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Title:
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Date:
2026

Citation:
Shao, L., Zhang, N., Niu, B. & Heese, S. S. (2026). Tax-induced Corporate In-kind Donations: Equilibrium Analysis and Policy Design. Manufacturing & Service Operations Management

Persistent Link:
https://hdl.handle.net/11343/371648

Manufacturing & Service Operations Management

Tax-induced Corporate In-kind Donations: Equilibrium Analysis and Policy Design

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Problem definition: Food-sector firms often make in-kind donations to help alleviate food insecurity. For example, major retailers such as Walmart and Kroger routinely donate products to food banks. To encourage such donations, many governments offer tax incentives to donor firms. We examine how tax incentives affect firms' operational and donation decisions, profits and consumer surplus, and we investigate the optimal design of such incentives.

Methodology/results: We develop an analytical model to study a firm's operational and in-kind donation decisions under capacity constraints, in a setting where consumers with heterogeneous valuations can either purchase a product from the firm or attempt to obtain a donated product from charitable organizations. Among other findings, we identify a threshold of the tax incentive rate above which the firm is willing to donate. While the firm always benefits from more generous incentives, consumer surplus follows a U-shaped relationship with respect to the incentive rate: a moderate incentive may result in lower consumer surplus than no incentive at all. Further, the optimal tax policy depends on the government's emphasis on social welfare, with donation tax incentives becoming desirable only when sufficient weight is placed on social welfare. These findings remain robust when accounting for competition from fringe firms and consumer heterogeneity in the acceptance of donated products. Finally, as an alternative policy intervention, government's direct market entry can be optimal at intermediate levels of social welfare concern.

Managerial implications: Our results provide guidance for governments that design tax policies to incentivize in-kind donations and alleviate food insecurity. Importantly, our results suggest that donation tax policies may have unintended adverse effects on consumers, and when weighing social welfare against tax revenue, it may be optimal for governments to avoid such policies.

Key words: donation tax incentive, corporate in-kind donation, consumer surplus, rational expectations equilibrium, pricing, government policy design

1. Introduction

Food insecurity is a pressing societal issue affecting countries across all levels of development. It is not limited to developing regions, but also affects populations in high-income nations. In the United

States, over a quarter of respondents to a survey have occasionally skipped meals due to rising food costs (Lanum, 2024). In Australia, 48% report anxiety or difficulty in consistently accessing adequate nutrition (Foodbank, 2023b). In Britain, 17% of workers skip meals to make ends meet, as household budgets remain strained by the high cost of living (Partington, 2025). To address food insecurity, many food-sector firms donate products to food banks, making these items accessible to populations unable to purchase them. For example, in the United States, firms that make in-kind donations and collaborate with Feeding America include grocery retailers such as Aldi, Target, and Walmart; food manufacturers such as General Mills, Kraft Heinz, and PepsiCo; and restaurants such as Olive Garden and Chick-fil-A. In 2022, United States retailers such as Kroger and Walmart donated about 2 billion pounds of food (Lowrey, 2024). Feeding America works with more than 200 food banks in the United States (Lowrey et al., 2023), and virtually all donation recipients are food insecure (Prayogo et al., 2018).

Beyond providing nutrition to food-insecure populations, firms that make such in-kind donations often receive tax benefits. These fiscal policies aim to encourage donations by offering tax deductions or credits to donor firms. The value of these tax incentives is determined by the cost or fair market value (FMV) of donated items. In Australia, businesses that donate to organizations with Deductible Gift Recipient status can deduct the cost basis of donated items as a business expense, thus reducing their taxable income. In the United States, an enhanced tax deduction mechanism enables businesses to claim deductions exceeding the cost of donated items (Natural Resources Defense Council, 2024). Other countries offer tax credits that directly reduce tax liability. For example, corporate entities in France can deduct 60% and those in Spain 35% of the cost basis of donated products from their corporate tax liability (European Commission, 2024). Similar tax policies specifically aimed at spurring food donations exist in Argentina, Colombia, Canada, and South Africa, among other countries (Plekenpol et al., 2021).

In this paper, we examine the effectiveness of tax incentives in promoting in-kind donations and their impact on a firm's operational decisions, profitability, and consumer surplus. We refer to the profit-driven donation behavior as *strategic donation*, which entails a strategic approach to donating products, often leading firms to increase their acquisition or production runs during the planning stage (Foodbank, 2017; Lowrey, 2024). While food donations help alleviate food insecurity, tax incentives designed to encourage such donations may have unintended consequences due to the strategic responses of profit-maximizing firms. To assess the overall effectiveness and potential trade-offs of donation policies, we consider an aggregate measure of consumer surplus that captures welfare effects through both market and donation channels. Specifically, it encompasses both donation recipients and consumers who purchase the product at the full retail price.

Accounting for the effects of such policies across key stakeholders, including the donating firm, paying consumers, and donation recipients, is crucial for effective policy design.

Our research thus addresses three research questions related to tax-induced corporate donations. First, how do donation tax incentives influence firms' willingness to engage in strategic donations, and under what conditions are such policies effective in increasing donation activity? Second, how do such tax incentives affect the market participants and their decisions, including firms' pricing, acquisition, and donation decisions as well as consumers' choices between purchasing products and relying on donations? Third, how should governments design donation tax policies when balancing social welfare and tax revenue considerations?

To address the above research questions, we develop an analytical model that incorporates a profit-driven firm and a continuum of consumers with heterogeneous valuations. Consumers can either purchase a product directly from the firm's sales channel or receive it through a donation channel. Based on consumer choices, the market is segmented into two groups: the buying group and the donation group. Most food-sector firms operate under capacity restrictions that arise due to limitations in sourcing capacity, storage space, or handling capabilities (Tan et al., 2021). These constraints impose a limit on the total quantity of product that can be procured, processed or handled within a given period, and thus constrain the combined quantity available to the firm for sale and in-kind donations. To elucidate the impact of tax incentives, we analyze two scenarios: Scenario N, where no such incentive exists; and Scenario T, where the tax incentive policy is in place. The solution concept employed is rational expectations (RE) equilibrium (Su and Zhang, 2008), which is appropriate for settings where both firm and consumer actions are unobservable. After characterizing the optimal firm decisions for a given tax regime, we then investigate the government's problem of determining the optimal tax incentive rate.

We summarize our key findings as follows. From the firm's perspective, we identify a threshold for the tax incentive rate, above which the firm is willing to donate. A lower (resp. higher) threshold implies the firm is more (resp. less) willing to donate. Several factors influence this threshold. Intuitively, as either the acquisition cost or the corporate income tax rate increases, the firm receives a greater tax benefit per unit of product donated. This makes the firm more likely to donate, resulting in a lower threshold for donation willingness. Additionally, the threshold increases with the donation utility rate (i.e., the ratio of consumer utility from donations relative to that from purchasing), but decreases with the firm's capacity level. To explain this, a higher donation utility rate means consumers are more inclined to receive donations, thereby reducing their propensity to purchase the product. This lowers the firm's profits, making it less likely to donate. As the firm's

capacity increases, it has more flexibility to balance sales and donations, making it more likely to take advantage of the donation opportunity to capitalize on the tax incentive.

We identify two key factors—the tax incentive rate and the capacity level—that jointly determine the firm's optimal operational decisions. As discussed earlier, the implications of donations are two-fold. On the one hand, donations cannibalize the firm's selling channel, reducing profits from product sales. On the other hand, donations provide the firm with an additional income source through tax incentives along with the induced goodwill effect. The firm primarily adjusts its price and acquisition quantity to balance the profit loss from cannibalization and the benefits from donations. This balance depends on both the tax incentive rate and the capacity level. With low capacity, the price in Scenario T, when the tax incentive rate is above the threshold, is always higher than in Scenario N. However, with high capacity, the tax incentive may induce price reductions, particularly when the tax incentive rate is moderate. Furthermore, as the tax incentive rate increases (once it surpasses the threshold), both the price and the donation fulfillment rate rise. To explain these results, when capacity is low, the donation amount tends to be small, making the cannibalization effect less pronounced. Since the tax incentive allows the firm to segment the market into buying and donation groups, the firm can charge a higher price to the buying group while benefiting from the tax savings from donations. In contrast, with high capacity, the firm may donate a larger quantity to capitalize on the tax savings, but this increases the risk of market cannibalization. When the tax incentive rate is moderate, the firm may reduce prices to attract more consumers to purchase the product, despite the potential cannibalization effect. One may draw a parallel to Lowrey (2024), where donations always raise product prices by improving the average quality of the remaining products after lower-quality items are donated. Our results enrich this discussion by demonstrating that the effect of donations on pricing also hinges on the interplay between tax incentive rate and firm capacity.

Counterintuitively, implementing a tax incentive policy can lead to lower consumer surplus than no policy at all. This holds even when the incentive rate is high enough to prompt the firm to donate. This outcome is driven by the dual effects of the tax incentive. On the one hand, the policy benefits the donation group due to the firm's donation behavior; on the other hand, it encourages the firm to increase prices, negatively affecting the buying group. As a result, the total consumer surplus (from both groups) in Scenario T follows a U-shaped curve with respect to the tax incentive rate, where a moderate tax incentive rate may lead to a lower consumer surplus than in Scenario N. Furthermore, the donation utility rate plays a critical role in determining the impact of the tax incentive policy on consumer surplus. Specifically, consumers only benefit from the policy when the

donation utility rate is high. Using calibrated parameter values, we also provide insights into the current tax incentive schemes of three countries with food donation–specific policies: the United States, Colombia, and France. Our analysis indicates that their current tax incentive rates fall within potentially critical ranges, with different implications for consumer surplus across countries. These findings suggest that policymakers should exercise caution when introducing tax incentives, as they might have unintended consequences and could potentially harm consumers.

The government faces the challenge of balancing two competing objectives: social welfare (consumer surpluses and firm profits) and tax revenue. Our findings suggest that if the government aims to introduce a donation tax policy, the optimal incentive rate should be set at the policy-effective threshold (resp. upper bound) if tax revenue (resp. social welfare) is prioritized. However, the government is better off introducing the tax policy only when the government places enough weights on social welfare. This implies that, despite always benefiting the firm, the introduction of a tax incentive may not be in the best interest of the government.

We examine the robustness of our findings through three extensions. First, we introduce a competitive fringe to show that both the consumer-surplus loss and the optimal policy structure persist, with the optimal incentive rate declining as competition intensifies. Second, we consider an alternative policy instrument, namely government's direct market entry, and show that it can be preferred at intermediate levels of social welfare concern. When the government places great emphasis on tax revenue, no intervention is optimal. When social welfare receives sufficiently high weight, the tax incentive dominates, as it generates a larger consumer surplus gain through the donation channel. Third, we consider consumer heterogeneity by allowing for two consumer segments with differing willingness to pay for donated products. We show that as the share of consumers with low acceptance of donated products increases, the policy-effective threshold declines. This makes the policy more likely to be effective, but it also intensifies the resulting loss in consumer surplus.

Our paper makes several key contributions. First, to the best of our knowledge, we develop the first analytical equilibrium model that jointly incorporates a strategic firm, strategic consumers, a donation channel, and government tax policy under capacity constraints. Leveraging an RE-equilibrium framework, we examine the firm's donation and operational decisions as well as consumers' choices, all of which are shaped by operational frictions and policy intervention. Second, we identify a policy-effective tax incentive threshold above which the firm begins donating and uncover a potential unintended consequence of donation tax incentives. While stronger tax incentives increase donations and firm profits, moderate incentive levels may reduce consumer surplus by inducing the firm to strategically raise its price. Third, we derive insights regarding the

government's optimal donation tax policy and show that, under some conditions, the government may be better off not introducing tax incentives at all.

The remainder of this paper is organized as follows. Section 2 reviews the related literature, and Section 3 presents the model setup. In Section 4, we characterize the firm's optimal decisions and examine how the tax incentive policy affects both the firm's decisions and consumer surplus. Section 5 investigates how the government should set the tax incentive rate. Section 6 explores several extensions of the base model and demonstrates the robustness of our insights. Finally, Section 7 concludes with a discussion of our findings and directions for future research. The online appendices provide detailed numerical calibrations, additional model extensions, and technical proofs.

2. Literature Review

This work is part of the extensive literature on socially responsible operations as in-kind donation represents a form of corporate social responsibility through which firms contribute directly to alleviating food insecurity. See, for example, Lee and Tang (2018) and Sunar and Swaminathan (2022) for thought pieces on this topic. Below, we review the literature most relevant to our work.

A growing body of literature in operations management incorporates government and non-government policies into firms' donation-related decisions. Within this literature, Taylor and Xiao (2014) study whether donors should subsidize consumer purchases or business sales to improve product availability and affordability. Berenguer et al. (2017) extend the problem to a setting where the price is determined before observing market conditions. Yu et al. (2018) consider different government policies that offer subsidies to consumers, manufacturers, or both to improve consumer welfare and manufacturer profit. Chu et al. (2018) examine the effects of inventory cost and demand uncertainty on firms' optimal decisions regarding donation policy.

The literature above considers a profit-maximizing firm whose socially responsible behavior (e.g., donation) is encouraged by policy interventions. In practice, however, some large firms may have strategic goals of engaging in socially responsible efforts even in the absence of policy interventions. Taylor and Xiao (2019) investigate the subsidy decision of a donor aiming to maximize product supply under various supply chain structures. Socially responsible behavior can also be motivated by market and economic benefits. For example, Lowrey et al. (2023) study an oligopoly model where donating low-quality products helps to enhance retailers' on-sale product quality and hence consumer utility. They find that donation raises retail price due to the quality-enhancement externality. Our model follows the tradition of Lowrey et al. (2023) in treating the donation channel as a secondary acquisition option for consumers. We depart from this work by incorporating both

policy and market incentives as key drivers of the firm's strategic donation decision and further examine the government's optimal tax incentive design problem.

More relevant to our work is Arya and Mittendorf (2015), who also delve into the impact of the donation incentive and identify a threshold differentiating donations and non-donations. There are, however, several key differences. First, they investigate a subsidy policy and briefly discuss the role of tax-related incentives in an extension. Second, consumer behavior is not featured in their model, but it is a key focus of ours. We employ the RE equilibrium approach and demonstrate that consumer behavior has a profound impact on how the donation tax policy affects the firm's optimal decisions and consumer welfare. Third, although they identify two opposing societal implications of the subsidy-based policy—encouraging donations while harming consumers by inflating the price—our results show that implementing tax-related incentives may either raise or reduce the price depending on the firm's capacity level and the tax incentive rate.

Overall, the setting we study differs in important ways. From a modeling perspective, the existing studies do not jointly consider: (a) a capacity constraint that creates a link between retail supply and donation quantity, (b) strategic consumer behavior where consumers rationally choose between purchasing at full price and seeking donations, and (c) a government designing an optimal donation tax incentive rate to balance firm profit, consumer surplus, and tax revenue. These modeling differences give rise to novel insights absent from the existing literature.

Our work is also related to the extensive literature that considers strategic consumers in operational settings. Su and Zhang (2008) characterize an RE equilibrium in a newsvendor model and find that strategic consumers lower the seller's stocking level, while Liu and van Ryzin (2008) examine the impact of strategic consumers on a firm's inventory decisions. Cachon and Swinney (2009) study a retailer's pricing, stocking, and quick response decisions when facing a mix of myopic, bargain-hunting, and strategic consumers who rationally choose between purchasing at full price or waiting for a markdown. Our setting differs from this literature in two important respects. First, rather than forming expectations about future markdown prices, consumers form rational expectations about the probability of receiving a donated product. This probability is determined endogenously by the firm's donation quantity relative to the mass of consumers seeking donations. Second, consumer segmentation is driven by heterogeneous valuations and donation acceptance rather than intertemporal patience. As tax incentives increase, some consumers may be induced to switch from purchasing to seeking donations. This mechanism generates a U-shaped relationship between tax incentives and consumer surplus, with no counterpart in existing models.

Finally, from a process perspective, in-kind donations are considered inputs to a nonprofit supply chain, with food banks serving as a key stakeholder that collects and distributes donated products

Table 1 Notation

Endogenous Variables		*Exogenous Parameters*	
Q	Firm's acquisition quantity	v	Consumer willingness to pay, $v \sim U[0,1]$
p	Firm's price	K	Firm's acquisition capacity, $K \in (0,1]$
ψ	Firm's donation quantity	c	Unit product acquisition cost, $c \in (0,1)$
v^*	Indifference point between buying and seeking donation	r	Corporate income tax rate, $r \in (0,1)$
D_b	Demand for buying	β	Donation-induced goodwill coefficient, $\beta > 0$
D_d	Demand for seeking donation	δ	Donation utility rate, $\delta \in (0,1)$
R	Donation fulfillment rate, $R = \psi / D_d$	γ	Government's welfare-concern parameter, $\gamma \in [0,1]$
λ	Tax incentive rate		

to people in need. A growing body of research has studied food bank operations, focusing on how to allocate donations across recipients equitably and efficiently (see, e.g., Lien et al., 2014; Eisenhandler and Tzur, 2019; Orgut and Lodree, 2023; Zou et al., 2025) and how to engage with donors to ensure quality donations (see, e.g., Daniels and Valdés, 2021; De La Torre Pacheco et al., 2023). Our paper complements this literature by studying the upstream firm's donation and operational decisions, an important antecedent to downstream distribution decisions. In particular, we examine how tax incentives shape the firm's donation behavior—which affects the amount of donated products flowing into the nonprofit supply chain—as well as how the government can design effective policy interventions to increase donation.

3. The Model

We consider a food-sector firm that, in addition to selling its products to consumers, may strategically donate products to charitable organizations and benefit from the tax deduction when available. Our base model is most applicable to branded packaged foods and specialized products for which the firm retains some pricing discretion, such as snack foods, beverages, and baby products. Packaged foods represent a substantial portion of products distributed through food banks; for example, they represent 50 to 65% of food bank volume in the United States (Feeding America, 2025), Australia (Foodbank, 2023a) and Argentina (Banco De Alimentos, 2023), respectively. In Section 6.1, we relax the market-power assumption by introducing a competitive fringe and show that our main structural insights remain robust. We consider two scenarios: Scenario N, where no tax incentive policy is introduced; and Scenario T, where the government introduces such a policy. For easy reference, all notation used in the base model is summarized in Table 1.

3.1. The firm

The firm's decisions include the acquisition quantity Q, the unit selling price p, and the donation quantity ψ. The acquisition quantity is subject to a maximum capacity level K, that is, $Q \leq K$. The capacity K captures the maximum quantity of products that the firm can procure, process, or handle within a given period, due to limitations in sourcing capacity, storage space, or handling capabilities, and it constrains the combined quantity available for sale and in-kind donations. Since capacity investment tends to be a long-term strategic decision, we treat K as an exogenous parameter given our focus on short-term operational decisions. We denote the corporate income tax rate by $r \in (0, 1)$ and the unit acquisition cost by c.

In Scenario T, the firm may gain tax-saving benefits if it donates. In practice, tax incentives are calculated based on the cost of donated products in countries such as Australia, France, and Spain (Foodbank 2024b, Legifrance 2024, European Commission 2024), or based on the product price in countries such as Canada and the United States (Natural Resources Defense Council 2024). We consider the cost-based tax incentive policy in our base model and relegate the analysis of the price-based policy to Appendix B.

The taxable income is calculated by subtracting a percentage of the donation value from the pre-tax profit, where the donation value is equal to the unit cost of the donated product multiplied by the donation quantity. The percentage is referred to as the tax incentive rate, denoted by λ. For example, Australia allows donations to Deductible Gift Recipient organizations to be fully deducted as business expenses from taxable income. Similarly, the United States permits enhanced deductions for certain qualified in-kind donations, enabling firms to deduct more than the product cost from their taxable income. France provides a 60% tax credit for corporate donations under the Aillagon Law of 2003; with a corporate income tax rate of 36.13%, this corresponds to a tax incentive rate of $60\%/36.13\% \approx 166\%$. Effective from 2025, Colombia's Ley 2380 expands tax incentives for food donors, increasing the tax credit for eligible donations from 25% to 37%; with a corporate income tax rate of 35%, this corresponds to an effective tax incentive rate of $37\%/35\% \approx 106\%$.

The tax liability is obtained by multiplying the taxable income by the corporate income tax rate r. The donation value (i.e., the deduction amount) is typically less than the pre-tax profit, in which case the taxable income is positive. However, if the deduction amount exceeds the pre-tax profit (i.e., a net operating loss occurs) or reaches the annual cap in the current fiscal year, firms can carry forward the undeclared deduction to subsequent years (e.g., five years in France and the United States, and ten years in Spain). Thus, the effective cap on tax incentives is often relatively generous in practice. Here we assume the cap is high enough so that it does not play a role in

the firm's optimal decisions, but we find the structural insights continue to hold if we relax this assumption. Following the literature, we use a symmetrical treatment for taxation on profits and losses (Shunko et al., 2017). Accordingly, the firm's after-tax profit in Scenario T is

$$\begin{aligned}\pi^T &= \underbrace{p\min\{D_b, Q\} - cQ}_{\text{pre-tax profit}} - \underbrace{r[p\min\{D_b, Q\} - cQ - \lambda c\psi]}_{\text{tax liability}} \\ &= (1-r)(p\min\{D_b, Q\} - cQ) + r\lambda c\psi.\end{aligned}$$

Here, the demand of the buying group is D_b (to be quantified later), the donation value is $c\psi$, the tax deduction amount is $\lambda c\psi$, the taxable income is $p\min\{D_b, Q\} - cQ - \lambda c\psi$, and the tax liability is $r[p\min\{D_b, Q\} - cQ - \lambda c\psi]$.

In Scenario N, there is no tax incentive for donations (i.e., $\lambda = 0$). The firm's price and acquisition quantity optimization problem reduces to

$$\max_{p \geq c, 0 \leq Q \leq K} \pi^N = (1-r)(p\min\{D_b, Q\} - cQ). \tag{1}$$

3.2. Consumer characteristics

The end market comprises a continuum of consumers with heterogeneous product valuations (or willingness to pay). For tractability, each consumer's valuation v is assumed to be uniformly distributed over $[0, 1]$; similar assumptions have been widely used in the literature (see, e.g., Özer and Zheng, 2016; Lowrey et al., 2023). In Appendix C, we consider a Beta distribution and demonstrate the robustness of our main results. We assume each consumer purchases at most one unit of the product, and the market mass is normalized to 1. Consumers can either buy products from the firm or wait for donated ones from charity organizations. In practice, some organizations require recipients to meet specific eligibility criteria—such as proof of low income or residency—before accessing assistance, while others impose no such requirements (Second Harvest of the Greater Valley 2023). For ease of exposition, we assume all consumers are eligible for accessing donations in our base model; introducing ineligible consumers does not alter our results (see Section 6.3).

It is worth clarifying four key factors that influence consumers' decisions to make a purchase or seek a donation. The first factor is the price of the product. According to recent reports and surveys, the rising price is the key reason preventing consumers from buying, contributing to household food insecurity (Foodbank 2023b, Lanum 2024, Partington 2025).

Second, the value consumers place on donations also plays a role. The perceived quality of donated products is typically lower than that of products purchased. This could be because the donated products are nearing their sell-by date. For instance, some of the products that a food

bank distributes may be past their 'Best Before' date, indicating a decline in quality, flavor, or texture (Foodbank 2024a). In addition, the psychological perception of shame or embarrassment may reduce consumer willingness to pay, and it has become the most significant barrier (ranked #1) to accepting donations (Foodbank 2023b). The consumer valuation from the donation channel is δv. Here $\delta \in (0,1)$ is referred to as the donation utility rate, with a larger δ implying a lower barrier for consumers to accept donations. We further show in Section 6.3 that allowing for two consumer segments with distinct donation utility rates does not alter our qualitative findings.

Third, whether or not consumers can obtain donated products also depends on the number of individuals needing donations and the amount of donations available. The higher the chance of obtaining donations, the more individuals will switch to seeking donations. In cases where donations are insufficient, the equity criteria for relief food distributors require that each individual have the same chance of receiving a donation (Hasnain et al. 2021; Feeding America 2024). Thus, we adopt a random rationing rule for allocating donations among people in need. This is also a common assumption in the literature on strategic consumers and strategic rationing (see, e.g., Liu and van Ryzin 2008, Su and Zhang 2008). The base model assumes that unsuccessful donation seekers exit the market; in Appendix D we show that letting them return to the retail channel leaves our structural results unchanged.

Fourth, consumers may derive additional utility when purchasing from a firm that engages in donation activities, reflecting goodwill or reputation enhancement (Lev et al., 2010; Chernev and Blair, 2015). This goodwill effect is positively associated with the donation amount and can translate into a willingness to pay a price premium for the firm's products. This benefit is only realized by purchasing consumers, as they internalize the firm's prosocial behavior. By contrast, donation recipients derive utility solely from the intrinsic value of the product. In Appendix E we examine the firm's operational and donation strategies as well as the government's policy design in a two-period model with goodwill persistence.

3.3. Interactions between the firm and consumers

In practice, consumers cannot observe the firm's donation quantity when deciding whether to buy the product, and thus the probability of receiving a donation remains unknown. At the same time, the firm is unaware of consumers' choices between buying and waiting for donations when making donation decisions. Here, we use the concept of RE equilibrium (Su and Zhang, 2008), where both parties make decisions based on the beliefs they form regarding unobserved actions. The firm's price and donation quantity decisions influence consumer choices, but consumers can only observe the former. Given price p and consumers' belief about the probability of obtaining a donation,

denoted by $\tilde{R}(\tilde{\psi}) \doteq \tilde{\psi}/D_d$ and referred to as the *anticipated* donation fulfillment rate, the expected utility of a consumer with valuation v is given by $U = \max\{v - p + \beta\tilde{\psi}, \tilde{R}(\tilde{\psi})\delta v\}$. Here, β measures the donation-induced goodwill enhancement effect, and D_d is the number of consumers in need of donations (to be quantified later). For buying consumers, donation-induced utility increases linearly with the donation quantity, thereby raising consumers' willingness to pay for the firm's product. For donation-seeking consumers, the utility improvement resulting from a larger donation quantity is captured through the higher probability of obtaining a donation, $\tilde{R}(\tilde{\psi})$.

One can see that there exists an indifference point $v^* = (p - \beta\tilde{\psi})/(1 - \delta\tilde{R}(\tilde{\psi}))$ that distinguishes consumers into the buying and donation groups. Consumers with valuations higher than v^* make a purchase, while those with valuations lower than v^* do not. Thus, their demands are $D_b = 1 - v^*$ and $D_d = v^*$, respectively. For a given indifference point $\tilde{v}$, the firm's donation quantity must satisfy $\psi \in [0, (Q - \tilde{D}_b)^+]$, where $\tilde{D}_b = 1 - \tilde{v}$ and $x^+ = \max\{x, 0\}$. The firm aims to maximize its after-tax profit by determining the product price, acquisition quantity, and donation quantity. For clarity, we provide a formal definition of an RE equilibrium for our problem below.

Definition 1. *Given the firm's price p and acquisition quantity Q, an RE equilibrium satisfies the following conditions: (1) $v^* - p + \beta\tilde{\psi} = \tilde{R}(\tilde{\psi})\delta v^*$; (2) $\psi^* = \arg\max_{\psi \in [0,(Q-\tilde{D}_b)^+]} \pi^T(Q, p, \psi)$; (3) $\tilde{\psi} = \psi^*$; (4) $\tilde{v} = v^*$.*

The first two conditions indicate that both parties make decisions rationally, while the other two require that expectations be consistent with outcomes. In particular, condition (1) prescribes the valuation of the consumer who is indifferent between buying the product and seeking a donation, and condition (2) specifies the donation quantity that maximizes the firm's profit. Based on condition (2), the optimal donation quantity is $\psi^* = (Q - D_b)^+$ because π^T increases with the donation quantity. This suggests that the firm would donate all surplus products if available. As such, if $Q \le D_b$, the donation quantity is 0 and the donation channel is muted. In this case, the indifference point is $v^* = p$ and the demand of the buying group is $D_b = 1 - p$; if $Q > D_b$, the donation quantity is $Q - D_b > 0$. In this case, the indifference point is $v^* = \frac{p + (\beta - \delta)(1 - Q)}{1 + \beta - \delta}$ and the demand of the buying group is $D_b = 1 - v^* = \frac{1 - p + (\beta - \delta)Q}{1 + \beta - \delta}$. Using these intermediary results, we reformulate the firm's price and acquisition quantity optimization problem in Scenario T:

$$\max_{p \ge c, 0 \le Q \le K} \pi^T = (1 - r)(p \min\{D_b, Q\} - cQ) + r\lambda c(Q - D_b)^+. \tag{2}$$

The demand of the buying group D_b depends on the firm's price p and acquisition quantity Q as discussed earlier. The constraint $p \ge c$ states that the firm does not price below cost, and the constraint $0 \le Q \le K$ states that the acquisition quantity does not exceed the capacity level.

3.4. The government

From the government's perspective, two key considerations arise: social welfare, which encompasses the welfare of all stakeholders (the firm, buyers, and donation recipients), and tax revenue. To determine the optimal tax incentive rate, the government must carefully balance these competing objectives. Following the approach in the literature (e.g., Fan et al. 2020), we define the government's objective as

$$GO = \gamma SW + (1-\gamma)TR,$$

where SW represents the social welfare, TR denotes the tax revenue, and $\gamma \in [0,1]$ denotes the degree of the government's social concern relative to its tax revenue. In our setting, the government's tax revenue is equal to the firm's tax liability, and a larger value of γ indicates that the government is more concerned about social welfare. Social welfare consists of the firm's profit and the consumer surplus; that is, $SW = CS + \pi$. The consumer surplus is given by

$$CS = \int_0^{v^*} R\delta v dv + \int_{v^*}^1 (v - p + \beta\psi) dv,$$

where the first term represents the surplus of the donation group, and the second term represents the surplus of the buying group.

The sequence of events is as follows. In Stage 1, the government determines the tax incentive rate λ. In Stage 2, the firm determines the production quantity Q at a unit cost c, subject to maximum capacity K. In Stage 3, the firm sets its product price p. In Stage 4, the firm determines the donation quantity, and the consumers opt to buy the product or seek donations. We note that Stages 2 and 3 can be swapped or combined. To analyze the game, we first study the firm's optimization problem under a given tax incentive rate in Section 4 and then examine the government's problem of determining the optimal incentive rate in Section 5. Our analytical analysis is supplemented with a calibrated numerical study; see Appendix A for model calibrations. Given the consumer utility follows a standard uniform distribution and the population of consumers is normalized to 1, we focus on cases where $K \in (0,1]$ and $c \in (0,1)$ throughout the analysis.

4. Equilibrium Analysis

In this section, we analyze the firm's optimal decisions and characterize the RE equilibrium under a given donation tax policy. To focus on more interesting cases, we make a technical assumption that $\delta \in (0, \bar{\delta})$ and $\lambda \in (0, \bar{\lambda})$, where $\bar{\delta} = \min\{\frac{(1-c)[2(2K+c-1)^+ + 1 - c]}{[(2K+c-1)^+ + 1 - c]^2} + \beta, 1\}$ and $\bar{\lambda} = \frac{(1-r)[1+(\beta-\delta)K]}{cr}$. The upper bound of δ ensures that the donation utility rate is not prohibitively high since otherwise the firm would not make donations in Scenario T. The upper bound of λ ensures that the tax incentive

policy is not excessively generous since otherwise the firm's optimal decisions would eliminate the buying group in Scenario T. The derivations of these conditions, along with closed-form expressions for the thresholds in the subsequent results, are provided in Appendix F.

4.1. Equilibrium characterization

Before presenting the equilibrium, we first provide an intermediary result that characterizes the case where the goodwill effect alone is sufficient to induce donations, irrespective of the tax policy.

LEMMA 1. *There exist two thresholds of β, $\hat{\beta}_{s0}$ and $\hat{\beta}_{i0}$, such that when $\beta \geq \max\{\hat{\beta}_{s0}, \hat{\beta}_{i0}\}$, the firm will always donate, even in the absence of tax incentives.*

Intuitively, when the goodwill effect is strong enough, the firm donates even without tax incentives. The threshold $\hat{\beta}_{s0}$ applies when $K \geq \frac{1-c}{2}$, while $\hat{\beta}_{i0}$ applies when $K < \frac{1-c}{2}$. Given that our objective is to examine the role of tax policy in promoting the firm's donation behavior, in the following we focus on cases where $\beta < \max\{\hat{\beta}_{s0}, \hat{\beta}_{i0}\}$, such that donations do not arise without policy support. This assumption also aligns with real-world observations, where firms often refrain from donating when policy incentives are weak or absent. Solving the problems in (1) and (2) gives the results in Proposition 1.

PROPOSITION 1. *The firm's optimal price, acquisition quantity, and donation fulfillment rate are as follows:*

(a) Scenario N: $p^{N*} = \max\{\frac{1+c}{2}, 1-K\}$, $Q^{N*} = \min\{\frac{1-c}{2}, K\}$, and $R^{N*} = 0$;

(b) Scenario T: There exist two thresholds of λ, $\hat{\lambda}_{s0}$ and $\hat{\lambda}_{i0}$, such that if $\lambda < \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$, the firm's optimal decision is the same as that in Scenario N; if $\lambda \geq \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$, $p^{T*} = \frac{(1-r)[1+K(\beta-\delta)]+rc\lambda}{2(1-r)}$, $Q^{T*} = K$, and $R^{T*} = \frac{(1-r)[K(2+\beta-\delta)-1]+rc\lambda}{(1-r)[1+(2-K)(\beta-\delta)]+rc\lambda}$.

For convenience, we depict the firm's optimal decisions in Figure 1. In Scenario N, the firm has no incentive to donate, and the problem is analogous to a standard pricing model with capacity constraints. As expected, the firm's optimal decisions depend on the capacity level K: the optimal acquisition quantity is the minimum between K and $(1-c)/2$, where the latter is the optimal unconstrained quantity.

In Scenario T, there are three different strategies for the firm (i.e., "full capacity, donation", "full capacity, no donation", and "partial capacity, no donation"), depending on the capacity level K and the tax incentive rate λ. We show that there is a threshold of λ, $\max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$, which takes different forms depending on the value of K. Here, $\hat{\lambda}_{s0}$ and $\hat{\lambda}_{i0}$ correspond to the cases of sufficient and insufficient capacity, respectively. For convenience, we refer to $\max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$ as *the policy-effective threshold*. If the tax incentive rate is below the threshold, the incentive policy fails

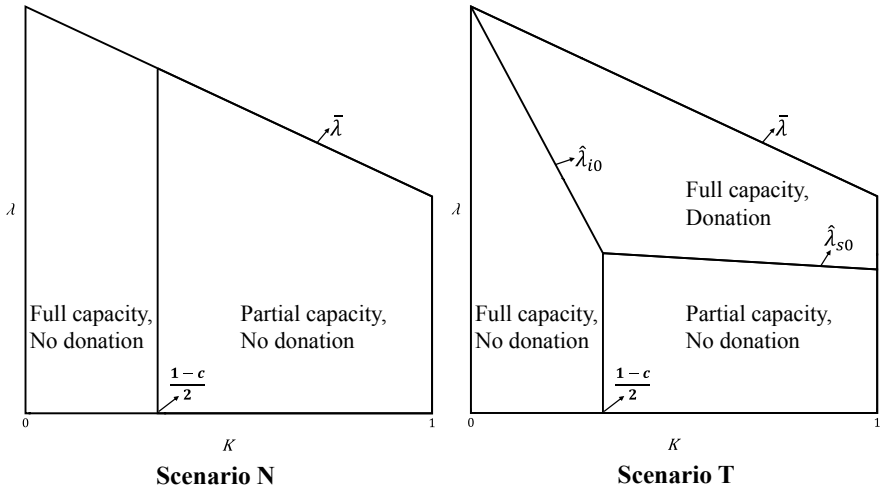


Figure 1 Illustration of the firm's optimal decisions in the two scenarios

to induce any donations. In this case, the firm may operate at full capacity when K is small, or at partial capacity when K is large. In contrast, it is more profitable for the firm to donate if the tax incentive rate is above the policy-effective threshold (i.e., $\lambda > \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$). Interestingly, the firm always operates at full capacity in this case; that is, when engaging in donations, the firm always benefits from using all its capacity. Another observation from Proposition 1 is that the donation fulfillment rate is always below 100% (i.e., $R^{T*} < 1$), even when the capacity level is high, suggesting that not all donation-seeking consumers can successfully receive donations.

To better understand the firm's donation decision, we examine how the policy-effective threshold is affected by various factors. A lower (resp. higher) threshold implies the firm is more (resp. less) willing to donate. We summarize the results in the following proposition.

PROPOSITION 2. *The policy-effective threshold* $\max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$ *increases with the donation utility rate* δ*, and decreases with the goodwill enhancement level* β*, the acquisition capacity level* K*, and the income tax rate* r*. The threshold increases with the acquisition cost* c *if* $K \geq \frac{1-c}{2}$ *and* $\beta > \delta$*, and decreases otherwise.*

The firm is less willing to donate with an increase in the donation utility rate δ. As δ increases, the expected utility from donation, $R\delta v$, also increases, which makes seeking donations more attractive to consumers. This raises the reservation utility of the buying group and weakens their willingness to purchase, thereby reducing the firm's sales revenue. To offset this profit loss, a higher tax incentive rate is required, leading to an increase in the policy-effective threshold. A larger β intuitively lowers the policy-effective threshold. When the goodwill enhancement effect is stronger, the firm can partially internalize the benefit of donation through increased willingness to pay, thereby reducing its reliance on policy incentives to sustain donation. The firm is also more willing to

donate when it has more capacity K. Since donations cannibalize the firm's sales, a larger capacity provides greater flexibility in balancing sales and donations, mitigating the cannibalization effect and strengthening the firm's incentive to donate. A higher income tax rate r amplifies the benefit of tax deduction, providing a stronger incentive for the firm to donate and further lowering the policy-effective threshold.

The effect of the acquisition cost c is more nuanced. On the one hand, a higher c increases the tax deduction per donated unit, strengthening policy-driven incentives and lowering the policy-effective threshold. On the other hand, it compresses the firm's margin, weakening goodwill-based incentives that operate through a price premium and, consequently, necessitating stronger policy support. As a result, when the goodwill enhancement effect is strong (i.e., $\beta > \delta$) and capacity is large ($K \geq \frac{1-c}{2}$), the margin effect dominates and the threshold increases with c. In contrast, when capacity is limited, both donation and pricing decisions are constrained by supply considerations, leaving little room for goodwill-induced margin gains; in this case, the policy effect dominates, and the threshold decreases with c.

4.2. Impact of donation tax incentives

In this subsection, we examine the impact of donation tax incentives. We start with the analysis of how the equilibrium outcomes change with λ.

PROPOSITION 3. *In Scenario T, the optimal price p^{T*} and the donation fulfillment rate R^{T*} are independent of the tax incentive rate λ if $\lambda < \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$ and increase with λ otherwise. In Scenario N, they are independent of λ.*

Intuitively, when the tax incentive rate is low in Scenario T (i.e., $\lambda < \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$) as well as in Scenario N, the firm does not donate. In these cases, an increase in the tax incentive rate has no impact on the firm's optimal decisions. However, when the rate is high enough so that it induces a positive donation amount (i.e., $\lambda \geq \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$), the firm raises its price as the rate increases. With a higher tax incentive rate, the firm benefits more from donations; the firm then charges a higher price p^{T*}, resulting in a smaller buying group but a larger donation-seeking group.

Next, we compare the equilibrium outcomes between Scenario T and Scenario N. We first investigate how tax incentives affect the firm's optimal pricing decisions.

PROPOSITION 4. *Comparison of the optimal prices in the two scenarios yields:*

(a) When $K \geq (1-c)/2$, there exist a threshold of λ, λ_{s1}, such that $p^{T*} = p^{N*}$ if $\lambda < \hat{\lambda}_{s0}$, $p^{T*} < p^{N*}$ if $\hat{\lambda}_{s0} \leq \lambda < \min\{\max\{\lambda_{s1}, \hat{\lambda}_{s0}\}, \bar{\lambda}\}$, and $p^{T*} > p^{N*}$ otherwise.

(b) When $K < (1-c)/2$, $p^{T*} = p^{N*}$ if $\lambda < \hat{\lambda}_{i0}$, and $p^{T*} > p^{N*}$ otherwise.

A key insight from Proposition 4(a) is that in the high capacity case (i.e., $K \geq (1-c)/2$), the optimal price in Scenario T may be either higher or lower than that in Scenario N, depending on the tax incentive rate. When the incentive rate is below the policy-effective threshold (i.e., $\lambda < \hat{\lambda}_{s0}$), the firm does not donate and thus charges the same price in both scenarios. When the incentive rate exceeds the threshold (i.e., $\lambda \geq \hat{\lambda}_{s0}$), the firm's pricing behavior bifurcates: the firm charges a lower price under a moderate incentive rate (i.e., $\lambda < \min\{\lambda_{s1}, \bar{\lambda}\}$), but raises the price when the incentive is sufficiently high (i.e., $\lambda \geq \min\{\lambda_{s1}, \bar{\lambda}\}$).

This non-monotonic pricing behavior reflects the twofold effect of donation. On the one hand, offering donations weakens the buying group's willingness to buy, prompting the firm to lower its price to retain that group. On the other hand, with tax incentives and goodwill effects, the firm can profit from reallocating supply to the donation group, allowing it to raise prices, shrink the buying group and expand the donation-seeking group. When the incentive rate is moderate, the negative effect on demand prevails, resulting in price reductions. Conversely, at high incentive rates, the donation benefit outweighs the cannibalization effect, motivating the firm to raise prices.

In the low capacity case (i.e., $K < (1-c)/2$), the firm's optimal acquisition quantity in both scenarios equals capacity (see Figure 1). Consequently, any increase in supply to one group comes at the expense of the other. Given this, the firm charges the same price in both scenarios when the tax incentive rate is low (i.e., $\lambda < \hat{\lambda}_{i0}$). However, when the incentive rate exceeds the threshold (i.e., $\lambda \geq \hat{\lambda}_{i0}$), the firm finds it optimal to charge a higher price to reduce demand from the buying group, thereby freeing up more capacity for donations and capturing greater tax savings and goodwill-induced benefits. This reflects the firm's strategic trade-off between selling at a profit and donating for tax and reputational benefits under a binding capacity constraint.

As can be seen from (2), the firm's profit in Scenario T increases with the tax incentive rate λ; thus, the firm's optimal after-tax profit is higher in Scenario T than that in Scenario N. Next, we examine the impact of tax incentives on the consumer surplus given the firm's optimal decisions. Proposition 5 below summarizes the results.

PROPOSITION 5. *Define* $\hat{\lambda}_0 \doteq \max\{\hat{\lambda}_{s0}, \hat{\lambda}_{i0}\}$. *If* $\lambda < \hat{\lambda}_0$, $CS^T = CS^N$; *otherwise, there exists a threshold of* δ, δ_1, *such that* $CS^T < CS^N$ *for* $\delta < \max\{\delta_1, 0\}$ *and* $CS^T > CS^N$ *for* $\delta > \max\{\delta_1, 0\}$.

Proposition 5 examines how implementing a tax incentive policy affects consumer surplus. There are three cases, depending on the values of the tax incentive rate λ and the donation utility rate δ. When λ is below the policy-effective threshold (i.e., $\lambda < \hat{\lambda}_0$), the firm does not donate in Scenario T due to insufficient incentives, and there is no difference in consumer surplus between Scenarios N

and T. When λ exceeds this threshold, the firm begins to donate. Common intuition may suggest that the consumer surplus should increase in this case, since some consumers benefit from free donations. The proposition confirms this intuition—but only when the donation utility rate is sufficiently high (i.e., $\delta > \delta_1$). If δ falls below this threshold (i.e., $\delta < \delta_1$), the overall consumer surplus in Scenario T becomes lower than in Scenario N. This occurs because the price increase associated with the donation policy negatively affects the buying group (see Proposition 4), outweighing the surplus gained by the donation group.

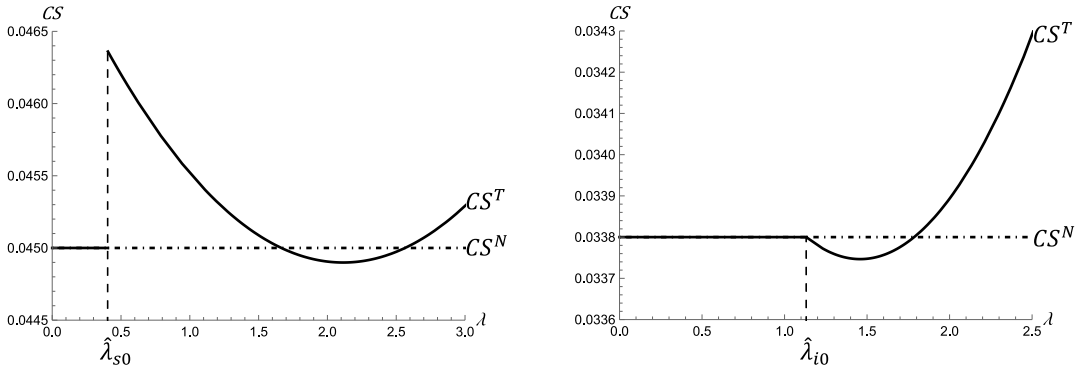
Figure 2 further illustrates the effect of the tax incentive rate on consumer surplus. We focus on the case where the tax incentive rate exceeds the policy-effective threshold (i.e., $\lambda > \hat{\lambda}_0$). In this case, consumer surplus exhibits a non-monotonic pattern: it first decreases and then increases with λ. As discussed in Proposition 3, both the product price and the donation fulfillment rate increase with the incentive rate, reflecting the dual effects of the policy: on the one hand, higher λ improves product access through greater donations, but on the other hand, it raises prices and harms the buying group. Consequently, at moderate levels of λ, the consumer surplus in Scenario T may fall below that in Scenario N. The relevance of these insights is further corroborated by our numerical analysis using calibrated parameter values and actual tax incentive rates (see Appendix A), which suggests that the current policies in Colombia and France effectively promote food donations but may reduce consumer surplus under certain conditions. These findings have important implications for tax incentive design, suggesting that governments should consider not only the social benefits of increased donations but also the potential adverse effects on purchasing consumers.

Additionally, in the high capacity case, we observe a discontinuity in the consumer surplus at the policy-effective threshold. Once λ crosses the threshold, the firm switches from a "partial capacity, no donation" strategy to a "full capacity, donation" strategy, resulting in a lower price (Proposition 4(a)) and a higher acquisition quantity. This shift benefits consumers, but in a discontinuous manner, underscoring the complex dynamics at play in policy-induced behavioral shifts.

5. Optimal Donation Tax Policy

Based on the characterization of optimal firm responses to donation tax incentives in Section 4, in this section we consider how the government should design the donation tax policy. As discussed in Section 3, the government determines the tax incentive rate to maximize a weighted sum of social welfare and tax revenue:

$$\max_{\lambda} GO = \gamma \cdot \left(\underbrace{\int_0^{v^*} R^* \delta v dv + \int_{v^*}^1 (v - p^*) dv}_{\text{consumer surplus}} + \underbrace{(1-r)(p^* \min\{D_b, Q^*\} - cQ^*) + r\lambda c\psi^*}_{\text{firm after-tax profit}} \right) + (1-\gamma) \cdot \underbrace{r[p \min\{D_b, Q^*\} - cQ^* - \lambda c\psi^*]}_{\text{tax revenue}},$$



(a) $K \geq (1-c)/2$ (b) $K < (1-c)/2$

Figure 2 **Impact of λ on the consumer surplus ($r = 0.3$, $c = 0.4$, $\delta = 0.4$, $\beta = 1.5$, $K = 0.305$ in panel (a) and $K = 0.26$ in panel (b))**

where p^*, v^*, R^*, Q^* and ψ^* are the equilibrium outcomes for a given tax incentive rate λ, as characterized in Proposition 1. Before optimizing the tax incentive rate, it is helpful to examine how a change in the tax incentive rate affects the government's dual considerations: social welfare and tax revenue.

LEMMA 2. *In Scenario T, for $\lambda \geq \hat{\lambda}_0$, the following statements hold:*

(a) There exists a threshold of λ, λ_1, such that the social welfare decreases with λ for $\hat{\lambda}_0 \leq \lambda < \max\{\lambda_1, \hat{\lambda}_0\}$ and increases with λ otherwise.

(b) The tax revenue decreases with λ.

In the policy-effective region (i.e., $\lambda \geq \hat{\lambda}_0$), social welfare as a function of the tax incentive rate λ exhibits a U-shaped pattern, similar to that of consumer surplus. In contrast, tax revenue monotonically decreases with λ. To balance these objectives, the government must calibrate the level of tax incentives to promote donations while not excessively eroding its tax base. We formalize the government's optimal tax incentive rate in the following lemma.

LEMMA 3. *In Scenario T, for $\lambda \geq \hat{\lambda}_0$, there exist a threshold of β, β_2, such that the optimal tax incentive rate λ^* in Scenario T is as follows:*

(a) When $\beta \leq \beta_2$, there exists a threshold, γ_1, such that $\lambda^* = \hat{\lambda}_0$ if $\gamma < \gamma_1$, and $\lambda^* = \bar{\lambda}$ if $\gamma \geq \gamma_1$.

(b) When $\beta > \beta_2$, there exist two thresholds, γ_2 and γ_3, such that $\lambda^* = \hat{\lambda}_0$ if $\gamma < \gamma_2$, $\lambda^* = \lambda_0$ if $\gamma_2 \leq \gamma < \gamma_3$, and $\lambda^* = \bar{\lambda}$ if $\gamma \geq \gamma_3$, where λ_0 solves $\frac{\partial GO}{\partial \lambda} = 0$.

Lemma 3 characterizes the optimal tax incentive rate λ^*, which depends on the government's welfare weight γ and the strength of goodwill enhancement β. When the goodwill effect is small (i.e., $\beta \leq \beta_2$), goodwill plays a limited role in sustaining donations, and the optimal policy is given

by a corner solution. The government either sets the minimal policy-effective rate $\hat{\lambda}_0$ to induce donations at the lowest fiscal cost (when γ is low) or switches to the upper bound $\bar{\lambda}$ (when γ is high), prioritizing donation expansion over tax revenue. When the goodwill effect is large (i.e., $\beta > \beta_2$), goodwill becomes an important market mechanism, giving rise to a three-region policy structure. For low γ, the government sets $\lambda^* = \hat{\lambda}_0$; for high γ, it sets $\lambda^* = \bar{\lambda}$. For intermediate values of γ, the optimal policy entails an interior incentive rate, $\lambda^* = \lambda_0$, to balance the welfare gains from donations against the fiscal cost of the tax incentive. Overall, a strong goodwill effect expands the scope for optimal policy design, allowing the government to move beyond corner solutions. By contrast, when the goodwill effect is weak, the policy design problem collapses to a binary choice between a weak intervention at $\hat{\lambda}_0$ and a strong intervention at $\bar{\lambda}$.

We are now in a position to evaluate the government's optimal choice regarding the provision of a tax incentive. If no incentive is offered, we have Scenario N. If an incentive is provided, we have Scenario T, with the optimal tax incentive rate determined by Lemma 3 over the policy-effective region. To guide this policy choice, we compare the government's objective function value in Scenario N with that in Scenario T, evaluated at the optimal tax incentive rate. For analytical tractability, we first conduct this comparison for the case of $\beta = 0$, and then use numerical analysis to examine the case of $\beta > 0$.

PROPOSITION 6. *Assume $\beta = 0$. The government's optimal tax policy decision is as follows:*

(a) When $K \geq (1-c)/2$, there exists a threshold of γ, γ_{s1}, such that the government does not offer a tax incentive (Scenario N) if $\gamma < \gamma_{s1}$; otherwise, the government offers a tax incentive (Scenario T) at a rate of either $\hat{\lambda}_0$ or $\bar{\lambda}$, as characterized in Lemma 3(a).

(b) When $K < (1-c)/2$, there exists a threshold of γ, γ_{i1}, such that the government does not offer a tax incentive (Scenario N) if $\gamma < \gamma_{i1}$; otherwise, the government offers a tax incentive (Scenario T) at a rate of $\bar{\lambda}$.

Proposition 6 characterizes the government's optimal tax policy with respect to the firm's capacity level in the absence of goodwill effects. In the high capacity case (i.e., $K \geq (1-c)/2$), we identify two thresholds of γ, such that the optimal tax incentive rate is zero when γ is low, equals the policy-effective threshold when γ is moderate, and reaches the upper bound when γ is high. In the low capacity case (i.e., $K < (1-c)/2$), a single threshold of γ is identified: the optimal tax incentive rate is set at the upper limit when γ exceeds this threshold, and zero otherwise. These results suggest that a donation tax policy is beneficial only when the government places significant emphasis on social welfare.

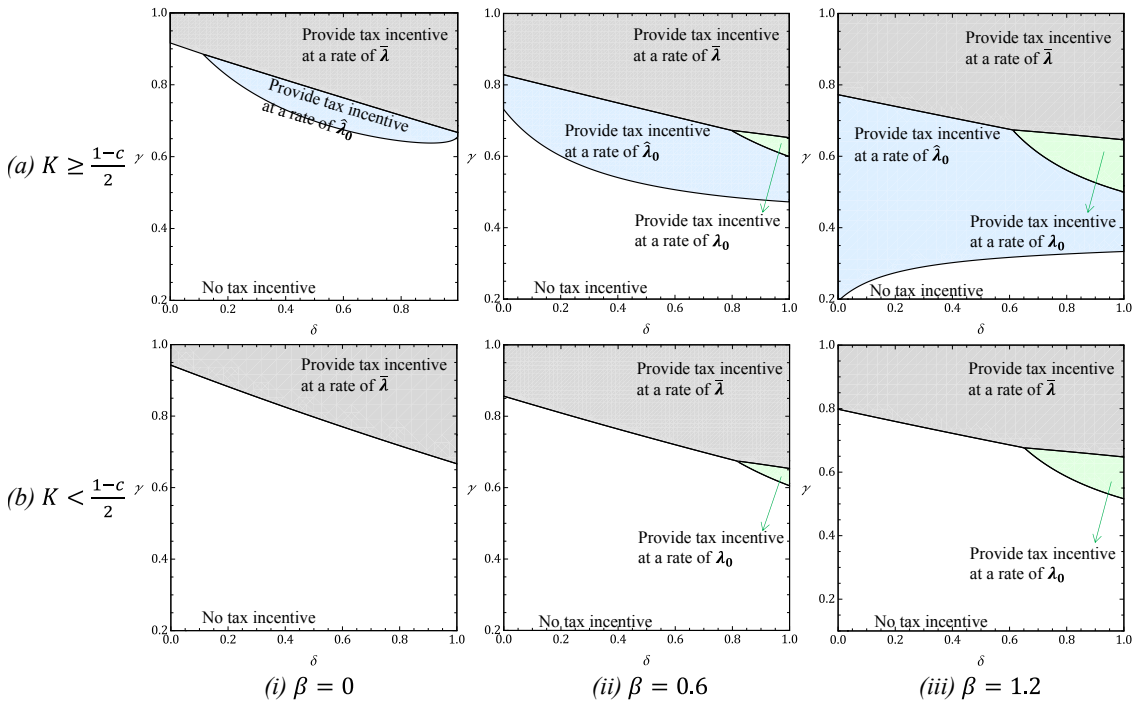


Figure 3 Government's optimal policy choice ($r = 0.3$, $c = 0.4$; $K = 0.32$ in panel (a) and $K = 0.28$ in panel (b))

The donation utility rate δ also influences the government's optimal policy. Figure 3 characterizes the optimal tax incentive rate across different combinations of the values of K, γ, β, and δ. We organize the discussion in two parts: the case without goodwill effects ($\beta = 0$, panel (i)) and the case with goodwill effects ($\beta > 0$, panels (ii)-(iii)).

Case without goodwill effects ($\beta = 0$). At high capacity, panel (a)(i) reveals a non-monotonic relationship between δ and the government's optimal decision when γ is moderate (e.g., $\gamma = 0.65$): the government opts not to provide tax incentives when δ is either small or large, but prefers to provide tax incentives at the policy-effective rate $\hat{\lambda}_0$ for medium values of δ. To understand this pattern, recall that the firm's profit is unaffected by the donation policy when the tax incentive rate is below the policy-effective threshold; we thus focus on how δ shapes consumer surplus and tax revenue. Relative to no policy, implementing $\hat{\lambda}_0$ reduces tax revenue while potentially raising consumer surplus. It can be shown that consumer surplus in Scenario T is itself non-monotonic in δ—small at both extremes. When δ is at either extreme, the consumer surplus gain fails to outweigh the tax revenue loss, rendering the policy undesirable. This non-monotonicity arises only at moderate γ: for sufficiently large or small γ (e.g., $\gamma = 0.95$ or $\gamma = 0.5$ in panel (a)(i)), the government's preference is more stable—it either provides or withholds the policy regardless of δ. In the low-capacity case (panel (b)(i)), the policy-effective threshold $\hat{\lambda}_0$ is never optimal; instead, the government implements the policy at the upper limit rate $\bar{\lambda}$ only when γ is large.

Case with goodwill effects ($\beta > 0$). When the firm derives goodwill benefits from donations, three observations emerge. First, as β increases, the region where no tax incentive is optimal shrinks, suggesting that the tax incentive policy is more likely to be adopted. A larger β implies greater goodwill benefits from donations, which increase both firm profit and consumer surplus, thereby strengthening the government's incentive to introduce a tax policy that encourages donations.

Second, the interior solution λ_0 arises when δ is sufficiently large. Lemma 3 establishes that when $\beta > \beta_2$—a condition equivalent to δ exceeding a threshold for any given $\beta > 0$—the optimal tax incentive rate lies in the interior of $[\hat{\lambda}_0, \bar{\lambda}]$ for intermediate values of γ. This interior solution corresponds to the green region in panels (ii) and (iii), which is concentrated in the high-δ portion of the parameter space. When consumers do not discount donated products a lot (large δ), the social value of expanding donations is large, so the government is compelled to expand donation volume above what $\hat{\lambda}_0$ delivers. As λ increases beyond $\hat{\lambda}_0$, however, the forgone tax revenue dominates the consumer surplus gain, generating an interior optimum.

Third, under higher capacity, panels (a)(i)–(iii) show that the blue region—where the government optimally sets the incentive rate at $\hat{\lambda}_0$—expands with a larger β, with a more pronounced expansion at lower values of δ. Since the firm does not donate in Scenario N, β affects consumer welfare only in Scenario T, where it generates an additional goodwill-induced consumer surplus of $\beta\psi$. This gain is particularly important when the donation channel itself provides limited consumer surplus. When δ is small, consumers derive relatively little utility from donated products, making $\beta\psi$ a major source of the additional consumer surplus generated by donations. As δ increases, the donation channel itself generates greater consumer surplus, reducing the relative importance of the goodwill effect and thus making the expansion of the blue region less pronounced.

6. Extensions

Our base model considers a single firm, donation tax incentives as the only form of government intervention, and homogeneous consumers. In this section, we extend the base model on these dimensions and demonstrate the robustness of our main findings along with additional insights.

6.1. Competitive fringe

Our first extension considers a *dominant firm-competitive fringe* market, in which the dominant firm sets price p and a group of fringe firms are price-takers. Consistent with the literature (Stigler, 1940; Raju and Zhang, 2005), the dominant firm anticipates total fringe supply at price p and serves the residual demand. This asymmetric market structure is a good representation of many industries including the grocery industry where there are a small number of big players (supermarket chains) alongside a large number of small players (grocery stores) (Raju and Zhang, 2005).

Fringe firms do not make donations and thus cannot capitalize on the consumers' donation-induced goodwill. We note that this treatment preserves the dominant firm's pricing advantage, so this extension should be interpreted as a robustness analysis of small-scale competition. As price-takers, the fringe firms supply at an effective price, $p^{\text{eff}} = p - \beta\tilde{\psi}$. Equivalently, consumers purchasing from the dominant firm pay p and derive goodwill utility $\beta\tilde{\psi}$, while those purchasing from fringe firms pay p^{eff} and derive no goodwill utility. Total fringe supply is given by $Q_f(p) = \sigma\big(p-\beta\tilde{\psi}\big)$, where σ denotes the scaled size of the fringe. This linear fringe supply is commonly used in the literature, and it formalizes the positive relationship between supply and price. We impose an upper bound on the fringe size, $\sigma < \bar{\sigma} = \min\{\frac{1-c}{c}, \frac{2[\delta K+(1-2K)(1-\sqrt{1-\delta})]}{2(K-\delta)+(1+\delta)(1-2K)\sqrt{1-\delta}}\}$. If σ exceeds the first threshold, the firm does not participate in the market in Scenario N (see the expression for Q^{N*} in Proposition 7), leaving the competitive fringe to serve the entire market. The second threshold rules out a third candidate policy rate that arises under sufficiently strong competitive pressure. For the calibrated parameter values derived in Appendix A, the first threshold is binding.

Given the fringe supply, the dominant firm's residual demand is given by $\tilde{D}_b = 1 - \tilde{v}^* - Q_f(p)$, while the donation demand remains as $\tilde{D}_d = \tilde{v}^*$. The consumer indifference point $\tilde{v}^*$ and the donation quantity $\tilde{\psi}$ are determined by the same RE equilibrium as in the base model, with $\tilde{D}_b$ replaced by its residual counterpart. Our base model emerges as the special case with $\sigma = 0$. As in the base model, we assume that β is bounded above by $\hat{\beta}_0^{(\text{cf})} \doteq \max\{\frac{\left\{c(\sigma+1)+2K-1+\sqrt{4cK(\sigma+1)+[1-c(\sigma+1)]^2}\right\}^2}{4K^2(\sigma+1)} - \frac{1-\delta}{\sigma+1}, \frac{1-(2-\delta)K}{K(\sigma+1)}\}$ to eliminate cases where the firm always donates even without tax incentives.

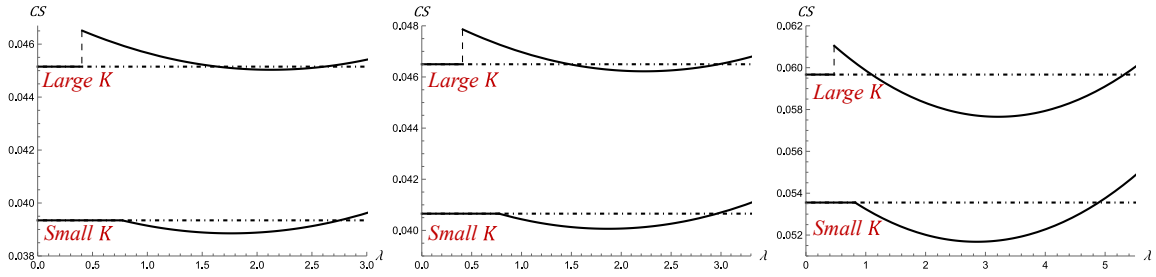
PROPOSITION 7. *In the competitive fringe model, the firm's optimal price, acquisition quantity, and donation fulfillment rate are as follows:*

(a) Scenario N: $p^{N*} = \max\{\frac{1+(\sigma+1)c}{2(\sigma+1)}, \frac{1-K}{\sigma+1}\}$, $Q^{N*} = \min\{\frac{1-(\sigma+1)c}{2}, K\}$, *and* $R^{N*} = 0$;

(b) Scenario T: There exist two thresholds of λ, $\hat{\lambda}_{s0}^{(\text{cf})}$ *and* $\hat{\lambda}_{i0}^{(\text{cf})}$, *such that if* $\lambda < \hat{\lambda}_0^{(\text{cf})} \doteq \max\{\hat{\lambda}_{s0}^{(\text{cf})}, \hat{\lambda}_{i0}^{(\text{cf})}\}$, *the firm's optimal decision is the same as that in Scenario N; if* $\lambda \geq \hat{\lambda}_0^{(\text{cf})}$, $p^{T*} = \frac{(1-r)[1+K(\beta-\delta+\beta\sigma)]+rc\lambda(\sigma+1)}{2(\sigma+1)(1-r)}$, $Q^{T*} = K$, *and* $R^{T*} = \frac{(\sigma+1)\{r[c\lambda(\sigma+1)+1]+K(1-r)(\beta-\delta+\beta\sigma+2)-1\}}{(1-r)\{(\sigma+1)(\beta-\delta)[2-K(1-\delta\sigma)]+(\delta\sigma+1)(\delta K\sigma+1)\}+c\lambda(\sigma+1)r(\delta\sigma+1)}$.

Proposition 7 characterizes the firm's optimal decisions under fringe competition. Two observations are in order. First, in the policy-effective region of Scenario T, the equilibrium price p^{T*} increases in the tax incentive rate λ, so the tax incentive continues to inflate the firm's price even when fringe competition is present. Second, fringe competition exerts the expected pressure on the dominant firm: in Scenario N, p^{N*} decreases with σ, since a larger fringe size intensifies competition. The same competitive pressure operates in the policy-effective region of Scenario T: both p^{T*} and π^{T*} decrease in σ, while the donation fulfillment rate R^{T*} increases in σ.

Figure 4 illustrates consumer surplus as a function of λ at different values of σ under fringe competition. One can observe that the non-monotonic effect of λ on consumer surplus continues to hold in Scenario T. Also, similar to our base model, the consumer surplus may be lower when the tax incentive rate is moderate; since fringe competition lowers the dominant firm's price and expands total market supply in both Scenario T and Scenario N, it does not qualitatively change the comparison result about consumer surplus.



(a) $\sigma = 0.001$ (b) $\sigma = 0.01$ (c) $\sigma = 0.1$

Figure 4 **Impact of λ on consumer surplus with competitive fringe; solid lines: CS^T, dash-dotted lines: CS^N ($r = 0.3$, $c = 0.4$, $\delta = 0.4$, $\beta = 1.5$, $K + \sigma c/2 = 0.305$ for Large K, $K + \sigma c/2 = 0.28$ for Small K)**

Under fringe competition, the government chooses the tax incentive rate λ to solve

$$\max_{\lambda} \; GO^{(cf)} = \gamma \cdot \Big(CS^{(cf)} + (1-r)(p^* \min\{\tilde{D}_b, Q^*\} - cQ^*) + r\lambda c\psi^* + (1-r)\pi_f \Big) + (1-\gamma) \cdot \Big(r(p^* \min\{\tilde{D}_b, Q^*\} - cQ^* - \lambda c\psi^*) + r\pi_f \Big),$$

where $\pi_f = \sigma(p^* - \beta\psi^*)^2/2$ denotes the fringe's pre-tax producer surplus. Consumer surplus $CS^{(cf)}$ takes the same form as in the base model, as consumers derive identical net utility whether they buy from the dominant firm or the fringe. For tractability, as in Proposition 6 we focus on $\beta = 0$.

PROPOSITION 8. *Assume $\beta = 0$. In the competitive fringe model, the government's optimal tax policy decision is as follows:*

(a) When $K \geq (1-(1+\sigma)c)/2$, there exist two thresholds of γ, $\gamma_{s1}^{(\mathrm{cf})}$ and $\gamma_{s2}^{(\mathrm{cf})}$, such that the government does not offer a tax incentive (Scenario N) if $\gamma < \gamma_{s1}^{(\mathrm{cf})}$, offers a tax incentive at a rate of $\hat{\lambda}_0$ when $\gamma_{s1}^{(\mathrm{cf})} \leq \gamma < \gamma_{s2}^{(\mathrm{cf})}$, and offers a tax incentive at a rate of $\bar{\lambda}$ when $\gamma \geq \gamma_{s2}^{(\mathrm{cf})}$.

(b) When $K < (1-(1+\sigma)c)/2$, there exists a threshold of γ, $\gamma_{i1}^{(\mathrm{cf})}$, such that the government does not offer a tax incentive (Scenario N) if $\gamma < \gamma_{i1}^{(\mathrm{cf})}$, and offers a tax incentive at a rate of $\bar{\lambda}$ otherwise.

In addition, the incentive rates $\hat{\lambda}_0$ and $\bar{\lambda}$ decrease with σ.

Proposition 8 shows that the government's optimal tax policy under fringe competition retains the structure of the base model. Further, the optimal candidate rates $\hat{\lambda}_0$ and $\bar{\lambda}$ both decrease in the fringe size σ, implying that the optimal incentive declines as competition intensifies. Stronger competition improves market access and puts downward pressure on prices even without government intervention, thereby reducing the marginal social benefit of supporting the donation channel. Consequently, the need for government intervention diminishes as σ increases.

6.2. Government direct market entry

In this extension, we consider an alternative government intervention, direct market entry, whereby the government enters the market through opening a store instead of providing tax incentives (**Scenario E**). Consistent with widely reported observations (see, e.g., Gelinas, 2025; The Washington Post Editorial Board, 2026), we assume that the government operates the store on a non-profit basis, selling the product at a price equal to its marginal cost, p_g. Suppose $p_g \geq c$ as public sector programs of this kind lack the scale and efficiency of larger retailers. The resulting game proceeds as in the base model, with the government store serving as an additional outlet. The government's market entry plays two distinct roles. First, it serves an *access-expanding role*: the government store absorbs consumers rationed out of the firm when its capacity is insufficient to meet consumer demand, and it provides a guaranteed fallback for the fraction $1-R$ of donation-seeking consumers who fail to receive donations. Second, it plays a *price-disciplining role*: the constraint $p \leq p_g + \beta\psi$ imposes an endogenous upper bound on the firm's price, since otherwise the firm will be crowded out by the government store.

The firm may still donate due to the donation-induced goodwill effect in this extended model, even without tax incentives. We now examine consumers' purchasing versus donation-seeking behavior. The consumer indifference point v^* is characterized as in the base model: $v^* = p$ if $Q \leq D_b$, and $v^* = \frac{p+(\beta-\delta)(1-Q)}{1+\beta-\delta}$ otherwise. Consumers with $v > v^*$ prefer to purchase from the firm (due to $v^* + \beta\psi - p > \max\{v^* - p_g, R\delta v^*\}$), while those with $v < v^*$ choose the donation channel (due to $R\delta v^* > v^* + \beta\psi - p > v^* - p_g$); among the latter, a fraction $1-R$ fail to receive donations, and only those with $v \geq p_g$ then turn to the government store. When the firm's capacity is insufficient, consumers in the buying group are rationed randomly, with each served by the firm with probability $\min\{\frac{K}{1-v^*}, 1\}$ and otherwise reallocated to the government store. The government store's demand is thus given by $D_g = (1 - v^* - K)^+ + (1-R)(v^* - p_g)^+$.

With direct market entry, the total consumer surplus decomposes into four components:

$$CS^E = \underbrace{\min\{\tfrac{K}{1-v^*},1\}\int_{v^*}^{1}(v-p+\beta\psi)dv}_{\text{consumers served by firm}} + \underbrace{\frac{(1-v^*-K)^+}{1-v^*}\int_{v^*}^{1}(v-p_g)^+dv}_{\text{consumers rationed to government}}$$
$$+ \underbrace{\int_{0}^{v^*}R\delta v\,dv}_{\text{donation recipients}} + \underbrace{\int_{p_g}^{v^*}(1-R)(v-p_g)^+dv}_{\text{non-recipients served by government}} .$$

The four terms capture, respectively, the surplus of consumers served by the firm, the surplus of consumers in the purchasing group who are rationed out due to capacity constraints and rely instead on the government store, the surplus of donation recipients, and the surplus of non-recipients who turn to the government store. In the subsequent analysis, we first consider the case with $\beta=0$ for analytical characterization, and then use numerical analysis to examine the case with $\beta>0$.

PROPOSITION 9. *Assume $\beta=0$. In Scenario E, where the government directly enters the market, the firm's optimal price, acquisition quantity, and donation fulfillment rate are as follows:*

(a) when $K<1-p_g$: $p^{E*}=p_g$, $Q^{E*}=K$, and $R^{E*}=0$;

(b) when $K\geq 1-p_g$: $p^{E*}=\min\{\max\{\frac{1+c}{2},1-K\},p_g\}$, $Q^{E*}=\max\{\min\{\frac{1-c}{2},K\},1-p_g\}$, and $R^{E*}=0$.

In the absence of a goodwill effect, the firm does not donate and the optimal price depends on its capacity level, the government's price and the unit acquisition cost. When $K<1-p_g$, the firm prices at the government's price level and sells its entire capacity, with residual demand served by the government store. When $K\geq 1-p_g$, the firm faces a pricing trade-off subject to the cap p_g. If the unconstrained optimal price $(1+c)/2$ is below p_g, the firm prices as in Scenario N; otherwise, the price cap binds and the firm sets its acquisition quantity to $1-p_g$.

From the government's perspective, direct market entry represents another policy instrument. Having analyzed the firm's optimal decisions under this policy instrument in Proposition 9, we now examine the government's optimal choice among three options: no intervention (Scenario N), tax incentive (Scenario T), and direct market entry (Scenario E).

PROPOSITION 10. *Assume $\beta=0$. When $p_g\geq\max\{1-K,\frac{1+c}{2}\}$, the government will not enter the market directly, and the optimal choice is the same as in Proposition 6; otherwise, the government's optimal choice is as follows:*

(a) When $K\geq(1-c)/2$, there exist two thresholds of γ, γ_{EN1} and γ_{ET1}, such that the government is better off with no intervention (Scenario N) if $\gamma\leq\gamma_{EN1}$, with direct market entry (Scenario E) if $\gamma_{EN1}<\gamma\leq\gamma_{ET1}$, and with the tax incentive (Scenario T) otherwise, where the optimal tax incentive rate is either $\hat{\lambda}_0$ or $\bar{\lambda}$, as characterized in Lemma 3(a).

(b) When $K < (1-c)/2$, there exist two thresholds of γ, γ_{EN2} and γ_{ET2}, such that the government is better off with no intervention (Scenario N) if $\gamma \le \gamma_{EN2}$, with direct market entry (Scenario E) if $\gamma_{EN2} < \gamma \le \gamma_{ET2}$, and with the tax incentive (Scenario T) otherwise, where the optimal tax incentive rate is $\lambda^* = \bar{\lambda}$.

The condition $p_g \ge \max\{1-K,\ (1+c)/2\}$ in Proposition 10 delineates when direct market entry is equivalent to no intervention. Since $\max\{1-K,\ (1+c)/2\}$ is the firm's optimal price in Scenario N, the government store does not play any role if it charges a higher price. The proposition further reveals that without goodwill effects, direct market entry emerges as the government's preferred instrument at intermediate values of γ. Direct market entry reduces the firm's profit (and hence the government's tax revenue) through its price-disciplining role, while benefiting consumers through expanded access and lower prices. When γ is small, the government weighs tax revenue heavily; since the consumer surplus gain cannot compensate for the tax revenue loss under direct market entry or the tax incentive policy, the government is better off with no intervention. As γ increases, consumer surplus gains more weight; no intervention becomes suboptimal despite incurring no fiscal cost, and the government chooses between tax incentives and direct market entry. Since direct market entry involves no fiscal expenditure and thus preserves tax revenue, it becomes the more attractive option. That is, Scenario E dominates for intermediate values of γ, where the government values consumer surplus enough to accept some tax revenue loss, but not enough to justify the high fiscal cost of a tax incentive. When γ increases further, a tax incentive becomes more appealing: while entailing a tax revenue loss, it generates a larger consumer surplus gain by inducing the firm to donate, thereby directly serving consumers who would otherwise be driven out of the market.

We conduct a numerical study for the case of $\beta > 0$, the results of which are illustrated in Figure 5. It demonstrates the robustness of Proposition 10 (corresponding to $\beta = 0$), and further suggest that the presence of donation-induced goodwill expands the region in which the tax incentive is optimal. Intuitively, a positive β amplifies the consumer surplus gain arising from donations, making the firm more likely to donate. The tax incentive thus delivers a higher social welfare return per unit of forgone tax revenue, and remains preferable over a wider range of parameters.

6.3. Consumer heterogeneity

In this extension, we consider two consumer segments with different levels of donation acceptance. A proportion $\alpha \in [0,1]$ of consumers has a donation utility rate δ_H, and the other proportion $1-\alpha$ has a donation utility rate δ_L, where $\delta_H > \delta_L$.

First consider the special case of $\delta_L = 0$. In this case, the low-valuation segment derives no utility from donations and effectively withdraws from the donation channel. An alternative interpretation

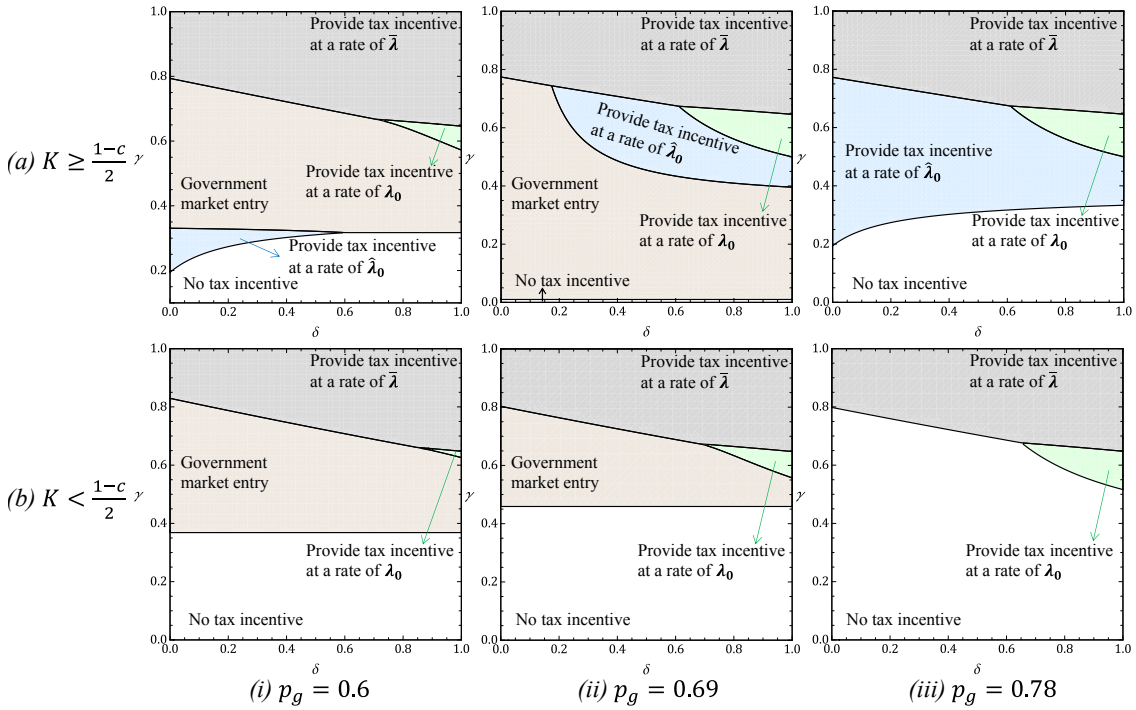
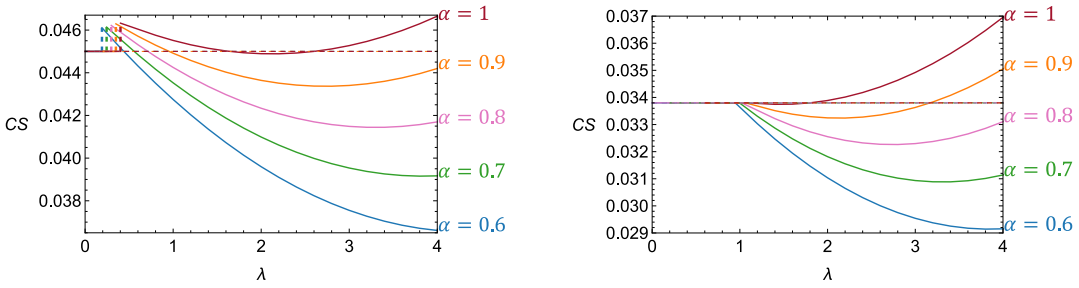


Figure 5 **Government's optimal choice under three scenarios ($r = 0.3$, $c = 0.4$, $\beta = 1.5$, $K = 0.32$ in Panel (a) and $K = 0.28$ in Panel (b))**

of this special case is that only a proportion α of consumers is eligible to access donations: in either interpretation, the market splits into a donation-accessing segment of size α and a donation-excluded segment of size $1-\alpha$, with the only difference being whether exclusion arises from self-selection ($\delta_L = 0$) or from an eligibility criterion. The introduction of donation-excluded consumers has two opposing effects: it raises the buying incentive of those without donation access but reduces the buying incentive of those with access. These two effects turn out to offset each other, and the firm's optimal price, acquisition quantity, and donation rate remain the same as those in the base model. Consumer surplus, however, splits into two components: the donation-accessing segment's surplus exhibits a U-shaped pattern in λ as in the base model, while the donation-excluded segment's surplus decreases with λ.

Next consider the case in which both segments derive positive donation utility rates. Given the firm's price p, the indifference points of the two segments, v_H^* and v_L^*, are determined by $v_H^* - p + \beta\tilde{\psi} = \tilde{R}(\tilde{\psi})\,\delta_H v_H^*$ and $v_L^* - p + \beta\tilde{\psi} = \tilde{R}(\tilde{\psi})\,\delta_L v_L^*$, where $\tilde{R}(\tilde{\psi}) = \tilde{\psi}/\tilde{D}_d$, $\tilde{\psi} = (Q - \tilde{D}_b)^+$, $\tilde{D}_d = \alpha v_H^* + (1-\alpha)v_L^*$, and $\tilde{D}_b = 1 - \alpha v_H^* - (1-\alpha)v_L^*$. Both segments face the same price p and the same donation fulfillment rate $\tilde{R}(\tilde{\psi})$, which simultaneously enter the indifference conditions and couple the values of v_H^* and v_L^*, leading to loss of tractability. We thus resort to numerical studies to demonstrate the robustness of our key findings. Figure 6 illustrates the impact of the tax

incentive rate on consumer surplus, mirroring the results in the base model. We observe two effects of α. First, a smaller α reduces total consumer surplus and enlarges the parameter region in which the policy leads to consumer surplus loss. When fewer consumers belong to the high-valuation segment, donation delivers lower consumer surplus, so total consumer surplus is uniformly lower. Second, a smaller α lowers the policy-effective threshold by reducing consumers' average donation utility rate, mirroring Proposition 2 where the threshold increases with δ in the base model.



(a) $K \geq (1-c)/2$ (b) $K < (1-c)/2$

Figure 6 **Impact of λ on consumer surplus in the model with heterogeneous consumers; solid lines: CS^T, dashed lines: CS^N ($r = 0.3$, $c = 0.4$, $\delta_H = 0.4$, $\delta_L = 0.1$, $\beta = 1.5$, $K = 0.305$ in (a) and $K = 0.26$ in (b))**

7. Conclusions and Future Research

Food insecurity remains a pressing global challenge and a key concern of the United Nations Sustainable Development Goals. In response, many governments have introduced tax incentives to encourage corporate in-kind food donations. This paper examines the interplay among donation tax incentives, firms' profit-driven donation decisions, and consumer behavior. Our analysis reveals how these incentives shape firms' operational and donation decisions, consumer welfare, and policy outcomes. The main findings and insights are summarized as follows.

First, our analysis identifies a critical threshold for the tax incentive rate, above which the firm is incentivized to donate; below this threshold, the policy fails to stimulate donation activity. This threshold is shaped by several factors, including the donation utility rate, the firm's capacity level, the unit acquisition cost, and the income tax rate. These findings provide useful insights for policymakers seeking to design effective donation tax incentives.

Second, our analysis of the firm's operational decisions reveals that tax incentive policies can lead to diverse pricing strategies, contingent upon the firm's acquisition capacity and the tax incentive rate. When capacity is high, the firm may lower its price under a tax incentive policy. Moreover, once the incentive rate exceeds the policy-effective threshold, both the price and donation fulfillment rate tend to rise with a higher incentive rate. In contrast, with tight capacity, the introduction of tax incentives consistently results in higher pricing.

Third, the relationship between consumer surplus and the tax incentive rate follows a U-shaped curve, indicating that a moderate incentive rate may paradoxically reduce total consumer surplus compared to the scenario without a tax policy. This arises from the policy's dual effect: it benefits the donation group but can harm the buying group due to price increases. Additionally, capacity plays an important role here. When capacity is limited, even a low incentive rate may reduce surplus by shifting supply toward donations at the expense of sales. These findings highlight the importance of considering unintended distributional effects when designing tax incentives.

We further study the government's policy design problem and demonstrate how the optimal tax incentive rate depends on market conditions and social welfare concern. Our findings reveal that tax incentives, although well-intended, can have adverse effects on consumers and firms. In balancing social welfare and tax revenue, the government may find it optimal to avoid such incentives.

Finally, we consider several extensions to assess the robustness and broader applicability of our insights. These include a competitive fringe setting to partially capture market competition, government direct market entry as an alternative policy instrument, and two consumer segments to reflect consumer heterogeneity in donation acceptance. We further examine price-based tax incentives (Appendix B), alternative consumer valuation distributions (Appendix C), donation seekers with a retail fallback option (Appendix D), and a two-period model with goodwill persistence (Appendix E). Collectively, these extensions demonstrate that our main insights continue to hold across alternative policy structures, consumer characteristics, and market settings.

Before concluding, we discuss potential areas for future research. First, while we have extended our base model to a competitive fringe setting, markets with more symmetric competition would entail a duopoly or oligopoly model (akin to Lowrey et al., 2023). Second, consumers are assumed to be rational under the RE equilibrium framework. In practice, however, consumers may exhibit some behavioral biases in the donation versus buying trade-off. Drawing on the revenue management literature (Özer and Zheng, 2016), one may extend our model to account for behavioral motives. Finally, empirical validation of our theoretical results would strengthen our understanding of economic and social implications of donation tax incentives.

Acknowledgments

The authors are grateful to the editors and reviewers for their helpful comments. Baozhuang Niu was supported by the National Natural Science Foundation of China (72125006, 72293564/72293560). Nan Zhang is the corresponding author.

References

Arya A, Mittendorf B (2015) Supply chain consequences of subsidies for corporate social responsibility. *Production and Operations Management* 24(8):1346–1357.

Banco De Alimentos (2023) Annual Report 2023. Available at `https://www.bancodealimentos.org.ar/reporte-2023/` (last accessed date: September 2, 2026).

Berenguer G, Feng Q, Shanthikumar JG, Xu L (2017) The effects of subsidies on increasing consumption through for-profit and not-for-profit newsvendors. *Production and Operations Management* 26(6):1191–1206.

Cachon GP, Swinney R (2009) Purchasing, pricing, and quick response in the presence of strategic consumers. *Management Science* 55(3):497–511.

Chernev A, Blair S (2015) Doing well by doing good: The benevolent halo of corporate social responsibility. *Journal of Consumer Research* 41(6):1412–1425.

Chu LY, Li G, Rusmevichientong P (2018) Optimal pricing and inventory planning with charitable donations. *Manufacturing & Service Operations Management* 20(4):687–703.

Daniels KM, Valdés L (2021) Trying and failing: Biases in donor aversion to rejection. *Production and Operations Management* 30(12):4356–4373.

De La Torre Pacheco S, Eftekhar M, Wu C (2023) Improving the quality of in-kind donations: A field experiment. *Manufacturing & Service Operations Management* 25(5):1677–1691.

Eisenhandler O, Tzur M (2019) The humanitarian pickup and distribution problem. *Operations Research* 67(1):10–32.

European Commission (2024) Financial rules on food donation. Available at `http://food.ec.europa.eu/system/files/2021-02/fw_factsheet_fd_financial-rules_en.pdf#:~:text=Tax%20deductions%20In%20Portugal%2C%20donors%20can%20deduct%20up,food%20will%20be%20used%20for%20a%20social%20purpose` (last accessed date: July 8, 2024).

Fan X, Chen YJ, Zhou J (2020) Social benefits of government investment in enterprises. *Naval Research Logistics* 67(2):108–125.

Feeding America (2024) Food insecurity among the overall population in the United States. Available at `http://map.feedingamerica.org/` (last accessed date: July 9, 2024).

Feeding America (2025) Annual Report 2025. Available at `https://www.feedingamerica.org/sites/default/files/2025-12/FA_25AnnReport_DIGITAL_final.pdf` (last accessed date: September 2, 2026).

Foodbank (2017) Submission in response to tax deductible gift recipient reform opportunities discussion paper. Available at `https://treasury.gov.au/sites/default/files/2019-03/Foodbank-Australia.pdf` (last accessed date: September 8, 2024).

Foodbank (2023a) Annual Report 2023-2024. Available at `https://www.foodbank.org.au/wp-content/uploads/Foodbank-SA-Annual-Report-2023-24.pdf` (last accessed date: September 2, 2026).

Foodbank (2023b) Foodbank hunger report 2023. Available at `http://reports.foodbank.org.au/wp-content/uploads/2023/10/2023_Foodbank_Hunger_Report_IPSOS-Report.pdf` (last accessed date: July 8, 2024).

Foodbank (2024a) Foodbank FAQs: What's the difference between 'Use By' and 'Best Before' and does Foodbank distribute food beyond these dates? Available at `https://www.foodbank.org.au/vic/faqs/` (last accessed date: August 10, 2024).

Foodbank (2024b) National food donation tax incentive. Available at `http://www.foodbank.org.au/wp-content/uploads/NFDTI-Briefing-Note.pdf` (last accessed date: July 8, 2024).

Gelinas N (2025) The grocery game isn't for government. *New York Times* - July 23:A23.

Hasnain T, Sengul Orgut I, Ivy JS (2021) Elicitation of preference among multiple criteria in food distribution by food banks. *Production and Operations Management* 30(12):4475–4500.

Lanum N (2024) More than a quarter of Americans admit to skipping meals due to skyrocketing grocery costs: Report. Available at `https://www.foxbusiness.com/media/quarter-americans-skipping-meals-skyrocketing-grocery-costs-report` (last accessed date: April 23, 2025).

Lee HL, Tang CS (2018) Socially and environmentally responsible value chain innovations: New operations management research opportunities. *Management Science* 64(3):983–996.

Legifrance (2024) General tax code. Available at `http://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000048806502` (last accessed date: October 23, 2024).

Lev B, Petrovits C, Radhakrishnan S (2010) Is doing good good for you? How corporate charitable contributions enhance revenue growth. *Strategic Management Journal* 31(2):182–200.

Lien RW, Iravani SMR, Smilowitz KR (2014) Sequential resource allocation for nonprofit operations. *Operations Research* 62(2):301–317.

Liu Q, van Ryzin GJ (2008) Strategic capacity rationing to induce early purchases. *Management Science* 54(6):1115–1131.

Lowrey JD (2024) Grocery stores that donate expiring food - instead of price discounting or discarding - make higher profits. Available at `https://theconversation.com/grocery-stores-that-donate-expiring-food-instead-of-price-discounting-or-discarding-make-higher-profits-234998` (last accessed date: April 30, 2026).

Lowrey JD, Richards TJ, Hamilton SF (2023) Food donations, retail operations, and retail pricing. *Manufacturing & Service Operations Management* 25(2):792–810.

Natural Resources Defense Council (2024) A farmer's guide to the enhanced federal tax deduction for food donation. Available at `http://www.nrdc.org/sites/default/files/farmers-federal-tax-deduction-food-donation.pdf` (last accessed date: July 8, 2024).

Orgut IS, Lodree EJ (2023) Equitable distribution of perishable items in a food bank supply chain. *Production and Operations Management* 32(10):3002–3021.

Özer O, Zheng Y (2016) Markdown or everyday low price? The role of behavioral motives. *Management Science* 62(2):326–346.

Partington R (2025) One in six UK workers skipping meals to make ends meet, says TUC. Available at `https://www.theguardian.com/business/2025/jan/12/one-in-six-uk-workers-skipping-meals-to-make-ends-meet-says-tuc` (last accessed date: April 23, 2025).

Plekenpol R, Leib EMB, Shapiro M, Nalbantoglu A (2021) Promoting food donation: Tax law and policy. Available at `https://www.foodbanking.org/resources/atlas-tax-law-issue-brief/` (last accessed date: April 27, 2026).

Prayogo E, Chater A, Chapman S, Barker M, Rahmawati N, Waterfall T, Grimble G (2018) Who uses foodbanks and why? Exploring the impact of financial strain and adverse life events on food insecurity. *Journal of Public Health* 40(4):676–683.

Raju J, Zhang ZJ (2005) Channel coordination in the presence of a dominant retailer. *Marketing Science* 24(2):254–262.

Second Harvest of the Greater Valley (2023) Who is eligible for food bank assistance. Available at `https://localfoodbank.org/who-is-eligible-for-food-bank-assistance/` (last accessed date: July 8, 2025).

Shunko M, Do HT, Tsay AA (2017) Supply chain strategies and international tax arbitrage. *Production and Operations Management* 26(2):231–251.

Stigler GJ (1940) Notes on the theory of duopoly. *Journal of Political Economy* 48(4):521–541.

Su X, Zhang F (2008) Strategic customer behavior, commitment, and supply chain performance. *Management Science* 54(10):1759–1773.

Sunar N, Swaminathan JM (2022) Socially relevant and inclusive operations management. *Production and Operations Management* 31(12):4379–4392.

Tan Y, Xiong Y, Gao H, Li X, Zhao H (2021) Less is more? The strategic role of retailer's capacity. *Production and Operations Management* 30(10):3354–3368.

Taylor TA, Xiao W (2014) Subsidizing the distribution channel: Donor funding to improve the availability of malaria drugs. *Management Science* 60(10):2461–2477.

Taylor TA, Xiao W (2019) Donor product-subsidies to increase consumption: Implications of consumer awareness and profit-maximizing intermediaries. *Production and Operations Management* 28(7):1757–

1772.

The Washington Post Editorial Board (2026) Mamdani forges ahead with government-run grocery stores. Available at `https://www.washingtonpost.com/opinions/2026/02/26/mamdani-grocery-stores-new-york/` (last accessed date: September 8, 2026).

Yu JJ, Tang CS, Shen ZJM (2018) Improving consumer welfare and manufacturer profit via government subsidy programs: Subsidizing consumers or manufacturers? *Manufacturing & Service Operations Management* 20(4):752–766.

Zou F, Sharma L, Pekgün P, Ahire SL (2025) Reducing food waste in U.S. food banks: The role of distribution strategies. *Production and Operations Management* 34(11):3667–3685.