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## Article

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# Blockchain-based food traceability system and pro-environmental consumption: A moderated mediation model of technology anxiety and trust in organic food product

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## ABSTRACT

Blockchain technology is increasingly recognized as a transformative tool for enhancing clarity and responsibility in the organic food supply chain, where concerns about product authenticity and safety are paramount. By offering provable and translucent information about the origination, production processes, and administration of organic items, blockchain helps to reduce information asymmetry and builds consumer trust, which is critical for purchase decisions in the organic food market. Drawing on insights from the trust theory and the stimulus-organism-response framework, this study uses a moderated mediation model to explore how technology anxiety negatively moderates the direct and indirect influences of blockchain-based food traceability systems on trust in organic food products and organic food purchase intention. Using a targeted sample of 5326 consumers in Vietnam, the PROCESS macro approach (models 8 and 4) is utilized to examine the formulated hypotheses. The results demonstrate that blockchain-based food traceability systems notably enhance consumer trust in organic food products and their intention to buy these products. Trust in organic food products serves as a mediator in the connection between blockchain-based traceability and purchase intention, while technology anxiety weakens the positive impacts of blockchain technology on trust and purchase intention when anxiety levels are high. This research makes crucial contributions to the literature by offering a mechanism-based explanation of how blockchain technology enhances consumer trust in organic food products and integrates technological anxiety as a moderator, providing a deeper understanding of how technological innovations shape consumer behavior. In light of the findings, several critical recommendations have been proposed for practitioners and policymakers.

## 1. Introduction

The protection and standards of food products have become major concerns on a worldwide scale (Yeke & Litoriya, 2024). It is estimated that every year, around 420,000 individuals lose their lives from ingesting tainted food, and an additional 600 million people suffer from foodborne illnesses (Treiblmaier & Garaus, 2023). Widely publicized food safety incidents, such as the contaminated milk scandal in China (Jia et al., 2012), the outbreak of mad cow disease in Britain (Berg, 2004), the E.coli-infected cucumbers in Germany, and the bacteria-tainted peanut butter in the USA (Garaus & Treiblmaier, 2021) have significantly heightened public interest in food traceability (Treiblmaier & Garaus, 2023). This concept is defined as the ability to monitor and track any food, feed, food-producing animal, or substance intended for

consumption through all stages of production, processing, and distribution (Karlsen et al., 2013), has become crucial in ensuring food safety and restoring consumer confidence in the food supply chain. To address food safety challenges, the WHO recommends that policymakers, manufacturers/farmers, and consumers collaborate to share relevant information across food value networks (Treiblmaier & Garaus, 2023). Profit-oriented companies are encouraged to implement food traceability systems, which can enhance food safety and profitability (Gallo et al., 2021). Providing consumers with information about product origins and transportation reduces information asymmetries, mitigates health risks, and better assesses product quality (Garaus & Treiblmaier, 2021).

Blockchain technology has garnered widespread attention due to its transformative potential in enhancing transparency, security, and efficiency across various industries, particularly with the development of

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innovative applications such as cryptocurrencies and smart contracts (Cozzio et al., 2023; Treiblmaier & Garaus, 2023). This surge in interest highlights blockchain's transformative potential in various sectors (Yele & Litoriya, 2024). Blockchain technology is characterized as a decentralized, shared record that can log exchanges between two entities in an efficient, reliable, and enduring manner (Singh & Kumar, 2024; Treiblmaier & Petrozhitskaya, 2023). This innovative technology is being touted as a conceivable resolution for improving food traceability and optimizing the food supply chain. Blockchain is often seen as a “trust machine” when it might serve as a “trustless” proof-related-mechanism, verifying whole deals on the system without the need for intermediaries (Li et al., 2023). Cryptographic ledger technology offers all stakeholders involved in the organic produce distribution network, including buyers, access to reliable traceability information, with dependable information on the manufacture, processing, and distributing food products (Tao & Chao, 2024). The transparency reduces the likelihood of fraud, establishing blockchain as a trust-building technology (Li et al., 2023) and thus fostering consumers' organic food consumption (Boller et al., 2024).

Currently, scholars have more frequently emphasized the essence of blockchain technology in facilitating comprehensive tracking throughout distribution networks (Li et al., 2023; Tao & Chao, 2024; Yap et al., 2023). Nevertheless, most studies have centered on the organizational perspective, such as the views of developers or companies involved in the supply chains (Shahzad et al., 2024; Zarbà et al., 2024). They have neglected mainly the consumer perspective, specifically how blockchain influences consumers' inclination to pay and their buying decisions (Li et al., 2023) while understanding this aspect is essential, as it dramatically affects the demand for and the success of blockchain-based systems (Duong, Vu, et al., 2024). Li et al. (2023) argue that many firms frequently do not adequately comprehend the significance of transparency revelation from the consumers' viewpoint. Consequently, gaining a thorough, empirically supported understanding of how blockchain generates and delivers value to consumers will enable enterprises/firms to decide whether they should invest in blockchain technology or not.

Moreover, technology anxiety (TA), defined as apprehension toward new technologies (Maduku et al., 2023), can significantly undermine consumer trust in blockchain systems (Alshurafat et al., 2023) and impede their purchasing decisions (Faqih, 2022). Understanding the moderating effects of TA is crucial to identifying barriers to consumers' blockchain technology adoption and purchase decisions and developing strategies to mitigate these negative effects, ensuring the effective implementation and widespread adoption of blockchain technology in the food industry. To address the aforementioned research gaps, our study adopts insights from the trust theory (McAllister, 1995) and the stimulus-organism-response (SOR) theory (Mehrabian & Russell, 1974) to draw on a moderated mediation model to investigate how TA and trust in organic food products (TIP) can moderate and mediate the relationship between blockchain-based food traceability system (BFT) and organic food purchase intention (IOF). Specifically, our study aims to address the following research questions (RQs):

RQ1. How can the integrated model of the trust theory and the SOR theory be effective and capable of explaining the role of BFT in shaping consumers' TIP and IOF?

RQ2. How does blockchain-based stimulus (BFT) increase consumers' cognitive organisms (TIP), which in turn develop their behavioral responses (IOF)?

RQ3. How does TA weaken the linkage between BFT and TIP, as well as between BFT and IOF, by potentially reducing the perceived value of transparency?

RQ4. To what extent does TA influence the mediating role of TIP in the relationship between BFT and IOF, and how does this moderation affect consumers' purchase intention?

This study uses a targeted sample of 5326 Vietnamese participants and employs the PROCESS macro (models 4 and 8) to test our proposed

moderated mediation model. From a theoretical perspective, our research contributes to the growing body of literature on the trust theory by demonstrating how BFT enhances consumer trust and influences purchase behavior in high-risk environments, such as the organic food sector. It further extends the integrated framework of the trust theory and SOR theory by incorporating TA as a key moderating variable, offering new insights into how psychological factors can shape the adoption of technological innovations. Managerially, our findings offer actionable insights for enterprises and policymakers. The study highlights the importance of blockchain technology as a tool for building consumer trust and suggests strategies for businesses to mitigate technology anxiety through education and user-friendly blockchain interfaces. Policymakers can also use these insights to encourage the broader adoption of blockchain for food traceability, ensuring better transparency and consumer confidence in the organic food supply chain.

## 2. Theoretical background and hypotheses development

### 2.1. Trust theory and trust in the organic food supply chain

Trust is a multifaceted concept that intertwines psychological, economic, and sociological dimensions, making it difficult to define or measure precisely (Meira et al., 2024). The various ways trust is defined—such as a readiness to rely, a presumption, or an outlook—have been suggested to create complexity, misalignment, and difficulties in dialogue among scholars (Isaeva et al., 2020). In this scenario, the customer (acting as the trustor) maintains a strong belief and positive anticipation that the service provider, whether the company itself or its representatives (as the trustee), will uphold their part of the exchange agreement (Sirdeshmukh et al., 2002; Tan & Saraniemi, 2022). By relying on the trustee's actions, the trustor places themselves at risk, consciously setting aside doubts, although the level of associated risk can vary significantly across different service industries (Isaeva et al., 2020). Mayer et al. (1995) described trust as a party's willingness to be vulnerable to the actions of another, based on the anticipation that the other will meet a convinced obligation that is necessary to the trustor, even in the absence of monitoring or control. Trust in food is developed through the ongoing relationships and exchanges among the diverse entities and institutions involved in the creation, supply, regulation, and consumption of food (Taufik et al., 2023; Xu et al., 2024).

According to the trust theory (McAllister, 1995), trust is demonstrated when one party shows confidence in the dependability and honesty of another party. Process-based personal trust underscores the importance of collecting detailed, partner-specific information to enhance interpersonal trust (Busch et al., 2024; Liu & Tao, 2022). As a result, this type of trust does not emerge immediately but builds progressively over time through multiple interactions, where consumers actively seek information to judge the reliability of companies (Li et al., 2023). When purchasing organic food, consumers' trust largely relies on their belief in the product's authenticity and effectiveness (Arslan & Alibaş, 2024). Nevertheless, most consumers lack the skills, resources, or technical knowledge to confirm the organic status of these products independently (Duong, Vu, et al., 2024). In response to various food industry scandals, advancements in production technologies, and the growing issue of obesity in numerous developed countries, consumers are becoming more concerned with knowing the source and ingredients of the products they buy (Ladwein & Sánchez Romero, 2021). Consequently, trust becomes especially crucial in the purchasing process, particularly for organic foods, where typical consumers cannot independently confirm the authenticity of the products.

In the organic food consumption context, consumer trust is primarily founded on the belief in the products' genuineness and their functional benefits (Contini et al., 2023). The organic label or certification is exclusively given to products created to uphold environmental sustainability, protect biodiversity, and ensure animal welfare (Ladwein & Sánchez Romero, 2021). Furthermore, while most products focus on

providing practical benefits, organic foods appeal to consumers' desire for health preservation and well-being (Duong, Vu, et al., 2024). Indeed, consumers believe that the health benefits of organic foods stem from their perceived naturalness, meaning they are free from harmful substances, pesticides, or components that could negatively impact health (Arslan & Alibaş, 2024; Boccia & Tohidi, 2024). Research has demonstrated that consumer trust positively influences the purchase of organic foods across different categories (Anisimova & Vrontis, 2024). The adoption of food traceability technologies has been increasingly implemented to enhance consumer confidence in food integrity further (Duong, Vu, et al., 2024; Garaus & Treiblmaier, 2021).

The literature on organic food has explored various factors contributing to consumer trust, particularly emphasizing the roles of trust in producers and the broader food chain. For instance, Meira et al. (2024) found that trust in organic products is shaped by both trust in the organization responsible for producing the goods and trust in the food chain's integrity. Similarly, Duong, Vu, et al. (2024) emphasized that trust in both organic food producers and sellers dramatically enhances consumer trust in organic food items, suggesting that multiple actors within the supply chain must maintain credibility to inspire consumer confidence. These findings underscore the pivotal role of trust within the supply chain, where consumers rely on relationships with producers, retailers, and certifying bodies to ensure the authenticity of organic labels. However, while these studies have examined trust dynamics within organic food markets, the role of blockchain technology in reinforcing consumer trust is a relatively recent area of inquiry. Studies like Duong, Vu, et al. (2024), Duong, Dao, et al. (2024), Li et al. (2023), Lin et al. (2021), and van Hilten et al. (2020) have explored blockchain's role in improving traceability and transparency in the organic food supply chain. These studies highlight how blockchain can either reinforce system trust (e.g., trust in certification bodies) or moderate the relationship between producer trust and consumer purchase intentions. However, our study takes a more comprehensive approach by examining how BFT reinforces consumers' IOF underlying a moderated mediation mechanism of TIP and TA. Especially our study also emphasizes the adverse effects of technology-related anxiety on these relationships between BFT, TIP, and IOF, which prior studies have overlooked.

Blockchain technology offers a unique and complementary layer of verification that builds upon traditional trust mechanisms. While previous studies have explored the reinforcing or weakening role of blockchain in specific types of trust, such as personal trust in producers or system trust in government bodies (Duong, Vu, et al., 2024; Li et al., 2023), our study extends this by examining how blockchain provides a more unified form of assurance that strengthens consumer perceptions of organic authenticity across the supply chain. This technology enables consumers to verify claims about organic practices, such as whether crops were grown without synthetic pesticides or whether animals were raised without antibiotics, ensuring that products labeled as organic genuinely adhere to the required standards. Furthermore, blockchain's decentralized and immutable nature ensures that no single entity can alter the dataset, diminishing the potential for fraud and enhancing consumer confidence (Akram et al., 2024; Sharma et al., 2023). While earlier studies have focused on the trust relationships between producers, retailers, and consumers, our framework extends these insights by demonstrating how blockchain technology can supplement these existing trust frameworks, offering an additional layer of technological verification.

## 2.2. Stimulus-organism-response framework

The SOR framework, proposed by Mehrabian and Russell (1974), has demonstrated its efficacy in explaining behavioral differences resulting from various marketing stimuli and cognitive processes (Dalvi-Esfahani et al., 2023; Duong, 2024). Its primary advantage lies in its flexibility, allowing researchers to explore a wide array of tangible and intangible, internal and external stimuli, as well as various experiential and non-

experiential organisms and response factors (Haq et al., 2024). The existing literature posits that the S-O-R model indicates an individual's cognitive organism (i.e., trust) is triggered by exposure to an outer stimulus. In this context, the stimulus (S) (i.e., blockchain technology adoption), represents the external factor that precipitates a change in the individual's internal state (Hsiao & Tang, 2021). The organism (O) encompasses an individual's internal experiences related to affective cognition, including both cognitive and emotional states, which refer to the mental processes involved in information processing (Pham et al., 2024). The response (R) denotes the resultant behavior, reflecting the individuals' ultimate actions prompted by a specific stimulus. Thus, the cognitive organism is essential in shaping these behavioral responses (Hsiao & Tang, 2021). The SOR framework highlights the crucial role of individual internal processing in reaction to external environmental stimuli (Mala Kalaiarasan et al., 2024). Previous studies within the information systems domain employed this framework to elucidate how information technology's attributes influence users' internal states and subsequent behaviors (Dalvi-Esfahani et al., 2023; Kumalasari & Priharsari, 2023). In this study, we integrate the trust theory within the SOR frame to draw a moderated mediation model, which investigates how TIP and TA mediate and moderate the relationship between BFT and IOF. The conceptual framework is summarized in Fig. 1.

The integration of trust theory within the SOR framework is highly appropriate for our study for several key reasons. First, the SOR model provides a strong foundation for exploring the linkage between external technology-related stimuli and consumer behaviors. In the context of BFT, blockchain technology serves as the external stimulus (S) (Garaus & Treiblmaier, 2021), which influences consumers' internal cognitive and emotional responses, specifically TIP. These internal responses (O) then lead to behavioral outcomes (R), such as the intention to purchase organic food. By incorporating trust theory into the SOR model, we understand how BFT cultivates trust, which subsequently affects consumer purchasing behavior. This integrated framework enhances our ability to explain consumer reactions to advanced technological applications within the food industry. Additionally, the SOR model's adaptability in considering both cognitive and emotional responses makes it particularly relevant to our research. Trust theory focuses on the cognitive process of trust development (Isaeva et al., 2020; McAllister, 1995), while the SOR framework accommodates the broader psychological impacts (Duong, Vu, et al., 2024). This combination enables us to analyze not only the direct effects of BFT on consumer behavior but also the moderating role of TA. Understanding how individual variations in technology-related concerns influence the effectiveness of BFT in fostering trust and promoting organic food purchases is crucial. This approach allows for developing targeted strategies to reduce TA and boost consumer acceptance of blockchain-based traceability systems. Ultimately, this contributes to the effective implementation and broader adoption of these technologies within the food industry, enhancing food safety and increasing consumer confidence.

## 2.3. Stimulus: Blockchain-based food traceability system

The BFT is designed as a stimulus within the SOR framework in our study. Blockchain technology offers a level of transparency and accountability unparalleled by traditional systems (Garaus & Treiblmaier, 2021). According to trust theory, trust is developed when consumers perceive reliability and integrity in the processes that affect them (Isaeva et al., 2020). Blockchain technology enhances this trust by providing an immutable and transparent ledger where all transactions and processes are recorded and can be traced back to their origin (Strebinger & Treiblmaier, 2024; Tan & Saraniemi, 2022; Yele & Litoriya, 2024). Such transparency enables consumers to confirm the genuineness and soundness of organic food items independently, thus fostering trust (Tao & Chao, 2024). When consumers can trace the journey of food products from farm to table, it guarantees that every party involved in the supply chain is responsible for their actions

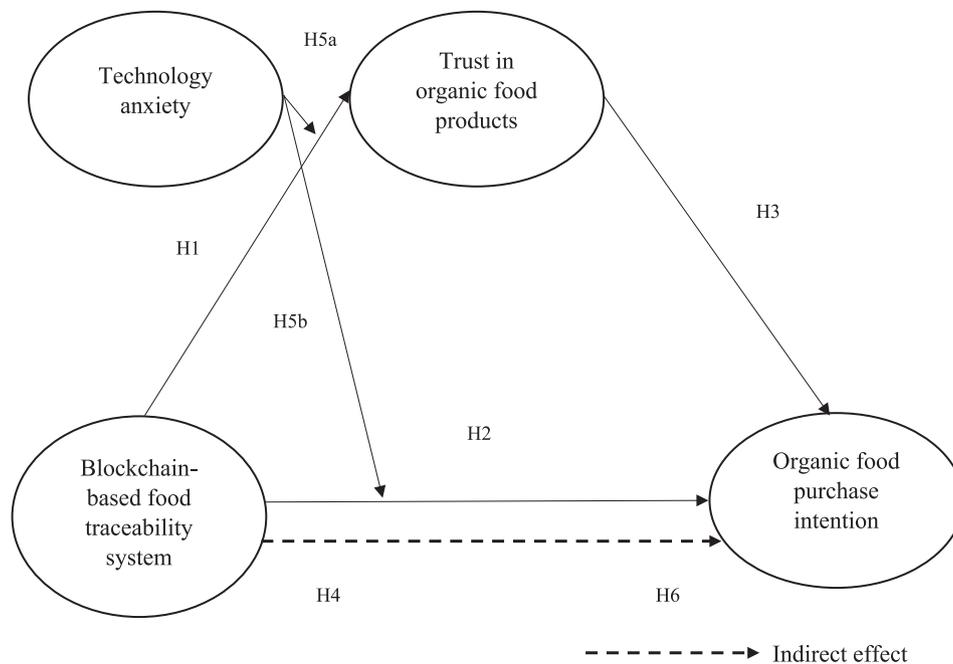


Fig. 1. Hypothesized model.

(Marchese & Tomarchio, 2022). This sense of accountability reassures consumers about the veracity of organic labels and certifications (Li et al., 2023), enhancing their trust in these products. Moreover, blockchain technology enhances food safety and quality assurance, which are critical attributes in building consumer trust (Ferreira da Silva & Moro, 2021).

In line with the trust theory, trust is developed when consumers perceive reliability and integrity in the processes that affect them (Chen et al., 2023; Khamitov et al., 2024). Food safety incidents and scandals have historically undermined consumer confidence in the food industry (Wognum et al., 2011). Blockchain's ability to provide detailed traceability information enables swift identification and resolution of sources of contamination or fraud (Tao & Chao, 2024). The knowledge that a robust blockchain-based system is in place for traceability assures consumers of the rigorous quality checks and standards maintained throughout the supply chain (Yele & Litoriya, 2024), thus increasing their TIP. Trust theory supports the idea that when consumers are confident in the reliability and integrity of the processes involved in delivering a product, their trust in the product itself increases (Leung et al., 2022). Empirical evidence further supports the positive impact of blockchain-based traceability on consumer trust (Cao et al., 2021). Therefore, it is assumed that there is a positive relation between a BFT and TIP.

**H1.** BFT has a positive impact on TIP.

Through several interrelated mechanisms, BFT is poised to positively influence consumers' purchase intentions regarding organic food products. First, the reduction of information asymmetry facilitated by blockchain technology significantly impacts consumer behavior (Tao & Chao, 2024). Information asymmetry in the food market arises when consumers need more crucial information about the products they buy, leading to uncertainty and hesitation (Yap et al., 2023). Blockchain-based traceability systems provide comprehensive and accurate data, including details on farming practices, processing methods, and transportation logistics (Shahzad et al., 2023; Tran et al., 2024). This availability of detailed information empowers consumers, reducing uncertainty and enhancing their confidence in the product (Cao et al., 2021). Trust theory suggests this confidence is a form of trust that plays a crucial role in shaping purchase intentions (Wang et al., 2022).

Consequently, when consumers feel more informed and confident about organic food products, their willingness to buy them will likely increase. Moreover, several prior studies report a positive correlation between transparency in the supply chain and purchase intention (Garaus & Treiblmaier, 2021; Rapezzi et al., 2024). For example, Tao and Chao (2024) indicates that consumers' purchase intentions were significantly higher when provided with transparent and accessible information about the product's origin and production processes. The following hypothesis is thus proposed.

**H2.** BFT has a positive impact on IOF.

#### 2.4. Organism: Trust in organic food products

In our study, TIP is determined as an organism within the SOR model. Trust theory posits that trust is a fundamental driver in consumer decision-making (Isaeva et al., 2020; Wistedt, 2024), particularly in markets where uncertainty and information asymmetry are prevalent, such as the organic food sector (Murphy et al., 2022). When consumers trust that organically-grown items are made following established standards, they are more inclined to develop a favorable perception toward buying them (Nguyen et al., 2023). This trust lessens apprehension about possible mislabeling or adulteration, hence increasing consumers' willingness to buy organic foods. Furthermore, consumers who trust the reality and worth of organic food products perceive a higher value in these products than in conventional alternatives (Meira et al., 2024). Trust theory supports this by suggesting that trust enhances perceived value, which is crucial in consumer choices, especially in markets where health, safety, and environmental concerns are paramount (Gong et al., 2021). Consequently, the higher the trust in consumers' organic food products, the greater the purchase intentions. Studies have also demonstrated that higher levels of trust in a product or brand led to increased purchase intentions. Meira et al. (2024), for example, illustrate that trust in products significantly affects their purchase intention. It is thus assumed that TIP holds a key position in influencing consumers' purchase decisions.

**H3.** TIP has a positive impact on IOF.

The mediating role of trust can be better understood via the application of theories related to trust, which emphasizes that trust serves as a

critical mediator in consumer decision-making processes (Dimiyati & Subagio, 2018; Karunasingha & Abeyssekera, 2022), particularly in contexts characterized by uncertainty and information asymmetry (Mayer et al., 1995; McAllister, 1995), such as the organic food market. In this study, BFT provides consumers with transparent and verifiable information about organic food products, reducing information asymmetry and fostering trust in the product. Trust develops when consumers perceive the information provided by the system (such as blockchain) to be reliable and credible, thus enhancing their confidence in the product's authenticity and integrity (Tan & Saraniemi, 2022). This increased trust, in turn, shapes consumer behavior (Meira et al., 2024), specifically influencing their intent to purchase organic food (Duong, Vu, et al., 2024). The mediation influence of trust can also be understood through the lens of the SOR framework. In this context, the BFT acts as the stimulus (S), which affects the consumer's internal state (organism, O) by enhancing TIP. This stimulus increases trust and then influences the consumer's response (R), specifically their intent to buy organic food. The mediation role of organisms in the relationship between stimulus and behavioral response within the SOR model has been affirmed in prior studies (Dalvi-Esfahani et al., 2023; Duong, 2024; Pham et al., 2024). Prior studies support the notion that trust mediates the relationship between information transparency and purchase intention (Hao et al., 2024; Tao & Chao, 2024; Wang et al., 2024). These studies have shown that when consumers are provided with transparent and credible information about a product, their trust in the product increases, which subsequently enhances their purchase intention. Thus, it is hypothesized that the relationship between BFT and IOF might be significantly mediated by TIP.

**H4.** TIP significantly serves as a mediator in the linkage between BFT and IOF.

### 2.5. Moderator: Technology anxiety

TA, is defined as the apprehension or fear experienced by individuals when using new technologies (Meuter et al., 2003), can significantly moderate both the primary and secondary connections between BFT, TIP, and IOF.

First, blockchain technology, being relatively new and complex, may induce anxiety among certain consumer segments (Gad et al., 2022). When consumers feel anxious about using blockchain-based systems, their ability to trust the information they provide may be compromised (Strebingler & Treiblmaier, 2024). This anxiety can stem from a lack of understanding of how blockchain works or from previous negative experiences with technology. Consequently, even though blockchain provides enhanced transparency and accountability, consumers with high TA may still harbor doubts and mistrust, undermining the system's potential trust benefits and purchase intention. In addition, TA can exacerbate the perceived risks of using blockchain-based traceability systems (Marikyan et al., 2022). Consumers who are anxious about technology may perceive a higher risk of data breaches, misuse of information, or technical failures (Tan et al., 2023). These amplified risk perceptions can overshadow blockchain technology's transparency and security benefits, leading to diminished trust in the information provided about organic food products and, subsequently, lower purchase intentions. Finally, when consumers experience high levels of anxiety related to the use of blockchain technology, their overall confidence and trust in engaging with products tracked by such systems may be diminished (Zhai et al., 2022). This reduced confidence and trust can translate into lower purchase intentions, as consumers may prefer to avoid products associated with technologies that make them uncomfortable. Consequently, TA acts as a barrier, preventing consumers from fully appreciating and trusting the advantages of blockchain-based traceability.

**H5.** TA significantly weakens the impact of BFT on (a) TIP and (b) IOF.

When TA weakened the impacts of BFT on TIP and IOF. It is also

assumed that the indirect impact of BFT on IOF through TIP is weakened because of the reasons as follows. One significant factor is the increased cognitive load associated with high levels of TA (Cezar & Maçada, 2023). When consumers experience anxiety about using new technologies, their ability to process and comprehend the benefits of BFT is impaired. The heightened cognitive load can lead to difficulties in understanding the transparency and accountability provided by blockchain technology, weakening the development of TIP. Furthermore, TA often leads to perceptions of complexity and usability issues (Chang, 2005; Rasool et al., 2022). Consumers with high TA may view blockchain systems as overly complex and challenging to utilize. This perception can erode their belief in using the system effectively to confirm the legitimacy of organic food items. When consumers doubt their ability to navigate and utilize blockchain technology, their trust in the information provided by these systems is reduced. As a result, the favorable indirect effect of blockchain transparency on purchase intention, mediated by trust, is diminished when the degree of TA is high.

**H6.** TA negatively moderates the indirect impact of BFT on IOF through TIP. As such, the positive mediation impact of TIP on the relationship between BFT and IOF is weakened when TA is high.

## 3. Methods

### 3.1. Sample

A structured online questionnaire survey was conducted in Vietnam to evaluate the proposed model. We used a purposive sampling technique to select participants who had recently bought organic food items and employed QR codes to track down the sources of these items within the last half of the year. To ensure the representativeness of our sample, we focused on targeting a diverse demographic by distributing the survey across various regions of Vietnam, including urban and rural areas, where organic food consumption is prevalent. This approach helps capture a broad spectrum of organic food consumers across different socio-economic backgrounds. Prior to engaging in the online questionnaire, all prospective participants are asked to respond to an initial inquiry: "In the last six months, have you used QR codes to trace the origins of organic foods when purchasing them?". If consumers select "No/Not yet", the survey will automatically conclude, and we will thank them for their interest in our research. If participants respond with "Yes", they will proceed to the subsequent questions in the survey. Qualified individuals who consented to participate in the study were given a concise summary of the main ideas pertinent to the investigation. Participants were notified about the aim of the research at the beginning of the survey. After finishing the survey, participants were appreciated for their willingness to participate voluntarily. Between mid-March and mid-June 2024, the survey was conducted digitally through Google Forms and distributed across various tools of social media, such as Zalo, Facebook, Viber, Instagram, and Messenger. The use of multiple social media platforms helped us reach a wide range of consumers from different age groups, income levels, and regions. The survey aimed to target consumers over the age of 18. Although the sample was not entirely random, we employed purposive sampling to ensure that our respondents were relevant to the study's objective—those who had experience with blockchain technology in the organic food supply chain. Therefore, the sample adequately reflects the target population of organic food consumers who engage with blockchain-based traceability systems. In addition, all participants gave informed consent, confirming their voluntary involvement.

After removing duplicates, inconsistencies, and nonstandard responses, 5326 valid responses were available for further analysis. The age distribution of participants showed that the largest group was aged 20–29 (35.8 %). This was followed by individuals aged 30–39 (24.6 %), 40–49 (21.4 %), under 20 (14.7 %), 50–59 (2.3 %), and over 60 (1.2 %). Moreover, the sample was slightly female-dominated, with women

making up 52.8 % of the respondents and men constituting 47.2 %. Most participants held a college degree, with 67.1 % of the sample having graduated from college. A quarter of the respondents (25 %) had completed only high school, while a smaller portion (7.9 %) held an advanced academic qualification. In terms of income, the participants mainly fell into the lower and middle-income categories. Over half (55.2 %) reported earning less than 30 million VND per month. The biggest income bracket was 20 to 30 million VND, encompassing 31.6 % of the participants, followed by the 30–40 million VND bracket at 31.0 %. Only a small fraction (13.8 %) belonged to the high-income groups, earning over 40 million VND per month.

### 3.2. Measures and questionnaires

The instrument, created by adapting validated measurement scales from earlier studies, served as the core of our data collection. Participants provided their responses on a seven-point Likert scale, with options ranging from “strongly disagree” (coded as 1) to “strongly agree” (coded as 7). A 4-item scale measured for BFT was adopted from Shahzad et al. (2023) (i.e., “It is easy to trace the time and locations of organic foods with a blockchain-enabled traceability system”) while the 6-item instrument measured for TIP was derived from Benson et al. (2020) (i.e., “I trust that organic foods are safe”). To capture TA, a set of five items was adopted from Meuter et al. (2003) (i.e., “Technological terminology sounds like confusing jargon to me”). Finally, 3 items reflected an intention to purchase organic food and were adapted from Ladwein and Sánchez Romero (2021) (i.e., “I plan to buy organic food”). Before collecting structured data, the questionnaire items were translated from English to Vietnamese using a back-translation method recommended by Brislin (1970). The survey was initially created in English and then translated into Vietnamese with the assistance of two bilingual researchers. It was subsequently back-translated into English. A third researcher reviewed the back-translated version to ensure it matched the original, and no significant discrepancies were identified. Additionally, a reversed question (IOF4 “I may not purchase organic foods in the future”) was incorporated to help manage and avoid bias and abnormal responses.

### 3.3. Analytical approach

The analysis of this research was accomplished by adopting SPSS version 28.0 and AMOS version 25.0. Initially, we assessed the reliability and accuracy of the measurements by calculating Cronbach's alpha for each variable and conducting a confirmatory factor analysis (CFA). Additionally, Harman's single-factor test and the common latent factor technique were employed to check for the existence of common method bias (CMB). In the social sciences, the PROCESS macro is often used to explore mediation, moderation, and interactions (Hayes, 2018), as structural equation modeling (SEM) has some shortcomings in testing moderated mediation models (Srivastava et al., 2024). Our research utilized the PROCESS macro (Model 4) to test the mediation effect of TIP. Furthermore, we conducted a moderated mediation analysis using Model 8 to evaluate the influence of TA on the moderated mediation

process (Hayes, 2018). Employing a randomized sample of 10,000 data points, we applied bootstrapping with 95 % CIs (confidence intervals) to assess the importance of the relationships in both Model 4 and Model 8.

## 4. Results

### 4.1. Scale examination

The skewness and kurtosis values presented in Table 1 indicate that all variables exhibit acceptable levels of normality, with skewness ranging from  $-0.876$  to  $0.504$  and kurtosis ranging from  $-1.988$  to  $0.759$ . These values suggest that the data distribution is within an acceptable range for further analyses, with no significant departure from normality (Hu et al., 2022). Moreover, several tests were conducted to evaluate the reliability and validity of the scales used in our research. Initially, the reliability of the scales was assessed using Cronbach's alpha ( $\alpha$ ) and composite reliability (CR) within the four-factor unconstrained measurement model. Results indicate that Cronbach's alpha if the reversed item (IOF4) is eliminated is  $0.846$ , which is higher than the original  $\alpha_{\text{IOF}}$  of  $0.765$ , while its squared multiple correlation is  $0.120$ . Therefore, IOF4 was excluded from the IOF scale before proceeding with the next analyses. After eliminating IOF4, the four-factor unrestrained CFA reports the satisfactory indices of fitness:  $\chi^2 = 1553.463$ ,  $df = 129$ ,  $GFI = 0.967$ ,  $AGFI = 0.956$ ,  $CFI = 0.981$ ,  $TLI = 0.978$ ,  $NFI = 0.979$ , and  $RMSEA = 0.046$ . Moreover,  $\alpha$  and CR of all scales were higher than the threshold value of  $0.7$ , while AVE of these scales was also higher than the cut-off value of  $0.5$  (see Table 1), and the factor loading of all items fluctuated from  $0.792$  to  $0.866$ , illustrating scales' reliability and validity (Fornell & Larcker, 1991; Pashutan et al., 2022). Moreover, to further assess discriminant validity, the square roots of the average variance extracted (AVE) values were compared with the inter-construct correlations. The results demonstrated that the square roots of the AVEs for all constructs were higher than the inter-construct correlations, indicating sufficient discriminant validity (Idiana et al., 2022).

### 4.2. Common method bias

Various analyses were carried out to examine common method variance (CMV). Initially, Harman's one-factor test was implemented to determine the degree of CMV. The findings revealed that five constructs had eigenvalues over  $1.0$ , with the largest variance contribution rate being  $42.446$  %, which falls under the  $50$  % cut-off values (Harman, 1976). Moreover, Table 2 reports that when all 18 items of the four constructs were retained in a one-factor model, it resulted in poor fit indices:  $\chi^2 = 15,412.069$ ,  $df = 135$ ,  $GFI = 0.663$ ,  $AGFI = 0.573$ ,  $CFI = 0.797$ ,  $TLI = 0.770$ ,  $NFI = 0.796$ , and  $RMSEA = 0.146$ . The divergences in factor loadings for the items are all below  $0.2$ . Additionally, the one-factor constrained model exhibits a dramatically poorer fit compared to the four-factor unconstrained model ( $\Delta\chi^2$  ( $df$ ) =  $13,858.606$  ( $6$ ),  $p < 0.001$ ). This result suggests that CMB is not a concern in our research.

**Table 1**  
Summary statistics and correlations.

Constructs	M	SD	S	$\lambda$	$\alpha$	CR	AVE	1	2	3	4	5	6	7	8
1. Age	2.642	1.111	0.404	$-0.306$	n.i	n.i	n.i	n.i							
2. Gender	1.472	0.499	0.113	$-1.988$	n.i	n.i	n.i	$0.014$	n.i						
3. Education	1.829	0.547	$-0.076$	$-0.023$	n.i	n.i	n.i	$0.113^{**}$	$0.113^{**}$	n.i					
4. Income	2.402	1.095	0.504	$-0.282$	n.i	n.i	n.i	$0.084^{**}$	$0.096^{**}$	$0.043^{**}$	n.i				
5. TIP	5.115	1.241	$-0.737$	$0.612$	$0.929$	$0.930$	$0.687$	$0.110^{**}$	$0.118^{**}$	$-0.001$	$0.012$	<b>(0.829)</b>			
6. BFT	5.238	1.279	$-0.876$	$0.759$	$0.907$	$0.908$	$0.711$	$0.091^{**}$	$0.104^{**}$	$0.010$	$0.010$	$0.752^{**}$	<b>(0.843)</b>		
7. TA	4.786	1.348	$-0.355$	$-0.309$	$0.919$	$0.919$	$0.694$	$0.129^{**}$	$0.067^{**}$	$-0.028^*$	$0.023$	$0.653^{**}$	$0.570^{**}$	<b>(0.833)</b>	
8. IOF	5.098	1.275	$-0.670$	$0.362$	$0.846$	$0.846$	$0.647$	$0.105^{**}$	$0.105^{**}$	$0.003$	$-0.001$	$0.696^{**}$	$0.647^{**}$	$0.672^{**}$	<b>(0.804)</b>

Notes:  $N = 5326$ .  $^{**}p < 0.01$ ;  $^*p < 0.05$ . n.i = non-information; M = Mean; SD = Standard deviation; S = skewness;  $\lambda$  = Kurtosis.

**Table 2**  
Fitness indices for measurement models.

Models		$\chi^2$ (df)	GFI	AGFI	CFI	TLI	NFI	RMSEA	$\Delta \chi^2$ (df)
Four-factor model	BFT, TA, TIP, IOF	1553.463 (129)	0.967	0.956	0.981	0.978	0.979	0.046	–
Three-factor model	BFT + TA, TIP, IOF	10,408.742(132)	0.723	0.641	0.864	0.842	0.862	0.121	8855.279 (3) ***
Two-factor model	BFT + TA + TIP, IOF	13,939.832 (134)	0.682	0.595	0.817	0.791	0.815	0.139	12,386.369 (5) ***
One-factor model	BFT + TA + TIP + IOF	15,412.069 (135)	0.663	0.573	0.797	0.770	0.796	0.146	13,858.606 (6) ***

Notes: N = 5326; \*\*\* $p < 0.001$ .

4.3. Hypothesis tests

The PROCESS macro approach (Models 8 and 4) was utilized to investigate the moderated mediation model, as suggested by Hayes (2018). Specifically, Model 8 examines the moderation effects of TA on the relationships between BFT, TIP, and IOF, while Model 4 focuses on the mediation effect of TIP on the relation between BFTs and the intention to purchase organic food. The  $R^2$  values for TIP and IOF were 0.642 and 0.589, respectively, both exceeding 0.1. This indicates that the conceptual model can explain a significant proportion of the variance in these dependent variables (Abakah et al., 2024). Table 3 reveals that BFT is positively and significantly related to TIP ( $\beta = 0.617, p < 0.001$ ) and intention to purchase organic food ( $\beta = 0.302, p < 0.001$ ), whereas TIP is also positively correlated with intention to purchase organic food ( $\beta = 0.309, p < 0.001$ ), supporting H1, H2, and H3. Moreover, results reveal that TIP significantly mediates the impact of BFT on the intention to purchase organic food ( $\beta = 0.363, 95\% \text{ CI } [0.332, 0.394]$ ), supporting H4.

The results reported that the influence of BFT on TIP ( $\beta = -0.018, p < 0.001, 95\% \text{ CI } [-0.027, -0.009]$ ) and intention to purchase organic food ( $\beta = -0.021, p < 0.001, 95\% \text{ CI } [-0.031, -0.011]$ ) were significantly weakened by TA. The negative moderating effects of TA on the relationships between the BFT, TIP, and the intention to purchase organic food were visually represented in Fig. 2 and Fig. 3. The simple slope test results showed that the impact of the BFT on TIP and the

intention to purchase organic food was significant across all levels of TA. Results also reveal that the positive influence of BFT on TIP and the intention to purchase organic food were lower when TA was at a high degree ( $\beta = 0.507, p < 0.001, 95\% \text{ CI } [0.479, 0.535]$ ;  $\beta = 0.175, p < 0.001, 95\% \text{ CI } [0.141, 0.209]$ , respectively), but these impacts increased significantly at the equal degree ( $\beta = 0.531, p < 0.001, 95\% \text{ CI } [0.511, 0.552]$ ;  $\beta = 0.203, p < 0.001, 95\% \text{ CI } [0.175, 0.231]$ , respectively) and low degree ( $\beta = 0.555, p < 0.001, 95\% \text{ CI } [0.536, 0.575]$ ;  $\beta = 0.231, p < 0.001, 95\% \text{ CI } [0.204, 0.258]$ , respectively). H5a and H5b were therefore supported.

Following the confirmation of moderation effects, a subsequent analysis was conducted to explore the moderated mediation impact of TA and TIP on the relationship between the BFT and IOF. The negative result of the moderated mediation index and its non-zero probability further support the hypothesis that TA moderates the indirect effect of the BFT on the intention to purchase organic food through TIP ( $\beta = -0.006; 95\% \text{ CI } [-0.009, -0.003]$ ). Notably, the results show that the moderated mediation influence was statistically significant at low, mean, and high levels of TA—with corresponding values of 0.172, 0.164, and 0.157, respectively. More importantly, pairwise contrasts between conditional indirect effects (effect 1 minus effect 2) illustrate that the indirect impacts with low TA were higher than the same effect with the mean (Contrast =  $-0.007, 95\% \text{ CI } [-0.012, -0.003]$ ) and high TA (Contrast =  $-0.015, 95\% \text{ CI } [-0.024, -0.006]$ ) while the indirect effect with mean TA was also higher than the same effect with high TA

**Table 3**  
Moderated mediation analyses.

Variables	$\beta$	se	t	p	LL	UL
Trust in organic food products (M) ( $R^2 = 0.642; F = 3175.445^{***}$ )						
Constant	0.368**	0.107	3.443	0.001	0.159	0.578
BFT	0.617***	0.021	29.866	0.000	0.576	0.657
BFT x TA	-0.018***	0.005	-3.850	0.000	-0.027	-0.009
Conditional influences of BFT at the values of TA (M $\pm$ S-D)						
-1 S.D. (-1.348)	<b>Influence</b>	<b>se</b>	<b>t</b>	<b>p</b>	<b>LL</b>	<b>UL</b>
M (4.786)	0.555***	0.010	55.789	0.000	0.536	0.575
+1 S.D. (1.348)	0.531***	0.010	50.631	0.000	0.511	0.552
	0.507***	0.014	35.890	0.000	0.479	0.535
Organic food purchase intention (Y) ( $R^2 = 0.589; F = 1902.738^{***}$ )						
Constant	0.330**	0.118	2.796	0.005	0.099	0.561
BFT	0.302***	0.025	12.293	0.000	0.254	0.350
TIP	0.309***	0.015	20.482	0.000	0.280	0.339
BFT x TA	-0.021***	0.005	-4.039	0.000	-0.031	-0.011
Conditional influences of BFT at the values of TA (M $\pm$ S-D)						
-1 S.D. (-1.348)	<b>Influence</b>	<b>se</b>	<b>t</b>	<b>p</b>	<b>LL</b>	<b>UL</b>
M (4.786)	0.231***	0.014	16.736	0.000	0.204	0.258
+1 S.D. (1.348)	0.203***	0.014	14.437	0.000	0.175	0.231
	0.175***	0.017	10.099	0.000	0.141	0.209
Boot indirect influence						
	<b>BootSE</b>				<b>BootLL</b>	<b>BootUL</b>
Indirect influence of BFT on IOF via TIP	0.363	0.016			0.332	0.394
Conditional indirect influences of BFT on IOF at the values of TA (M $\pm$ S.D.)						
-1 S.D. (-1.348)	<b>Influence</b>	<b>BootSE</b>			<b>BootSE</b>	<b>BootSE</b>
M (4.786)	0.172	0.012			0.148	0.196
+1 S.D. (1.348)	0.164	0.012			0.142	0.188
	0.157	0.012			0.134	0.180
Moderated mediation index						
	<b>Influence</b>	<b>BootSE</b>			<b>BootSE</b>	<b>BootSE</b>
	-0.006	0.002			-0.009	-0.002
Comparative analysis of conditional indirect influences (difference between influence 1 and influence 2)						
	<b>Influence 1</b>	<b>Influence 2</b>	<b>Contrast</b>	<b>BootSE</b>	<b>BootLL</b>	<b>BootUL</b>
	0.164	0.172	-0.007	0.002	-0.012	-0.003
	0.157	0.172	-0.015	0.004	-0.024	-0.006
	0.157	0.164	-0.007	0.002	-0.012	-0.003

Notes: N = 5326; \*\*\* $p < 0.001$ , \*\* $p < 0.01$ ; \* $p < 0.05$ .

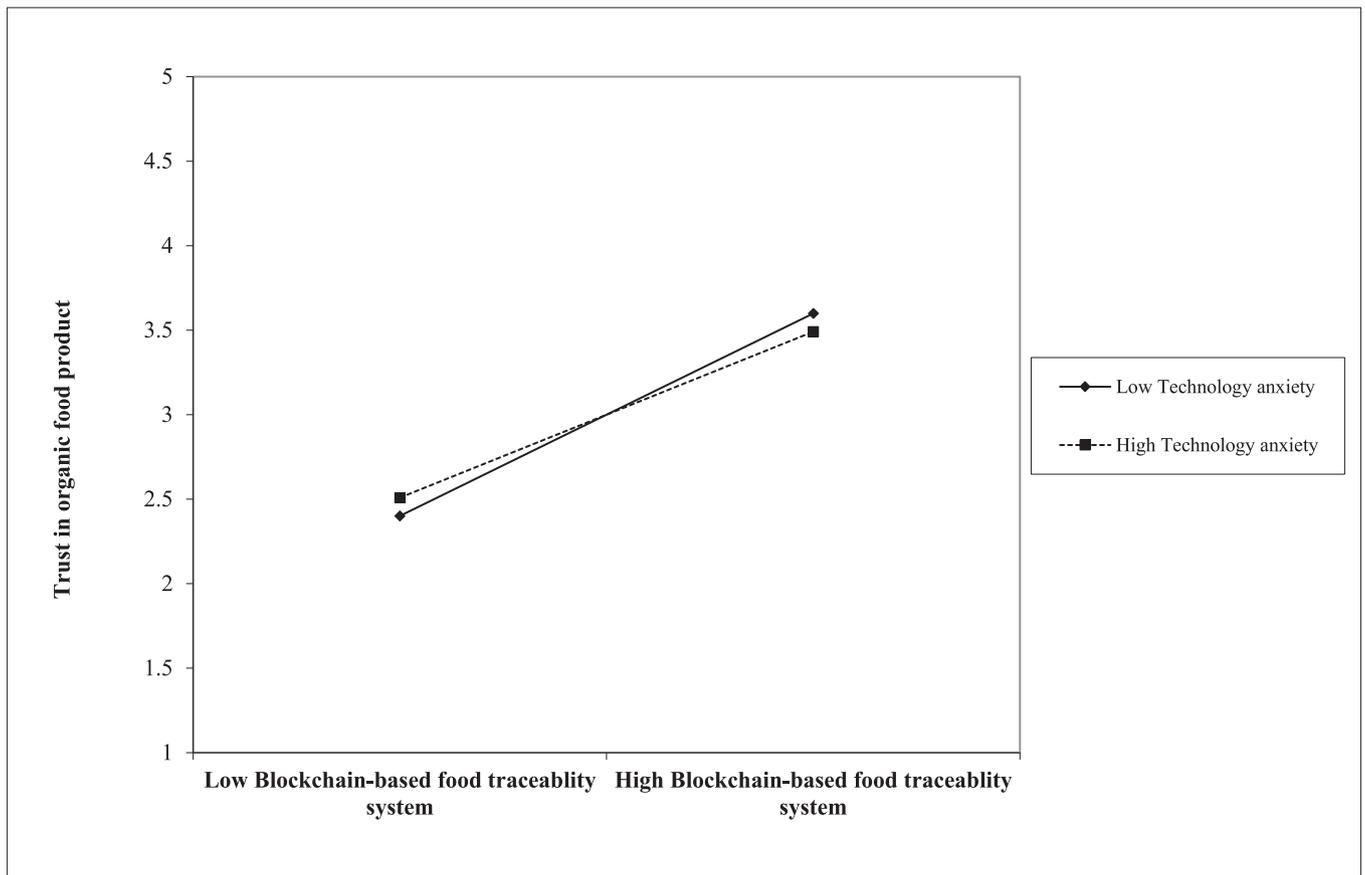


Fig. 2. Interaction effect of TA and BFT on TIP.

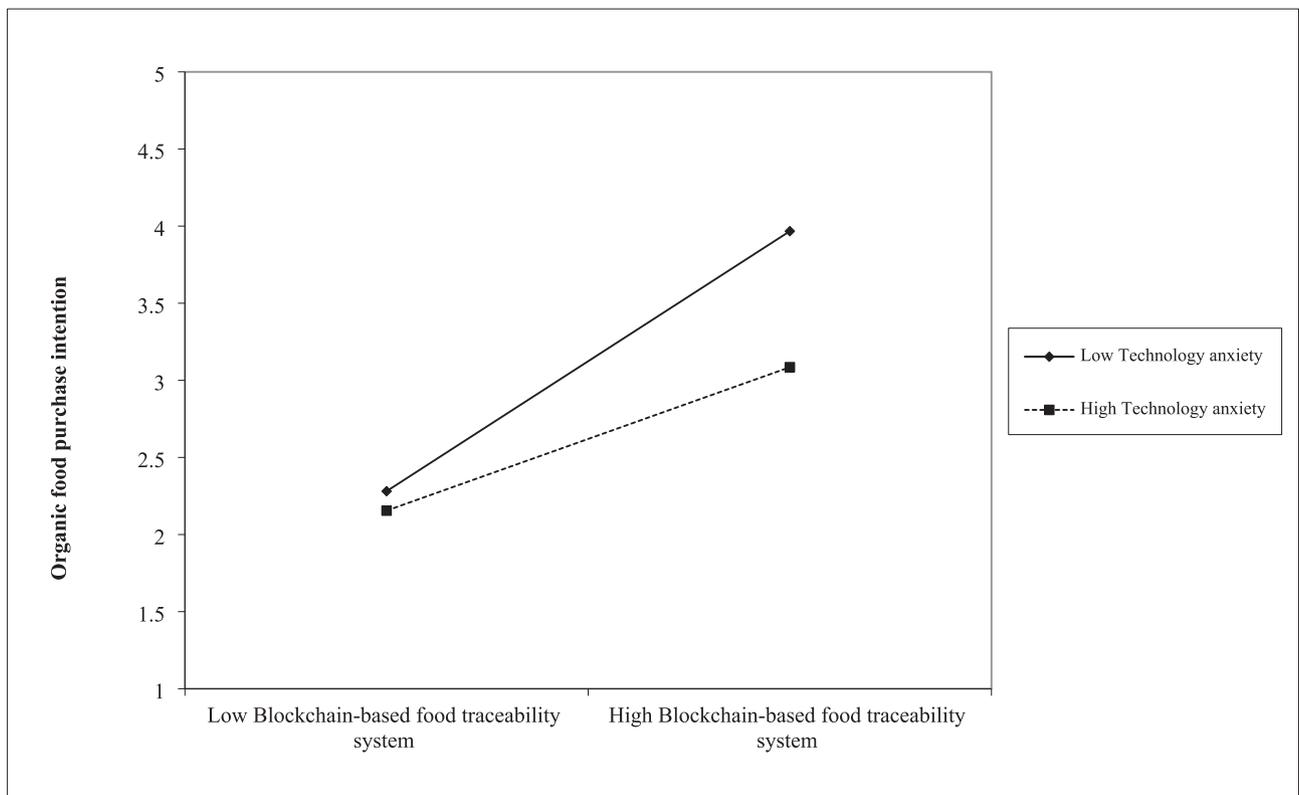


Fig. 3. Interaction effect of TA and BFT on OFI.

(Contrast =  $-0.007$ , 95 % CI [ $-0.012$ ,  $-0.003$ ]). This result demonstrates that the conditional effects of the BFT on the intention to purchase organic food via TIP varied significantly across different levels of TA, pertaining to the support for H6. The summary of hypothesis testing is presented in Fig. 4.

#### 4.4. Robustness checks

We conducted robustness checks by re-testing the hypotheses using the PLS-SEM technique in SmartPLS. This method was employed as an alternative to APROCESS macro to validate the findings due to the growing preference for variance-based SEM techniques, especially in cases involving large samples, as noted by Vaithilingam et al. (2024). The results from PLS-SEM, presented in Table 4, are consistent with the findings from the PROCESS macro approach, providing additional confidence in the robustness of our results. Moreover, the results from PLS-SEM indicate that the factor loadings for all constructs exceeded the recommended threshold of 0.70, with  $\alpha$  and CR values well above 0.80, demonstrating strong internal consistency and reliability. All constructs' AVE was above the 0.50 threshold, indicating satisfactory convergent validity. Furthermore, the Fornell-Larcker criterion was used to assess discriminant validity, with the square roots of AVEs exceeding the inter-construct correlations, confirming that the constructs are distinct from each other. The hypotheses tested with PLS-SEM reaffirmed the relationships between BFT, TIP, IOF, and the moderating role of TA. All hypotheses were supported, and the significance levels remained consistent with the initial PROCESS macro analysis. This additional analysis ensures the findings' robustness and reliability, affirming that PROCESS macro analysis and PLS-SEM methods yield consistent results.

#### 5. Discussion

Our study's findings indicate that BFT is positively and significantly related to TIP and intention to purchase organic food. These results highlight the critical role of BFTs in enhancing trust and driving

purchase intentions in the organic food market.

First, the significant connection between BFT and TIP illustrates the effectiveness of distributed ledger technology in addressing transparent and responsible issues within the food supply chain. Blockchain's ability to provide a well-established and transparent record of the whole supply chain allows consumers to independently validate the legitimacy and integrity of organic labels, which builds trust, as aligned with the trust theory (Isaeva et al., 2020). This finding is also aligned with some prior studies when these studies reveal that the adoption of blockchain traceability systems in the food industry can increase consumers' product trust (Cao et al., 2021; Tao & Chao, 2024). This strengthened transparency can help diminish information asymmetry and boost consumers' trust in the quality and safety of organic food items. The significant impact on trust is particularly crucial in the organic food market, where concerns about mislabeling and food fraud are prevalent (Yele & Litoriya, 2024). When consumers can access reliable and verifiable information about organic foods' origins and production processes, blockchain technology might foster a higher level of trust, which is essential for consumer satisfaction and loyalty.

Furthermore, the positive relation between BFT and IOF indicates that the enhanced trust facilitated by blockchain technology translates into actual consumer behavior. When consumers trust the authenticity and quality of organic food products, they are more likely to purchase these products (Cao et al., 2021). This result is consistent with some prior studies indicating that trust is a critical antecedent to purchase intention (Garaus & Treiblmaier, 2021; Rapezzi et al., 2024). The implementation of blockchain technology thus serves as a valuable strategy for organic food producers and retailers to increase consumer confidence and drive sales. By leveraging blockchain for traceability, these businesses can effectively address consumer concerns and differentiate their products in a competitive market (Shahzad et al., 2023; Tao & Chao, 2024; Tran et al., 2024). The significant relation between BFT and IOF also suggests that consumers value transparency and accountability in purchasing decisions. As consumers become increasingly aware of and concerned about food safety and ethical production

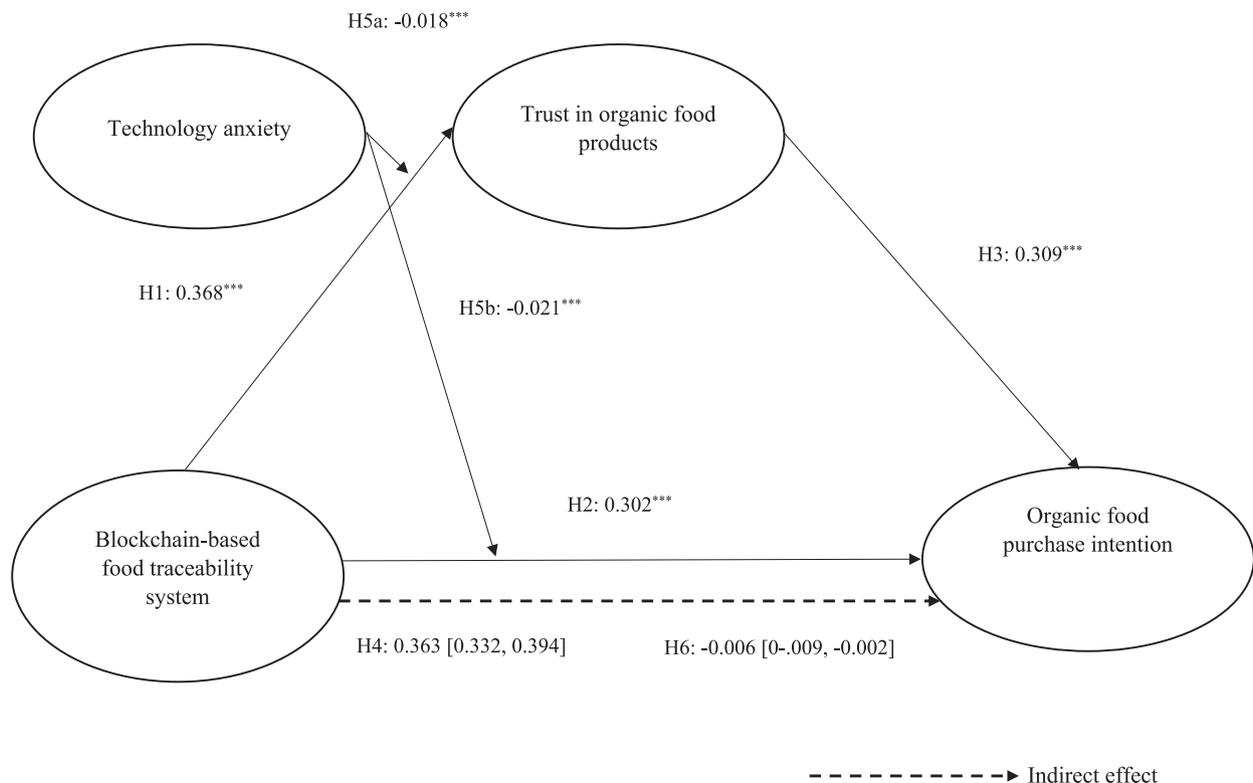


Fig. 4. Hypothesis testing results.

**Table 4**  
Robustness checks with PLS-SEM.

Hypotheses	Relationships			$\beta$	P-value	Supported
H1	BFT	→	TIP	0.547***	0.000	Yes
H2	BFT	→	IOF	0.203***	0.000	Yes
H3	TIP	→	IOF	0.301***	0.000	Yes
H4	BFT	→	TIP	0.165***	0.000	Yes
H5a	TA*BFT	→	TIP	-0.025**	0.001	Yes
H5b	TA*BFT	→	IOF	-0.028***	0.000	Yes
H6	TA*BFT	→	TIP	-0.007**	0.001	Yes

Notes: N = 5326; \*\*\* $p < 0.001$ , \*\* $p < 0.01$ .

practices, they are more inclined to support products and brands that prioritize these values (Garau & Treiblmaier, 2021). By providing a transparent and accountable supply chain, blockchain technology meets these consumer demands and encourages more informed and confident purchasing decisions.

The results of our study demonstrate that TIP is positively correlated with IOF, indicating the importance of trust as a determinant of consumer behavior. When consumers trust the authenticity and quality of organic food products, they are more likely to exhibit a stronger intention to purchase (Tao & Chao, 2024). This relationship is well-documented in consumer behavior literature, where trust is a crucial factor influencing purchase decisions (Jai et al., 2013; Lang & Rodrigues, 2022). Trust reduces perceived risks and uncertainties, making consumers more confident in buying (Meira et al., 2024). Consequently, establishing TIP is essential for increasing consumer purchase intentions and fostering market growth. However, it is important to consider that not all research aligns with these positive outcomes. In one research, Watanabe et al. (2020) argue that consumer trust may not significantly influence purchase intentions due to consumers' limited interest in labels and certifications, particularly since the measurement instrument used in this study was focused on trust in labels, seals, and certifying bodies.

Moreover, the mediation analysis reveals that TIP significantly mediates the impact of BFTs on the intention to purchase organic food. In this case, blockchain technology's enhanced transparency and accountability build consumer trust, which in turn drives their purchase intentions. According to trust theory, trust plays a critical role in reducing uncertainty and perceived risks (Isaeva et al., 2020; Wistedt, 2024), particularly in markets where consumers are concerned about the authenticity and integrity of products, such as organic food. This mediation effect further highlights the pathway through which blockchain technology impacts consumer behavior. By improving transparency and offering traceable, credible information, blockchain technology bolsters TIP, positively affecting consumers' intentions to purchase organic food. This is consistent with trust theory's assertion that trust acts as a vital mechanism linking transparency and accountability with positive behavioral outcomes (Kang & Hustvedt, 2014; Schnackenberg & Tomlinson, 2016). The significant mediation effect also suggests that the full potential of blockchain-based traceability systems is realized through their ability to build consumer trust (Meira et al., 2024; Tao & Chao, 2024). While blockchain technology directly improves transparency and accountability, its ultimate impact on purchase intentions is mediated by the trust it fosters.

The results reveal that TA weakens the effects of BFTs on TIP and intention to purchase organic food products. This finding suggests that high levels of TA can diminish the positive impacts of blockchain technology on both trust and purchase intention. When TA is high, consumers may struggle to understand and trust the functionalities of blockchain technology. This anxiety can lead to cognitive overload (Gad et al., 2022; Marikyan et al., 2022), where blockchain technology's perceived complexity and novelty become barriers to its acceptance. Therefore, although blockchain technology offers enhanced transparency and security, the anxiety surrounding its use can overshadow these benefits, leading to lower levels of TIP and reduced purchase intentions. The varying degrees of TA also reveal a gradient effect where

lower anxiety correlates with more substantial positive impacts of blockchain technology. At moderate levels of TA, the beneficial effects of blockchain are more pronounced, and at low levels of anxiety, these effects are maximized. This finding suggests that reducing TA can progressively enhance the efficacy of blockchain-based traceability systems.

Finally, our study's findings further support the hypothesis that TA moderates the indirect influence of BFTs on the intention to purchase organic food through TIP. The results show that the moderated mediation effect was statistically significant at various levels of TA. These findings indicate that as TA increases, the strength of the mediated relationship between BFTs and purchase intention via trust decreases. This moderated mediation effect suggests that consumers with lower TA can better trust and subsequently act on the information provided by blockchain systems, leading to a stronger IOF. When TA is high, consumers may experience cognitive overload and fear (Cezar & Maçada, 2023), which inhibits their ability to trust the information provided by blockchain technology fully. High TA diminishes trust and, in turn, weakens their intention to purchase organic food products. Conversely, when TA is low, consumers are more likely to appreciate the transparency and accountability provided by blockchain systems, leading to higher trust and stronger purchase intentions.

## 6. Conclusion

### 6.1. Theoretical implications

By integrating the trust theory with the SOR framework, this study makes several significant theoretical contributions to the existing literature on blockchain technology, consumer behavior, and food supply chain management.

One of the primary contributions of this research is its advancement of the literature on blockchain-based food traceability systems, particularly in how blockchain technology functions as a key mechanism for ensuring transparency and accountability within the food supply chain. By delving deeper into the theoretical underpinnings of blockchain technology, this study moves beyond simply establishing a positive relationship between blockchain adoption and consumer trust. Instead, it provides a more comprehensive, mechanism-based explanation of how blockchain technology enhances trust, particularly in the context of organic food products where concerns about product authenticity and safety are prevalent (Duong, Vu, et al., 2024). Blockchain technology's immutable and transparent nature plays a pivotal role in addressing these concerns by allowing consumers to verify the entire supply chain in real-time. This verification process fosters a higher level of confidence in organic products as consumers can directly access information regarding the origins, production methods, and handling of these products. From a theoretical standpoint, blockchain technology serves as a trust-building mechanism because it shifts the power of validation from producers to consumers, who now have control over verifying the authenticity of the claims made (Duan et al., 2024). This shift enhances the product's credibility in the consumer's eyes and allows blockchain to function as a critical trust facilitator. Moreover, this research illustrates how blockchain technology can be effectively integrated into broader frameworks that seek to explain consumer behavior, particularly in

industries where trust is paramount to purchasing decisions. The study suggests that blockchain technology should not merely be viewed as a digital tool but as a transformative mechanism that fundamentally alters the relationship between producers and consumers by embedding transparency at the core of that relationship.

This research significantly expands our knowledge of trust theory (McAllister, 1995) by building upon and extending previous works examining trust's role in organic food supply chains (Duong, Vu, et al., 2024). For instance, previous studies have explored the relationship between personal trust in organic food producers and system trust in regulatory bodies (Li et al., 2023) showing that these trust elements are critical for shaping consumer purchasing behaviors. By incorporating blockchain technology into this framework, our research goes beyond traditional trust constructs, highlighting how blockchain can simultaneously reinforce system trust and provide an additional layer of assurance through its tamper-proof nature (van Hilten et al., 2020). Thus, this study confirms earlier findings on the importance of trust between consumers and supply chain actors and introduces blockchain as a moderating force that enhances trust transparency across the entire chain. Trust theory posits that consumers rely heavily on trust when making decisions in environments where product verification is difficult or impossible without external validation mechanisms, such as labels or certifications (Zhao et al., 2019). In this context, our research extends the theoretical conversation by showing that product-specific trust—trust in organic food products' quality, authenticity, and integrity—is more critical to purchase intention than trust in the underlying blockchain technology used to verify them. The importance of this distinction lies in the fact that while blockchain enhances the transparency of the food supply chain, the consumer's belief in the organic product's authenticity and adherence to organic standards ultimately drives their purchase decisions.

This study also contributes to the trust theory (McAllister, 1995) by demonstrating how blockchain's ability to provide verifiable, transparent information about the production and origins of organic products reinforces product-specific trust, which in turn mediates the influence of blockchain on consumer purchase intention. By framing trust in organic food products as the key mediator between technological stimuli and behavioral outcomes, the research provides a nuanced theoretical foundation for future studies (Duong, Dao, et al., 2024; Ho et al., 2024). This distinction is precious in markets where credibility and authenticity are paramount and where consumers may be less concerned with the technological systems behind product verification and more focused on trusting the product itself. The study, therefore, not only deepens the theoretical understanding of trust mechanisms but also clarifies that trust in the product, rather than in the technology used to authenticate it, is the more direct determinant of consumer behavior.

Another theoretical contribution of this research is its investigation of how blockchain-based traceability systems reduce information asymmetry in the organic food supply chain (Ho et al., 2024). Information asymmetry, where consumers have less knowledge about product quality than producers or retailers, has long been a challenge in the food industry, particularly in markets where consumers cannot directly observe production processes (Sgroi, 2023). In the context of food safety, this asymmetry can lead to consumer distrust, as previous studies have shown that a lack of transparent information can increase consumer concerns about product integrity and safety (Duong, Vu, et al., 2024). Our study demonstrates that blockchain technology can bridge this information gap by giving consumers access to transparent, reliable, and verifiable information about the origins and handling of organic food products. This reduction in information asymmetry builds trust and empowers consumers to make more informed purchase decisions. By linking the reduction of information asymmetry to increased consumer trust and purchase intention, this study enhances the theoretical understanding of traceability's role in improving food safety, quality perceptions, and market efficiency. Moreover, it contributes to the broader literature on how technological innovations can mitigate the effects of

information asymmetry in complex supply chains.

Finally, this research makes a novel contribution by identifying the moderating role of TA in the relationship between BFT, trust, and purchase intention. The negative moderated mediation effect of TA highlights how consumer apprehension toward technology can diminish the positive impacts of blockchain systems (Li, 2024; Pham et al., 2024). This insight is crucial for developing more effective strategies to mitigate TA and enhance the adoption of blockchain-based solutions. By integrating TA into the SOR framework, our study expands the extent of literature on the factors influencing consumer behavior in response to technological innovations. Moreover, the pairwise contrasts between conditional indirect effects further enrich the theoretical contributions of this research. The results demonstrate that the indirect effects of blockchain-based traceability on purchase intention, mediated by trust, vary significantly with different levels of TA. This gradient effect emphasizes the importance of addressing consumer TA to maximize the benefits of blockchain technology (Al Shbail et al., 2023). Such nuanced insights contribute to the theoretical discourse on how psychological factors, like anxiety, can modulate the effectiveness of technological interventions in consumer markets.

## 6.2. Practical implications

The findings from this research provide several valuable insights into the organic food industry, particularly for enterprises and policymakers interested in enhancing consumer trust and purchase intentions.

The positive influence of BFT on consumer trust and purchase intent is highly relevant to the organic food market, where concerns about authenticity, product quality, and safety are paramount. Implementing BFT solutions offers organic food producers and retailers a strategic tool to increase transparency and accountability in their supply chains, ultimately improving consumer confidence. By allowing consumers to access verifiable information about the origins, production methods, and handling of organic products, businesses can address issues of information asymmetry—where consumers typically lack knowledge about product quality—and build more vital trust. This transparency can differentiate organic products in a crowded marketplace and potentially justify premium pricing, as consumers perceive traceable, trustworthy organic foods to be of higher value. To ensure consumers have the highest intention to purchase, it is crucial that businesses not only adopt blockchain technology but also actively communicate its benefits through consumer-friendly interfaces, educational content, and marketing campaigns that emphasize how blockchain enhances product authenticity and quality.

Moreover, the role of TA in moderating the influence of blockchain on consumer trust and purchase intention underscores the importance of implementing strategies that minimize consumer apprehension toward new technologies. To effectively leverage blockchain technology, businesses must focus on reducing TA through initiatives that make blockchain systems more approachable and user-friendly. Providing clear, accessible explanations of how blockchain improves food safety and quality, alongside interactive tools or tutorials that guide consumers through the blockchain process, can alleviate concerns and build confidence. Offering robust customer support and integrating feedback mechanisms will further address consumers' specific fears about the technology. Marketing strategies should highlight successful case studies using blockchain effectively to ensure transparency in the food industry, thereby showing consumers tangible benefits and positive outcomes. By mitigating TA and ensuring that consumers understand the value of blockchain, businesses can maximize its positive effects on consumer trust and, ultimately, on purchase intentions under various conditions. Additionally, simplifying the user interface of blockchain platforms and ensuring they are intuitive for all consumers, regardless of their technical expertise, will further reduce TA and enhance the likelihood of adoption.

Policymakers are vital in promoting blockchain technology within

the organic food industry, particularly by establishing industry-wide standards and encouraging widespread adoption. By endorsing blockchain as a standard for food traceability, governments can improve transparency and ensure that consumers can access trustworthy and verifiable information about the food they purchase. Policymakers can further facilitate blockchain adoption by offering incentives such as tax breaks or subsidies to businesses that implement traceability systems and by recognizing companies that lead in transparency efforts. Additionally, public campaigns led by policymakers that highlight the benefits of blockchain for food safety and quality assurance can raise consumer awareness and encourage greater trust in organic food products. Government initiatives could also focus on creating a unified regulatory framework for blockchain technology in the organic food sector, ensuring consistency across the industry. Through education, regulation, and incentives, policymakers can play a crucial role in accelerating the adoption of blockchain technology, ensuring that the organic food market becomes more transparent, reliable, and aligned with consumer expectations for product authenticity.

### 6.3. Limitations and future research perspectives

While our study offers valuable viewpoints on consumer trust and purchase intentions, several limitations should be acknowledged. These limitations also present opportunities for future research to refine and extend our findings.

Firstly, our study's cross-sectional design limits the ability to establish causality. Although significant relationships were found between blockchain technology, trust, and purchase intention, whether these relationships persist over time remains uncertain. Cross-sectional studies provide only a snapshot in time, and without a temporal perspective, the directionality of these relationships can be questioned (Rindfleisch et al., 2008). Future research could employ longitudinal designs to observe changes in consumer trust and purchase intentions as they interact with blockchain-based traceability systems. Longitudinal studies help confirm the stability and causality of these relationships by tracking consumer behaviors and attitudes over time (Achu et al., 2024; Bala, 2020). Secondly, our sample was drawn from a specific region in Vietnam, potentially limiting the generalizability of our findings to other contexts. Vietnam's cultural, economic, and regulatory context may differ significantly from the other areas, influencing how consumers perceive and adopt blockchain technology (Hofstede, 2001). Future studies also can replicate this research in different geographical and cultural settings to validate the findings across diverse contexts. Comparative studies across various regions would provide a more comprehensive understanding of how local factors—such as cultural values and regulatory environments—impact the effectiveness of blockchain-based traceability systems (Khan et al., 2024).

Thirdly, our study focused on TA as a moderating factor, but other psychological and demographic variables may also influence consumer trust and purchase intentions. Prior research has highlighted those factors such as age, education level, familiarity with technology, and personal values regarding food safety and sustainability play crucial roles in shaping consumer behavior (Pandey et al., 2023; Xu et al., 2024). Future research should explore these variables to understand better the factors influencing consumer acceptance of blockchain-based traceability systems. Including these variables would offer a more detailed consumer behavior analysis, capturing how consumer segments respond to blockchain technology (Strebinger & Treiblmaier, 2024). Additionally, the reliance on self-reported data introduces the potential for social desirability bias and other response biases (Larson, 2018). While self-reported measures are common in consumer behavior research, they can sometimes diverge from actual behavior, as consumers may overstate their intentions to align with socially desirable responses (Podsakoff et al., 2012). Future studies could complement self-reported data with behavioral measures, such as tracking actual purchase data or conducting field experiments, to provide more robust evidence of the

influence of BFT on consumer behavior. Using observational or experimental methods can offer more reliable insights into how blockchain technology influences consumer actions, validating self-reported intentions with observed behaviors (Gopalan et al., 2020).

Lastly, while our study highlighted the importance of addressing TA, it did not explore specific interventions to mitigate this anxiety. Maduku et al. (2023) suggest that targeted interventions, such as educational programs or user-friendly interface designs, can help reduce anxiety around new technologies. Future research should develop and test targeted interventions to reduce TA, such as educational programs, user-friendly interface designs, and comprehensive customer support. Experimental studies evaluating the effectiveness of these interventions would provide valuable insights into how businesses can enhance consumer comfort and acceptance of blockchain technology. Interventions like interactive tutorials or personalized customer support could prove instrumental in alleviating technology anxiety (van Orden et al., 2022), thereby fostering greater consumer adoption of blockchain-based systems.

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### CRedit authorship contribution statement

**Cong Doanh Duong:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Formal analysis, Data curation, Conceptualization. **Thi Van Hoa Tran:** Software, Resources, Project administration, Methodology, Investigation, Funding acquisition. **Thanh Hieu Nguyen:** Validation, Supervision, Software, Resources, Project administration, Methodology. **Thi Viet Nga Ngo:** Visualization, Validation, Software, Resources, Methodology, Investigation, Funding acquisition. **Trong Nghia Vu:** Visualization, Supervision, Software, Resources, Methodology, Investigation.

### Declaration of competing interest

The author(s) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

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