

Does Scarce Inventory Information Disclosure Strategy Promote Online Sales? The Moderating Role of Discount

Xi Xi, School of Management, Harbin University of Commerce, China & Binzhou Institute of Technology, China*

Feifei Ren, School of Management, Harbin University of Commerce, China*

Weiqian Liu, School of Management, Harbin University of Commerce, China

Yuan Yuan Chen, AECC Sichuan Gas Turbine Establishment, China

ABSTRACT

In pursuit of promoting sales, certain e-commerce vendors post scarce inventory messages on product pages to signal impending stockouts. To explore how disclosure information strategy regarding scarce inventory influences online sales, this study utilizes Chinese e-commerce data collected from February 1st to April 30th, 2023 and constructs an empirical model that delves into the relationship between the disclosure of scarce inventory information and online sales based on the signal theory. The empirical findings reveal a positive impact of scarce inventory information disclosure on online sales, with this impact being more pronounced under the moderating role of the commodity discount rate. These results hold substantial theoretical implications and offer valuable insights for practical applications in the e-commerce domain.

KEYWORDS

Commodity Discount Rate, Commodity Discount Time, Information Disclosure, Scarce Inventory, Online Sales

INTRODUCTION

The internet is experiencing unprecedented growth, emerging as a vital force propelling China's economic and social development (Meng et al., 2023). Online sales, in turn, are marked by a significant positive trend, and internet marketing has become increasingly prosperous (Yang, 2021). However, information asymmetry is a common phenomenon in e-commerce platforms. Online stores can use a variety of ways to transmit signals to eliminate information asymmetry and affect the consumption process of customers. In signal theory, a signal refers to an observable and operable individual characteristic, which is sent to eliminate the information asymmetry (Spence, 2002). Online stores generally transmit commodity signals through e-commerce platforms. One type of signal is the objective information of commodities, such as color and texture, which are unalterable. The other type is alterable signals, including commodity inventory and discounts. Alterable commodity signals often appear in the marketing strategies of online stores, such as disclosing scarce inventory and discount messages. Online stores send scarcity signals to indicate that the availability of commodities

DOI: 10.4018/JOEUC.342112

*Corresponding Author

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

is limited (Lynn, 1991), which will stimulate consumers' strong desire to purchase (Schindler, 1989). For instance, Nike has created a limited collection of star basketball shoes to persuade basketball fans, which sends a scarcity signal to consumers. Given their adoration of basketball stars, together with the psychology of herd mentality, curiosity, and showing off, many basketball aficionados can be easily attracted by this hunger marketing (Zheng, 2022). Moreover, because e-commerce can disclose both commodity discount rates and commodity discount time messages, these discount signals can improve consumers' purchase intention (Aggarwal et al., 2011). This paper considers whether signals disclosing scarce inventory or offering discounts by online stores to consumers can effectively promote online sales.

Previous studies underscore the significance of information disclosure regarding scarce inventory on online sales, although the extent of this influence remains uncertain. On one hand, scarcity and lower-availability commodities transmit the scarcity signal to consumers to fuel their purchasing desire (Brock, 1968; Jung & Kellaris, 2004; Roux et al., 2015). The information disclosure of scarce inventory serves as a signal to consumers, potentially heightening their inclination to make a purchase (Gierl & Huettl, 2010; Wells et al., 2011). Scholars have proven that scarcity signals can indeed enhance consumers' purchase intention. For example, Oruc (2015) clarifies that consumers' value perception, such as commodity attraction, availability expectations, product quality, and so on, will be affected by the commodity scarcity signals, thus affecting consumers' purchasing decisions. Nichols (2012) finds that the commodities' scarcity signal arouses consumers' perception of competitiveness, thus prompting their willingness to purchase and pay to a certain extent. So, the information disclosure of scarce inventory is a scarcity signal that can promote the consumer's purchase intention, thereby boosting the sales of online sales. On the other hand, conflicting evidence exists. Park et al. (2020) discovered that information disclosure of scarce inventory for durable commodity orders led to a 17.6% decline in daily sales of commodities. Chaouachi & Rached (2012) reveal that consumers' defense mechanisms make them more vigilant towards scarcity signals. This, to some extent, inhibits the promotional effect of the scarcity signal on purchase intention. So, the information disclosure of scarce inventory may not promote the consumer's purchase intention or online sales. Thus, it can be seen that the signal of information disclosure regarding scarce inventory may have both positive and negative effects on online sales, revealing uncertainty in the conclusion.

This study utilizes Chinese e-commerce data collected from February 1 to April 30, 2023 and constructs an empirical model to explore how the signal of disclosure information strategy regarding scarce inventory influences online sales. At the same time, commodity discount rate and commodity discount time are also common signals sent by online stores, whether these signals can play a moderating role in the relationship between disclosure information regarding scarce inventory and online sales is a key question in this paper.

THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

Scarce Inventory Information Disclosure and Online Sales

Based on the signal theory, the main channel for online consumers to obtain commodity information is the disclosed information on e-commerce platforms, and online stores' information disclosure of scarce inventory sends a vital scarcity signal to consumers (Gierl & Huettl, 2010; Wells et al., 2011). After receiving the signal, their perception of commodity value and purchase desire will increase, which is more likely to promote online sales (Aggarwal et al., 2011). Online stores often use "scarce inventory information disclose" to show the scarcity signal of commodities and this message will affect consumers' perception of commodities (Cui et al., 2019; Jung & Kellaris, 2004). To explore the relationship between scarce inventory information disclosure and online sales, some scholars study from different perspectives. On one hand, the scarcity signal can increase consumers' purchase intention, for example, Calvo et al. (2023) propose that the disclosure of scarcity inventory information

leads to a significant increase in hourly sales. Wu et al. (2012) integrate consumer perceived value and purchase intention to explain the scarcity impact on product sales. Zhu & Ratner (2015) find that disclosing scarcity inventory information can trigger psychological arousal among consumers, and moderate psychological arousal can stimulate consumers' purchase intention. On the other hand, scarcity signals can positively influence consumer responses because consumers can express their uniqueness by owning scarce commodities. The scarcity of commodities provides consumers with unique experiences and increases their purchase intention (Snyder, 1992), and consumers' purchase intention is closely related to the success of online transactions (Pan et al., 2023). The scarcity signal of inventory proves to be a potent stimulus for the competitive psychology of consumers, fostering a heightened willingness to purchase and, consequently, escalating online sales.

Based on the above analysis, this study proposes the following hypotheses:

H1: Information disclosure of scarce inventory prompts online sales.

The Moderating Role of Commodity Discounts

In the realm of commodity discounts, the preferential force exerted by online stores on the promotional commodities is called the *commodity discount rate*. A specific period during which online stores offer price discounts to boost sales is called *commodity discount time*. *Commodity discount rate* and *commodity discount time* are two important commodity discount signals made by online stores in e-commerce platforms, which can remind consumers that the current commodity price is below the original level, thereby prompting them to make purchase decisions (Gierl & Huettl, 2010; Wells et al., 2011). In addition, both the *commodity discount rate* and *commodity discount time* convey the scarcity signals to consumers. These signals, often accompanied by a countdown clock and a scarce inventory, induce a sense of urgency in consumers, compelling them to make timely purchases (Aggarwal et al., 2011). At the same time, scarcity signal also enhances consumers' perception of the commodity value and they are more likely to make purchase decisions.

Commodity daily sales are very sensitive to changes in commodity prices (Park et al., 2020). The commodity discount rate not only enhances consumers' perceived value of the product but also strengthens their purchase intentions (Grewal et al., 1998). Price reduction signals are sent by online stores to intensify consumers' purchase desire (Zhu et al., 2018); with an increase in the discount rate, the improvement in consumers' purchase intention becomes more pronounced (Anderson & Simester, 1998). Simultaneously, a purchase price lower than the original price of a commodity enhances consumers' value perception, further strengthening their purchase intentions (Carlson & Kukar-Kinney, 2018). Consequently, for a given commodity, the discount rate is directly proportional to the purchase desire. Greater discounts signals lead to heightened consumer responsiveness to price, elevating the perceived value of the commodity. Discount sales strategies, such as price reductions, effectively promote consumers' purchase intentions and contribute to a more favorable shopping experience.

Commodity discount time signal induces time tension, creating a perception of limited time for consumers to determine whether they want to purchase the discounted commodity on time (Payne et al., 1996). With the increase of commodity discount time pressure, the relationship between consumers' purchase intention and discount becomes closer (Lin & Chen, 2013). Rieskamp & Hoffrage (2008) suggest that individuals, when perceiving time pressure, pay attention to the calculation of individual opportunity cost, influencing their purchasing decisions. Considering these perspectives, individuals' strategic choices and decision-making are influenced by two key factors. The first factor is the limited time for information processing, the scarcity of commodity quantity, and the restricted time for commodity discount activities; the second factor is the limited time for discount, where failure to make a purchase decision within the specified time may result in a missed opportunity. Therefore, limited *commodity discount time* effectively stimulates consumers' desire to purchase scarce commodities.

As a result, this study argues that *commodity discount rate* and *commodity discount time* can moderate the path of information disclosure of scarce inventory in online sales and proposes the following hypotheses:

- H2: *Commodity discount rate* plays a positive moderating role in the relationship between scarce inventory information disclosure and online sales.
- H3: *Commodity discount time* plays a positive moderating role in the relationship between scarce inventory information disclosure and online sales.

METHODS

Measurement of Variables

Three daily household online stores were chosen as the data samples because all three stores exhibited high sales and relatively positive reviews on the Taobao platform. This ensures the stability of the research, preventing other data fluctuations due to reputational issues. Additionally, within the observation period, all three stores had experienced phenomena involving the disclosure of scarce inventory and discounts, which were not caused by any holiday or occasional promotions. Last, these three stores had a considerable number of followers, and a significant portion of them are loyal consumers. This implies that when scarcity signals emerge, a substantial number of consumers are likely to pay attention to this information and react. Additionally, in choosing the control group, we considered three other stores, ensuring that they sell consistent and similar products. However, within the same observation period, these three other stores did not exhibit actions corresponding to the aforementioned signals. With the above considerations, the empirical data in this paper were all obtained from the real transaction data of the three daily household online stores with 4.75 million, 2.11 million, and 1.75 million followers respectively on Taobao in China from February 1 to April 30, 2023, and the value of each variable is calculated according to the following formula:

Online Sales

According to the existing literature and real-time observation of online data, the explained variables selected in this paper are as follows:

1) Daily Sales Volume

The *daily sales volume* of commodities can be obtained by calculating the initial inventory level of commodities (days) and the final inventory of commodities (days). The formula is as follows:

$$\text{Daily sales volume} = \text{initial inventory} - \text{final inventory}$$

2) Daily Sales Income

The *daily sales income* of commodities can be obtained by calculating the final price of commodities sold and the *daily sales volume* of commodities.

The formula is:

$$\text{Daily sales income} = \text{final selling price} \times \text{daily sales volume}$$

Information Disclosure of Scarce Inventory

The explanatory variables in this paper are information disclosure of scarce inventory, where *Treat* and *Time* are adopted as dummy variables of information disclosure of scarce inventory. The interaction term of the two, denoted as the differential term *DID*, is calculated as

$$DID = Treat \times Post$$

DID serves as an indicator of whether the sample is influenced by the information disclosure of scarce inventory. If the sample is affected by the information disclosure of scarce inventory, the variable value is 1; otherwise, it is 0.

The *Treat* variable indicates whether the sample is the subject of disclosing scarce inventory information. If it is the subject of disclosing scarce inventory information, the *Treat* value is 1; if not, the *Treat* value is 0.

The *Post* variable represents the dummy variable for the time when scarce inventory information is disclosed. It distinguishes between the time before and after the disclosure of commodity-scarce inventory information. A value of 1 indicates the period post-disclosure, while a value of 0 indicates the period pre-disclosure.

Moderator Variables

1) Commodity Discount Rate (*Disrate*)

When a commodity is traded within a discount context, the final transaction price is lower than the market price or initial price from the merchant. Both the initial price and the discounted price are concurrently displayed on the webpage, creating a stark contrast. This discounted price is presented in a more visually impactful manner, effectively stimulating consumers' purchasing desires. The *commodity discount rate*, expressed as a percentage, is calculated using the following formula:

$$\text{Commodity discount rate} = \frac{\text{initial price} - \text{final price}}{\text{initial price}} \times 100\%$$

This formula quantifies the percentage reduction in the initial price to the final (discounted) price, providing an intuitive measure of the discount applied.

2) Commodity Discount Time (*Distime*)

During a commodity's sale process, the discount time is typically set to be very short. This strategic choice allows consumers to navigate the commodity interface while observing the constant reduction in the remaining time for the discount period. The goal is to create a sense of time pressure, effectively stimulating consumers to make purchases. The specific formula for calculating the *commodity discount time* is:

$$\text{Commodity discount time} = \text{End date of commodity discount campaign}(\text{days}) - \text{Start date of commodity discount campaign}(\text{days})$$

This formula provides a straightforward measure of the duration of the commodity's discount campaign, contributing to the creation of a time-sensitive atmosphere designed to encourage consumer buying behavior.

Control Variables

In the process of examining the influence of information disclosure of scarce inventory on online sales, it is essential to account for not only core research variables but also additional factors that may influence the results. Therefore, this study incorporates these potentially influential variables as control variables in the research model. Based on existing research, the selected control variables are common factors affecting the *daily sales volume* of commodities, including:

1) The Favorable Rate of the Commodity (Favrate)

Online comments affect consumers' trust in the commodity (Zhao et al., 2023), which in turn affects online sales, so we need to consider "*favrate*." The favorable rate of commodities is determined by the ratio of favorable comments to the total number of comments. The formula is:

$$\text{Favorable rate} = \frac{\text{the number of favorable comments}}{\text{the total number of comments}} \times 100\%$$

2) Express Fee Payment by Consumers (Expfee)

During transactions, the seller typically either covers the express fee or the buyer pays it. If the seller covers the fee, the variable "*expfee*" is assigned 0; otherwise, it is assigned 1.

3) Previous Price (Preprice)

The *previous price* signifies the initial defined price at the time the commodity was first offered for sale.

4) Delivery Time (Delttime)

The *delivery time* represents the period within which the commodity will be shipped, typically at the discretion of the seller and often limited to 7 days. It is assigned 0 for commodities shipped within 7 days or 1 otherwise.

The variables in this paper are shown in Table 1. It should be particularly noted that *DID* appears in the model as the product term of the variable *treat* and the variable *post*, indicating whether the sample is under the information disclosure of scarce inventory.

Model Design

Compared with other measurement methods, the DID (difference-in-differences) model has many unique advantages (Nawaz et al., 2021; Xu, 2017). By adopting the DID regression method, this paper successfully solves the endogeneity problem between the dependent variables and independent variables, which provides strong support for the follow-up research; second, panel data is used for regression analysis, and the DID method can effectively eliminate the interference caused by unobserved individual characteristics. Third, the DID model also allows for parallel trend tests, effectively contrasting online sales before and after the disclosure of scarce inventory. This aids in determining whether the disclosure of scarce inventory information is the key factor influencing online sales.

In this paper, data from three necessity stores in Taobao were treated as a treatment group and data from different three stores within the same period were treated as a control group. We chose different stores within the same time instead of the same stores within different periods to eliminate the influence of special offers in different periods of the year, since June, November, December have the biggest shopping offers in China and pre-orders even start in October; additionally, July and August are summer vacation which tend to offer different pricing strategies than our observed period. Therefore, we determined that controlling the period is more essential than controlling the stores. However, we still carefully selected three other stores with similar commodities for the control

Table 1. Variable Definition Table

Variables	Name	Meaning
Online sales (Y)	<i>Volume</i>	<i>Daily sales volume = initial inventory - final inventory</i>
	<i>Income</i>	<i>Daily sales income = final selling price × daily sales volume</i>
Information disclosure of scarce inventory	<i>DID</i>	<i>DID = Treat × Post</i> , it serves as an indicator of whether the sample is influenced by the information disclosure of scarce inventory. If the sample is affected by the information disclosure of scarce inventory, the variable value is 1; otherwise, it is 0.
	<i>Treat</i>	<i>Treat</i> variable indicates whether the sample is the subject of disclosing scarce inventory information. If it is the subject of disclosing scarce inventory information, the <i>Treat</i> value is 1; if not, the <i>Treat</i> value is 0.
	<i>Post</i>	<i>Post</i> variable represents the dummy variable for the time when scarce inventory information is disclosed. It distinguishes between the time before and after the disclosure of commodity-scarce inventory information. A value of 1 indicates the period post-disclosure, while a value of 0 indicates the period pre-disclosure.
Regulating variable (Z)	<i>Disrate</i>	<i>Commodity discount rate = (initial price - final price)/initial price × 100%</i>
	<i>Distime</i>	<i>Commodity discount time = End date of commodity discount campaign (days) - Start date of commodity discount campaign (days)</i>
Control variable (X)	<i>Favrate</i>	<i>favorable rate = (the number of favorable comments / the total number of comments) × 100%</i>
	<i>Expfee</i>	Express Fee Payment by Consumers, If the seller covers the fee, the variable “ <i>Expfee</i> ” is assigned 0; otherwise, it is assigned 1.
	<i>Preprice</i>	Previous Price signifies the initial defined price at the time the commodity was first offered for sale.
	<i>Delttime</i>	Delivery time, it is assigned 0 for commodities shipped within 7 days or 1 otherwise.

group. The influence of scarce inventory disclosure on online sales is analyzed, and endogenous problems such as store differences in commodities are solved. The generalized DID experimental model is set as follows:

$$Y_{i,t} = \alpha + \beta_1 DID_{i,t} + \beta_2 Treat_i + \beta_3 Post_t + \omega X_{i,t} + \varepsilon_{i,t} \quad (1)$$

In model (1), *Y* refers to the online sales, and *X* refers to the control variables: *favorable rate*, *express fee payment by consumers*, *previous price*, and *delivery time*. *t* in the model refers to the timeline before and after the disclosure of inventory information, *i* represents the commodity, *Treat_i* stands for the group, if the commodity belongs to the treatment group, the *Treat* value is 1, otherwise it is 0. *Post_t* refers to whether the commodity has disclosed the scarce inventory information, if the scarce inventory information has been disclosed, then the *Post* is 1, if not, *Post* is 0. *DID_{i,t}* = *Treat_i* × *Post_t*; it shows whether the commodity is in the disclosure period and represents the influence of information disclosure of scarce inventory. The coefficient this paper focuses on is β_1 , which measures the influence of information disclosure of scarce inventory on the results of online sales.

To observe the moderating role of *commodity discount rate* and *commodity discount time* in the influence of information disclosure of scarce inventory on online sales, we added the variables

commodity discount rate and *commodity discount time* according to model (1), forming the model shown in formula (2) below:

$$Y_{i,t} = \alpha + \beta_1 DID_{i,t} \times Z_{i,t} + \beta_2 Treat_i \times Z_{i,t} + \beta_3 Post_t \times Z_{i,t} + \beta_4 DID_{i,t} + \beta_5 Treat_i + \beta_6 Post_t + \beta_7 Z_{i,t} + \omega X_{i,t} + \varepsilon_{i,t} \quad (2)$$

Model (2) introduces moderator variables denoted as *Z*, building upon the foundation of model (1). Through observation of the online sales market outcomes for commodities with disclosed scarce inventory information after various discounts, the moderating roles of the *commodity discount rate* and *commodity discount time* in the relationship between information disclosure of scarce inventory and online sales become apparent.

RESULTS

Descriptive Analysis

In this study, STATA 15 was employed to analyze the collected data. A total of 3,078 samples from Taobao constitute the treatment group, while an equivalent number of samples from stores selling similar commodities on the same platform form the control group. Following data cleaning and processing, a unique consolidated dataset is derived, comprising 6,156 samples for endogenous empirical research. The online sales of these commodities were observed from February 1 to April 30, 2023. The descriptive statistics are shown in Table 2. The average *DID* for the commodities is 0.13, indicating that 13% of the surveyed sample comprises commodities subject to the information disclosure of scarce inventory. This rate aligns with the proportion of commodities at the end of sales in general stores.

The data reveals substantial fluctuations in the *daily sales volume* of general merchandise, ranging from 0 to 6, with an average *daily sales volume* of 2.958 and a standard deviation of 1.414, attesting to the reliability of the survey data.

Table 2. Results of Descriptive Statistics Analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>income</i>	6156	7.048	0.762	4.865	8.664
<i>volume</i>	6156	2.958	1.414	0	6
<i>DID</i>	6156	0.13	0.337	0	1
<i>Treat</i>	6156	0.174	0.379	0	1
<i>Post</i>	6156	0.413	0.492	0	1
<i>disrate</i>	6156	0.268	0.078	0	0.49
<i>distime</i>	6156	2.42	0.495	1	3
<i>favrate</i>	6156	0.64	0.11	0.375	0.928
<i>expfee</i>	6156	0.26	0.439	0	1
<i>preprice</i>	6156	4.223	0.581	1.262	5.686
<i>delttime</i>	6156	0.058	0.234	0	1

Table 3. The Influence of Information Disclosure of Scarce Inventory on Online Sales

VARIABLES	Income	Volume
<i>DID</i>	0.335***	0.00397
	-10.56	-0.0521
<i>Treat</i>	-0.229***	0.118
	(-5.028)	-1.237
<i>Post</i>	0.176***	-0.0560*
	-14.67	(-1.703)
<i>favrate</i>	0.146*	4.328***
	-1.707	-15.96
<i>expfee</i>	-0.00263	-0.249***
	(-0.121)	(-5.028)
<i>deltme</i>	-0.120**	0.528***
	(-2.178)	-4.631
<i>preprice</i>	-1.010***	-0.537***
	(-35.93)	(-11.36)
<i>Constant</i>	11.15***	2.490***
	-8.82	-8.7
<i>Observations</i>	6,156	6,156
<i>R-squared</i>	0.612	0.206

Note. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Main Effect

Using descriptive analysis as a foundation, we established a DID model to validate the research hypotheses and examine the effect of information disclosure of scarce inventory on online sales. Table 3 describes the insights into the impact of information disclosure of scarce inventory on both the *daily sales income* and *daily sales volume* of online commodities.

According to the regression results of *DID* value and online sales, we observed the following: 1) Influence on *daily sales income*. The difference value of the *daily sales income*, under the condition of information disclosure of scarce inventory, is positively correlated. With a 99% confidence interval, it is evident that inventory information disclosure significantly correlates with daily online sales. Hence, H1 is supported, indicating that the information disclosure of scarce inventory significantly boosts the daily online sales of a commodity. (2) Influence on *daily sales volume*. Regarding the *daily sales volume* of commodities, the results indicated that while the information disclosure of scarce inventory contributes to an increase in sales volume, the effect is not statistically significant.

In examining the control variables, the most influential control variable is the *delivery time* of the commodity. Commodities with a delivery time exceeding 7 days exhibit a more substantial negative influence on *daily sales volume*, although *daily sales volume* remains positive. This suggests that faster shipping positively influences consumer preference. Additionally, an increase in the *previous price* of a commodity corresponds to a reduction in its daily sales, with higher *previous prices* leading to more pronounced negative effects on online sales.

The empirical findings demonstrate that, in comparison to the average results before the information disclosure of scarce inventory, such disclosure leads to an increase in daily sales. Overall, this influence is positive and statistically significant, providing effective support for H1.

Table 4. Moderating Effect of Commodity Discount Rate and Commodity Discount Time

VARIABLES	The moderating effect of <i>commodity discount rate</i>		The moderating effect of <i>commodity discount time</i>	
	<i>income</i>	<i>volume</i>	<i>income</i>	<i>volume</i>
<i>DID</i> × <i>Distime</i>	0.391***	0.940***	0.223	0.401*
	(4.207)	(4.048)	(1.633)	(1.72)
<i>Treat</i> × <i>Distime</i>	1.614**	2.354**	0.073	0.0356
	(2.270)	(2.072)	(0.586)	(0.16)
<i>Post</i> × <i>Distime</i>	0.308	0.914*	0.00821	0.0835
	(1.318)	(1.933)	(0.212)	(1.119)
<i>DID</i>	0.187***	0.0507	0.842***	0.826
	(3.208)	(0.414)	(2.622)	(1.534)
<i>Treat</i>	0.0919	0.426	0.567*	0.119
	(0.462)	(1.299)	(1.826)	(0.229)
<i>Post</i>	0.0686	0.341***	0.160*	0.313*
	(1.125)	(2.605)	(1.673)	(1.695)
<i>Distime</i>	2.403***	2.041***	0.842***	0.826
	(11.19)	(4.565)	(2.622)	(1.534)
<i>favrate</i>	0.187**	4.487***	0.163*	4.536***
	(2.158)	16.64)	(1.831)	(16.63)
<i>expfee</i>	0.00702	0.240***	0.00704	0.237***
	(0.325)	(4.930)	(0.324)	(4.835)
<i>deltime</i>	0.114**	0.543***	0.140**	0.466***
	(2.127)	(4.714)	(2.475)	(4.169)
<i>preprice</i>	0.986***	0.490***	1.011***	0.529***
	(34.40)	(10.27)	(35.92)	(11.29)
<i>Constant</i>	7.647***	3.461***	11.01***	1.792***
	- 136.	27.79	7.217	5.422
<i>Observations</i>	6156	6156	6156	6156
<i>R-squared</i>	0.095	0.022	0.596	0.212

Note. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Moderating Effect

To enhance the observation and analysis of the impact of information disclosure of scarce inventory on online sales and to mitigate any potential interference with result reliability, the moderator variables – *commodity discount rate* and *commodity discount time* – were individually introduced. This addition allows us to assess the effects of these moderator variables on the relationship between information disclosure of scarce inventory and online sales, as detailed in Table 4.

Regarding the moderating effect of the *commodity discount rate* on online sales, the first column of Table 4 displays the analysis. It reveals that under the condition of information disclosure of scarce inventory, the *commodity discount rate* significantly and positively promotes daily online sales income.

Moving to the second column of Table 4, the results illustrate the moderating effect of the *commodity discount rate* on *daily sales volume*. The coefficient for the commodity term is 0.940 and is significant within the 99% confidence interval. This signifies that, under the condition of information disclosure of scarce inventory, the *commodity discount rate* substantially promotes the *daily sales volume*. The significant data underlines the reasonable association between the increase in online sales and the *commodity discount rate*. *Commodity discount rate* has a significant boost to both income and volume, this supports H2, indicating that the *commodity discount rate* plays a positive moderating role in the relationship between information disclosure of scarce inventory and online sales.

In terms of the moderating effect of *commodity discount time* on online sales, the third column and fourth column of Table 4 present the analysis. The third column of Table 4 reveals that under the condition of information disclosure of scarce inventory, the *commodity discount time* doesn't significantly promote daily online sales income. Data in the fourth column of Table 4 illustrates the moderating effect of the *commodity discount time* on *daily sales volume*. The coefficient for the commodity term is 0.401 and is significant within the 90% confidence interval. This signifies that, under the condition of information disclosure of scarce inventory, the *commodity discount time* substantially promotes the *daily sales volume*. Under the condition of information disclosure of scarce inventory, *commodity discount time* can significantly increase volume, but not income, which means H3 is not fully verified.

Robust Test

Parallel Trend Test

Parallel trend test is the most important step in the construction of DID model, serving as a common method to assess the robustness of an economic model. In alignment with the model design, the sales parallel trend of the treatment group and the control group was examined. By calculating the sales for a total of 6,156 samples from February 1 to April 30, 2023, a comprehensive evaluation was conducted to determine if the commodities exhibited the same sales trend before the disclosure of scarce inventory information. This assessment also addressed the suitability of randomly selected stores on the same platform as the control group for experimental interpretation. The sales of each commodity were computed as follows:

$$\text{daily sales volume} \times \text{final price on that day}$$

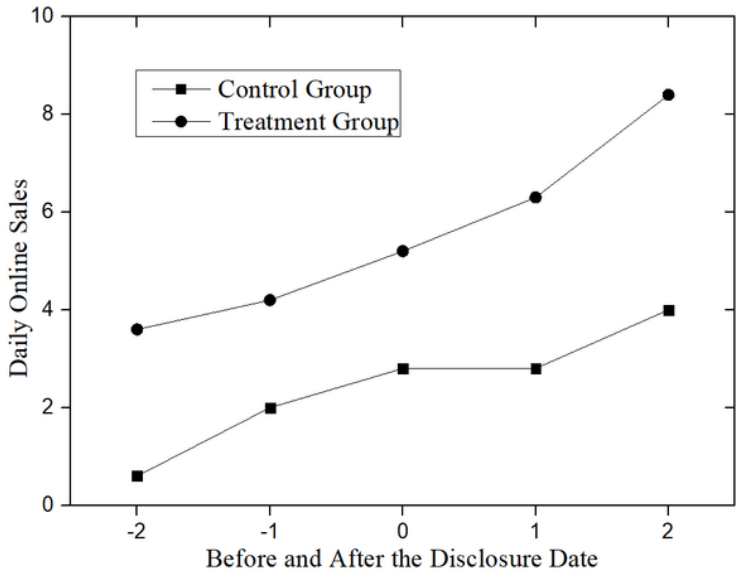
This allows us to determine the total daily sales income of the control group and the treatment group, respectively. After the natural logarithmic transformation of these daily sales, we can determine the daily sales growth trend of the treatment group and control group, which are shown in Figure 1 below:

The results indicate that the treatment group and the control group achieved an effective balance in all covariates. Moreover, the sales trends of the treatment group and the control group were remarkably similar before the disclosure of commodity scarcity inventory information. Before the disclosure of commodity scarcity inventory information, the sales trend was parallel. After the information disclosure of scarce inventory, the sales of the treatment group increased significantly more than that of the control group. This analysis reasonably supports the conclusion that the current sales outcomes of the three online stores on Taobao are influenced by the disclosure of scarce inventory information.

PSM Test

This paper does not attempt to control for non-superficial demand shocks, under which information disclosure of scarce inventory is endogenous concerning each dependent variable. To solve such endogenous problems, this paper focuses on capturing and processing a subset of data in the process of data cleaning and sorting, which leverages the inherent characteristic of big data to control for the impact of inventory scarcity messages. This paper further classifies these commodities into the

Figure 1. Daily Sales Trends of the Treatment Group and the Control Group



following categories through their respective commodity characteristics: first, the same commodity source, which refers to the commodities with identical or similar keywords, brand and commercial images; second, commodities sold on the same date, which ensures that in the experiment, the treatment group, and the control group coincide at the time point under the parallel trend; third, the same final price, which indicates that the commodities are generally priced differently in the treatment group and the control group, but through discounts, the final price can be the same; fourth, same popularity of the commodity, which accounts for commodities with similar popularity levels. This paper, by observing the online sales of these two groups of commodities, matches the same commodity in the treatment group and the control group according to the changes in the *daily sales volume* and *daily sales income* to observe the specific influence of the information disclosure of scarce inventory on online sales under the state of natural sales.

This paper employs a matching without-substitutions approach to ensure ample variation in the control group. The matching process eventually yielded 5,928 subsamples, resulting in a total of 2,964 pairs. Table 5 reports the *DID* results after matching.

The results show that the treatment group and the control group achieved an effective balance on all variables. The estimated coefficient of *DID* is significantly positive at the 1% level. Therefore, regarding the impact of scarce inventory disclosure on online sales, the results of the *DID* model consistently support the previously established hypothesis.

Hypothesis Testing

In this study, 3,078 samples obtained from Taobao are taken as the treatment group, and 3,078 samples obtained from similar commodities sold on Taobao are taken as the control group. Information disclosure of scarce inventory is the independent variable, online sales is the dependent variable, and *commodity discount rate* and *commodity discount time* are the moderator variables. The interaction between variables is systematically analyzed, the influence of scarce inventory disclosure on online sales is investigated, the hypothesis is verified, and the following results are shown:

Table 5. Results of the DID Model After Matching

VARIABLES	Income	Volume
<i>DID</i>	0.311***	0.023
	-9.359	-0.026
<i>Treat</i>	-0.405***	0.200**
	(-7.73)	-2.31
<i>Post</i>	0.145***	-0.102***
	-7.29	(-2.72)
<i>Favrate</i>	0.183**	4.469***
	-2.171	-16.76
<i>Expfee</i>	-0.00267	-0.248***
	(-0.124)	(-4.983)
<i>Divtime</i>	-0.0823	0.432***
	(-1.496)	-3.548
<i>Preprice</i>	-0.999***	-0.540***
	(-35.64)	(-11.20)
<i>Constant</i>	11.08***	2.416***
	-8.809	-8.265
<i>Observations</i>	5,928	5,928
<i>R-squared</i>	0.607	0.197
<i>Adjusted R2</i>	0.0313	0.0313

Note. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

- 1) The regression effect of *DID* value and online sales indicates that information disclosure of scarce inventory significantly correlates with daily online sales, with a positive difference in the *daily sales income* of commodities under this condition. Under a 99% confidence interval, it can be concluded that the information disclosure of scarce inventory significantly increases the daily online sales of commodities. This supports H1: Information disclosure of scarce inventory prompts online sales.
- 2) Under the condition of information disclosure of scarce inventory, the *commodity discount rate* can positively and significantly promote daily online sales, supporting H2: *Commodity discount rate* plays a positive moderating role in the relationship between information disclosure of scarce inventory and online sales.
- 3) Under the condition of information disclosure of scarce inventory, *commodity discount time* can significantly increase volume, but not income, which means H3 is not fully verified.
- 4) Control variables reveal that the most influential factor is the *delivery time* of the commodities. Commodities shipped in more than 7 days have a greater negative influence on the *daily sales volume*, while the *daily sales volume* of the commodity remains positive. The faster the commodities are shipped, the more consumers will favor them. Additionally, an increase in the *previous price* of a commodity leads to a reduction in daily sales, with higher *previous prices* correlating with more negative online sales.

DISCUSSION

It has become a marketing strategy frequently adopted by many online stores to influence online consumers' purchase intention by disclosing commodity scarcity inventory information to target consumers. Building upon the theoretical framework of the signal theory, this paper adopts an empirical model of DID method to study the topic of the influence of information disclosure of scarce inventory on online sales. There is no doubt that this study contributes significantly to the in-depth exploration and understanding of the internal mechanism involved in information disclosure of scarce inventory. Furthermore, it sheds light on the effective utilization of the marketing function inherent in such information disclosure.

CONCLUSION AND CONTRIBUTION

Information disclosure of scarce inventory has a positive influence on online sales (H1), and the *commodity discount rate* plays a positive moderating role in the relationship between information disclosure of scarce inventory and online sales (H2), and *commodity discount time* can significantly increase online volume, but not income (H3). The information disclosure of scarce inventory will greatly increase both the sales volume and sales income of commodities. Furthermore, this effect will be more significant under the moderating effect of the *commodity discount rate*.

First, this paper reveals that the two signals of scarce inventory and *commodity discount rate* can promote online sales, which enriches the application of signal theory in the e-commerce field and effectively combines the signal theory with e-commerce research. Signal theory mainly focuses on how to eliminate information asymmetry by transmitting signals, and online stores can autonomously convey different types of signals to consumers to reduce information asymmetry. Second, this study demonstrates that the signal of *commodity discount rate* can increase both online volume and income, and the signal of *commodity discount time* can only increase online volume. These rarely noticed results contribute to the findings that certain signals have distinct effect in online marketing strategies. Third, while previous studies had contradictory results on relationship between scarce inventory information and consumers' purchase (Nichols, 2012; Oruc, 2015; Chaouachi & Rached, 2012; Park et al., 2020b), this paper demonstrates that they are positively related, especially with respect to online e-commerce platforms.

Managerial Implications

The study of online signals of scarce inventory and discount have contributed to online e-commerce marketing strategies. On one hand, when developing promotional strategies, online stores can promote online sales and increase profit margins by sending signals of scarce inventory and/or discount rates to consumers. On the other hand, although discount duration helps increase sales volume but not sales income, online stores can still make full use of such a strategy to clear unnecessary large inventories. In addition, online stores must not rely on the information disclosure of scarce inventory as their exclusive marketing strategy. In the competitive landscape of e-commerce, even as many other online stores adopt this approach, it remains imperative to explore novel and effective marketing methods to thrive.

Limitations

It is crucial to acknowledge the limitations inherent in this study. The empirical data, drawn from transactions on the Taobao platform from February 1 to April 30, 2023, provides valuable insights into the current dynamics of e-commerce. However, it is imperative to recognize that our results are contingent on the specific conditions prevalent during this period, and the rapidly evolving nature of the e-commerce landscape raises questions about the generalizability of our conclusions over an extended timeframe. Additionally, the comprehensiveness of our data analysis may be influenced by the scope of the study, specifically focusing on three houseware stores. As we delve into the text, it is

essential to keep these limitations in mind, understanding that the applicability of our findings may be subject to changes in e-commerce policies and the evolving nature of consumer behavior preferences. With these considerations, future studies need to proceed with exploring the intricate relationship between information disclosure of scarce inventory and online sales, where further optimization in these aspects can lead to more valuable and enduring conclusions.

CONFLICTS OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

FUNDING STATEMENT

University Nursing Program for Young Scholars with Creative Talents in Heilongjiang Province
Contact: Xi Xi
Award/Contract ID: UNPYSCT-2020207
University Nursing Program for Young Scholars with Creative Talents in HUC
Contact: Xi Xi
Award/Contract ID :2020CX45

PROCESS DATES

March, 2024
Received: December 1, 2023, Revision: March 8, 2024, Accepted: February 27, 2024

CORRESPONDING AUTHOR

Corresponding author1: Xi Xi: cc_58@163.com
Corresponding author2: Feifei Ren: rrren9020@163.com

REFERENCES

- Aggarwal, P., Jun, S. Y., & Huh, J. H. (2011). Scarcity Messages. *Journal of Advertising*, 40(3), 19–30. doi:10.2753/JOA0091-3367400302
- Anderson, E. T., & Simester, D. I. (1998). The role of sale signs. *Marketing Science*, 17(2), 139–155. doi:10.1287/mksc.17.2.139
- Calvo, E., Cui, R., & Wagner, L. (2023). Disclosing product availability in online retail. *Manufacturing & Service Operations Management*, 25(2), 427–447. doi:10.1287/msom.2020.0882
- Carlson, J. R., & Kukar-Kinney, M. (2018). Investigating discounting of discounts in an online context: The mediating effect of discount credibility and moderating effect of online daily deal promotions. *Journal of Retailing and Consumer Services*, 41, 153–160. doi:10.1016/j.jretconser.2017.12.006
- Chaouachi, S. G., & Rached, K. S. B. (2012). Perceived deception in advertising: Proposition of a measurement scale. *Journal of Marketing Research & Case Studies*, 2012, 1–15. doi:10.5171/2012.712622
- Cui, R., Zhang, D. J., & Bassamboo, A. (2019). Learning from inventory availability information: Evidence from field experiments on Amazon. *Management Science*, 65(3), 1216–1235. doi:10.1287/mnsc.2017.2950
- Gierl, H., & Huettl, V. (2010). Are scarce products always more attractive? The interaction of different types of scarcity signals with products' suitability for conspicuous consumption. *International Journal of Research in Marketing*, 27(3), 225–235. doi:10.1016/j.ijresmar.2010.02.002
- Grewal, D., Krishnan, R., Baker, J., & Borin, N. (1998). The effect of store name, brand name and price discounts on consumers' evaluations and purchase intentions. *Journal of Retailing*, 74(3), 331–352. doi:10.1016/S0022-4359(99)80099-2
- Jung, J. M., & Kellaris, J. J. (2004). Cross-national differences in proneness to scarcity effects: The moderating roles of familiarity, uncertainty avoidance, and need for cognitive closure. *Psychology and Marketing*, 21(9), 739–753. doi:10.1002/mar.20027
- Lin, Y.-H., & Chen, C.-F. (2013). Passengers' shopping motivations and commercial activities at airports—The moderating effects of time pressure and impulse buying tendency. *Tourism Management*, 36, 426–434. doi:10.1016/j.tourman.2012.09.017
- Lynn, M. (1991). Scarcity effects on value: A quantitative review of the commodity theory literature. *Psychology and Marketing*, 8(1), 43–57. doi:10.1002/mar.4220080105
- Meng, F., Jiang, S., Moses, K., & Wei, J. (2023). Propaganda information of internet celebrity influence: Young adult purchase intention by big data analysis. *Journal of Organizational and End User Computing*, 35(1), 1–18. doi:10.4018/JOEUC.318128
- Nawaz, M. A., Seshadri, U., Kumar, P., Aqdas, R., Patwary, A. K., & Riaz, M. (2021). Nexus between green finance and climate change mitigation in N-11 and BRICS countries: Empirical estimation through difference in differences (DID) approach. *Environmental Science and Pollution Research International*, 28(6), 6504–6519. doi:10.1007/s11356-020-10920-y PMID:32997248
- Nichols, B. S. (2012). The development, validation, and implications of a measure of consumer competitive arousal (CCAr). *Journal of Economic Psychology*, 33(1), 192–205. doi:10.1016/j.joep.2011.10.002
- Oruc, R. (2015). *The effects of product scarcity on consumer behavior: A meta-analysis*. Europa-Universität Viadrina Frankfurt.
- Pan, X., Xiong, W., Pu, S., Han, F., & Zhang, A. (2023). Trust, perceived benefits, and purchase intention in C2C e-commerce: An empirical testing in China. *Journal of Organizational and End User Computing*, 35(3), 1–15. doi:10.4018/JOEUC.325508
- Park, S., Rabinovich, E., Tang, C. S., & Yin, R. (2020). The impact of disclosing inventory-scarcity messages on sales in online retailing. *Journal of Operations Management*, 66(5), 534–552. doi:10.1002/joom.1082
- Payne, J. W., Bettman, J. R., & Luce, M. F. (1996). When time is money: Decision behavior under opportunity-cost time pressure. *Organizational Behavior and Human Decision Processes*, 66(2), 131–152. doi:10.1006/obhd.1996.0044

- Rieskamp, J., & Hoffrage, U. (2008). Inferences under time pressure: How opportunity costs affect strategy selection. *Acta Psychologica*, 127(2), 258–276. doi:10.1016/j.actpsy.2007.05.004 PMID:17640605
- Schindler, R. M. (1989). *The excitement of getting a bargain: Some hypotheses concerning the origins and effects of smart-shopper feelings*. ACR North American Advances.
- Snyder, C. R. (1992). Product scarcity by need for uniqueness interaction: A consumer catch-22 carousel? *Basic and Applied Social Psychology*, 13(1), 9–24. doi:10.1207/s15324834basp1301_3
- Spence, M. (2002). Signaling in retrospect and the informational structure of markets. *The American Economic Review*, 92(3), 434–459. doi:10.1257/00028280260136200
- Wells, V., Valacich, , & Hess, . (2011). What signal are you sending? How website quality influences perceptions of product quality and purchase intentions. *Management Information Systems Quarterly*, 35(2), 373. doi:10.2307/23044048
- Wu, W., Lu, H., Wu, Y., & Fu, C. (2012). The effects of product scarcity and consumers' need for uniqueness on purchase intention. *International Journal of Consumer Studies*, 36(3), 263–274. doi:10.1111/j.1470-6431.2011.01000.x
- Xu, Y. (2017). Generalized synthetic control method: Causal inference with interactive fixed effects models. *Political Analysis*, 25(1), 57–76. doi:10.1017/pan.2016.2
- Yang, J. (2021). An empirical analysis of psychological factors based on EEG characteristics of online shopping addiction in e-commerce. *Journal of Organizational and End User Computing*, 33(6), 1–17. doi:10.4018/JOEUC.286767
- Zhao, Z., Yang, Y., Liang, J., Garcia-Campayo, J., Wang, Z., Perez, H. M., Li, H., & Borao, L. (2023). An empirical analysis of trust, perceived benefit, and purchase intention in C2C electronic commerce in China. *Journal of Organizational and End User Computing*, 35(3), 1–16. doi:10.4018/JOEUC.325797
- Zheng, K. (2022). The analysis of Nike's marketing strategy from social media and consumer psychology & behavior. *BCP Business & Management*, 34, 436–442. doi:10.54691/bcpbm.v34i.3046
- Zhu, D. H., Wang, Y. W., & Chang, Y. P. (2018). The influence of online cross-recommendation on consumers' instant cross-buying intention: The moderating role of decision-making difficulty. *Internet Research*, 28(3), 604–622. doi:10.1108/IntR-05-2017-0211

Xi Xi is a professor at School of Management, Harbin University of Commerce. Her research interests include tech mining, technological forecasting, strategic innovation and business intelligence. Her research has been published in Technological Forecasting and Social Change, Knowledge-Based Systems, among others.

Feifei Ren is a master student at School of Management, Harbin University of Commerce, China. Her research interests include tech mining and technological forecasting. Her research has been published in Technological Forecasting and Social Change.

Weiqian Liu is a master student at School of Management, Harbin University of Commerce, China. Her research interests include link prediction and technological forecasting.

Yuanyuan Chen is working at AECC Sichuan Gas Turbine Establishment. Her research interests include e-commerce and business management.