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# The Multifaceted Impact of Matching Policy on Crowdfunding Platforms: Evidence from DonorsChoose

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## ABSTRACT

Donation-based crowdfunding platforms use matching policies where leadership donors match contributions at certain rates. While matching policy have been applied in many crowdfunding platforms, a lot remains unknown about their effectiveness and how they can be optimized to incentivize charitable donations. Leveraging data from donors choose, this study explores the policy in boosting charitable donations. Our findings demonstrate that, at the platform level, matching policy have a positive impact on the overall donation performance of the platform, but also compromise the fairness of donations. At individual level, we find that donors who have made donations on the platform before are less influenced by matching policy, and it has higher utility for less experienced donors. This work provides one of the first systematic analyses that connect micro-level data patterns with macro-level donor behaviors to disentangle the matching policy.

## Keywords

Crowdfunding, matching policy, donor behavior, fundraising performance

## INTRODUCTION

Donation-based crowdfunding platforms (e.g., DonorsChoose) which strive to encourage more people to donate to social causes have gained popularity as a means of promoting charitable giving. To incentivize donations, such platforms often utilize matching policy to increase donation efficiency by attracting large-scale participation

from organizations and institutions. Matching policy means that an organization or institution agrees to match individual donations up to a certain amount, effectively greater the impact of each donor's contribution. This would be a form of a halo effect, leading to a positive impact on individual contributions by providing additional information to donors. The support from prominent organizations and institutions would act as a persuasive indicator for donors, conferring credibility and validation to the project and its objectives. Donors may be more inclined to do donation when they see that their contribution matches by a large organization. However, this halo effect may create information asymmetry and potentially change the decision-making process for different types of donors. For example, risk-averse donors may be more likely to donate when they see the endorsement of large organizations, while other donors may be more influenced by the specific details of the project or the reputation of initiators. Furthermore, donors who are already acquainted with the organization might be less swayed by the halo effect of matching offer, as they could already possess a steadfast dedication to the organization and a comprehensive grasp of the implications of their contributions.

Some research studies have indicated that matching offer positively influences individual contributions (Eckel and Grossman 2003; Eckel and Grossman 2008; Chen et al. 2005; Meer 2017). However, some studies have found conflicting evidence, demonstrating crowding-out effects which refers to the phenomenon where the existence of a matching policy leads to a decrease in individual

contributions from donors (Huck and Rasul 2011). There are some other studies have showed no significant effect of matching policy on donor behavior (Karlan et al. 2011; Rondeau & List 2018).

We propose that these inconsistent findings may be attributed to the complexity of donor behavior. For example, different types of donors may vary in motivations and preferences, which in turn may lead to diverse responses to matching policy. By examining donor behavior, we can better understand the underlying reasons for these discrepancies and gain valuable insights into the effectiveness of matching policy. This perspective is crucial, as it allows us to explore the nuances of donor decision-making processes, and ultimately uncover the impact of matching policy on different types of donors. Due to the importance of this approach, we focus on the contribution of donor behavior as our primary research angle. To better understand the effects of matching policy on donor behavior, we pose the following research questions: *How does the implementation of matching policy on donation-based crowdfunding platforms influence donors' behavior? And, how does such implication affect the success of different types of projects?* To answer these research questions, this study draws on signal theory and proposes a research model that contribute to the existing body of knowledge on the effectiveness of matching policy and provide valuable insights for crowdfunding platforms which seek to optimize their strategies for promoting charitable giving.

By adopting Interrupted Time-Series Analysis to analyze the effect of matching policy, we uncovered insights that optimize this policy to encourage charitable giving and maximize the impact of individual donations. This can offer insights into how the matching policy can be designed and implemented most effectively to encourage charitable giving and maximize individual donations.

## THEORETICAL BACKGROUND AND HYPOTHESIS

### Matching Policy on Crowdfunding Platform

Crowdfunding, a kind of crowdsourcing and alternative financing by which individuals, via the Internet-based platforms, can finance a person, cause, event, or new business venture. This method makes use of the easy accessibility of vast networks of people through crowdfunding platforms to bring initiators and investors together, with the potential to reduce the time and opportunity cost of soliciting small quantities of money from large numbers of donors. As crowdfunding comes in a variety of fundraising activities and what is offered in return for the funds, scholars have distinguished between investment-based, reward-based, and donation-based crowdfunding platforms. We note that many real-world investment-based or reward-based crowdfunding platforms include some donation-based elements of warm glow. Crowdfunding platforms studied in this research refer to donation-based crowdfunding platform.

Methods making crowdfunding platforms more accessible for fundraising were always explored in crowdfunding fields, wherein matching policy is one popular way enhancing reputation and delivering atmospheres of high willingness to donate money in crowdfunding platforms. Specifically, this policy in the economics fields (Karlan & List 2020), refers to a policy that a third party agrees to match donations up to a certain limit. Matching projects provided by crowdfunding platforms would extend the charitable contributions of their users to foster users' willingness to donate on their own initiative (Meier 2007) and enhance their donations (Bakija et al. 2011). Moreover, some platforms developed cause-related marketing strategy by matching the charitable contributions of their users or linking charitable giving to users' purchase for the projects.

Research on the effect of matching policy on crowdsourcing platforms can be broadly divided into two major research steps: mechanisms of crowdfunding and variety of matching policy. For the literatures on the mechanisms of crowdfunding, prior studies have investigated how project-related factors (Mollick 2014; Doosti & Tan 2018) and fundraiser-related factors (Mollick 2014) affect fundraising performance. Individual funding behaviors are also explored from the perspective of rational and irrational herding (Burtch et al. 2013), home bias (Lin & Viswanathan 2016), and the deadline effect in the fundraising process (Kuppuswamy & Bayus 2018). Another stream of works on matching policy focused on information policy (e.g., whether to hide a certain piece of information for public consumption (Behl, et.al, 2020), fundraising mechanism design (Althoff et al. 2015). Although the efficacy of matching policy in stimulating individual donations in traditional fundraising channels has long been investigated, the results of existing works are inconclusive. Specifically, on the one hand, some prior researchers found that matching policy has a positive impact on individual behavior by increasing average individual contributions (Eckel & Grossman 2008). Whereas other works found a null or negative effect from matching policy due to the crowding-out effect (Karlan & List 2020).

### Halo Effect

The halo effect is a cognitive bias in impression formation whereby the general evaluation of individuals' attributes is based on the evaluation of a single attribute. The term halo effect was first proposed by Thorndike to describe the radiating effects of a single attribute on the evaluations of other attributes. The term resonates with paintings from the medieval period, in which saints were often crowned with a glowing circle around their heads, representing their general reverence or goodness. Empirically, the halo effect has been observed in numerous domains of impression formation. Early demonstrations of the effect, for instance, have shown that central attributes, such as prestige or popularity, have predictable and radiating effects on the inferences of other attributes. Compared to projects that are

not supported by large corporations, projects supported by large institutions are often assumed to be more competent and successful, even though none of these inferences are supported by evidence.

Together, these results cast light on the associative nature of impression formation. Unlike the individual trustworthiness, trustworthiness of institutions is a global or “umbrella” trait that is fundamental to social perception (Fiske et al., 2007), with diverse implications in numerous life domains, such as in assessing another person's good or ill intentions. The applicability of halo effect in understanding the role of external funding and its influence on donor behavior in donation-based crowdfunding. But are the projects supported by large institutions always trustworthy? Since acts of corporate social responsibility—even when they are unrelated to the institutions’ core business, as in the case of charitable giving to socially responsible causes—can influence consumer perceptions of the functional performance of the institutions’ products.

### Hypotheses Development

Leveraging signaling theory and existing literature on crowdfunding and matching offer, we aim to decipher the relationship between matching policy and donor behavior on donation-based crowdfunding platforms. Prior research suggests that matching offer enhances donor behavior. Some literature highlights the price effect of matching offer, where the effective cost of donating drops as each dollar donated leads to a higher charitable contribution.

**Hypothesis 1:** *The adoption of a matching policy on crowdfunding platforms will amplify the generosity of donors.*

In the context of donation-based crowdfunding platforms, the introduction of a matching policy has been observed to draw the attention and participation of leadership donors, who typically offer substantial charitable gifts and support a myriad of projects. Hence, we postulate an increase in donation frequency, defined as the rate at which donors commit to projects, considering both the volume of donations and the temporal gaps between them.

**Hypothesis 2:** *The implementation of a matching policy on crowdfunding platforms will increase the donation frequency from donors.*

Donors' prior donation experiences and geographic locations have been identified as potential sources of heterogeneity in their responses to matching policy. Donors with a rich history of donations might exhibit distinct preferences and motivations in comparison to those newer to the act. Matching policy provide donors with an expanded selection of projects they can support and avenues to enhance the impact of their contributions.

**Hypothesis 3:** *The implementation of a matching policy on crowdfunding platforms will increase the donation richness from donors.*

Such a shift in donor behavior, catalyzed by the introduction of matching policy, might not just influence the volume of donations but also their distribution pattern. The true essence of crowdfunding platforms lies in democratizing support, in ensuring that every worthy cause, irrespective of its socio-economic context, gets a fighting chance. But if matching policy skew this balance and redirect donations predominantly to certain projects, then donation fairness could potentially be compromised.

**Hypothesis 4:** *The implementation of a matching policy on crowdfunding platforms will decrease the donation fairness across projects.*

## METHODOLOGY

### Sample Datasets

DonorsChoose.org serves as the focal crowdfunding platform in our study, offering insights into the ramifications of matching policy in crowdfunding ecosystems. Established as a digital philanthropic conduit, DonorsChoose.org facilitates charitable contributions aimed at bolstering the educational experiences of underserved students. Public school educators curate project appeals on the platform, detailing resources needed – be it basic stationary for literary activities or advanced equipment for scientific exploration. These proposals draw the attention of individual benefactors who feel a resonance with the objectives and consequently make donations.

Our analytical journey draws from a dataset procured from Kaggle.com, which chronicles the narrative of DonorsChoose.org during its phase of introducing the matching policy spanning March 2002 through May 2018. This policy offers a symbiotic match of corporate sponsorships to qualifying projects. Rich in temporal depth, the dataset captures the platform's evolution pre and post the introduction of this policy. It sheds light on donor demographics, their donation trajectories, project nuances, and donor inclinations. Given its voluminous nature - capturing over 6 million donations linked to 664,100 projects from 1,282,165 patrons, culminating in \$282 million - the dataset emerges as a treasure trove of insights about philanthropic tendencies. A testament to DonorsChoose.org's dedication to maintaining project caliber is its vast donor base. The data architecture comprises five distinct clusters: "Projects," "Essays," "Gift Cards," "Resources," and "Donations," offering a holistic understanding of projects, associated resources, donation patterns, and supplementary descriptive metadata. Each project is earmarked with a unique identifier, with the rest of the six variables presented in descriptive text format.

### Operationalization of Focal Variables

To answer our study question, we have created a collection of behavioral variables that include donor's generosity, frequency of donations, richness distribution of donated material, and fairness distribution of projects. Specifically, donor's generosity is defined as the ratio of a donor's monthly donation to their average donation per month prior

to that month. The frequency of donations reflects the average interval of two donations per month for a specific donor, calculated by taking the inverse of the time between two donations. Richness of donated material is calculated using the HHI, which captures the diversity of the donated items across different subject areas. Fairness represents the distribution of poverty levels among the schools that receive the donations. The formulae for the variables employed are therefore summarized in Table 1.

Variable	Definition	Formula
Generosity	It measures how much a donor gives relative to their own historical average.	$\frac{\sum_1^{n_c} \sum_1^{s_k} \frac{d_{ij}}{ a_k/(s_k-1)-d_{ij} }}{n_c}$ , where $d_{ij}$ represents the donation $j$ of donor $i$ . $a_k$ represents the total amount donated to project $k$ , $s_k$ means the number of donors for project $k$ , $n_c$ means the total number of projects in month $c$ .
Frequency	It determines how often a donor contributes.	$\frac{1}{\sum_1^{n_c} \frac{\sum_1^{m_{ik}} (d_{it}-d_{i(t-1)})}{m_{ik}-1}}$ , where $d_{it}$ represents the donation timestamp $t$ of donor $i$ , $m_{ik}$ means the total times that donor $i$ donated to a project $k$ , $n_c$ means the total number of projects in month $c$ .
Richness	It captures the diversity and range of items or subjects that donations cover.	$\frac{\sum_1^{n_c} \sum_{l=1}^6 \left(\frac{b_l}{p_l}\right)^2}{n_c}$ , $l = 1, 2, 3, 4, 5, 6$ , where $b_l$ means the number of projects in primary subject $l$ , $p_l$ means number of projects for donor $i$ , $n_c$ means the total number of projects in month $c$ .
Fairness	It reflects how donations are distributed concerning the poverty levels of the receiving schools.	$\sum_1^{n_c} \frac{\sum_{o=1}^6 \left(\frac{c_o}{p_i}\right)^2}{n_c}$ , where $c$ represents number of projects, $o$ indicates the type of poverty level from one to four $c_o$ means the number of projects in poverty level $o$ , $p_i$ means number of projects in all poverty level, $n_c$ means the total number of projects in month $c$ .

Table 1. Summary of Formulas

### Data Analysis

To effectively examine donor behavior at the project level, we initially gauged the overall efficacy of the matching policy using Propensity Score Matching (PSM) (Rosenbaum & Rubin, 1983). PSM, a widely recognized statistical technique, approximates the conditions of a randomized experiment by adjusting for observable variations between treatment and control groups. This methodology allows us to effectively discern the causal influence of the matching policy on donor behavior at the project level, especially concerning donation behavior and

fundraising outcomes. Following the PSM implementation, we further delved into the matching policy's repercussions on various donor types. Utilizing ANOVA, we studied the policy's impact on diverse donors. This statistical method pinpointed which donor groups were most influenced by the matching policy (Bra et al., 2022).

The post-hoc significance in this study is twofold. Firstly, it allows a detailed exploration of the matching policy's effects post-PSM implementation, ensuring a thorough understanding of donor behavior variations. Secondly, the use of PSM ensures the dataset's balance, providing a stable foundation for post-hoc examinations and eliminating potential biases, thus solidifying our conclusions.

## ANALYTICAL RESULTS

### Interrupted Time-Series Analysis

Using Interrupted Time-Series Analysis, we analyzed the role of matching policy on several behavioral variables. Our monthly time-series data were analyzed using a generalized linear model donors' behavior and categorizing whether the platform is affected by the matching policy. GLM to examine donor behavior before and after the implementation of the policy (Althoff et al., 2015). In our analysis, we utilized Harmonic functions of time to adjust for seasonality. First, seasonal patterns in time-series data are generally consistent across periods and may lead to autocorrelation and over-dispersion, making other essential elements of the data harder to discern. Second, seasonal effects can obscure other associations of interest, making it challenging to interpret the data without making seasonal adjustments (Lovell et al., 1963).

Let  $Y_t$  be the outcome at time  $t$ ,  $T_t$  be a time variable,  $X_t$  be an indicator for the post-intervention period (0 before the intervention and 1 after), and  $Z_t$  be the interaction term  $T_t \times X_t$ . The basic model for ITSA can be represented as:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 Z_t + \epsilon_t$$

Where  $\beta_0$  is the baseline level of the outcome,  $\beta_1$  is the pre-intervention trend of the outcome,  $\beta_2$  captures the immediate change in the outcome level after the intervention,  $\beta_3$  represents the change in the post-intervention trend of the outcome compared to the pre-intervention trend,  $\epsilon_t$  is the error term.

Our model segmented data at a breakpoint defining the pre-policy and post-policy periods. The breakpoint, October 2007, divides the data into these two periods. Figure 1 displays the observed data as a series of black points, with the red wavy line indicating the predicted trend adjusted for seasonality. The red straight line demonstrates the de-seasonalized trend. To represent the hypothetical scenario without policy intervention, we introduce a dashed line. The gray zone highlights the timeframe post the implementation of the matching policy in October 2007.

The ITSA Results for the effects of matching policy on donor behaviors are presented in Table 2. The 'Generosity'

variable had a coefficient of 0.243 with a p-value of 0.001, indicating that there was a significant increase in donors' willingness to donate more following the implementation of the matching policy. Conversely, the 'Frequency' variable had a significant negative coefficient (-0.316) with a p-value of 0.000, indicating that donors decreased their donation frequency after the implementation of the matching policy. However, the 'Richness' variable had a coefficient of 0.005 with a p-value of 0.520, indicating that there was no sign. While the 'Fairness' variable had a significant negative coefficient (-0.019) with a p-value of 0.000, indicating that the distribution of poverty levels in the donated schools became less equitable following the implementation of the policy. This finding suggests that the resources were more concentrated in certain schools or areas, potentially exacerbating existing disparities in resource allocation rather than promoting a more balanced distribution of donations.

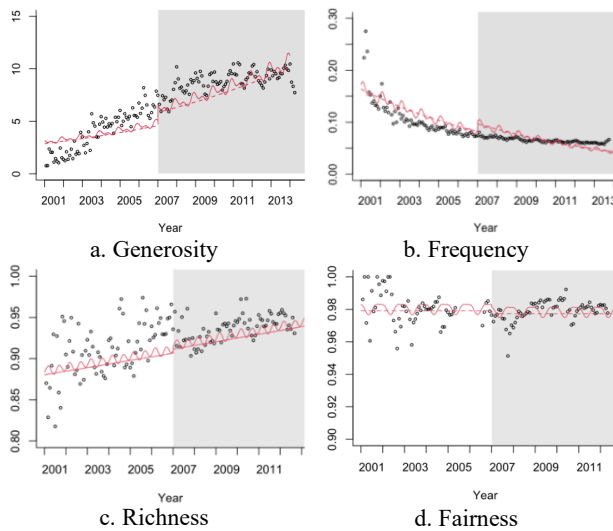


Figure 1. the Effect of Matching Policy on Platform Profitability

Dependent Variable	Unadjusted Model		Seasonality-Adjusted Model	
	coefficient	p-value	coefficient	p-value
Generosity	0.233	0.062	0.243***	0.001
Frequency	-0.168	0.072	-0.316***	0.000
Richness	0.005	0.551	0.005	0.520
Fairness	-0.019***	0.000	-0.019***	0.000

Table 2. GLM Results for the Effect of Matching policy on Donor Behaviors

### Propensity Score Matching

In this investigation, we employed Propensity Score Matching (PSM) as a rigorous methodological approach to discern the behavioral dynamics of donors associated with projects exhibiting both the presence and absence of matching policy on donorschoose.org. Our data segregation yielded three distinct categories:

Group 1: Projects devoid of matching policy.

Group 2: Projects under the matching policy un-matched.

Group 3: Projects under the matching policy matched.

Post the execution of PSM, the study ventured into an array of pairwise t-tests. By harnessing the common variance typified as the mean square within groupings, we adeptly calibrated the  $\alpha$  error threshold, ensuring its optimal alignment for the entirety of the experiment.

The PSM protocol was augmented with a stringent 1-to-1 exact matching criterion. The culmination of our PSM elucidation manifested in three equilibrated cohorts: Group1 with 22,703 projects and 23,027 donors; Group2 amassing 241,564 projects and 731,408 donors; and Group3, inclusive of 149,942 projects and 427,978 donors. The resultant matching, predicated on harmonious demographics and donation characteristics, instills confidence in attributing observed variances in donor comportment directly to the matching policy, excluding extrinsic confounding interferences. Table 3 explains the meaning of the variables in the subsequent testing of donors' behavior.

Variable	Definition
average_amount	The average monetary contribution to a project. Indicates whether donations are large or numerous.
total_amount	Cumulative monetary contributions for a project. Reflects overall fundraising success.
donor_count	Number of individual donors for a project. Indicates breadth of support.
donation_lag	Time between consecutive donations. Suggests momentum or frequency of donations.
old_donor_ratio	Proportion of returning donors to total donors. Indicates donor loyalty or attraction of new ones.
local_donors_ratio	Fraction of donors from the project's locality. Shows local community engagement and support.
distance	Average geographical distance between the project and its donors. Indicates local or distant support.

Table 3. Donor Behaviors variable

### Post-hoc Results matching offer of Donor Typologies: Implications for Philanthropic Behavior

A tripartite group differentiation was subsequently devised to probe the shifts in philanthropic inclinations: Group 1 epitomizes the pre-policy landscape, Group 2 embodies projects that post-policy was bereft of endorsements by corporate behemoths, and Group 3 delineates projects that garnered such corporate matches.

Pre-policy, seasoned donors manifested a propensity for more generous contributions, selectively funneled towards geographically proximate endeavors. This potentially alludes to an amalgam of platform familiarity and localized altruism governing their decisions. Post-policy, however, their predilections skewed towards non-corporately endorsed projects. While their philanthropic cadence intensified for endorsed projects, the quantum of individual donations attenuated, subtly hinting at the peripheral impact of the matching apparatus on this cohort. Contrastingly, novice donors, in their nascent engagement, demonstrated amplified largesse pre-policy. The post-policy delta between corporate-endorsed and independent projects was more subdued, insinuating a more profound influence of the matching mechanism on this cohort.

Categories	Variable	I	J	Mean Difference	Sig.	95% Confidence Interval		Result
						Lower Bound	Upper Bound	
Local Donors	average_amo nt	1	2	648.436*	0.000	643.808	653.064	3 < 2 < 1
			3	671.706*	0.000	666.985	676.426	
		2	3	23.270*	0.000	21.337	25.202	
	donor_count	1	2	-2.971*	0.000	-3.110	-2.830	1 < 3 < 2
			3	-2.274*	0.000	-2.420	-2.130	
		2	3	0.697*	0.000	0.640	0.760	
	donati on_lag	1	2	0.383*	0.000	0.247	0.520	2 < 1 < 3
			3	-1.167*	0.000	-1.321	-1.012	
		2	3	-1.550*	0.000	-1.676	-1.424	
	old_d onor_r atio	1	2	28.201*	0.000	27.997	28.404	3 < 2 < 1
			3	29.362*	0.000	29.155	29.570	
		2	3	1.162*	0.000	1.077	1.247	

Non-local Donors	distan ce	1	2	20.870*	0.000	19.818	21.920	2 < 3 < 1
			3	7.777*	0.000	6.707	8.847	
		2	3	-13.093*	0.000	-13.511	-12.674	
	averag e_amo nt	1	2	161.110*	0.000	159.570	162.650	3 < 2 < 1
			3	169.735*	0.000	168.164	171.306	
		2	3	8.625*	0.000	7.981	9.268	
	donor_count	1	2	-2.971*	0.000	-3.110	-2.830	1 < 3 < 2
			3	-2.274*	0.000	-2.420	-2.130	
		2	3	0.697*	0.000	0.640	0.760	
	donati on_lag	1	2	0.383*	0.000	0.247	0.520	2 < 1 < 3
			3	-1.167*	0.000	-1.321	-1.012	
		2	3	-1.550*	0.000	-1.676	-1.424	
	old_d onor_r atio	1	2	28.201*	0.000	27.997	28.404	3 < 2 < 1
			3	29.362*	0.000	29.155	29.570	
		2	3	1.162*	0.000	1.077	1.247	

### CONCLUSION

Donors on charitable crowdfunding platforms face significant transaction costs when evaluating potential projects to fund. As a result, these platforms are challenged to encourage continuous contributions from donors. Matching policy have long been utilized to incentivize charitable giving in various fundraising channels, but the underlying mechanisms of the usage of matching policy remains underexplored. Given the increasing importance of crowdfunding as a new channel to mobilize collective action for social good, it is important to conduct systematic research to better understand how matching policy can



effectively encourage donations on crowdfunding platforms. In this study, we investigate how different types of donors respond to matching policy in terms of various outcome at DonorsChoose.org, building upon our verification of the mechanisms of matching policy in promoting donations.

Our study demonstrates that matching policy have a positive impact on the generosity, average donation amount, and donation frequency of donors. Furthermore, matched projects were found to increase the variety of projects donors contribute to. However, the findings also reveal that matched project can decrease the donation frequency and fairness of donations among students of different poverty levels. Overall, our study highlights the importance of tailoring promotional strategies to different donor groups. The findings suggest that the role of matching policy on project outcomes is more complex, as it prompts donors to engage in more comprehensive evaluations before making their donations. This highlights the importance of understanding the multifaceted effects of matching policy on donor behavior and project success to design more effective and targeted strategies for charitable crowdfunding platforms.

This study has identified some limitations that can be addressed in future research. First, our analysis only considers the donation behaviors of donors on the DonorsChoose platform, which limits our understanding to other type of crowdfunding platforms. Second, while our study divides donors into subgroups based on location and experience level, a more precise classification of donors based on psychological and demographic characteristics could provide a deeper understanding of the mechanisms underlying the effects of matching policy. Despite these limitations, our study has contributed to the literature on charitable crowdfunding by highlighting the effectiveness of matching policy as a promotional strategy and providing practical insights for third-party organizations and crowdfunding platforms.

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