. MY designed the questionnaire and analyzed the data. XC revised the manuscript. All authors contributed to the article and approved the submitted version.

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