The Impact of Green Disclosure Nudging in Online Reuse Markets: Evidence from a Natural Experiment

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Abstract

As the environment continues to deteriorate, for managers, the means of shifting consumer behavior to "green" is urgently needed. Information disclosure as a tactic to promote green consumption has been widely studied, which typically stimulates demand for new green products through cost disclosure. In contrast, the impact of environmental benefit information disclosure on green consumption, especially on online reuse platforms, remains to be ascertained. In this study, we examine the economic effects of a green disclosure nudge through a natural experiment. Drawing on daily sales data, we find that the green disclosure nudge can stimulate consumer demand and generate economic benefits. We provide suggestive evidence that this positive effect stems from an increase in consumers' perceptions of the functional and symbolic value of used products, respectively. In addition, exploratory analysis shows that the nudge may have potential social benefits. The findings provide practical and theoretical implications for promoting green consumption.

Keywords: Green disclosure nudging, natural experiment, online reuse platforms

Introduction

The development of the internet has laid the foundation for the emergence of online platforms that facilitate connections among consumers and change traditional consumption patterns (Zervas et al. 2016; Nian et al. 2021). Online reuse platforms, as one of these platforms, offer a new channel for consumers to exchange used products and have been a great success for their transparent prices and low transaction costs (Bakos 1997; Brynjolfsson and Smith 2000; Dhanorkar 2019). The rapid proliferation and popularity of online reuse platforms (e.g., eBay, OfferUp, and Craglist) illustrate the importance of online reuse platforms in secondary markets. While online reuse platforms are booming, they inevitably encounter some challenges in that consumer demand for used products stems primarily from their cheapness rather than their environmental benefits. We argue that a green disclosure nudge as a possible IT solution can make consumers aware of the environmental benefits of used items and thus effectively promote consumer demand for used items. Therefore, it is of great importance to investigate the impact of the green disclosure nudge on consumer demand for used items (i.e., green consumption) on the online reused platform.

Previous research on green consumption has focused on the demand for environmentally friendly products from the perspectives of government policy (e.g., HOV policy), social focus (e.g., media coverage), and

corporate strategy (e.g., green enhancement) (He et al. 2021; Chen et al. 2019; Newman et al. 2014). Although the influence of online platforms has grown along with the size of their economies, their role in driving green consumption has rarely been studied, especially in the case of online reuse platforms (e.g., Poshmark and eBay). In addition, environmental products that are the main focus of existing research are those that add a green factor to conventional counterparts, such as the use of environmentally friendly materials or clean energy (Tezer and Bodur 2020; Chen et al. 2019); these products still essentially require the consumption of existing environmental resources. In contrast, used products are inherently "green". This is the case for two reasons. First, because used products may cannibalize and reduce consumer demand for new products (Waldman 1997; Ghose et al. 2005; Ghose et al. 2006; Bennett et al. 2015), they may inhibit environmental extraction and pollution at the source. Second, an online reuse platform facilitates the formation of a closed-loop supply chain (Dhanorkar 2019), which can reduce the amount of waste that needs to be recycled and disposed of, ultimately reducing environmental pollution.

Recently, researchers have paid special attention to the design of green nudges as a way to facilitate green consumption and promote sustainable behavior (Schubert 2017; Carlsson et al. 2021). There are many forms of green nudges (Carlsson et al. 2021), and the one we are interested in is the promotion of pro-environmental behavior through a green disclosure nudge that discloses the environmental benefits (e.g., reduced carbon emissions) of used products. The green disclosure nudge can help consumers make better consumption choices by overcoming inattention and imperfect information about the environmental benefits of used product transactions (Allcott and Sweeney 2017; Tiefenbeck et al. 2018). However, there are few studies exploring the role of the green disclosure nudge on online reuse platforms. To fill this research gap, we examine how the disclosure of environmental benefit information through green disclosure nudging affects consumer demand for used products on the online resue platform.

There has been a debate about the quality of green products, with some studies arguing that the green attributes of these products are acquired at the expense of function (Newman et al. 2014) and others holding the opinion that the functional attributes of products increase with the improvement of green attributes (Gupta and Sen 2013). These views are based on new products, and the green attributes of such products are orthogonal to the functional attributes (Newman et al. 2014). In contrast, we argue that for used items, their green attributes should be considered part of their overall function. The disclosure of their unique environmental benefits can enhance consumers' perception of their overall function, while there remains a concern that such disclosure may affect consumers' perception of their original utility. In addition, the disclosure of environmental benefits is likely to enhance the symbolic value consumers derive from purchasing used items, as it signals a pro-environmental image (He et al. 2021). Furthermore, in addition to the impact on the platform, such disclosure may also generate social benefits by influencing consumer behavior. Thus, we seek to address the following questions:

(1) Does green disclosure nudging on online reuse platforms affect consumer demand for used items?

(2) What are the underlying mechanisms behind the green disclosure nudging effect?

(3) Can green disclosure nudging on online reuse platforms generate social and environmental benefits?

To answer these questions, we obtain a unique dataset from one of the largest online reuse platforms in China, on which users can sell used products. The dataset mainly involves user-level transaction data dating back to the inception of the platform, which consists of 51,540,097 transactions for 4,608,017 users. On June 22, 2021, the platform disclosed the environmental benefits of used products in the form of labels that show reduced carbon emissions and cover its entire C2C market. This exogenous shock provides us with a natural experiment to examine the effect of the green disclosure nudge on user sales.

Our main analyses show that the green disclosure nudge increased user sales by 5.2%, indicating a significant increase in consumer demand for used products after the environmental benefits of used products were disclosed. There are no seasonal effects that would interfere with our estimations. We also find that the positive effect of the green disclosure nudge is stronger for consumers in poorer ecological environments and higher social classes. Moreover, we observe that when the ecological environment of consumers is good enough, the positive effect will even disappear, but there is no significant negative impact; this suggests that consumers' concerns about the quality of conventional green products do not apply to used goods. Overall, these results provide evidence that the green disclosure nudge increases sales by enhancing the functional value and symbolic value of used goods. Finally, we find that the green disclosure nudge may be associated with improvements in air quality.

This research contributes to the IS literature on online reuse platforms and green consumption in several ways. First, our study sheds light on how a green disclosure nudge as a green IS strategy promotes consumer green consumption on the online reuse platform. Specifically, we focus on the green consumption of consumer demand for used and secondary goods, complementing previous literature that has focused primarily on conventional green products. Second, our study empirically investigates the underlying mechanisms (i.e., functional value and symbolic value) behind the effect of the green disclosure nudge on green consumption on the online reuse platform. Third, our study not only focuses on the economic impact of the green disclosure nudge (i.e., customer demand for used products) but also extends the current focus of green consumption from economic benefits to societal and environmental spillovers (i.e., air quality index).

Our findings offer important practical implications for managers. The disclosure of environmental benefit information, as opposed to cost information, can also promote consumers to make greener choices; however, when assessing the stimulating effect of environmental benefit information on consumer demand, it is still necessary to account for market characteristics. Considering the role of platforms in stimulating consumption and the cost of green disclosure nudging, strategic cooperation can be reached between the government and platforms to make full use of their respective advantages to promote green consumption.

Literature Review

Green Consumption and Secondary Markets

Although most people are concerned about the environment and are willing to engage in green consumption, there appears to be a significant gap between their explicit attention to green consumption and their actual behavior, a phenomenon referred to as the intention-behavior gap (Peattie 2010; Carrington et al. 2014; Bodur et al. 2015; Sachdeva et al. 2015). To better understand and eliminate the gap, numerous marketing and social psychology studies have investigated the willingness and motivation behind green consumption, suggesting consumer decision-making is complex and malleable (Griskevicius et al. 2010; Gupta and Sen 2013; Peloza et al. 2013; White et al. 2019; Yan, Keh, and Wang 2021; Yan, Keh, and Chen 2021). Meanwhile, in order to stimulate green consumption, there is increasing research interest in the design (e.g., eco-labels) and practical effects of green marketing tactics (Newman et al. 2014; Gosselt et al. 2019; Chen et al. 2019; He et al. 2021). While extant studies mainly examine green marketing strategies from the perspective of companies, society, and government, less is known about how to increase consumers' purchase of environmentally-friendly products through platform intervention, which has been proven to have a significant impact on the behavior of platform participants (e.g., identify disclosure (Pu et al. 2020)).

According to Peattie (2010), green consumption refers to consumer behavior that is oriented toward sustainable development (e.g., purchasing environmentally friendly products or saving resources). Although it is a distinct form of prosocial behavior (Yan, Keh, and Chen 2021), there is no clear and consistent notion of it within previous research because it is highly similar to other concepts (e.g., ethical, sustainable, or responsible consumption) (Peattie 2010; Tezer and Bodur 2020; Yan, Keh and Wang 2021).

Green consumption seems to be an oxymoron because "green" implies the protection of the ecological environment, whereas "consumption" conveys the destruction of it (Peattie 2010). However, such contradiction appears to be mitigated in the context of online secondary markets. This is the case for two reasons. First, secondary markets provide an opportunity for consumers to transfer used products to those who value them. Thus, online reuse platforms could reduce the generation of waste by redirecting the reusable goods away from the waste stream, consequently delivering environmental benefits by reducing the amount of waste that needs to be disposed of (Dhanorkar 2019). Second, cannibalization effects have been proposed and demonstrated to exist between new and used products (Waldman 1997; Ghose et al. 2005; Ghose et al. 2006; Bennett et al. 2015), which might in the long term contribute to the conservation of environmental resources by reducing the purchase of new goods. Despite the environmental benefits of secondhand trading, little extant work has taken note of this and explored its impact on consumer behavior.

Nudges and Green Nudges

Nudging is defined as a behavioral intervention that steers people's behavior predictably through a change in the decision environment without prohibiting any options or significantly changing economic incentives

(Cadario and Chandon 2020). Nudges take many forms, including labels on products, graphic images on billboards, or purposeful default options, and they have been analyzed in depth in existing studies (Schubert 2017). As a policy instrument favored by policymakers, nudges can be used in a wide range of scenarios, such as healthy eating nudges, savings nudges, and digital nudges (Cadario and Chandon 2020; Blaufus and Milde 2021; Huang et al. 2018; Huang et al. 2019). In these cases, nudges are used to improve individuals' choices and overall welfare.

Green nudges, as an extension of the nudging concept in environmental policy, have increasingly attracted the attention of policymakers and scholars as environmental issues have intensified; such nudges are intended to make people's behavior more sustainable and environmentally friendly (Schubert 2017; Carlsson et al. 2021). Similar to nudges, there are many types of green nudges discussed in depth in the literature (Carlsson et al. 2021). However, unlike nudges that are self-focused (Carlsson et al. 2021), green nudges are designed to reduce negative externalities by steering people's behavior (e.g., promoting green consumption). In some cases, such green nudges have proven more effective than potential alternatives (e.g., incentives, information and education campaigns, or moral suasion) (Schubert 2017). Examples of widely studied green nudges include eco-labels on products (Schubert 2017), social comparisons (Allcott and Kessler 2019), and goal setting and commitment (Harding and Hsiaw 2014). Most existing studies target the quantity and quality of resource consumption, providing experimental evidence for the effect of designed green nudges.

However, despite the existing work on green nudges, according to Allcott and Mullainathan (2010), there is a lack of concerted effort by researchers, policymakers, and businesses to translate behavioral science insights into scaled interventions, moving continuously from the laboratory to the field to practice. Although a growing body of research examines the effectiveness of interventions through field and laboratory experiments, few studies have explored the practical effects of large-scale green nudges due to cost constraints.

Information Disclosure Through a Green Disclosure Nudge

Consumers constantly make decisions under imperfect information (Allcott and Knittel 2019). There are significant evidences that consumer behavior will be systematically biased due to inattention or imperfect information against what is predicted by conventional economic theory (Abaluck and Gruber 2011; Allcott and Knittel 2019; Carlsson et al. 2021). One of the ways to overcome this bias and nudge decision-making is information disclosure (Allcott and Sweeney 2017; Tiefenbeck et al. 2018). Information disclosure on online platforms and its influence have attracted the interest of academics in the IS field in recent years (e.g., identify disclosure and social information disclosure) (Pu et al. 2020; Rong et al. 2022). However, not all the information disclosed is beneficial to buyers and platforms (Zhou et al. 2018).

As a form of green nudges, information disclosure has aroused the interest of policymakers and scholars. Extant studies have designed various ways of information disclosure and have shown mixed effects on green consumption. For example, Tiefenbeck et al. (2018) find that real-time feedback can reduce the amount of water people use. In contrast, Allcott and Knittel (2019) show that providing fuel economy information in terms of individually tailored annual and lifetime fuel cost information has no effect on consumers' purchasing decisions. These studies mainly focus on the effects of environmental information disclosure on consumer behavior. This is typical of the vast majority of studies, which consider the behavioral impact of cost information disclosure (e.g., energy, fuel, water, and carbon); we note that there is little attention paid to the environmental benefit information disclosure.

Eco-labels, as a primary example of information disclosure and green nudges, have been investigated broadly. Carbon labels, a type of eco-label (Liu et al. 2016), provide cost disclosure by stating the total amount of a product's greenhouse gas emissions within a defined supply chain, and they must comply with a mix of third-party and government standards (Liu et al. 2016; Rondoni and Grasso 2021). However, it has proven difficult for consumers to make sense of the value of carbon labels (Upham et al. 2011; Guenther et al. 2012), possibly because they cannot intuitively understand the environmental benefits of the product. Furthermore, although such labels have been extensively investigated in the context of food consumption (Rondoni and Grasso 2021), there remains limited empirical evidence on the influence of environmental disclosure on consumer purchases, especially in the IS literature. Thus, of particular interest to us is the behavioral impact of information disclosure on online platforms, which directly quantifies the environmental benefits of the product and is called a green disclosure nudge in this paper.

Methodology

Empirical Context

ZhuanZhuan (henceforth, ZZ) is one of the largest online reuse platforms in China, with more than 30 categories of products. Launched in November 2015, the service offers a platform for both buyers and sellers to trade in secondhand products. In November 2016, the daily order volume on the ZZ platform exceeded 500,000 products and the daily turnover exceeded 90 million yuan. As of July 2018, the number of registered users exceeded 200 million, and the number of monthly active users reached 50 million. There are two markets on the platform, one of which is the official market that mainly conducts B2C business. The other, which we are interested in, is the free market, which allows users to buy and sell freely.

On June 22, 2021, a green label appeared in the platform's free market. This label was only visible to registered users and revealed the amount of carbon emissions that could be saved if the user purchased this secondhand item instead of a new one. Figure 1 presents a screenshot of the green label, which consists of a green logo and a description stating that buying the product can reduce carbon emissions by 39kg. The amount of this reduction in carbon emissions is measured by the group standard "Technical specification at project level for assessment of greenhouse gas emission reductions—Second-hand goods platform" ("the Standard" hereafter), which was developed under the leadership of the Chinese National Institute of Standardization, with the participation of ZZ Group, Tsinghua University, and international consulting companies. The Standard differs from the usual measure of information on environmental costs (e.g., carbon emissions) because it determines the project boundary, greenhouse gas emission source, greenhouse gas type, and baseline scenario of the secondhand trading platform, then forms an assessment method for emission reduction. Meanwhile, it is the first standard in China and even the world to account for the greenhouse gas emission reduction of used goods trading platforms, which makes it possible to conduct research on information about environmental benefits and not only environmental costs. The emergence of the green label, which is placed online by the platform and which is purely exogenous, provides us with a unique natural experiment to investigate the economic effects of the green disclosure nudge.

Figure 1. A Used Product with a Green Disclosure Nudge

Data Collection

We obtain a unique dataset from the ZZ platform through crawler technology. The dataset consists of three parts: (1) secondhand goods transaction data, (2) user profile data, and (3) user entry time data. The transaction data is based on 51,540,097 free market transactions recorded from 4,608,017 users between October 2015 and November 2021, and it includes the description of the product and the timing of the transaction. User profile data is derived from the user's home page and includes the user's name,

description, and address. User entry time data can be obtained through the dynamic information of users, which records user activity on the platform. We combine the data from the three parts using a unique identification ID. To examine the effect of the green disclosure nudge, we focus on user sales before and after the changes.

We complement the ZZ dataset with an extensive set of variables from the National Bureau of Statistics (NBS). The NBS dataset tracks the annual economic, demographic, and geographic characteristics of all provinces and major cities in China (e.g., GDP, per capita income, and the area of national nature reserves). To identify how many potential consumers are in a given market, we treat provinces as geographically isolated markets, and we exploit these variables to examine the potentially heterogeneous impact of the green disclosure nudge across different regional characteristics. In addition, we collect city-month level air quality data from the Ministry of Ecology and Environment to explore the possible social effect of the green disclosure nudge.

Empirical Strategy

We are interested in the changes in user sales before and after the green disclosure nudge. The rollout of the green label is mandatory and covers the entire platform, which means that there are no suitable users who are not affected by the green label to frame the counterfactual in this period. Thus, we adopt an interrupted time-series strategy in which the counterfactual is the sales of users before the time intervention (Zhang and Zhu 2011; Gonzalez-Navarro 2013; Pu et al. 2020). In order to alleviate concerns about seasonal effects and other external factors, we use the sales of users during the same period in 2019 and 2020 as another counterfactual (Zhang and Zhu 2011). To do this, we rely on search engines to find out all the news about ZZ in the last few years and extract important events, which will guide us to choose a reasonable time window. Specifically, we first sort out the collected events that might affect the sale performance of the ZZ platform. Then we exclude observations in 2019, even though the platform was not disturbed by Covid-19 during this period. We note that on May 6, 2020, ZZ Group merged with another B2C mobile platform and then replaced the usual 525 secondhand festival with a 618 joint promotion that was mainly held at the official market on June 18; this event may have had an impact on sales in the free market. Thus, the platform environment in 2020 is more aligned with the 2021 environment than the 2019 environment.

However, there remains a concern that Covid-19, which hit China in 2020 and severely hindered social and consumer activity, may have a certain impact on the platform. To alleviate this concern, we focus on observations after April 29, 2020, when national epidemic prevention and control became normal, according to the white paper "Fighting Covid-19: China in Action" released by the State Council Information Office. To further determine the time window, we plotted a timeline of ZZ-related events that occurred after April 29, 2020 and 2021, as shown in Figure 2. Importantly, there was a traffic-attracting event in which the official ZZ flagship store entered Xianyu, one of the largest C2C secondhand goods transaction platforms, on July 7, 2020, which attracted a lot of online media coverage. On the same day, the CEO of ZZ Group responded and confirmed the news, which may have driven more traffic to the platform and thus increased sales.

Based on the timeline of events (Figure 2), we focus on the period between May 25 (4 weeks before the nudge) and August 16 (8 weeks after the nudge) as the time window of this study. We choose this relatively short time window mainly to meet two requirements: (1) minimal external interference and (2) the consistency of the external environment of the platform in 2020 and 2021. In order to reduce external interference, we need to choose a time period near the green disclosure nudge but with as few promotions as possible. We have not excluded observations that were influenced by the 618 joint promotion, as doing so would make the number of observation periods before the green disclosure nudge very small. However, we exclude observations after August 16, 2021: even though there is no news that the platform held an 818 joint promotion on August 18, 2021, most e-commerce platforms, including JD.com and Taobao, will hold 818 promotions every year, which may impact the sales of the ZZ platform. Moreover, an imprint of 818 experience can exist and can bias the estimates (Ru et al. 2021). To ensure consistency of the external environment, the optimal choice is to find the period in 2020 and 2021 that has the same external interference, which is between May 20 and July 7. However, this would result in very few observation periods after the green disclosure nudge. Between May 25 and August 16, the period we choose, the platform only held one 618 joint promotion, as it did between May 20 and July 7. Although the platform had a traffic-attracting event in 2020, we can control it in the subsequent estimation.

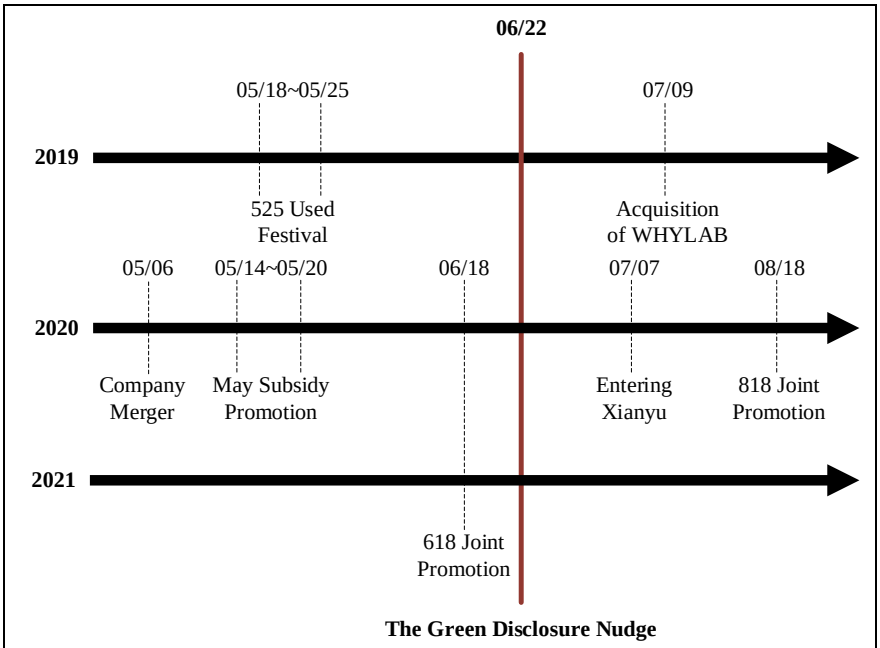

Figure 2. The Timeline of Events

In our empirical setting, the users on the platform are the sellers. Although there are more than 20 million users on the platform, not all of them are active and have sold items on the platform. Therefore, to understand how the green disclosure nudge affects consumers' purchase behavior, we focus on the active users who sold at least one item during the observation period (i.e., from May 25, 2021 to August 16, 2021) and we conduct the analysis at the user-day level. The final dataset is exceedingly huge, containing 233,162 sellers and 19,398,687 observations.

Model Estimation and Results

As our dependent variable, *Sales*, is count data with significant over-dispersion (M=0.1536, SD=3.2634), we use a negative binomial regression model to estimate the effect of the green disclosure nudge on users' sales. To account for the heterogeneity across users, we include user fixed effects (i.e., a single dummy for each user). We identify the effect of the green disclosure nudge by using the following form:

$$Sales_{it} = \alpha_i + \beta_0 + \beta_1 Green_t + \epsilon_{it}, \quad (1)$$

where i and t indicate a user and a day, respectively. $Sales_{it}$ is the dependent variable, representing the number of goods sold by user i on day t. User-level fixed effect is captured by α_i, controlling for the unobservable time-invariant characteristics of each user. $Green_t$ is a dummy variable that equals 1 after time of the green disclosure nudge and 0 otherwise, indicating whether the information about the product's environmental benefit is disclosed. The key parameter of interest in this model is β_1, which captures the effect of the green disclosure nudge on user sales. Lastly, β_0 is an intercept and ϵ_{it} is the unobserved individual random error for each user. To estimate the negative regression model, we use the *xtnbreg* procedure in Stata. In addition, we use other model specifications to further verify the effect of the nudge, including OLS, Poisson, and zero-inflated models.

Main Effect

The columns in Table 1 present the estimated effect of the green disclosure nudge on user sales using Equation (1). Column (1) shows the result of the negative binomial panel regression with user fixed effects. The estimated coefficient of focal variable, *Green*, is positive (0.0503) and statistically significant (p<0.001), which amounts to a 5.2% [exp(0.0503)-1] increase in unit sales of each user in response to the green disclosure nudge. Furthermore, we also investigate whether the positive effect exists in other models. Column (2) and column (3) are the results of OLS regression and Poisson regression with user fixed effects,

respectively. Column (4) and column (5) provide the results of zero-inflated models. The estimated coefficients β_1 in four columns are significantly positive, consistent with the results in column (1).

	Negative Binomial	OLS	Poisson	Zero-Inflated Poisson	Zero-Inflated Negative Binomial
	(1)	(2)	(3)	(4)	(5)
	Sales	Sales	Sales	Sales	Sales
Green	0.0503***	0.0258***	0.1739***	0.1678***	0.1886***
	(0.0061)	(0.0030)	(0.0175)	(0.0192)	(0.0277)
_cons	0.1065***	0.1363***		1.0986***	-1.9981***
	(0.0222)	(0.0020)		(0.0422)	(0.0371)
User FE	Yes	Yes	Yes	No	No
Observations	19,398,686	19,398,686	19,398,686	19,398,687	19,398,687
R^2		0.7863			

Table 1. The Effect of Green Disclosure Nudging on User Sales

Notes. (1) Bootstrap standard errors. (2)(3)(4)(5) Robust standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Robustness Check

Seasonal Effects

In this study, we examine the effect through a natural event and the comparison of users' sales before and after that event. However, there is grounds for concern that the positive effect may be due to the fact that user sales on the platform during our observation period are higher after late June of each year (i.e., seasonal effects). To mitigate the concern, following Zhang and Zhu (2011), we examine the sales of users on the platform using the same period of the previous year (i.e., between May 25 and August 16), in which external interference to the platform is almost uniform except for one traffic event. This event occurred on July 7, when the official ZZ flagship store entered its biggest competitor, Xianyu. The event was widely reported by the news media, and the CEO of ZZ responded to it on the same day, which may have brought more traffic to the platform and led to an increase in sales of users on the platform. Therefore, we control for this traffic effect and use the following model to examine seasonal effects:

$$Sales_{it} = \alpha_i + \beta_0 + \beta_1 After_t + \beta_2 Traffic\ Event_t + \epsilon_{it}, \quad (2)$$

where $After_t$ is the dummy variable that is used to segment time and takes the same value as $Green_t$ in Equation (1). The corresponding coefficient, β_1, can be used to test for the presence of seasonal effects. Moreover, we include the variable $Traffic\ Event_t$, which is a dichotomous variable and indicates whether a traffic event occurred on day t, taking the value of 1 after that event and 0 otherwise. By doing this, we can control the potential impact of the traffic event. The other variables in Equation (2) have the same meaning as those in Equation (1).

We first estimate the model using negative binomial panel regression, with the result in Table 2 column (1). After controlling for the traffic event and user-level fixed effect, the focal parameter β_1 is not significantly different from zero, indicating no change in sales. Thus, we can rule out seasonal effects as a concern. In addition, in line with our expectations, β_2 is significantly positive, which means that the traffic event has a significant positive impact on user sales. There are two alternative explanations for this, one being that media coverage attracts more attention for the platform, thus increasing its visibility and attracting more people to participate in its activities. The other possibility is that the number of Xianyu users is considerable, and the entry of ZZ increases the channels for Xianyu users to access the ZZ platform, attracting Xianyu users to join ZZ and contribute to its sales. We then estimate Equation (2) through different empirical specifications. Table 2 columns (2) and (3) show the results of OLS regression. While column (3) removes users without sales during the observation period on the basis of column (2) to exclude inactive users, the results are similar. Table 2 column (4) is the result of Poisson regression, which remains consistent. In addition, the results are robust in the zero-inflated models. Overall, all the results remain consistent with the previous analysis, which provides strong empirical evidence for the exclusion of seasonal effects.

	Negative Binomial	OLS		Poisson
	(1)	(2)	(3)	(4)
	Sales	Sales	Sales	Sales
After	-0.0102	-0.0005	-0.0019	-0.0075
	(0.0088)	(0.0009)	(0.0035)	(0.0177)
Traffic Event	0.1687***	0.0153***	0.0627***	0.2791***
	(0.0093)	(0.0015)	(0.0061)	(0.0207)
_cons	0.2699***	0.0479***	0.1960***	
	(0.0308)	(0.0009)	(0.0037)	
User FE	Yes	Yes	Yes	Yes
Observations	3,904,533	15,985,264	3,904,533	3,904,533
R^2		0.7146	0.7131	

Table 2. Seasonal Effects of User Sales

Notes. (1) Bootstrap standard errors. (2)(3)(4) Robust standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Placebo Test

We have provided empirical evidence indicating the relationship between the green disclosure nudge and user sales. However, there remains a concern that the green disclosure nudge effect may be an accidental result derived from other unobservable factors. Thus, to further check the results of our analyses are not simply a consequence of spurious correlation, we conduct a placebo test. First, we use observations in 2021 as the treatment group and observations in 2020 as the control group that is used to examine seasonal effects and is almost consistent with the treatment group except for the green disclosure nudge. Then, we run a series of phantom regressions (Rishika et al. 2013). We set the time of the nudge backward from the real time by 7, 14, and 21 days and conduct negative binomial regressions through the DID paradigm with user, day, and year fixed effects to test the false treatment effects. The estimate of the focal parameter corresponding to the treatment effects is statistically indistinguishable from zero in all cases, which suggests that the fake intervention has no effect on consumer demand for used products. Therefore, our main results can be attributed to the disclosure of environmental benefit information.

Additional Tests

To obtain more accurate estimations and enhance causal inferences, we performed a series of additional analyses, including the inclusion of the control variable (i.e., the 618 joint promotion activity), the use of different time windows (i.e., 4 weeks before and after the nudge, 4 weeks before and 6 weeks after the nudge), and the aggregation of observations to the weekly level. These results are consistent with the main analyses.

Mechanism

Functional Value

The ZZ platform uses labels to disclose the amount of emission reductions obtained through the free market sales of used products. Thus, we argue that the disclosure of environmental benefit information influences consumer demand through a mechanism related to the functional value it provides: the reduction of carbon emissions. Due to their unobservable nature, the environmental benefits of used products are often ignored by consumers. Even if consumers are aware of these environmental benefits, this awareness is still ambiguous because there is no way to measure the benefits without the Standard, which can also lead to consumers' underestimation or neglect. This issue has been well addressed in the form of labels on the ZZ platform. The key benefit of the platform's adoption of this coercive approach is that it discloses the environmental benefits of used products for consumers without compromising the quality consumers value. Therefore, in our view, such a label increases the functional value of used products by disclosing their environmental benefits, which contributes to consumer demand.

However, there is widespread debate about the quality of green products. Previous studies hold the popular

view that green products are usually of lower quality than their conventional counterparts (Griskevicius et al. 2010; Lin and Chang 2012; Pancer et al. 2017). This view is built on the traditional zero-sum perspective, which argues that resources are limited and that enhancing green attributes needs to come at the expense of functional attributes (Newman et al. 2014). In contrast, the positive resource synergy perspective links the green attributes and functional attributes of products, believing that they change in concert (Gupta and Sen 2013). In its object and scenario, our study is a departure from prior studies that attach green attributes to conventional products. Used goods are uniquely and inherently green, but consumers may not be aware of this fact. Therefore, the disclosure of environmental benefits actually complements the product's original functional attributes, enhancing the overall functional value of the product. However, there remains a concern that consumers' perception of the functional attributes of used products may be affected by their green features, resulting in a weakening of the overall functional value perception. In what follows, we provide suggestive evidence to support the emission reduction mechanism. We then examine whether there exists a negative effect of the green disclosure nudge.

The core of the green disclosure nudge is that it quantifies and informs consumers about the carbon emissions that used goods transactions can reduce. Since carbon emissions affect the ecological environment, consumers' perception of this functional value will be affected by the environment they live in. Once a person has experienced a strong stimulus, subsequent stimuli become insignificant to him or her. Thus, if a consumer lives in a region with a good ecological environment, then the function of improving the environment is of limited appeal: they may think that the ecological environment does not need to be improved, so the effect of used product exchange is relatively limited. When, on the other hand, the ecological environment in a region is poor, consumers are more eager to improve it. As a result, they perceive the functional value of environmental improvement more strongly, which will lead to more demand for used goods.

We therefore expect that the effect of the green disclosure nudge will be smaller in provinces where the ecological environment is better. To measure a consumer's ecological environment, we use the proportion of national nature reserves and change our Equation (1) by adding one interaction, $Green_t \times Environment_i$, where the $Environment_i$ is the ratio of national nature reserves to the province's land area. We estimate the DID specification using negative binomial regression, and the corresponding results are reported in column (1) of Table 3. The coefficient of the interaction term is significantly negative, which suggests that the increase in sales of used goods diminishes as the environment improves. In addition, we use alternative environmental measurements to enhance the robustness of the results. We first use $Area_i$, the area of national nature reserves. The coefficient of interest is negative and significant, shown in column (2) of Table 3. Second, we use the median split base on the value of the area of national nature reserves and divide it into high and low levels. Then we use $Hign\ Area_i$ to denote the grouping result, which equals 1 if user i is assigned to high level and 0 otherwise. The coefficient of the interaction term is also significantly negative in column (3) of Table 3, consistent with previous results.

	(1)	(2)	(3)	(4)	(5)
	Sales	Sales	Sales	Sales	Sales
Green	0.0667***	0.0550***	0.0605***	0.0586***	-0.0083
	(0.0075)	(0.0067)	(0.0066)	(0.0111)	(0.0269)
Green × Environ.	-0.5423**				
	(0.2045)				
Green × Area		-0.0006*			
		(0.0003)			
Green × High Area			-0.0360**		
			(0.0110)		
Green × Level_1					0.0669*
					(0.0293)
Green × Level_2				-0.0055	0.0614*
				(0.0137)	(0.0290)
Green × Level_3				-0.0030	0.0639
				(0.0202)	(0.0332)
Green × Level_4				-0.0669*	

				(0.0293)	
_cons	0.1064***	0.1066***	0.1058***	0.1066***	0.1066***
	(0.0237)	(0.0150)	(0.0196)	(0.0196)	(0.0196)
User FE	Yes	Yes	Yes	Yes	Yes
Observations	19,398,686	19,398,686	19,398,686	19,398,686	19,398,686

Table 3. DID Estimations on Users with Different Environments

Notes. Bootstrap standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To gain a deeper understanding of the functional value provided by the green disclosure nudge, we explore a potential boundary condition for its promotion of green consumption. Since consumers' perception of the value of reducing carbon emissions decreases as the environment improves, we speculate that when the ecological environment is good enough, the functional value will become quite low or even disappear. In this case, the green disclosure nudge may not work as a way to promote sales of used products, or there may be a negative impact, as previously discussed.

Based on the proportion of national nature reserves, we divide the ecological environment into four different levels. We use the users who live in the first-level (the lowest level) environment as the benchmark, and we create three binary variables $Level\_j_i$ to describe user i's surrounding environment, where j ranges from 2 to 4 and a higher j represents a better ecological environment. To explore the potential effect, we change Equation (1) to (3) by adding three interactions: $Green_t \times Level\_j_i$.

$$Sales_{it} = \alpha_i + \beta_0 + \beta_1 Green_t + \sum_{j=2}^{4} \beta_j Green_t \times Level\_j_i + \epsilon_{it}. \quad (3)$$

The parameters β_j capture the difference in sales for users in different levels (i.e., from level 2 to 4) compared to users in the worst environment (i.e., level 1). The results are reported in Table 3, column (4). Consistent with our expectations, the coefficient of $Green\ Disclosure_t$ is significantly positive. While the coefficients of $Green_t \times Level\_2_i$ and $Green_t \times Level\_3_i$ are not significantly different from zero, the coefficient of $Green_t \times Level\_4_i$ is negative and significant, which supports our expectation that the green disclosure nudge has less of an effect on those in better environments. In addition, the sum of the coefficients of $Green\ Disclosure_t$ and $Green_t \times Level\_4_i$ is negative, suggesting the negative effect of the green disclosure nudge on consumers in the best environment (i.e., level 4). However, when we set users at level 4 (i.e., the highest level) as the benchmark in column (5) of Table 3, we find the negative effect is not significant.

Symbolic Value

The utility of goods may derive not only from their functional value but also their symbolic value (Frake 2017). The transaction of used goods, as green consumption, is a uniquely environmentally friendly behavior. However, most people's awareness of this pro-environmental behavior is vague, and the main reason for them to purchase used goods is that they are cheaper, not greener, than new ones. According to conspicuous conservation theory (Sexton and Sexton 2014), consumers will show their conscientiousness and seek status through some prosocial behaviors that are conspicuously visible. Thus, the green disclosure nudge has made it possible to alleviate this situation. Green labels remind consumers of the environmental benefits of used goods, signal a pro-environment image, and enhance the symbolic value of used goods. Moreover, the symbolic value of used goods can help consumers enhance their self-image and gain social status related to environmental protection (Grubb and Grathwohl 1967; Sexton and Sexton 2014). As a result, the green disclosure nudge can contribute to consumers' demand for used goods by enhancing the symbolic value of these goods.

We argue that the signal strength of green labels is influenced by the social class of consumers (Dubois et al. 2015; Eom et al. 2018; Yan, Keh, and Chen 2021). Social class is a comprehensive construct that reflects individuals' material and social resources as well as their self-perception of relative standing (Kraus et al. 2012; Trautmann et al. 2013). Compared with low social class consumers, high-class consumers have more resources and can afford higher costs. They also pay more attention to individualistic self-concept and social status (Kraus et al. 2012; Piff and Robinson 2017). Thus, compared with the cost performance and practicality of used products valued by low-class consumers, high-class consumers expect to gain social status from purchasing used items, which suggests that the symbolic value of the products is more

important to them.

In order to measure the social class of consumers more comprehensively, we use regional GDP as our variable, as it objectively reflects the development level of the region where the consumer is located. We expect the effect of the green disclosure nudge to be more positive in provinces with higher GDP. To investigate this expectation, we extend Equation (1) by adding one interaction, $Green_t \times GDP_i$, where the GDP_i is the gross domestic product of user i's region. The estimation of the interaction indicates how the impact of the green disclosure nudge on user sales varies across different GDPs. The results are shown in Table 4, column (1). The coefficient of the interaction is positive and significant, which suggests that the green disclosure nudge effect is intensified as the GDP of the consumer's region increases. We also take the logarithm of GDP as a robustness check, with the results reported in Table 4, column (2). The coefficient of interest is again significantly positive, which is in line with previous results.

	(1)	(2)
	Sales	Sales
Green	0.0192	0.0112
	(0.0107)	(0.0129)
Green× GDP	0.0051***	
	(0.0015)	
Green× Log(GDP)		0.0563**
		(0.0182)
_cons	0.1058***	0.1058***
	(0.0196)	(0.0151)
User FE	Yes	Yes
Observations	19,398,686	19,398,686

Table 4. DID Estimations on Users with Different GDPs

Notes. Bootstrap standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Exploratory Analysis

Our results so far indicate that the green disclosure nudge can contribute to an increase in user sales by enhancing the functional and symbolic value of used goods, which produces economic benefits for the platform. However, it remains unclear whether the green disclosure nudge is socially beneficial. Although previous literature has suggested that encouraging green consumption among consumers is one way to solve environmental issues (Yan, Keh, and Chen 2021) that may have long-term environmental benefits (Griskevicius et al. 2010; Sachdeva et al. 2015), only a few studies have provided empirical evidence for the environmental benefits of secondhand transactions. For example, Dhanorkar (2019) find that the entry of the online reuse platform Craigslist led to a reduction in municipal solid waste. Since the recycling and disposal of municipal solid waste creates pollution (e.g., air pollution caused by incineration), it is possible that the entry of online reuse platforms decreases pollution generation by reducing municipal solid waste. Alternatively, the potential cannibalization effect of used goods on new products may generate environmental benefits by reducing the industrial development and production of new products, which is a major source of air pollution. Therefore, we presume that the green disclosure nudge can to a certain extent prevent air pollution by stimulating consumers' demand for used goods.

To explore the possible social benefits of the green disclosure nudge, we use the air quality index (AQI) as our dependent variable, where a lower value indicates better air quality. With the interrupted time strategy and the DID paradigm analyzed at the city-month level, we find that the green disclosure nudge contributes to air quality improvement.

Discussion

While many studies have explored strategies to stimulate green consumption (Peloza et al. 2013; Bodur et al. 2015; He et al. 2021; Chen et al. 2019), they mainly focus on new products, and limited studies have focused on how to stimulate consumer demand for used products on the online reuse platform. In contrast to cost-oriented green information, which has received much attention in the literature, the green disclosure

nudge quantifies and informs consumers about the environmental benefits of secondhand transactions. Such quantified disclosure can stimulate consumer demand for used items by shifting consumers to a lower construct level and making them directly aware of the consequences of purchasing behavior, which may go beyond functional and symbolic value. To the best of our knowledge, this study is the first to investigate the impact of the disclosure of environmental benefit information through a green disclosure nudge on consumer green consumption on the online reuse platform.

The main findings of this study include the following. First, we find that after the implementation of the green disclosure nudge, users' sales increase by 5.2%, which indicates that the disclosure of environmental benefit information can stimulate consumers' demand for used goods. Second, by performing the analysis for the same time period in the previous year, we rule out the possibility that this effect is due to seasonal variation that may lead to a natural increase in sales for users. Third, we further explore the mechanism underlying the green disclosure nudge effect. Our analyses suggest that the green disclosure nudge enhances the functional and symbolic value of used products, which ultimately promotes consumer demand for secondhand items. We also find that consumers who live in areas with better environmental quality have a lower perception of functional value conferred by green labels. Moreover, the emergence of such green labels may even have a negative impact by reducing their perception of the functional attributes of the product itself. Fourth, in addition to economic benefits for platforms, the green disclosure nudge may also generate social benefits by improving the environment.

Theoretical Implications

Our work contributes to several important streams of literature. First, it expands extant research scenarios and perspectives on green consumption. Most research on green consumption focuses on the development of green products, which attach green attributes to conventional products (e.g., the use of green materials and clean energy) (Tezer and Bodur 2020; Chen et al. 2019). We focus on used items that have intrinsically green attributes but for which the environmental benefits are easily overlooked. In addition, although the question of how to promote green consumption is a hot topic, existing studies have mainly considered it from the perspective of companies, society, and government (Newman et al. 2014; Gosselt et al. 2019; Chen et al. 2019; He et al. 2021). With the vigorous development of the platform economy, online reuse platforms have also emerged as a new sharing/reuse economy (Dhanorkar 2019), which expands the secondary market and provides new design options for stimulating green consumption. Adopting a platform perspective, we explore the role of online reuse platforms in shifting consumers to green consumption.

Second, our study adds to the IS literature on green marketing strategies. To stimulate green consumption, there is a growing interest in various green marketing strategies, including monetary and non-monetary incentives (Gallagher and Muehlegger 2011; He et al. 2021). Green nudges have attracted the attention of policymakers and marketing scholars as a tactic that aims to reduce negative externalities by nudging consumers towards green choices (Schubert 2017; Carlsson et al. 2021). While information disclosure as a green nudge is common in applications such as product labels, the information disclosed is primarily cost-related (e.g., energy, fuel, water, and carbon) (Allcott and Sweeney 2017; Allcott and Knittel 2019; Tiefenbeck et al. 2018; Rondoni and Grasso 2021). In contrast, this study focuses on the role of environmental benefit disclosure in green consumption. Nudging consumer behavior through such positive information disclosure can trigger consumers' intrinsic motivation for green behavior, which can have a more long-term impact. The disclosed green information may convey a signal of social responsibility to consumers, increasing actual purchasing behaviors of used products and creating positive feedback, which may even influence consumers' daily behaviors (e.g., prosocial actions). Our analyses show that the green disclosure nudge can in fact encourage green consumption among consumers. Specifically, after the platform quantifies and discloses the environmental benefits of used goods (i.e., reduced carbon emissions) in the form of labels in accordance with the Standards, there is a significant increase in sales for users on the platform. Our findings also complement the scope of the IS literature on green nudges by using an online reuse platform as the research setting.

Third, our study contributes to the stream of literature on the practical effects of green nudges. The existing studies focus mainly on the design of green nudges (Peloza et al. 2013; Pancer et al. 2017; Gosselt et al. 2019). Although there is some experimental evidence showing that nudges are effective, their real-world effectiveness still needs to be verified (Allcott and Mullainathan 2010). We test the practical effect of the green disclosure nudge through a natural experiment with high external validity. In addition, we note that

studies on sustainable products have focused primarily on consumer attitudes rather than actual purchase behavior (Olsen et al. 2014; Gershoff and Frels 2015; Yan, Keh, and Chen 2021). The current study is among the first studies to empirically investigate the actual adoption of sustainable products on online resue platforms. Furthermore, through exploratory analysis, we find that the green disclosure nudge can not only promote consumer demand for used products but may also produce spillover effects on society and the environment through improved air quality.

Lastly, our study broadens the understanding of the perceived quality of green products. There has been a debate about the functional attributes and green attributes of green products in existing research. In regard to the development of green products, compensatory inference assumes that the green attributes of a product come at the expense of some functional attributes (Newman et al. 2014). However, the positive resource synergy perspective offers the opposite view: green and functional attributes increase together (Gupta and Sen 2013). In the current research context, green products are used items that have green attributes in their own right. Thus, we consider the green attributes of used items as part of their overall functional attributes. Our analyses suggest that disclosing the environmental benefits of used products can increase consumers' perception of products' functional value and symbolic value without reducing the perception of their utility (independent of their green attributes).

Managerial Implications

The results of our study yield several important managerial implications. First, a green disclosure nudge can promote a green transformation among consumers. Currently, cost disclosure is a popular method for promoting pro-environment consumer behavior. Although studies have confirmed the effectiveness of such cost disclosure (e.g., Tiefenbeck et al. 2018), this approach is not applicable in every case (e.g., Allcott and Knittel 2019). For example, some studies show that it is difficult for consumers to understand the cost information conveyed by traditional carbon labels (e.g., carbon footprint labels) (Upham et al. 2011; Guenther et al. 2012; Liu et al. 2016), probably because the information is not intuitive. In addition, a green logo without any information may also fail to motivate consumers to purchase (Lin and Chang 2012). Yet our results provide empirical evidence that intuitive and clear information disclosure of environmental benefits via the green disclosure nudge can facilitate consumer understanding and their green consumption.

Second, the design of green marketing strategies needs to account for market characteristics. Although our results suggest a positive effect of the green disclosure nudge, managers also need to consider the heterogeneity of this effect across markets with different characteristics. Our results show that the positive effect of the green disclosure nudge is stronger for markets with a poor ecological environment or high GDP. Moreover, this positive effect may be weakened or may even disappear for markets with better ecological environments, and efforts in these markets can be reduced to save costs.

Finally, strategic cooperation between the platform and the government may promote the development of green consumption. Specifically, it is possible that consumers may question statements made or standards set by stakeholders (e.g., companies or platforms), as they may be concerned about greenwashing and false environmental claims (Pancer et al. 2017; Gosselt et al. 2019). However, third-party or government certification can increase consumer trust (Darnall et al. 2018). Another challenge of green disclosure nudging is that although it is an effective way to increase consumer trust in information, it is more difficult and expensive than cost disclosure, especially for used goods or pro-environmental behaviors. To reduce this cost, a platform can choose to strategically cooperate with the government on win-win projects. For governments, greater collaboration with platforms may be more effective than some policies (e.g., HOV policy (He et al. 2021)) in motivating green consumption: the fast-growing platform economy is a social force that could be effectively mobilized.

Limitations and Future Research

In our investigation of the user-level effects of the green disclosure nudge, we focus our analysis on sales, which can reflect consumer demand for used products. We argue that the green disclosure nudge may not only have an impact on the demand side but may also affect the supply of used goods to a certain extent. Specifically, due to the warm glow effect (Tezer and Bodur 2020), the green disclosure nudge might prompt users to post more used items on the platform, increasing the supply of used products and therefore sales. Thus, further research could investigate the impact of the disclosure of environmental benefit information

on supply measurement in the secondary market and check other possible explanations. In addition, due to data limitations, our heterogeneity analyses primarily focus on geographically isolated markets from the seller's perspective. In order to obtain more practical conclusions, it is suggested that future research may be analyzed from a consumer perspective through field experiments or other research methods. However, the focus of both demand-side and supply-side investigations would be the ultimate economic benefits for the secondary market. Since an important function of the secondary market is to achieve long-term environmental benefits (Dhanorkar 2019), a green disclosure nudge may similarly have social benefits by influencing the secondary market. Although we provide preliminary evidence that the green disclosure nudge may have an impact on air quality, the mechanism behind the effect is still unknown. In addition, the research on how the secondary market generates social benefits remains in its infancy. As a result, another important research direction in the future is to explore how secondary markets may use green marketing strategies to ultimately generate environmental benefits. Furthermore, future research could explore the heterogeneity across product characteristics from the product page level. An interesting idea is that the magnitude of the disclosed number (e.g., 37kg vs. 70kg) may affect the actual consumers' purchasing decisions, and this dynamic may be linear or non-linear, which can be investigated in depth for future research. Given the cannibalization effect between old and new products, the green disclosure nudge may also exacerbate such cannibalization by stimulating consumer demand for used goods, which in turn impacts the new product market. Thus, future research could further explore the potential negative effects of green disclosure nudging.

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