

On the willingness to donate “panic bought” supplies: a novel form of freight demand management

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Abstract

Purpose – This study aims to assess the potential of a novel freight demand management (FDM) initiative to mitigate the effects of “panic buying,” better termed disaster-related buying behaviors (DRBBs). The initiative involves encouraging individuals who “panic bought” critical supplies to donate part of these excess supplies to people in need.

Design/methodology/approach – To evaluate the potential of appeals to donate “panic-bought” supplies, a survey was conducted specifically examining the purchase, hoarding and donation behaviors related to facemasks in China during the peak of the COVID-19 crisis. The authors conducted a thorough analysis of the data and used econometric models to understand the socio-economic factors that foster, or deter, the donation of critical supplies to others.

Findings – The data collected show that more than one-third of respondents were unable to purchase facemasks due to shortages. Econometric models were estimated to identify the socio-economic factors influencing the willingness to donate excess supplies. The findings indicate that approximately 13.7% of participants were willing to donate surplus facemasks, with donation behavior influenced by gender and education level. These results suggest that public appeals for donations could serve as a corrective tool to address DRBB-induced shortages.

Research limitations/implications – Some limitations should be acknowledged. First, the survey only collected data related to facemask buying behavior. Purchases of other types of products, such as hand sanitizer and toilet paper, were not studied. Second, on account of the cultural and economic differences, caution is suggested at the time of extrapolating the findings of this research to different socio-economic contexts.

Originality/value – This research provides critical insights into mitigating DRBBs through FDM strategies. The identified managerial initiatives offer practical guidance for policymakers and relief groups in their efforts to prevent and control these detrimental buying behaviors.

Keywords Disaster-related buying behavior, Panic buying, Supply chain disruptions, Freight demand management, Humanitarian logistics

Paper type Research paper

1. Introduction

“Panic buying” is a common occurrence in the aftermath of large disasters and catastrophes. It exacerbates the challenges already faced during disasters, making it harder for relief efforts to effectively respond to the needs of affected communities. For example, after the Port-au-Prince earthquake and the Tohoku disasters, residents in or near the affected area rushed to buy food, bottled water and other critical supplies in large amounts to protect against likely shortages, leading to the removal of critical supplies that otherwise could have been delivered to those who needed them most (Holguín-Veras *et al.*, 2013).

During the COVID-19 pandemic, purchases of personal protective equipment (PPE), along with the misuse and overuse of PPE, caused a severe disruption to the global supply of these critical items (World Health Organization, 2020). The resulting global shortages of PPE affected health-care workers in the frontlines, who were forced to disregard safety protocols by reusing facemasks, gowns and face shields, and in some cases, wearing trash bags to prevent

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infection (New York Post, 2020). The so-called “panic buying” aggravated the shortages of PPE and contributed to the high rates of fatalities among doctors and nurses who cared for COVID-19 patients (Lapolla *et al.*, 2020).

On the basis of the fieldwork research conducted by his team – and in agreement with the disaster research literature that clearly shows that instances of panic behavior are extremely rare – Holguín-Veras *et al.* (2016) concluded that the term “panic buying” is a misnomer and should not be used. More recently, using behavioral data collected during the COVID-19 pandemic, Holguín-Veras *et al.* (2023) coined the term “Disaster-Related Buying Behaviors,” or DRBBs, to refer to the wide range of purchasing behaviors prompted by the expectation of, and the actual impacts of, extreme events. DRBBs were defined as “the purchase of supplies by individuals and/or businesses in anticipation of, during, and after the disaster with a different pattern than the one in normal conditions.” In addition, they developed a data-driven taxonomy of objectives pursued by the purchasers, and the reasons (and themes of reasons) that prompt DRBBs. In doing so, the resulting taxonomy unified the research contributions of the multiple disciplines that have studied DRBBs from primarily single-discipline perspectives. These analyses led to the identification of three major objectives:

- 1 self-preservation;
- 2 altruism; and
- 3 opportunism, as well as 24 reasons to enact DRBBs.

These reasons were further categorized into eight themes:

- 1 needs anticipated;
- 2 regret avoidance;
- 3 precaution;
- 4 convenience;
- 5 COVID-19 risk reduction;
- 6 social cues;
- 7 altruism; and
- 8 opportunism (Holguín-Veras *et al.*, 2023).

As shown, these reasons do not reflect irrational decision-making or unthinking behavior. The fundamental tenet of that research is that, since DRBBs are shaped by rational decisions based on the information and expectations, albeit sometimes biased or erroneous, consumers have about the availability of basic supplies, it is possible to mitigate DRBBs by effective freight demand management (FDM) programs, inducing consumers to change their purchasing behaviors using rational arguments.

The starting point of applying FDM in preventing/mitigating “panic buying” is that modern supply chains built around just-in-time manufacturing are not necessarily able to cope with sudden and unexpected increases in demand (Hobbs, 2020). A consequence of supply chain efficiency is the removal of not fully used resources such as excess inventories, and transportation and production capacity, which are essential to cope with such unanticipated demand increases. This is particularly the case for supply chains that handle low profit margin goods with steady demand patterns because, there is no financial incentive to maintain large safety inventories (Childerhouse and Towill, 2000). Increasing the availability of basic supplies in the short term is not possible. Recognizing this problem, researchers have tried to increase the agility and

resilience of humanitarian supply chains through strategies such as transshipping stock (Toyasaki *et al.*, 2017), pre-positioning critical supplies (Loree and Aros-Vera, 2018) and sharing information and resources (Paul and Chowdhury, 2020). However, as stated by Holguín-Veras *et al.* (2012), the impacts of regular disasters on supplies and needs are completely different from the impacts of catastrophic events on supplies and needs; supply chain plans designed for regular disasters cannot be scaled up to deal with catastrophes, as the latter are qualitatively different from the former. Thus, the only option is to undertake vigorous demand management efforts in the case of large disasters and catastrophes. It follows that, if the shortages are the result of a sudden increase in demand, the most efficient way to address the issue is to attack the root of the problem by inducing consumers to change behavior. In this context, there are three main FMD initiatives:

- 1 rationing of basic supplies at point of sales;
- 2 inducing consumers to reduce their purchases; and
- 3 appealing to the purchasers of critical supplies to donate part of the items they purchased.

The main focus of the paper is on the latter alternative. Needless to say, these complementary alternatives should be used in combination for maximum effectiveness.

Unlike rationing and purchase limitation, appealing to customers who already purchased basic supplies in excess of their needs to donate to others, (or return to the stores) part of the supplies they are hoarding is corrective in nature. Essentially, the appeal to donate some of supplies purchased seeks to correct the effects of the purchasing decisions already made. This is particularly important because, in most cases, public and private-sector leaders are caught by surprise by the advent of “panic buying” and are slow to react. For example, in China, it took ten days for the first city, Xiamen, to take steps to limit the purchase of facemasks after the COVID-19 was confirmed to spread from person to person (Sina News, 2020). By the time they managed to put rationing in place, the damage had been done. Should appeals to consumers hoarding supplies be effective in inducing them to donate part of these supplies, another tool would be put in the hands of disaster responders to mitigate the effects of the most detrimental expressions of DRBBs.

The main goal of this paper is to contribute to a better understanding of how to manage the most detrimental expressions of DRBB purchases through a novel FDM initiative – appealing to donate excess supplies. To achieve this goal, the following objectives must be achieved:

- to gain insight into the socio-economic features associated with DRBBs; and
- to assess the viability of asking individuals who are in possession of basic supplies in excess of their actual needs to donate part of these supplies for the benefit of other individuals.

To this effect, the authors conducted a survey at the height of the COVID-19 pandemic in China to gather socio-economic data from a sample of individuals and ask respondents if they would be willing to donate part of the excess supplies they had purchased, for the benefit of others. It should be noted that, although the survey only asked respondents about their willingness to donate part of the supplies they were hoarding,

the results in the paper provide insight into other practical possibilities such as returning to the stores part of the excess supplies that consumers have.

In contrast to other surveys, like that conducted by Holguín-Veras *et al.* (2023), which collected data about purchases of broad categories of supplies, the survey in this paper focuses on facemasks, the single item that experienced the most extreme and far-reaching shortages (Xinhua News, 2020a). Such a focus provides an opportunity to collect highly specific data about purchase levels and actual use. The focus on facemasks provides a compelling case from which important lessons can be extracted, providing a pathway to help develop FDM programs to mitigate the shortages of critical supplies in disaster environments.

The research reported in this paper is an exploratory study. It produces major contributions to the demand management of DRBBs, or so-called “panic buying.” To start, the research established the potential of a program to foster the donation/return of excess “panic bought” supplies as a corrective measure. This is important because the donation/return program is a completely new concept that would complement existing programs such as rationing. In addition, the research quantified the impact of a proposed donation program and established that the proposed program could also work with returns to the retailers for refunds. The research, using econometric modeling, also identified the population segments that tend to purchase the largest amount of facemasks as well as the population segments most inclined to donate excess supplies. The last major contribution is the identification of the key components of donation/return programs. The identification of these components provides a template for action that could be used effectively in crisis situations where there is a high probability of “panic buying.” The remainder of this paper is organized as follows. Section 2 reviews the literature. Section 3 describes the methodology and a general descriptive analysis of the socio-economic characteristics of the sample. Section 4 reports the observed DRBBs of facemasks in China during the COVID-19 crisis. Section 5 discusses willingness to donate excess facemasks to others in need. Section 6 discusses the recommendations to manage the demand. Section 7 summarizes the chief findings of the research conducted.

2. Literature review

This section provides a review of the literature related to “panic buying.” The literature review also examines the measures recommended in previous research to manage “panic buying.” These measures include those that are preventive in nature, as well as corrective actions in the context of disasters, with a focus on FDM, a transportation field that seeks to modify freight demand to help achieve policy goals.

2.1 Panic buying

“Panic buying” is a frequent occurrence in anticipation of future shortages (Smith, 1936). It is always associated with scarcity, limited retail availability and rising prices, which are early signals of on-coming shortages (Stiff *et al.*, 1975). It should be noted that fieldwork research in the aftermath of disasters led researchers to question the “myth” of widespread

“panic.” Quarantelli (1954) stated that there are specific conditions that lead to panic, such as feelings of possible entrapment or helplessness, concluding that “*compared with other reactions panic is a relatively uncommon phenomenon.*” Recognizing the limitations of the term, Holguín-Veras *et al.* (2016) originally suggested the term “precautionary/opportunistic buying.” Later, using data collected during the COVID-19 pandemic, Holguín-Veras *et al.* (2023) coined the term “Disaster-Related Buying Behaviors” as it is neutral and better describes the phenomenon. These undesirable purchases often result in a large number of critical supplies being withdrawn from markets, reducing or depriving the opportunity of those who are in greater need of these supplies from accessing them (Loxton *et al.*, 2020; Yuen *et al.*, 2020).

There are many explanations regarding the reasons behind “panic buying.” Psychological research shows that “panic buying” is, in part, a mechanism to cope with emotional distress, which is influenced by the behavior of the crowd (Sneath *et al.*, 2009). Consumers tend to engage in “panic buying” under the conditions of perceived scarcity to avoid anticipated regret (Gupta and Gentry, 2019). Kennett-Hensel *et al.* (2012) found that buying behaviors in the aftermath of natural catastrophic events are closely associated with emotional distress; disaster survivors use consumption to alleviate anxiety and resolve their sense of loss. With respect to “panic buying” in the COVID-19 crisis, Yuen *et al.* (2020) suggested that it was triggered by individuals’ beliefs about the threat of the health crisis and scarcity of products and fear of the unknown caused by negative emotions and uncertainty. They also considered that consumers view “panic buying” as a mechanism to relieve anxiety and regain control over the crisis. Larson and Shin (2018) found that shoppers under the greatest emotional strain are often the ones out shopping the most in disaster times. In essence, “panic buying” is, at least in part, an emotional reaction to stressful events (Loxton *et al.*, 2020).

2.2 Measures to manage “panic buying” and freight demand management

FDM is formally defined as:

[...] the area of transportation policy that seeks to induce the demand generator to enact changes in demand patterns to increase economic productivity and/or efficiency; and/or enhance sustainability, quality of life, and/or environmental justice [...] (Holguín-Veras and Sánchez-Díaz, 2016).

FDM measures allow for the modification of the demand in terms of the purchase amount, purchase frequency, timing of delivery, destination of delivery, mode or vehicle type used to transport the cargo (Holguín-Veras and Sánchez-Díaz, 2016). Some FDM initiatives include changes in freight mode choice, off-hour deliveries, staggered pick-up/deliveries and receiver-led consolidations programs. FDM initiatives are powerful because changing the demand has upstream impacts on supply chains.

FDM has also the potential to change the consumer behavior of households, which ultimately can prevent/mitigate “panic buying.” Recommendations to prevent so-called “panic buying” are commonly related, but not limited to, restricting or rationing purchases during disasters. Rationing in the context of disasters is a mechanism to adjust the demand of essential goods to the supply when disruptions cause shortages. An

example of this was the gas rationing measure implemented after Hurricane Sandy (New York Times, 2012). Similar to the shortage in the 1970s due to the oil crisis, gas rationing helped to foster a fairer distribution of what was limited available gas after Hurricane Sandy. Federal Emergency Management Agency (2004) also mentioned the rationing of essential supplies, providing guidelines on how to ration food and water during emergencies.

More recently, the COVID-19 pandemic and the ensuing widespread “panic buying” prompted researchers to study potential public-sector initiatives to manage DRBBs. For example, Hamilton (2020) questioned the type of governmental intervention and also suggested limiting the quantities of essential items as a controlling measure. Arafat *et al.* (2020a) recommended rationing and social sanctions, the use of media, promotion of kinship feeling, assurance from an authority and psychological measures to cope with “panic buying.” Arafat *et al.* (2020b) suggest assurance of stocks, rationing, raising awareness, punishment to maleficent sellers and disseminating information to the general public on the inventory status to prevent “panic buying.” Taylor (2021) suggested retailer actions such as limiting purchases, public education, targeting excessive anxiety among people who are most likely to engage in “panic buying” and framing messages by media, community leaders or social influencers.

Overall, the literature on measures to manage “panic buying” indicates that while there is limited research focused on strategies to prevent “panic buying,” such as rationing, no publication discusses donations as a mitigating measure for “panic buying.” The idea of appealing to consumers to donate excess supplies, as an FDM strategy that helps to mitigate the impact of “panic buying” and is motivated by the fact that altruistic behaviors frequently appear in crisis environments (Lemieux, 2014). Kaniasty and Norris (1995) suggested that in the aftermath of disasters such as hurricanes, floods or earthquakes, it is common for people in the affected areas and communities to help each other immediately. Although it is believed that mass panic and self-preservation are the natural response to disasters, expressions of mutual aid are common and often predominate (Mawson, 2005; Lemieux, 2014).

The widespread altruism discussed in the literature indicates that, as an FDM strategy to correct the effects of “panic buying,” donation has a solid foundation in the real world. The literature review reveals that no previous publication has assessed the potential impacts of appealing to those individuals that “panic bought” basic supplies to donate them for the benefit of individuals in need. To help fill this research void, the research reported here analyzes survey data collected during the early stages of the COVID-19 crisis to gain insight into the potential impacts of asking individuals who own excess amounts of basic supplies to donate them to others in need and to identify the population segments more (or less) inclined to donate excess basic supplies. Gaining insight into these influencing factors can help identify ways to arrest such detrimental DRBBs.

3. Methodology

This section discusses how the data on purchasing patterns of facemasks during the COVID-19 pandemic in China was

collected, as well as the socio-economic characterization of the data.

3.1 Data collection

The data used in this paper were collected from February 24 to March 9, 2020, when the pandemic in China was at its worst, as the number of new cases peaked in February 2020. Deploying the survey during this period allowed the authors to collect accurate and reliable data, because the respondents were still going through the crisis, and the memories of the impacts of the pandemic on their purchase intentions and behaviors had not faded over time. In addition, it provided the authors with an opportunity to assess the potential of appeals to donate excess supplies to mitigate the effects of “panic buying” in the early stages of the crisis, in an environment where modern supply chains were unable to meet the soaring demand. The target respondents of this survey were adults living in China. The authors collected a total of 1,065 observations, four of which were incomplete. Thus, 1,061 valid observations were included in the analysis.

The survey used in this paper was designed following Sinclair (1975), starting with general questions and ending with sensitive ones. Specifically, the investigation started with questions concerning purchases of facemasks: the amount and type of facemasks purchased and where they were purchased. Next, questions were asked regarding attitudes toward buying masks, the price paid and the maximum price they would be willing to pay for the facemasks. Then, the questionnaire asked respondents their perceptions of the crisis, its potential duration and the importance they ascribed to using masks, both before and after the crisis. The survey also asked about the respondents’ frequency of going out of the home and the number of masks needed per day during the crisis, as well as whether or not they had excess masks and their willingness to donate them. The next question focused on understanding the likelihood of hoarding facemasks in the future. Finally, the survey collected the socio-demographic characteristics of the respondents. Hypothetical bias occurs when there is a discrepancy between stated and actual behaviors, which is common in stated preference surveys (Bohm, 1972). Little and Berrens (2004) found that dichotomous choice, certainty correction and the use of a cheap talk script can help mitigate hypothetical bias. Similarly, Loomis (2014) argued that using uncertainty recoding and the referendum form of dichotomous choice question format may help reduce hypothetical bias in contingent valuation method surveys. For this reason, to mitigate hypothetical bias, the question related to a respondent’s willingness to donate excess facemasks is designed as a binary choice (yes/no).

3.2 Sample characteristics

To obtain results representative of the entire country, the authors used statistical weights combined with an iterative proportional fitting (IPF) procedure to expand the sample to match national statistics (Lomax and Norman, 2015). The national demographic data used as control values cite from the National Bureau of Statistics of China (National Bureau of Statistics of China, 2019, 2020). Table 1 summarizes the demographic characteristics of the data. The gender distribution is 48.9% female and 51.1% male. Most of the respondents are 51 years old

Table 1 Demographic distribution of respondents

Variables	%
Gender	
Female	48.9
Male	51.1
Age	
Under 30	20.1
31–50	39.4
51+	40.5
Income	
< \$4,396	35.1
\$4,396–\$14,655	35.1
> \$14,655	29.8
Region	
Urban	60.6
Rural	39.4
Education	
High school or below	36.7
Bachelor's degree	38.3
Master or doctorate degree	25.0
Source(s): Authors' own work	

or older (40.5%), a vulnerable population segment due to health conditions. By contrast, the lowest range in the sample are aged under 30 years old (20.1%). In the analysis, Chinese RMB were converted to USD based on the exchange rates on September 25, 2020. Based on the classification of income groups suggested by Kochhar (2015), global population can be divided into three groups: less than \$4,396, between \$4,396 and \$14,655 and higher than \$14,655. These correspond to low-income, middle-income and high-income, respectively. The most predominant personal annual income categories are low-income (35.1%) and middle-income (35.1%), followed by high-income with 29.8%. The vast majority of respondents are located in urban areas (60.6%). Also, 36.7% of respondents have not pursued post-secondary education.

4. Reported disaster-related buying behaviors

This section discusses the key results of the data analyses conducted by the authors regarding the reported DRBBs. The discussion focuses on the observed purchase quantities and factors influencing purchase quantity.

4.1 Observed purchase quantity

Table 2 shows the breakdown of the number of facemasks purchased during the COVID-19 crisis. The respondents can be categorized into three groups:

- 1 respondents who bought facemasks (53.7% of the respondents);
- 2 respondents who attempted to buy facemasks but could not buy them due to shortages (34.1%); and
- 3 respondents who did not try to buy facemasks (12.2%).

The survey did not ask respondents their reasons for not having tried to buy facemasks. However, the data show that 20.3% of

Table 2 Breakdown of facemasks purchased during COVID-19 crisis

Type of action	Purchase quantity (pieces)	% of respondents
Bought	1–20	14.7
	21–50	17.4
	51–100	13.9
	101–200	5.2
	201–300	1.5
	301–500	0.4
	> 500	0.7
Could not buy (stockout)	0	34.1
Did not try to buy	NA	12.2
Source(s): Authors' own work		

the respondents in this group had excess masks, and 51.9% considered facemasks as “somewhat important” or “not important,” indicating that these respondents may have already had facemasks on hand, or considered facemasks not important enough. As shown, a large percentage (87.8%) of the surveyed individuals attempted to buy facemasks. It is important to mention that, notwithstanding that China is able to produce 20 million facemasks every day (Xinhua News, 2020b), more than a third of the respondents failed to buy facemasks because of shortages. By the end of the survey (in early March 2020), only 12.2% of the respondents had not attempted to buy facemasks after the outbreak.

Among those who bought facemasks, the most frequent purchase quantity was between 21 and 50 facemasks, followed by 1–20, and 51–100. Individuals who bought more than 100 facemasks account for 14.3% of the total purchasers. Although only a small proportion of people bought more than 300 facemasks, this type of behavior is bound to be problematic because of the large purchase quantity. Overall, the observed average purchase quantity is 65 facemasks per person, equivalent to more than two months of supply per person.

4.2 Factors influencing purchase quantity

DRBBs were manifested by the large quantity of purchased facemasks during the COVID-19 pandemic in China, causing shortages. To further understand the relation between socio-economic characteristics and DRBB purchases, this section uses discrete choice models to identify the effects of socio-economic variables on the purchase amount of facemasks decision. The type of discrete choice models depends on the structure of the choice problem and the assumptions made about the distribution of errors. The econometric analyses of purchase quantity in this paper are conducted using an ordinal logit model. The ordinal logit model, which is used to model an ordinal scale of preferences such as willingness to change behavior, is evaluated by a Likert scale from not likely to extremely likely.

The questionnaire included the question:

Q1. How many masks did you buy during the crisis?

The responder had to select between a set of categories related to the amount of facemask they bought. These categories are

structured as an ordered set of choices. To consider the ordering information of the data, ordered probability models are used (McKelvey and Zavoina, 1975). In this research, the *purchase quantity* was collected as a set of ordered categorical data – the intervals of the quantity of facemasks – which is why an ordered logit model is appropriate. The categories given in the survey were coded with the following values for modeling purposes: 0 for 1–20, 1 for 21–50, 2 for 51–100, 3 for 101–200, 4 for 201 or more facemasks. For the formulation of an ordered logit model, refer to McKelvey and Zavoina (1975). Moreover, for modeling purposes, age and income were treated as continuous variables to more precisely reflect their potential effects. To achieve this, values were generated using uniform random sampling within the bounds of the original categorical intervals for age and income (Little and Rubin, 2002; Kropko et al., 2017). The standard commercial software STATA was used to estimate models presented in this paper. For modeling purpose, the authors made the following assumptions:

- Respondents purchased the facemasks for personal use, not for business purposes. (To exclude business buying behavior, we clarified in the survey introduction that the facemasks referred to are solely for personal use)
- The facemasks referred to in this paper are intended for use in response to COVID-19, not for other purposes such as preventing haze pollution.
- Since all types of facemasks included in this survey are disposable, it is assumed that they were not used, nor were they expected to be used, repeatedly.

Table 3 shows the ordered logit model for purchase quantity. The results show that all variables, except those related to education, are statistically significant. Notably, the model indicates that females are more inclined to purchase larger quantities of facemasks compared to males. This finding is consistent with previous research showing that women tend to exhibit more panic buying behavior than men (Wu et al., 2024). With respect to age, older individuals tend to buy fewer facemasks than younger individuals (Lins and Aquino, 2020; Chua et al., 2021). One possible explanation is that younger people may have lower emotional resilience, making them more

Table 3 Ordered logit model for purchase quantity

Variables	Coefficient	z	$P > z $
Female	0.43681	2.8000	0.0050**
Age	-0.02999	-3.7000	0.0000***
Bachelor's degree	0.29610	1.1900	0.2350
Master or doctorate degree	0.05633	0.2200	0.8300
Income	0.00002	5.9900	0.0000***
Threshold parameters			
Threshold 1		-1.37471	
Threshold 2		0.07767	
Threshold 3		1.22516	
Threshold 4		2.64833	
Log likelihood		-865.16559	
McFadden pseudo ρ^2		0.03030	

Note(s): Significant at the 1% (***), 5% (**) and 10% (*) levels Base categories. Gender: male, education: high school or below

Source(s): Authors' own work

susceptible to negative emotions than the elderly (Carstensen et al., 2020), which are known to drive panic buying (Kennett-Hensel et al., 2012). As for income, individuals with higher incomes do purchase larger quantities, though the effect size is relatively small; this finding also supports evidence from prior studies indicating that higher-income groups are more likely to engage in panic buying (Yoshizaki et al., 2020; Chua et al., 2021). The effects of interaction terms on purchase quantity were evaluated, but none was statistically significant, suggesting they do not meaningfully explain variation in quantity purchased and are therefore not shown.

5. Willingness to donate excess facemasks and influencing factors

The main objective of this section is to gain further insight into the socio-economic influencers of respondents' *donation willingness*. To this effect, the authors analyzed the reported willingness to donate excess facemasks and used econometric techniques to assess the role of the demographic attributes studied in the descriptive analysis on the *donation willingness*.

5.1 Reported willingness to donate excess facemasks

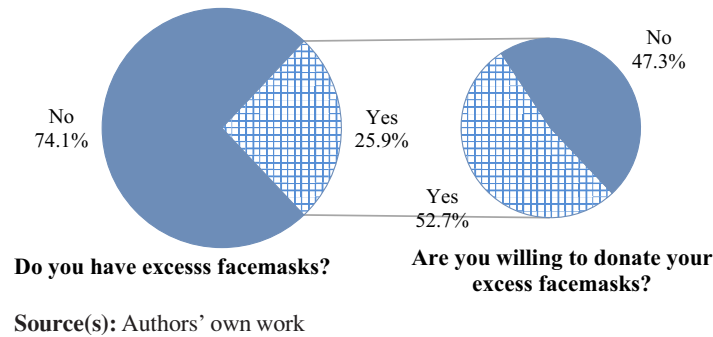
To gain insight on the potential of corrective measures to mitigate the effects of "panic buying," the survey first asked the respondents if they had extra masks beyond their immediate needs. It then inquired whether those individuals who possessed surplus facemasks were willing to donate them to others in need. The results are shown in Figure 1. In total, 25.9% of the respondents stated that they had excess facemasks. Although it is not possible to completely rule out the possibility that some excess facemasks may have been purchased before the pandemic, the data show that 61.6% of the respondents did not use masks as daily necessities in normal times. Moreover, since in normal conditions it is easy to purchase facemasks – which are sold in thousands of convenience stores – there is no need to stock up on facemasks. These considerations suggest that the majority of the facemasks hoarded were purchased during the pandemic.

Out of the 25.9% of respondents that had excess facemasks, 52.7% indicated that they would be willing to donate them, representing 13.7% of the sample. This is consistent with the findings of Kaniasty and Norris (1995) that altruistic behaviors are prevalent in the aftermath of disasters. These results showed that 40.2% (13.7%/34.1%) of the 34.1% of the respondents who could not buy facemasks would have an opportunity to purchase facemasks if a donation program had been in place. This FDM approach is important on account of the practical impossibility of mitigating shortages by rapidly increasing the supply of facemasks. Although this result may be influenced by cultural factors, it reveals that such appeals could indeed be of great help as a corrective measure to be used once hoarding of basic supplies has taken place. It is important to mention that this result is consistent with research showing that altruistic actions in disaster environments abound (Solnit, 2010).

5.2 Factors influencing willingness to donate

The econometric analyses of donation willingness are conducted using binary logit models. The binary logit model, which is one of the most frequently used discrete choice

Figure 1 Willingness to donate excess facemasks



models, is used to model “yes or no” choices such as the willingness to use a new technology. In the binary logit model, the observed data is specified in equation (1) (Greene, 2003):

$$y_i = 1 \cdot \text{if and only if} \cdot y_i^* > 0 \tag{1}$$

The explanatory variables include socio-economic attributes of the respondents, and since the binary model formulated is logit, it has a logistic distribution (Berkson, 1944), which is indicated in equation (2):

$$Prob(y_i = 1/x_i) = \frac{e^{x_i\beta}}{1 + e^{x_i\beta}} = \Lambda(x_i\beta) \tag{2}$$

where $\Lambda(\cdot)$ refers to the logistic cumulative distribution function (Greene, 2003).

The model presented in this section aims to gain insight into the socio-economic factors associated with the willingness to donate excess facemasks. The data used to estimate the model comes from responses to the question:

Q2. Are you willing to donate the extra masks you have?

Table 4 presents the binary logit model for donation willingness. It is important to note that age and income are not statistically significant, meaning there is no evidence of a relationship between these variables and the willingness to donate excess facemasks. As indicated in the table, females

Table 4 Binary logit model for donation willingness

Variables	Coefficient	z	P > z
Female	-0.42579	-1.7900	0.0740*
Age	0.01372	1.0700	0.2850
Bachelor's degree	-2.25804	-3.4700	0.0010***
Master or doctorate degree	-2.26322	-3.4300	0.0010***
Income	-2.78E-06	-0.5100	0.6090
Constant	1.69897	2.1200	0.0340**
Log likelihood		-214.08068	
Mcfadden pseudo ρ^2		0.06120	

Note(s): Significant at the 1% (***), 5% (**) and 10% (*) levels. Base categories. Gender: male, education: high school or below
 Source(s): Authors' own work

exhibit a lower willingness to donate their surplus facemasks compared to men. The purchase quantity model in Table 3 – which shows that women are more likely to purchase larger quantities – is consistent with this finding, as it indicates that they are also less likely to donate excess facemasks. In terms of education level, the results show that individuals with higher levels of education are less likely to donate excess facemasks. The similar negative coefficients for both bachelor's and master's/doctorate degrees suggest that once individuals have more than a high school education, the level of higher education has little additional impact on their willingness to donate surplus facemasks. In essence, both bachelor's and graduate-level degrees reduce donation propensity by roughly the same amount compared to the baseline (high school or below). This is consistent with research findings showing that the expectation for donations in China is negatively associated with education levels (Nie et al., 2022). Although there may be multiple explanations for this result, a plausible one is the brutally competitive educational system, where students compete for a relatively small number of openings and faculty attention. In such an environment, it is easy to forget about the needs of others. Overall, when comparing both the purchase quantity and donation willingness models (i.e. Tables 3 and 4, respectively), a consistent pattern emerges: those who purchase the highest quantity of facemasks are also the least likely to donate their excess facemasks.

Table 5 shows a model in which interaction terms were included to examine whether the effects of gender, age, education and income on donation behavior varied in combination. The results show that most interaction effects are not statistically significant, implying that they do not meaningfully explain variation in donation willingness. However, two interaction terms – gender and age and age with a bachelor's degree – are statistically significant at the 10% level. These reveal more nuanced patterns. The interaction between gender and age suggests that the decline in donation willingness with age is more pronounced among women, indicating that women may become less inclined to donate as they grow older, at a faster rate than men. By contrast, the interaction between age and holding a bachelor's degree shows that the negative association between higher educational attainment and donation willingness becomes less pronounced as individuals get older. This suggests that the negative impact of holding a bachelor's degree on donation willingness is attenuated with age. Elasticity estimates further reinforce these

Table 5 Binary logit model for donation willingness (with interaction terms)

Variables	Coefficient	z	P > z	Elasticity
Female	1.36846	0.5600	0.5730	0.19797
Age	-0.17343	-1.4300	0.1520	-1.85460
Bachelor's degree	-14.24482	-1.8200	0.0690*	-0.60068
Master or doctorate degree	-11.99990	-1.5200	0.1280	-0.26960
Income	-0.00015	-1.6500	0.1000	-0.96844
Female and age	-0.05158	-1.7800	0.0750*	-0.26447
Female with bachelor's degree	-1.61377	-0.0800	0.9380	-0.01434
Female with master or doctorate degree	-1.19019	-0.5700	0.5700	-0.08354
Female and income	0.00002	1.4300	0.1520	0.04246
Age and bachelor's degree	0.22531	1.8500	0.0640*	1.15048
Age and master or doctorate degree	0.16787	1.3600	0.1750	0.76222
Age and income	3.52E-07	0.6800	0.4970	0.08070
Bachelor's degree and income	0.00013	1.4700	0.1420	0.32375
Master or doctorate degree and income	0.00012	1.4500	0.1470	0.47587
Constant	12.43733	1.5900	0.1130	
Log likelihood			-205.28047	
McFadden pseudo ρ^2			0.09980	

Note(s): Significant at the 1% (***), 5% (**) and 10% (*) levels. Base categories. Gender: male, education: high school or below

Source(s): Authors' own work

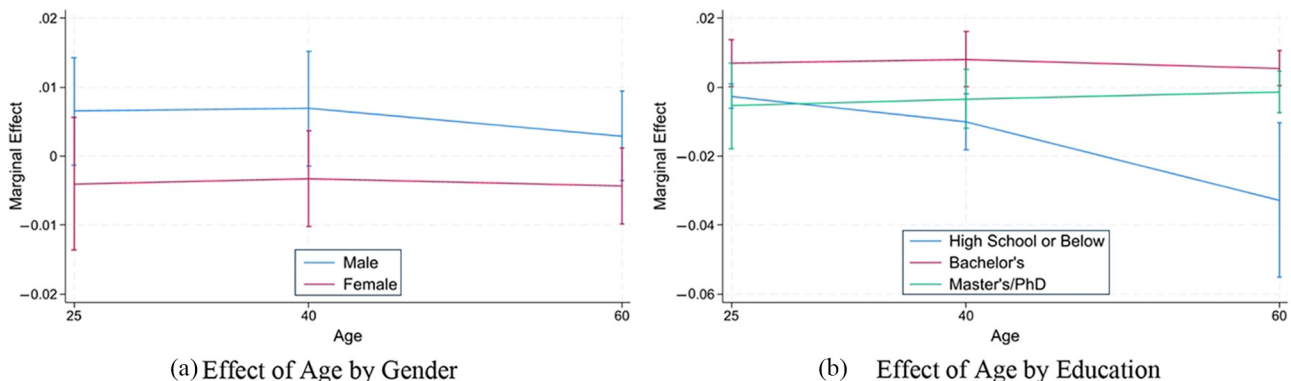
patterns. For females, an increase in age is associated with a decrease in the probability of donating, whereas for individuals with a bachelor's degree, an increase in age is linked to a relatively higher likelihood of donation compared to those with lower education levels.

To illustrate how the effects of statistically significant variables vary across subgroups, Figure 2 presents marginal effect plots showing how the impact of age on the probability of donating differs by gender and education level. To facilitate clearer interpretation of age effects, representative values were selected based on the midpoints of the age groups from Table 1: 25 for respondents under 30, 40 for those aged 31–50 and 60 for those aged 51 and older. These midpoints serve as meaningful anchors for estimating and visualizing marginal effects. The plots demonstrate how socioeconomic variables jointly influence the likelihood of donating. Notably, the vertical lines extending from each point represent 95% confidence intervals, indicating the range of uncertainty surrounding the estimated marginal effects. Narrower intervals suggest greater precision, while wider intervals reflect more variability and less certainty. Because donation willingness is a binary outcome, these marginal effects represent changes in the predicted probability of being willing to donate.

confidence intervals, indicating the range of uncertainty surrounding the estimated marginal effects. Narrower intervals suggest greater precision, while wider intervals reflect more variability and less certainty. Because donation willingness is a binary outcome, these marginal effects represent changes in the predicted probability of being willing to donate.

Figure 2(a) shows the effect of age by gender on willingness to donate. It shows that while donation willingness exhibits a mild decline with age, this effect is more pronounced for males than for females, as men's marginal effect starts positive but decreases with age. By contrast, women's willingness to donate remains relatively stable and slightly negative across age groups. Figure 2(b) presents the marginal effects of age by education level. Although individuals with a high school education or less are the most likely to donate excess supplies (as shown in Table 4), the marginal effects suggest that their willingness to donate may decline with age, exhibiting a noticeably negative

Figure 2 Marginal effects for donation willingness



Source: Authors' own work

slope at older ages. By contrast, those with higher education levels (bachelor's and master's/PhD) display relatively flat trends, with marginal effects near zero and stable across age categories. For individuals with a bachelor's degree, the marginal effects even show a slight upward trend with age, suggesting a positive indication that these individuals may demonstrate increasingly altruistic behavior as they grow older.

6. Components of donation/return programs

The research found that a significant portion of the individuals that purchased excess supplies are willing to donate, at least part of these supplies, to people in need. Specifically, this segment represents 13.7% of the overall sample population. Taking into account that the survey did not consider the alternative of returning to the vendor for a refund, the estimate of 13.7% is likely to be a lower bound of the potential impact of a combined donation/return program. The research, through econometric modeling, also identified the population segments most likely to donate excess supplies, including males and those with relatively basic education. In addition, the authors conducted elasticity and marginal effect analyses to examine the interactions among key variables. The next step is to design the key components of a donation/return program. This section puts together the key components of donation/return programs recommended in this paper.

6.1 Determination of the suitability of a donation/return program

Research indicates that supplies prone to being affected by DRBBs have the following features: are critical to the functioning of the economy and/or the population; have steady demand patterns that are very easy to forecast in normal conditions; have relatively low profit margins that do not encourage suppliers to maintain excess production capacity or inventories; or are supplies such as fuel, that have constrained storage or production capacities (Holguín-Veras *et al.*, 2023). Facemasks are an example of this. The combination of these factors translates into an inelastic supply that cannot rapidly increase to match the surging demand produced by DRBBs. For this reason, the first important step of donation/return programs is to identify the type of supplies vulnerable to DRBBs, as doing so enables the identification of the key stakeholders to engage in the effort. Supplies that meet the conditions of DRBBs should be the subject of close monitoring to decide if there is a need to manage their demands.

However, the very nature of donation/return programs imposes additional constraints that reduce the range of supplies that could be part of a donation/return program. For instance, perishable foods and medications are not good candidates because they could spoil easily (perishable foods) or could put people at risk if not managed properly (medications). However, items such as non-perishable food, personal care items, baby products and kitchen items in the original packaging are typically needed following a disaster and can be managed reasonably well (Iowa-Missouri Conference of Seventh-day Adventists, 2019). Given that different disasters may require different items, and that critical needs change rapidly, confirming what is needed, where it is needed and getting it

there at the right time is key for donation/return programs (Federal Emergency Management Agency, 2022).

6.2 Identification of the key targets of donation/return program, the messages to send, the messenger(s) to lead the efforts and the potential supplies to manage

The research conducted in this paper, together with Holguín-Veras *et al.* (2023), reveal that different population segments enact different manifestations of DRBBs, purchase different amounts of basic supplies and have different levels of willingness to change their behavior (Calderón *et al.*, 2025). This creates a situation where the selection of the population segment(s) to be the focus of the program is crucial. To start, a general campaign – one not designed with a specific population segment(s) in mind – is not likely to be cost-effective because the messages are not likely to resonate with those population segments that create the problem. Similarly, targeting population segments that are minor contributors to the problem, or major contributors that are extremely reluctant to change behavior, will not be cost-effective approaches.

The identification of the program's target segments could be readily accomplished, as done in the paper, by means of a small survey that collects data about the purchasing of basic supplies in excess of needs and willingness to donate/return some or all these supplies to people in need or to retailers for a refund. In cases where conducting a survey is not possible, another option is to use qualitative approaches – in-depth interviews and focus groups – to gain insight into the potential target population segments. As shown in Holguín-Veras *et al.* (2017), qualitative research techniques can be remarkably accurate in gaining insight into complex phenomena.

Having identified the target population segments, the next step is to identify the most effective messages to induce these individuals to donate/return excess critical supplies, as well as to identify the appropriate messenger(s). The chief insight from Holguín-Veras *et al.* (2022) that it is advantageous to select as the messenger(s) those agents that are perceived by the target population as trustworthy. The stronger the trust, the more likely that the behavior change will take place. The challenge is that different population segments have different opinions of the trustworthiness of the agents involved in relief efforts (Holguín-Veras *et al.*, 2022; Calderón *et al.*, 2025). Thus, research is needed to identify, for a specific socio-economic context, who are the trusted messengers for the various target population segments.

6.3 Design plans for gathering and distributing excess critical supplies

An efficient gathering and distributing plan are essential for the implementation of donation/return programs, necessitating the involvement of the private sector. Partnering with retailers bypasses the need to create a logistical network from scratch to manage the supplies collected. Moreover, engaging retailers that sell the supplies simplifies the process for consumers, making it clear where they can take the supplies they want to donate/return. Where it is not possible to collaborate with the retailers, creating a suitable logistic network from scratch would be the only option. To this effect, it is critical to:

- ensure that donation and returns channels have a visible presence so that potential participants are able to donate and return the critical supplies with ease;
- provide individuals who lack critical supplies with easy access to the donated and returned supplies; and
- engage local community groups so that they use their local knowhow, distribution channels and human resources to invite donations and returns, match needs and distribute relief supplies among the needy.

It is also important to engage media outlets to ensure that the donation/return campaign receives solid media coverage.

Obviously, a donation/return program must consider the risk of a recycling and collection process under disaster circumstances. For instance, during a pandemic, special care is needed to comply with the health and safety of customers and employees. During the COVID-19 pandemic, many stores modified, suspended or extended their return policies; stores that accepted returns isolated the products for 48–72 h, others cleaned them with disinfectant (National Retail Federation, 2020).

In addition, it is important to enact complementary measures such as implementation of rationing programs, controlling price gouging and implementing education programs, as doing so will contribute to effective management of panic buying. Such carefully designed efforts would go a long way to reducing the most detrimental expressions of DRBB.

7. Conclusion

The research reported in this paper studied the “panic buying” of facemasks, the purchasing and hoarding patterns exhibited by the various population segments in China during the COVID-19 pandemic. These purchasing decisions are based on rational considerations implies that it is possible to change the behavior of the individuals that participate in “panic buying” by means of rational appeals. The paper uses the term DRBBs, because it is more general and does not pre-judge the motivations or the rationality behind the purchases.

As part of the research, the authors conducted comprehensive analyses of the data collected by a survey of 1,061 Chinese citizens at the height of COVID-19 crisis in China. The analysis of the data revealed how problematic DRBB purchases were during the COVID-19 pandemic, reflected by the fact that more than a third of the respondents could not buy facemasks because of shortages. The data about purchase quantities show that the quantity of facemasks purchased was substantial, as the average number of facemasks purchased was 65 facemasks (a more than two-month supply of disposable facemasks). These findings confirmed that DRBB purchases aggravate the shortages of critical supplies in crisis situations. Moreover, the authors estimated econometric models to identify the population segments most inclined to purchase excess supplies.

A major focus of this research was the study of respondents’ willingness to donate excess facemasks to people in need (*donation willingness*). The result shows that about 13.7% of the sample stated they would be willing to donate excess facemasks to others, which implies that appeals to the public to donate facemasks could help mitigate the shortages created. This is very important because it implies that it is possible to correct, to some extent, the problem created by excess purchasing. Used

in combination with preventive FDM efforts – rationing and appeals by trusted agents to limit purchases in crisis situations – appeals to donate excess supplies could be effective in managing the demand created by DRBBs. The authors’ conjecture is that these encouraging results are a lower bound of the potential impact, because they do not include the individuals that would be willing to return excess supplies for a refund. Thus, including a return for a refund option is bound to increase the impacts of the resulting donation/return program.

To gain further insight into the socio-economic factors influencing willingness to donate, the authors estimated econometric models to identify the socio-economic traits associated with donation behavior. Among the various socio-economic attributes that impact the decision-making process, gender and education play a statistically significant role. The findings indicate that males and those with relatively basic education are more likely to donate excess facemasks. Another important observation is that individuals with higher levels of education are less likely to donate excess facemasks. This is concerning, as highly educated individuals typically play a significant role in philanthropy. The lack of a vigorous philanthropic inclination among the educated class could prove problematic during large disasters and catastrophic events, where the needs far exceed the response capabilities of the public sector. However, this negative effect may be mitigated by age, as the marginal effect analysis suggests that individuals with a bachelor’s degree tend to exhibit increasingly altruistic behavior as they grow older.

Given the potential for donating excess supplies to mitigate the detrimental impacts of DRBBs, the paper suggests implementing a donation/return program that includes the following key components:

- determine the suitability of a donation/return program;
- identify the population segments most likely to participate in DRBBs and most willing to change behavior, together with the identification of the messages to send, the trusted messenger(s) to lead the efforts and the potential supplies to manage; and
- design plans for gathering “panic bought” critical supplies and distributing them to individuals in need.

In the opinion of the authors, these suggestions could play a key role in arresting detrimental DRBBs, as well as correcting the negative effects of the DRBB purchases already made.

Notwithstanding that these insights are based on data from China, the donation/return program outlined here is likely to be of wider applicability. However, some limitations should be acknowledged. First, the survey only collected data related to facemask buying behavior. Purchases of other types of products, such as hand sanitizer and toilet paper, were not studied. Second, on account of the cultural and economic differences, caution is suggested at the time of extrapolating the findings of this research to different socio-economic context. The chief takeaway is that mitigating DRBBs requires a multipronged effort encompassing all of the tools available, ranging from corrective actions, e.g. donation of excess supplies, all the way to instilling pro-social attitudes in the general population, as well as strong public–private sector collaborations. The authors’ hope is that the findings reported in this research will help disaster response agencies and relief

groups to take adequate measures to prevent and control these detrimental buying behaviors.

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