Research article

"If you don't buy it, it's gone!": The effect of perceived scarcity on panic buying

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Abstract: To identify the mechanisms by which perceived scarcity affects consumers' panic-buying behaviours and to explore the underlying reasons for panic-buying. Building on signalling theory and scarcity theory, we constructed a model of panic-buying behaviour. In total, 361 sources of valid data were collected via online questionnaires, and partial least squares structural equation modelling was employed for the empirical analysis. In the context of COVID-19, perceived scarcity significantly and positively influenced the macro signals, for example, by impacting perceived value and perceived competitiveness. Furthermore, perceived scarcity significantly affected consumers' micro signals, such as their perceived anxiety and perceived uncertainty. In combination, perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty significantly and positively influenced consumers' panic-buying behaviours. Trust in the government also played a significant role by regulating consumers' micro signals and macro signals. The originality of this paper lies in its in-depth exploration of the multiple impacts of scarcity on consumer perceptions and it reveals the reasons for panic-buying behaviours. In doing so, it provides practical guidelines and understanding for consumers, businesses and the government.

Keywords: panic buying; scarcity; signalling theory; consumer internal state; government trust

1. Introduction

Public health events, such as the Black Death [1], the Ebola virus [2], SARS [3] and COVID-19 [4],

have a profound and far-reaching impacts on national economies, political security and social stability. As everyone is well aware, the most recent public health event, COVID-19, has impacted the entire world for over three years since its initial outbreak. This has threatened the political and economic stability of nations and triggered a global economic recession. In addition to endangering people's lives, COVID-19 has set in motion significant negative impacts on individuals, families and social stability. Many countries have adopted policies such as quarantine, travel restrictions and self-imposed quarantine to control the spread of COVID-19. This has led to massive business shutdowns and labour losses, further impacting global industry and supply chains [5]. The economic insecurity, stress and uncertainty brought about by COVID-19 have also fuelled fears of domestic violence. During the COVID-19 period, a study found that parental job loss was a significant risk factor for child maltreatment, which included psychological and physical abuse [6]. A survey of 6,854 USA and Canadian adults showed that COVID-19 also had a strong negative effect on people's emotional and psychological well-being. The number of people psychologically affected far exceeded the number of people actually infected by COVID-19 [4]. This study confirmed that about 38% of respondents felt moderately distressed by the emotional stress caused by COVID-19, while about 16% of respondents felt highly distressed. In addition, survey data from China indicated that the outbreak posed a serious threat to people's mental health, precipitating psychological burdens such as panic, anxiety and depression [7]. This report analysed 52,730 valid questionnaire responses and found that almost 35% of respondents were suffering from psychological distress as a result of the epidemic, with more than 5% of them experiencing severe psychological distress. The uncertainty, severity and scarcity brought about by COVID-19 meant that consumers were more likely to engage in panic-buying behaviours. They were trying to alleviate the anxiety caused by the crisis by hoarding large quantities of goods [8].

Panic buying describes the behaviour that occurs when consumers, predicting a shortage of goods due to an unexpected event and based on their perceptions of real-life events, buy large quantities of commodities without taking their usual requirements as the standard [9]. Panic buying tends to occur frequently during a public health emergency, such as in China, the UK, Australia and many other countries. People crowd into supermarkets to stock up on whatever they perceive to be essential, and COVID-19 precipitated many such buying sprees. Wuhan (February 2020) and Shanghai (April 2022) both saw panic-buying behaviours when the government instituted controls in the face of COVID-19. In Britain, the outbreak also caused people to become concerned about food shortages. This triggered panic buying on a massive scale, adding £1 billion to the value of food [5]. The panic buying of large quantities of toilet paper in many countries, such as the USA and Singapore, received widespread media and academic attention [10]. Although panic-buying behaviour can ease consumers' psychological anxiety and mitigate perceived threats, it also causes genuine shortages of products and ultimately exacerbates public anxiety [11]. It has been shown that both macro-signal factors and consumers' micro-signal factors contribute to panic-buying behaviours. Macro-signal factors include disruptions to product supply [12], government interventions [13] and the spread of misinformation on social media [14]. All of these factors significantly and positively affect the panic-buying behaviour of consumers. Consumers' micro-signal factors include their physiological needs [15], anxiety [8] and perceptions of scarcity [16]. Any of these can encourage irrational panic buying by consumers.

Among the various macro and micro factors, scholars have found that consumers' perception of scarcity is the most critical factor leading to their panic-buying behaviours [16,17]. Perceived scarcity refers to consumers' subjective perceptions of a lack of products and resources [18]. Existing research has mainly focused on consumer panic buying in a general retail environment but less often as

prompted by sudden public health events. Research confirms that a scarcity of products and resources will increase their value as perceived by consumers [18], thus affecting the decision-making process. A survey of consumers in the travel industry shows that, where consumers have power and status, scarcity strengthens their purchase intention [19]. Research is still limited in relation to panic-buying behaviour during COVID-19. There is not only a limited number of such studies, but there is also insufficient in-depth exploration of how scarcity affects panic-buying behaviour. There is no effective explanation for the mechanism of action between the two factors. Furthermore, despite the fact that the COVID-19 containment in China ended in December 2022, people's panic-buying behaviours have continued. Therefore, there is a need for further research into the mechanisms affecting panic-buying behaviour during and after public health emergencies. Therefore, we put forward the following two questions:

1) *How does perceived scarcity affect consumers' panic-buying behaviour?*
2) *How does perceived trust in the government interact with consumer psychology and panic buying?*

This study involved employing signalling theory and scarcity theory to build a model of consumer panic-buying behaviour. We have divided the signals affecting consumers into macro and micro signals. We categorize perceived value and perceived competitiveness as macro signals and perceived anxiety and perceived uncertainty as micro signals. In existing studies on panic-buying behaviour, perceived scarcity is considered to be the key to its occurrence. This paper argues that there is a deep mechanism connecting panic-buying behaviour with perceived scarcity and that several macro and micro factors may be significant contributors to that mechanism. Therefore, this paper focuses on exploring consumers' macro signals, including perceived value and perceived competitiveness, and also their micro signals, which include perceived anxiety and perceived uncertainty. Furthermore, the paper explores whether the level of trust in the government affects the macro and micro signals differently. For this study, a questionnaire-based survey was conducted. Partial least squares structural equation modelling (PLS-SEM) was used to analyse the data. The study explores consumers' persistent panic-buying behaviour under the influence of COVID-19, as distinct from the research conducted into panic buying in the early stages of COVID-19. The study enriches research findings in the fields of scarcity and panic buying, and it helps to reveal the underlying mechanisms by which scarcity impacts consumer panic-buying behaviour. It also provides suggestions for consumers, businesses and governments, so they can respond better to the panic-buying behaviour triggered by public health emergencies.

This paper is divided into the following main sections. The first section is an introduction, in which we state the background on the current research on panic buying. The second section is a literature review, in which we provide a review of studies on panic-buying behaviour and perceived scarcity in the context of COVID-19. In the third section, we develop a model using signalling theory and scarcity theory, and we propose a hypothesis for testing whether perceived scarcity affects the macro signals and micro signals received by consumers, which in turn affect panic-buying behaviour. In addition, the paper explores the moderating role of perceived trust in the government in terms of how it affects the relationship between consumer influences and panic buying. The fourth section describes the research design. The fifth section presents the data analysis, where we evaluate the validity of the model by using measurement and structural models, and we explore the moderating role of trust in the government by using multi-group analysis. The sixth section is the discussion, wherein we discuss the findings. The seventh section presents the contribution made and its significance. The

eighth section deals with limitations and future research. Finally, the paper concludes with a summary of the full paper.

2. Literature review

During previous public health emergencies, panic-buying behaviour by consumers has been a frequent occurrence in many countries [9]. Islam et al. [20] argue that, fundamentally, consumers experience anxiety and fear both before and during a panic-buying process due to their perceived scarcity of both the time needed to shop and the future availability of products. The resulting scarcity of products further exacerbates consumers' fears and contributes to more panic buying. Moreover, Blocker et al. [21] point out that external resource shocks can affect the resource dynamics of individual consumption adequacy. Resource shocks are considered as disruptions in access to or use of resources caused by sudden events, such as earthquakes, volcanic eruptions, COVID-19 and so on [21]. COVID-19, as such a 'shock', greatly influenced consumers' panic-buying behaviours. In April 2022, a major outbreak occurred in Shanghai, China, leading to a surge in infections. Out of anxiety and fear of the unknown, a large number of residents stocked up on essential items, such as fruits, vegetables, masks and toilet paper, either offline or through online platforms, in response to the threats posed by the outbreak. This caused a rapid shortage of supplies. The scarcity of products further exacerbated consumers' fears and intensified the occurrence of the panic-buying behaviour. Panic buying refers to the situation in which the purchase of one or more necessities of life far exceeds the normal requirements [22]. This tends to happen when a major disaster has occurred or may occur [16]. In the early stages after the outbreak of COVID-19, Yuen et al. [9] confirmed that when consumers anticipate a disaster, they are likely to exhibit panic-buying behaviour and purchase an excessive quantity of products.

During COVID-19, panic-buying behaviour was not only harmful, but it spread quickly, affecting a wide range of areas. It occurred in various countries, frequently prompting unrest and affecting social stability. Scholars have shown that both macro factors and consumers' micro factors are major reasons for panic-buying behaviours [12]. Macro-signal factors, such as disruptions in the supply of goods and services, can exacerbate consumer fears and cause them to stock up on products. Research done by Prentice et al. [13] has shown that government intervention can be an important macro-signal factor affecting panic-buying behaviour. The majority of respondents from Australia, India, China, Vietnam and Indonesia agreed that government interventions regarding the outbreak, such as strict travel controls and daily infection screenings, were important factors that led them to panic buying [13]. Conversely, government support and reassurance, such as financial support and effective management, gave people a sense of security and greatly reduced the likelihood of panic-buying behaviours. Ahmad and Murad [14] have pointed out that social media spread a great deal of fear and anxiety in relation to COVID-19, potentially causing damage to mental health. While information on social media can help consumers make informed decisions, it can also make them anxious, leading to panic-buying behaviours [23]. In addition, existing research suggests that the social learning effect generated by the multiple reference groups around consumers is also an important external factor influencing consumers' panic-buying engagement [13].

In addition to these macro-signal factors, consumers' own micro-signals have a significant influence on their panic-buying behaviours. In the early stages after the COVID-19 outbreak, numerous scholars studied panic buying. Using Maslow's motivation and survival theories, Yuen et al. [15] constructed a consumer panic-buying model. This shows that consumers' needs for survival, safety,

socialization and respect have varying degrees of impact on their panic-buying behaviours [15]. Other studies show that, due to the uncertainties of an epidemic, consumers will be prone to anxiety and that this will lead to panic-buying behaviours [8]. Arafat et al. [16] conducted a content analysis of media reports and found that about 75% of the reports concluded that consumer perception of scarcity was the most significant reason for their panic-buying behaviours. Other scholars have confirmed that perceived scarcity can influence consumers' panic-buying during tendencies a public health emergency. The stronger the perception of scarcity, the more likely it is that panic buying will occur [8,24].

Taking China as an example, under the continuous impact of COVID-19 over three years, the impact of perceived scarcity was different from that during the earlier COVID-19 period due to the intermittent and uncertain closures and control of cities. Perceived scarcity was continuously reinforced in the minds of consumers and gradually became an important signal influencing consumer panic buying. In recent years, due to the impact of COVID-19, there has been a gradual increase in research exploring the impact of perceived scarcity on panic-buying behaviour in the context of sudden public health events [25]. However, there are still some limitations of the existing studies. On the one hand, most existing studies discuss the joint effect of perceived scarcity and other variables on panic-buying behaviour [15], but they lack focus on perceived scarcity. As perceived scarcity clearly plays a very important role in the occurrence of panic-buying behaviour, it is important to focus on the mechanisms of the perceived scarcity variables in influencing panic-buying behaviour. On the other hand, most of the existing studies have explored the direct or single-weighted indirect effects of perceived scarcity on panic buying [11,20], with little research examining the deeper mechanisms by which perceived scarcity affects consumers' panic-buying behaviours. This paper argues that the existing literature is unable to effectively explain how perceived scarcity affects panic buying in relation to the persistent effects of the COVID-19 outbreak and that the mechanism of interaction between the two needs to be explored in greater depth. On this basis, the paper argues that consumers' internal psychological states may be an important element in revealing this mechanism, as well as a key factor that determines the influence of perceived scarcity on panic buying. In addition, existing research has not explored the moderating role of the level of trust in the government in the relationship between perceived scarcity and panic-buying behaviour. The perceived level of trust in the government not only influences consumers' decision-making processes, but it also contributes to effective governmental decision-making.

3. Development of the theoretical model and hypotheses

3.1. Development of the theoretical model

Signalling theory describes the facts that, in the context of COVID-19, the information received is uncertain and that consumers are surrounded by a variety of different signals, which we classify as macro and micro signals. Under the primary signal of perceived scarcity, the macro signals refer to consumers' perceptions of the value of goods and the impact that their perceptions of the competitive landscape has on themselves in the macro environment. Micro signals refer to consumers' perceptions of uncertainty about the future and their anxieties in the micro domain.

Scarcity theory explains how people react and decide when they are faced with scarce resources [26]. From an economic perspective, scarcity refers to the limited availability of resources or non-renewable resources [27]. Currently, this theory is mainly used in the fields of mathematics, business economics,

engineering, computer science and ecology. In certain situations, scarce products are particularly attractive to consumers. However, the scarcity of the same product may vary in different situations, resulting in different consumer responses. Studies have shown that people's perceptions will be influenced by a scarcity of external products [28]. For example, daily necessities became scarce during COVID-19 because cities were locked down due to the pandemic. Under such circumstances, there will be panic buying, resulting in further scarcity of products. However, when an item is a luxury item, its scarcity is unlikely to cause panic buying, regardless of changes in the macro signals.

As shown in Figure 1, we constructed a model of panic-buying behaviour based on signalling theory and scarcity theory. First, in Stage 1, we investigated the mechanisms of perceived scarcity in relation to the macro and micro signals, including perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty. In Stage 2, we studied how this mechanism prompted panic-buying behaviour. Next, we studied the moderating effects of high and low levels of trust in the government on the four factors mentioned above and panic-buying behaviour.
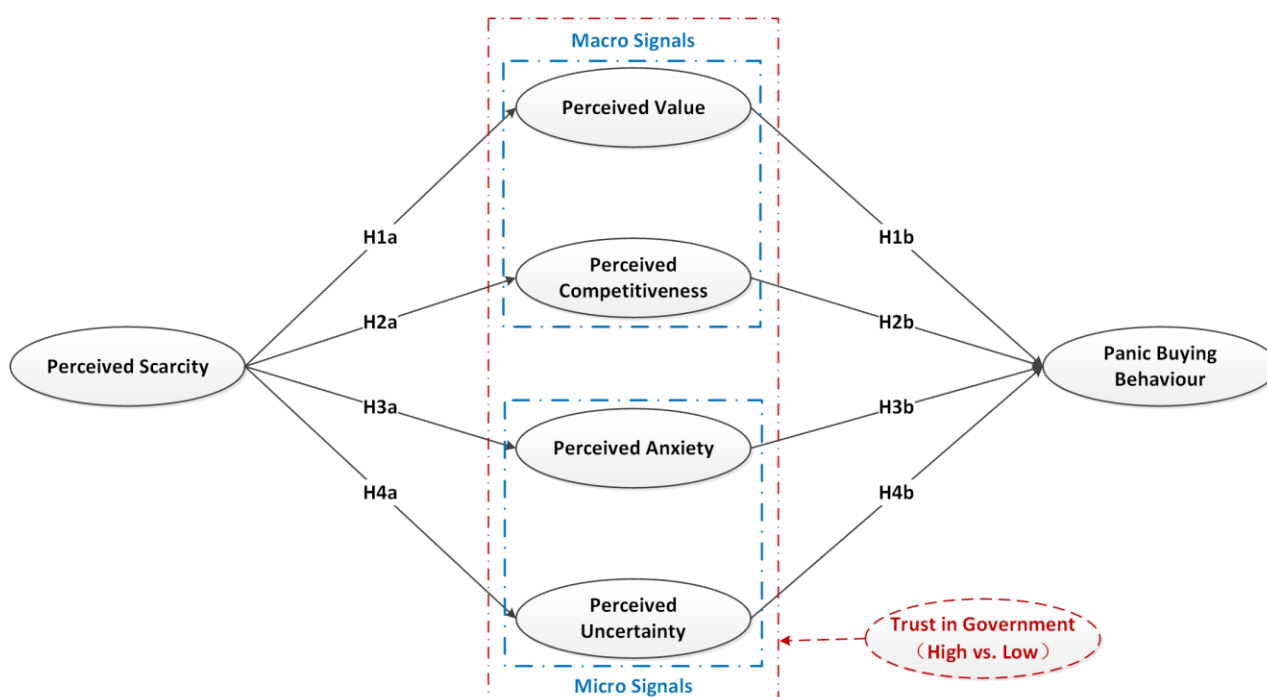
Figure 1. Research model.

3.2. Development of hypotheses

3.2.1. Macro signals

Perceived value describes consumers' evaluation of goods or services once they have balanced them against their own requirements [29]. Consumers often have different perceptions of the value of a particular product due to their own inner and environmental conditions [30]. According to the commodity theory proposed by the psychologist Brock [31], scarcity enhances the value of any product that can be valued. Studies with different types of people have found that participants with high levels of narcissism have a stronger preference for scarce products than those with low levels of narcissism.

For narcissists, perceived scarcity significantly increases their perception of a product's value [32]. Other studies have also shown that perceived product scarcity strengthens consumers' value perceptions of a product [18]. In the context of the epidemic, people's perceptions of the scarcity of certain items were enhanced by the spreading of various rumours, and the practical value of those items was amplified in people's minds [33]. Therefore, we hypothesise the following:

H1a. Perceived scarcity significantly and positively affects perceived value.

In the process of considering and selecting products, the more consumers appreciate the value of particular products, the more likely they are to exhibit purchasing behaviours [34]. Jeong and Ko [35] showed that, for the consumer, perceived value is positively moderated by sustainable fashion and purchase intention. Molinillo et al. [36] demonstrated and confirmed this conclusion. During the COVID-19 outbreak, panic buying associated with psychological reactions emerged in several countries [37]. A large number of consumers hoarded daily necessities to avoid anticipated threats of scarcity [9]. Therefore, we contend that, in a situation in which there is an outbreak of an epidemic with possible shortages of material goods, consumers will perceive the products as having higher value, and their panic-buying behaviours will increase. Therefore, we hypothesise the following:

H1b. Perceived value significantly and positively affects panic-buying behaviour.

Perceived competitiveness refers to consumers' sense of being in competition with other consumers to achieve specific goals in a consumption scenario [38]. The components of perceived competitiveness include the presence of other competitors and anticipation anxiety. Competitive consumers enjoy the competitive process and hope to succeed over other consumers in the competition for products, thus differentiating themselves from others [39]. Existing studies have proven that scarcity can effectively awaken consumers' perceived competitiveness [40]. When a product is scarce, it not only increases consumers' desire to obtain the product, but it also makes them feel competitive with other consumers over their desire to obtain the product. Singh et al. [41] have discussed the mechanism by which perceived scarcity affected perceived competitiveness during COVID-19. This study confirms the view that perceived competitiveness is significantly enhanced by scarcity. Therefore, the stronger consumers' perceptions of product scarcity, the more likely it is that their internal competitiveness will be stimulated. Thus, we propose the following:

H2a. Perceived scarcity significantly and positively affects perceived competitiveness.

Under conditions of scarcity, consumers with highly competitive traits show stronger purchase desire [42]. Aggarwal et al. [43] show that perceived scarcity and purchase intention are mediated by consumers' perceived competitiveness. The stronger their perceived competitiveness, the stronger the purchase intention of consumers [43]. In addition, when consumers perceive a scarcity of resources, people with greater hedonistic shopping motivation, who are both competitive and have unique needs, are more likely to exhibit panic-buying behaviours [44]. Singh et al. [41] confirmed the findings of ÇInar [44], which showed that perceived competitiveness, generated by scarcity during the COVID-19 pandemic, could significantly and positively influence customers' panic-buying intentions. Therefore, we believe that the stronger the perceived competitiveness of consumers, the more likely it is that they will resort to panic-buying behaviour. Thus, we propose the following:

H2b. Perceived competitiveness significantly and positively affects panic-buying behaviour.

3.2.2. Micro signals

Anxiety is an emotional state caused by external environmental stimulation and internal negative

cognition [45]. As the COVID-19 pandemic swept around the globe, many countries imposed crowd control in shopping malls and other public places, which affected the mental health of people around the world [46]. A survey showed that the prevalence of anxiety among medical workers during the COVID-19 epidemic was as high as 300% [47]. Sterman and Dogan [48] experimented with consumer ordering and found that consumers would feel anxious when faced with a possible shortage of goods and would purchase more goods than needed. Sim et al. [37] found that perceived scarcity affected anxiety during the COVID-19 pandemic. Omar et al. [8] confirmed that perceived scarcity can positively affect anxiety and lead significantly to panic-buying behaviour. Therefore, we propose the following:

H3a. Perceived scarcity significantly and positively affects perceived anxiety.

Research has found that anxiety sensitivity is an important risk factor for negative emotional arousal. To relieve the negative emotions caused by anxiety, consumers have a stronger tendency to shop [49]. In the context of COVID-19, consumers around the world hoarded goods out of panic to reduce their anxiety and other negative emotions [9,37]. Consumers tend to regard panic buying as an important means of relieving anxiety [9]. Omar et al. [8] also showed a significant correlation between perceived anxiety and panic-buying behaviour. The stronger the perceived anxiety, the more likely consumers are to resort to panic buying. Hence, it is believed that resource scarcity can significantly stimulate consumers' anxiety, causing them to engage in panic-buying behaviour to reduce their negative emotions and feel in control in a crisis. Therefore, we propose the following:

H3b. Perceived anxiety significantly and positively affects panic-buying behaviour.

Perceived uncertainty refers to the psychological state of an individual who doubts whether a future expectation is true [50]. This state is caused by the individual's conscious sense of being ignorant about something [51]. A study of corporate resources shows that companies are threatened not only by scarcity in their product offerings, but also by future uncertainty [52]. Medical resources were faced with potential scarcity during the COVID-19 pandemic, which caused a great deal of uncertainty at both the social and individual levels [53]. The perceived uncertainty mentioned in this paper refers to consumers' doubts about whether the products and resources they need can be adequately obtained in a timely manner. Greater perceived scarcity has a higher likelihood of being accompanied by more intense uncertainty. Therefore, we hypothesise the following:

H4a. Perceived scarcity significantly and positively affects perceived uncertainty.

Xu and Sattar [54] found that fresh COVID-19 outbreaks could make the public feel insecure and damage their mental health. Scholars have pointed out that people cope with uncertainty through cognitive avoidance and even through abusing drugs to reduce their fear of uncertainty [51]. Panic buying is another important means by which people deal with uncertainty [55]. A study by Aljanabi [56] proved that consumers reduce the anxiety caused by perceived uncertainty through panic-buying behaviours and the hoarding of goods. This conclusion is consistent with the research results of Dickins and Schalz [57], which demonstrate the significant and positive impact of shopping and hoarding. This paper argues that the anxiety related to product availability during an outbreak and the resulting uncertainty regarding resources can prompt consumers to take action. Therefore, we hypothesise the following:

H4b. Perceived uncertainty significantly and positively affects panic-buying behaviour.

3.2.3. Trust in the government as a moderator

Trust refers to a person's dependence on and feeling of security in relation to someone or something else [58], as well as confidence in their expectations of the other party. When people have confidence and satisfaction in the performance of their government, they will show trust in the government [59], and their behaviours will more closely follow governmental policies, regulations and instructions [60]. Wong and Jensen [61] found that governments attach importance to public trust in risk management. Prati et al. [62] found that the actions suggested by the government to control the spread of H1N1 influenza happened more easily when people trusted the government. A study in Poland showed that trust in the government reduced by 22% the fear and other negative emotions caused by food restrictions during the COVID-19 pandemic [63]. Therefore, this paper argues that trust in the government can be a regulating variable that affects both the micro and macro signals. The higher the level of people's trust in the government, the more other negative emotions, such as fear, will be reduced and the more the impact of both the micro and macro signals on panic-buying behaviours will be reduced. The lower the level of trust in the government, the more difficult it is to reduce negative psychological factors such as fear, and control the effects of perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty on panic buying. This is expressed in the following hypothesis:

H5. *Trust in government moderates the variables of the macro and micro signals.*

4. Research design

An online questionnaire survey was used to collect the data. The scale was modified and adjusted according to the characteristics of panic-buying behaviour. The questionnaire was answered on a 7-point Likert-type scale. In addition, the demographic information of the respondents was collected. This experiment mainly explored whether perceived scarcity would affect consumers' macro and micro signals, and it explored the internal mechanisms of the consumers' panic-buying behaviours. The sample for this experiment needed to meet the following conditions: First, they needed to be over 18 years of age. Second, they needed to have been affected by the epidemic. Third, they must have had at least one supermarket or online shopping experience in the past year.

We conducted two rounds of pre-testing to ensure that the questionnaire was effective. For the first round of the pre-test, we recruited 10 college student volunteers who met the requirements. This round aimed to test the rationality and clarity of the questionnaire. Based on the feedback received, we revised some of the questions. We then conducted a second round of pre-testing using a sample service. A total of 30 questionnaires were collected and their reliability and validity were preliminarily tested. We then further adjusted and optimized the design of the questionnaire items accordingly and invited experts to review them. Finally, we settled on the formal questionnaire (as shown in Appendix).

Participants were informed about the details of the study, including its purpose and process. The questionnaires were distributed and 477 completed questionnaires were collected. Questionnaires that had been answered in less than 5 minutes, questionnaires in which answers consistently focused on a particular choice and questionnaires in which the choices showed an obvious regularity or in which reverse questions were answered incorrectly were eliminated. After 116 invalid responses were eliminated, a total of 361 valid questionnaires were obtained. These were then divided into two groups according to the trust levels of the subjects, yielding 177 valid questionnaires with a low level of trust

and 184 valid questionnaires with a high level of trust (Table 1). The proportion of male and female respondents was balanced and conformed to the demographics. Respondents were also evenly distributed across age groups. In addition, more than half of the respondents in this survey had a bachelor's degree.

Table 1. Respondent statistics, N = 361.

Measure	Category	N	Percent
Gender	Male	171	47.37%
	Female	190	52.63%
Age	18–25	53	14.68%
	26–35	76	21.05%
	36–45	89	24.65%
	46–55	52	14.40%
	56–65	51	14.13%
	Over 65	40	11.08%
Education	College	83	22.99%
	Bachelor's Degree	217	60.11%
	Post Graduate Degree	61	16.90%
Perceived Trust	Low	177	49.03%
	High	184	50.97%

Nonresponse bias refers to the fact that respondents who do not respond bias the results. We addressed this issue by comparing the age and gender of the respondents collected in the early versus the later period [64]. We defined the 189 people who completed the questionnaire earlier as early respondents and the 172 people who completed the questionnaire later as late respondents. A t-test revealed no significant difference between the early and late respondents in terms of gender or age ($t >$ 1.960), so we excluded the effect of a non-response bias.

Our model consists of two distinct stages. In the first stage, we explore the effect of perceived scarcity on four factors, namely the consumers' macro signals and micro signals. In the second stage, we further explore the effects of these factors on consumers' panic-buying behaviour. In addition, our model incorporates trust in the government as a moderating variable. Thus, our study is exploratory, focusing on exploring the internal mechanisms of panic buying. Structural equation modelling (SEM) is a multivariate statistical technique that combines factor and path analyses. Its advantage lies in its ability to conduct a quantitative study of the interactions between multiple variables. There are two main reasons for our selection of SEM. First, it can reveal the driving force of the analysis in three dimensions and at different levels. This multilevel causal relationship is more suitable for the complex research scenarios explored in this study, and it can simultaneously estimate the factor structure and the factor relationships, which is difficult to achieve through traditional regression analysis. Second, this study involves a number of latent variables that cannot be directly measured, and SEM is able to deal with these latent variables and their indicators and, at the same time, provide a process for conceptual modelling and verification.

Further, we employed PLS-SEM for our data analysis mainly because this method is suitable for

the complex structural model employed in this study and also for exploring the mechanism and model of panic-buying behaviour based on signalling theory and scarcity theory. In addition, PLS-SEM was considered appropriate for exploring the relationships described in the model. First, it is effective in performing traditional linear regression analyses for small samples and problems with multiple correlations. Second, it has no specific requirement for data distribution and can manage errors caused by variable measurements. Therefore, we used SmartPLS 3.3.9 software and PLS-SEM to verify our hypotheses.

5. Data analysis

5.1. Measurement model

First, we evaluated the measurement model. This included evaluating the content validity, convergent validity and discriminant validity. Content validity tests the internal consistency and reliability of the indicators. The Cronbach's alpha (CA) of all latent variables exceeded 0.734 and the composite reliability (CR) of all latent variables exceeded 0.849, both of which therefore exceeded the standard that conforming data must be greater than 0.7 [64] (Table 2). In addition, all outer loading values exceeded 0.708 (Table 3). This indicated that the content validity of the model was high.

Table 2. Construct reliability and validity.

	CA	CR	Average Variance Extracted
Panic Buying (PB)	0.855	0.912	0.775
Perceived Value (PV)	0.807	0.886	0.721
Perceived Competitiveness (PC)	0.734	0.849	0.652
Perceived Anxiety (PA)	0.858	0.913	0.779
Perceived Uncertainty (PU)	0.823	0.894	0.738
Perceived Scarcity (PS)	0.870	0.920	0.794

Table 3. Cross loadings and outer loadings.

	PB	PV	PC	PA	PU	PS
PB.1	**0.891**	0.494	0.598	0.424	0.404	0.339
PB.2	**0.887**	0.522	0.604	0.474	0.484	0.310
PB.3	**0.863**	0.532	0.574	0.355	0.370	0.339
PV.1	0.533	**0.873**	0.539	−0.024	0.427	0.200
PV.2	0.477	**0.823**	0.494	−0.080	0.366	0.164
PV.3	0.480	**0.851**	0.518	−0.027	0.471	0.164
PC.1	0.517	0.532	**0.806**	0.237	0.290	0.330
PC.2	0.589	0.497	**0.809**	0.154	0.308	0.297
PC.3	0.523	0.449	**0.808**	0.232	0.256	0.368

	PB	PV	PC	PA	PU	PS
PA.1	0.405	−0.076	0.213	**0.878**	0.206	0.320
PA.2	0.439	−0.036	0.224	**0.889**	0.207	0.294
PA.3	0.418	−0.021	0.239	**0.880**	0.189	0.306
PU.1	0.397	0.453	0.313	0.118	**0.851**	0.197
PU.2	0.440	0.427	0.314	0.272	**0.885**	0.245
PU.3	0.394	0.401	0.283	0.186	**0.841**	0.201
PS.1	0.328	0.174	0.366	0.313	0.239	**0.893**
PS.2	0.338	0.212	0.387	0.274	0.229	**0.893**
PS.3	0.332	0.171	0.343	0.342	0.201	**0.886**

Note: Bold numbers indicate outer loadings on the assigned constructs.

Next, we used the average variance extracted (AVE) to evaluate convergent validity. The AVE values of all indicators exceeded 0.8, indicating that the convergent validity of the model was good [65]. Finally, we used the square root of all AVE values and heterotrait–monotrait ratio (HTMT) to evaluate the model's discriminant validity. The square root of all AVE values exceeded the correlation coefficients of the other potential variables (Table 4), and all HTMTs were less than 0.85 (Table 5), which indicated that the discriminant validity of this model was excellent. In short, all of these results were satisfactory and indicated that the model had good reliability and validity [66].

Table 4. Fornell-Larcker criterion results.

	PB	PV	PC	PA	PU	PS
PB	**0.880**					
PV	0.586	**0.849**				
PC	0.673	0.609	**0.808**			
PA	0.477	−0.050	0.256	**0.882**		
PU	0.479	0.496	0.353	0.227	**0.859**	
PS	0.374	0.208	0.410	0.347	0.250	**0.891**

Note: Bold numbers represent the square roots of the AVEs.

Table 5. HTMT results.

	PB	PV	PC	PA	PU	PS
PB						
PV	0.704					
PC	0.848	0.792				
PA	0.554	0.065	0.324			
PU	0.567	0.610	0.453	0.266		
PS	0.434	0.247	0.514	0.403	0.294	

5.2. Structural model

Next, we evaluated the structural model. We obtained the model's explanatory power (R^2), the path coefficient and predictive accuracy Q^2 via the bootstrapping algorithm of the SmartPLS 3.3.9 software. It was necessary to first check for collinearity among the indicators. The R^2 value exceeded 0.75, indicating strong explanatory power. An R^2 value between 0.50–0.75 indicates moderate explanatory power. An R^2 value of 0.25–0.50 indicates weak explanatory power [67]. Figure 2 shows the standardized path coefficient and the t-value, while the R^2 value for panic-buying behaviour was 0.660, indicating strong support for the model. Generally, Q^2 values of 0–0.25 indicate low correlation; Q^2 values of 0.25–0.5 indicate moderate forecast correlation, and a Q^2 value over 0.5 indicates that the prediction is highly correlated [68]. The Q^2 value for panic-buying behaviour was 0.502, showing that it had a high correlation and a good fit. As shown in Figure 2, the results indicate that all eight paths based on signalling theory and scarcity theory confirmed the hypotheses. The path coefficients for the effect of perceived scarcity on perceived value ($\beta = 0.208$, $t = 3.111$), and for the effect perceived uncertainty on panic buying ($\beta = 0.097$, $t = 2.224$), were lower than the other six path coefficients, but they also passed the test for significance. Therefore, all of the hypotheses in this paper were verified.
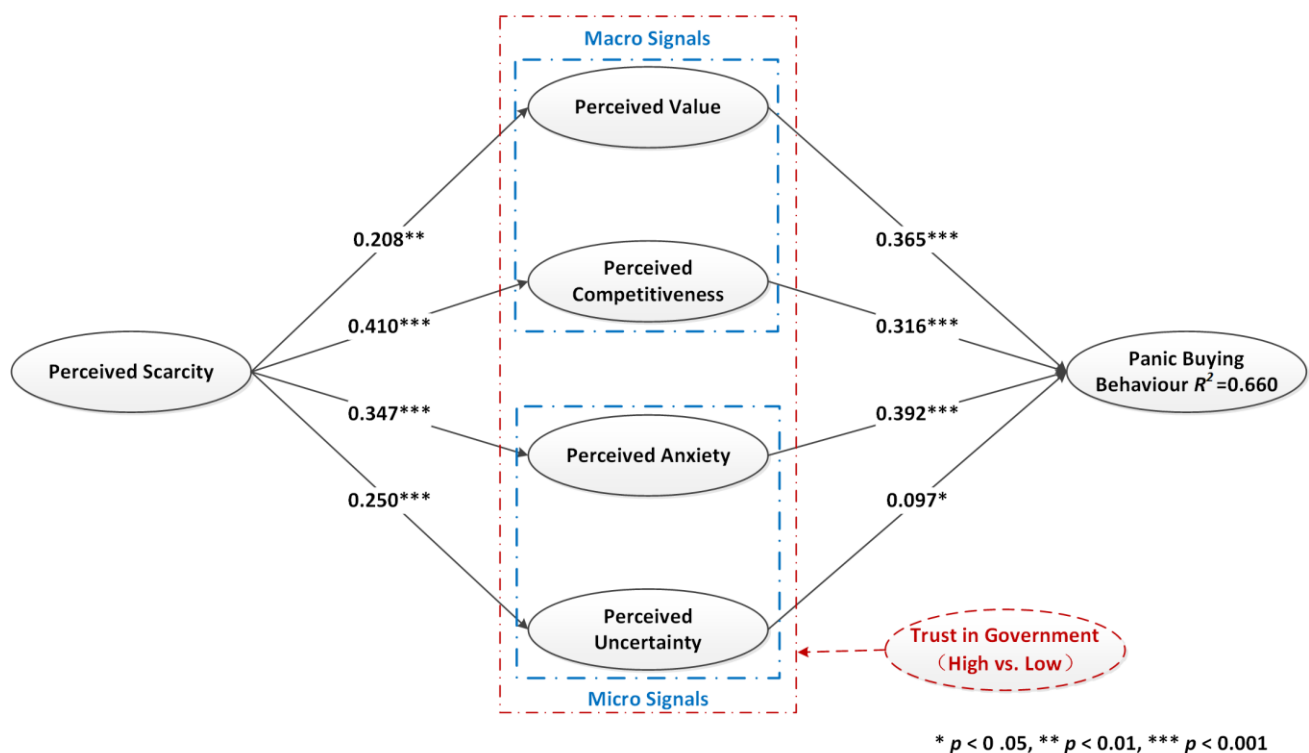
Figure 2. Research model showing results of partial least squares analysis.

5.3. Multi-group analysis

Hair et al. [68] pointed out that partial least squares multigroup analysis (PLS-MGA) can be used to study the moderating effects between variables. Therefore, we used PLS-MGA to analyse whether

trust in the government significantly influenced consumer regulation of micro signals and macro signals, as expressed in the hypothesis H5. Based on the responses to the question about the level of trust in the government, we considered those who selected between 1 and 3 as having a low level of trust. Those who selected from 5 to 7 were considered to have a high level of trust, and we eliminated those questionnaires in which the subjects selected 4, indicating a moderate level of trust. We then compared the two different levels of trust in the government (low vs. high) and used formula (1) to test this. As shown in Table 6, the p value for the effect of government trust on perceived value and panic-buying behaviour was 0.447, which was not significant. The p values for the effect of government trust on perceived competitiveness, perceived anxiety, perceived uncertainty and panic buying were 0.044, 0.002 and 0.013, respectively. This indicates that different levels of trust in the government result in significant differences in these factors.

$$t = \frac{Path_{sample\_1} - Path_{sample\_2}}{\left[\sqrt{\frac{(m-1)^2}{(m+n-2)} \cdot S.E._{sample1}^2 + \frac{(n-1)^2}{(m+n-2)} \cdot S.E._{sample2}^2}\right] \cdot \left[\sqrt{\frac{1}{m} + \frac{1}{n}}\right]}$$

(1)

Table 6. Parametric significance test results.

	Path Coefficients (1 - 2)	**p-Value (1 vs 2)**
PV -> PB	0.117	0.447
PC -> PB	0.405	0.044
PA -> PB	0.290	0.002
PU -> PB	−0.319	0.013

Notes: 1 = Trust in government - low, 2 = Trust in government - high.

Table 7 shows the path coefficients and significance values under the conditions of low and high levels of trust. First, the different levels of perceived trust in the government yielded significant differences between perceived competitiveness and panic buying: $p = 0.023 < 0.05$ is significant for low levels of trust, while $p = 0.077 > 0.05$ for high levels of trust is not significant. Second, different levels of perceived trust in the government yielded significant differences between perceived anxiety and panic buying, with a β value of 0.684 for low levels of trust, which is greater than the β value of 0.394 for high levels of trust. This indicates that under the same conditions of perceived anxiety, consumers with low levels of trust will more easily resort to panic buying than those with high levels of trust. Finally, different levels of perceived trust in the government corresponded to significant differences in relation to perceived uncertainty and panic buying. At low levels of trust, $p = 0.394 > 0.05$, which was not significant, while at high levels of trust, $p = 0.000 < 0.001$, which was significant. It can be concluded that different levels of perceived trust in the government result in significant differences in regulating perceived competitiveness, perceived anxiety and perceived uncertainty, but have no significantly different effect in terms of regulating perceived value.

Table 7. Partial least squares analysis results for two treatment groups.

	β-values (1)	*β*-values (2)	*t*-value (1)	*t*-value (2)	*p*-value (1)	*p*-value (2)
PV -> PB	0.281	0.164	2.529	1.348	0.011	0.178
PC -> PB	0.184	−0.221	2.281	1.769	0.023	0.077
PA -> PB	0.684	0.394	11.427	4.484	0.000	0.000
PU -> PB	0.051	0.370	0.853	3.869	0.394	0.000

Notes: 1 = Trust in government - low, 2 = Trust in government - high.

6. Discussion

There is an intrinsic link between sudden public health events and consumer panic buying. This study used the COVID-19 pandemic as an example to explore the deep-seated mechanisms by which perceived scarcity affects consumer panic buying. We constructed a model of consumer panic-buying behaviour that is based on signalling theory and scarcity theory, and it explores the mechanisms by which macro and micro factors, such as perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty, play a role in consumers' irrational behaviours. In addition, to further explore the influence of trust in the government on consumer behaviour, we also investigated the moderating effect of perceived government trustworthiness on the macro and micro factors and the panic-buying behaviour of consumers. As obtained through empirical analysis, the main findings of this study are as follows:

First, in Stage 1, the results of this study show that perceived scarcity can significantly and positively affect the macro and micro factors of consumers [22], affecting perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty. In the event of an emergency public health event, consumers are likely to have a stronger perception of scarcity. As consumers' perceptions of product scarcity increase, in their minds, the value of the goods will also increase. In addition, consumers are more likely to have a desire to compete with other consumers due to their subjective perceptions of scarcity. They are also more likely to feel negative emotions as a result of commodity scarcity. We found that perceived scarcity has a significant impact on panic-buying behaviour [20]. To summarise, a perception of scarcity not only significantly affects the internal psychological state of consumers [9], but it also causes panic-buying behaviours.

Second, in Stage 2, this study confirms that the macro signals and micro signals received by consumers can significantly and positively affect the consumers' panic-buying behaviours. In relation to the macro signals, the higher the perceived value, the stronger the purchase intention and the more likely the consumer will engage in the corresponding purchasing behaviour [35]. In situations of actual or subjective resource scarcity, consumers are more likely to be aware of the concept of competing with others for those resources, thereby generating higher perceived competitiveness and further influencing panic buying. Consumers' assessment of the perceived value of external products, together with their competitive feelings regarding the products, as caused by an environment of perceived scarcity, triggers their panic-buying behaviour. In relation to the micro signals, they are more likely to feel anxious and have uncertainties about the future [41]. The source of these emotions is the uncertainty and unstable developments in society as a whole when a sudden public health event is experienced, which causes consumers to worry and fear for the normal order of life, thus triggering their anxious feelings. During their panic buying, consumers stock up on supplies for a period of time

in the future; this gives them a sense of security and eases their anxiety and uncertainties about the future. Influenced by these strong psychological factors, consumers are more likely to show a strong desire to buy, thus readily resorting to panic-buying behaviours.

Finally, in terms of the moderating effect of trust in the government, this study confirms that perceived competitiveness, perceived anxiety and perceived uncertainty all made a significant difference in consumers' panic-buying behaviours. The positive effects of perceived competitiveness on panic buying were strongly enhanced by low levels of trust in the government. A low level of trust in the government is more likely to enhance the perceived positive effect of anxiety on panic-buying behaviours. A survey conducted in Poland showed that trust in the government could significantly reduce negative emotions during the COVID-19 outbreak [63]. The more trust the public has in the government, the easier it is to underestimate the potential risks and reduce the actions taken by individuals [61]. Therefore, this paper argues that the lower the level of consumers' trust in the government, the easier it will be for them to take personal action to mitigate the potential dangers brought about by the epidemic and mitigate their negative emotions. Perceived competitiveness and perceived anxiety have the significant and positive effects on panic buying [9,41,44]. Therefore, when a consumer's trust in the government is low, they are more likely to be aware of the scarcity crisis caused by the epidemic, and thus more likely to be influenced by both competitiveness and anxiety, the possibility of impulsive purchasing is likely to increase.

7. Contribution and significance

Regarding its academic contribution, this paper has enriched the understanding of panic-buying behaviours that occurred during the COVID-19 pandemic. Panic buying substantially reduces the level of stability of people's lives. While previous researchers have mainly explored the issue in relation to the early stages of scarcity, the goal of this study was to explain the enduring effects that develop over a long period of time in an unstable state that swings between scarcity and normality. Therefore, while building on existing scholarship, it is of great academic significance to explore the mechanisms of panic-buying behaviour from the perspective of scarcity. The study also explored the multiple impacts of perceived scarcity on consumer perceptions and, through this, has revealed the internal mechanisms underlying panic-buying behaviours. Previous studies have not thoroughly examined the relationship between perceived scarcity and panic-buying behaviour. As a result, existing research on the impact of scarcity on panic-buying behaviour is inadequate for explaining the causes of this apparently irrational behaviour. Furthermore, there is a lack of in-depth discussion in the existing literature on the significance of trust in the government. This paper confirms that having trust in the government can make a significant difference by regulating consumers' micro signals and macro signals.

From a practical perspective, the results of this study have reference value and implications for various interest groups. We have shown that consumers should pay attention to whether there is a real product scarcity during a public health emergency, and that they should reduce irrational purchasing behaviours precipitated by subjective perceptions of scarcity. The results can also help merchants formulate reasonable sales strategies in relation to scarcity theory, and thus alleviate the anxiety of consumers and contribute to the stability of society. In addition, merchants can inform consumers of their inventory situation in advance and thereby satisfy the consumers' desire to control the scarcity crisis. The results can also be helpful for governments by showing that it is necessary to improve government credibility and understand the factors that influence consumers' panic buying. The results

could also prompt governments to offer counselling services to help people affected by the pandemic and thereby ease their negative emotions. This study enriches the research findings in the fields of scarcity and panic buying during the COVID-19 pandemic, and it helps to reveal the underlying mechanisms by which scarcity affects consumers' panic-buying behaviours. It also provides suggestions for consumers, businesses and governments that will allow them to better cope with the panic-buying behaviour triggered by an epidemic.

8. Limitations and future research

We analysed the mechanism by which perceived scarcity affects consumers' panic-buying behaviour, focusing on the mediating role of the consumers' micro signals and macro signals. We also explored the moderating effect of perceived trust in the government on people's intrinsic psychological state and their panic-buying behaviours. While this paper makes a sound contribution to theory and practice, the study also had some limitations. First, the study examined panic-buying behaviour in the context of a public health emergency by using the COVID-19 pandemic as its example. This form of irrational buying behaviour was not discussed in any specific retail context. However, there is a great difference between the purchasing habits of consumers when in traditional offline, physical stores and when in online purchasing mode. Future studies should consider the differences between consumers' panic-buying behaviours in various shopping situations. Second, the size of the sample included in this study met the requirements but could be further improved. Larger quantities of data would make the results more comprehensive. Therefore, future studies should increase the number of respondents to make the research conclusions more significant. Third, the respondents in this study were mainly consumers in China and Australia. The study lacks an exploration of consumer behaviour in other cultural contexts. Future research could expand the area from which respondents are drawn to explore the effect of perceived trust in the government on panic-buying behaviours across cultures.

9. Conclusions

Guided by signalling theory and scarcity theory, we explored the mechanism by which scarcity affects consumers' micro signals and macro signals through two stages. We also explored how trust in the government makes a significant difference in regulating these variables. The data were collected via a questionnaire survey and were analysed by PLS-SEM. The results showed that the macro signals and the micro signals variables, such as perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty, were key to explaining the impact of scarcity on panic-buying behaviour. In addition, multiple psychological factors contributed to consumers' underlying reasons for panic buying. Perceived value, perceived competitiveness, perceived anxiety and perceived uncertainty each had a significant and positive influence on perceived scarcity and panic-buying behaviours. Moreover, perceived trust in the government played a moderating role between consumers' perception variables and their panic-buying behaviours. Specifically, the lower the level of trust in the government, the more perceived competition and perceived anxiety are likely to motivate consumers to engage in panic-buying behaviours. Furthermore, this paper contributes to the literature on panic-buying behaviour and explains the importance of trust in the government during a public crisis. In addition, this paper gives feasible suggestions from the perspectives of the consumers, the government and businesses, all of which can help reduce consumers' panic-buying behaviours and therefore have practical value in

maintaining social stability.

Use of AI tools declaration

The authors declare that they have not used artificial intelligence tools in the creation of this article.

Acknowledgments

Conflict of interest

The authors declare that there is no conflict of interest.

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Supplementary - Measurement Items

Factors	Questions	Source
Perceived Scarcity	I found my favorite product was often scarce. There was only a limited number of products on the shelf. While shopping, I found that there were a limited number of product choices.	Byun and Sternquist [69]
Perceived Uncertainty	The certainty that COVID-19 will not cause social risk to you is (extremely uncertain to extremely certain). The certainty that COVID-19 will not harm you is (extremely uncertain to extremely certain). The certainty that COVID-19 will not affect your family is (extremely uncertain to extremely certain).	Han et al. [70]
Perceived Competitiveness	I enjoy competition more than others. I feel that it is important to outperform others. I feel that winning is extremely important.	Gupta and Gentry [42]
Perceived Anxiety	I often feel affected by the posts on social media about coronavirus infection. I often feel affected by the talks of a novel coronavirus pandemic on the newspaper and news channels. I often get afraid if anyone in my social circle reports of being sick.	Roy et al. [71]
Perceived Value	The choice of buying the goods was the right decision. I obtained good results from buying the goods. Overall, buying the goods was valuable and worth it.	Lee et al. [72]

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Factors	Questions	Source
Trust in Government	I think the government is able to manage the COVID-19 pandemic properly. I think the government is transparent in providing information about COVID-19. I have confidence in the government officials to make the right decision when it comes the COVID-19 pandemic.	Shanka and Menebo [73]
Panic Buying	During the COVID-19 pandemic, when I was shopping at any market, I felt the desire to buy as soon as I found the products I wanted. During the COVID-19 pandemic, when I was shopping in any market, I tended to buy products that I usually do not consider buying. During the COVID-19 pandemic, when I was shopping at any market, I could not resist buying products that I usually do not need.	Omar et al. [8]