Ann Oper Res
DOI 10.1007/s10479-011-0967-3

Publicity vs. impact in nonprofit disclosures and donor preferences: a sequential game with one nonprofit organization and *N* donors

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Abstract Charitable giving is one of the essential tasks of a properly functioning civil society. This task is greatly complicated by the lack of organizational transparency and by the information asymmetries that often exist between organizations and donors in the market for charitable donations. The disclosure of financial, performance, donor-relations, and fundraising-related data is thus an important tool for nonprofit organizations attempting to attract greater donations while boosting accountability and public trust. There are, however, varying payoffs associated with such disclosure depending on the nature of donor preferences and the relative openness and effectiveness of competing organizations. To help understand the interplay between nonprofit organizational disclosures and individual donations, we present a novel game-theoretic model of disclosure–donation interactions that incorporates the predominant forms of both donor preferences and "value-relevant" information.

Keywords Voluntary disclosure · Nonprofit organizations · Donations · Charitable giving · Game theory · Organizational communication · Strategic communication

This research was partially supported by the United States Department of Homeland Security through the National Center for Risk and Economic Analysis of Terrorism Events (CREATE) under award number 2010-ST-061-RE0001. However, any opinions, findings, and conclusions or recommendations in this document are those of the authors and do not necessarily reflect views of the United States Department of Homeland Security, or CREATE.

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Published online: 21 September 2011

1 Introduction

The nonprofit sector plays a crucial role in maintaining a healthy civil society; citizens everyday rely on it to help deliver programs and services in the arts, education, health care, the environment, sports, professional associations, humanitarian services, and countless other areas. The sector in turn relies heavily on charitable contributions from corporations and private individuals. In the United States alone, such contributions are delivered at the rate of $300 billion annually.

There is effectively a "market" for charitable contributions, and one of the critical market decisions nonprofit managers face is how open they should be with the general public regarding their relationships with donors, the nature of their fundraising and donation activities, their internal organizational actions, and their financial, strategic, and social performance. Judicious disclosure of such data can be a powerful tool for nonprofit organizations hoping to achieve market differentiation, attract greater donations, and boost accountability and public trust. In effect, voluntary organizational disclosure can play a powerful role in reducing information asymmetries, maintaining market efficiency, and delivering better social outcomes. Yet the disclosure decision is not without risk; the payoffs associated with disclosure ultimately vary with donor preferences.

Our understanding of disclosure–donor interactions is not deep. Prior game-theoretic studies have focused on the disclosure of details related to fundraising campaigns and emphasized donors with "publicity-maximizing" utility functions, while empirical studies have focused on the effects of financial efficiency ratios on individual and aggregate levels of donations. Previous studies have not modeled the interactions between levels of performance-related organizational disclosures and charitable contributions by donors with "impact-maximizing" utility functions. Overall, we do not have a good sense of the outcomes generated by donor-organization interactions covering a realistic range of donor preferences and types of information disclosed. We aim to help deepen our understanding by presenting a scalable 1 organization, N-donor[1] game of disclosure–donation interactions that incorporates all primary forms of donor preferences that are amenable to influence by organizational actions.

2 Information in the market for charitable contributions

Before discussing the relevant literature on organizational disclosure upon which we build our model, we first present some critical details about the nature of the donations market. Charitable contributions to the 1.6 million nonprofit organizations[2] in the United States are considerable: In 2006, total private giving reached $295 billion (Blackwood et al. 2008). Donations form a critical part of the nonprofit revenue stream, and the competition can be intense.

[1] In this paper we focus on individual donors rather than organizational donors such as foundations, governments, and business.

[2] Though a variety of different terms are used—nonprofit, non-governmental, philanthropic, tax-exempt, or social sector organizations—all US nonprofit organizations have three things in common: (1) they are voluntary and self-governing; (2) they may not distribute profits; and (3) they serve the public as well as the common goals of their members. Nonprofit organizations in the United States are defined and regulated primarily under the federal tax code. The three predominant types of tax-exempt organizations under the code are 501 (c)(3), or "charitable" organizations; 501(c)(4), or "social welfare" organizations; and religious congregations.

In many ways, this market is analogous to the capital markets, with firms competing to raise funds by securing "investors"—in the form of donors willing to help an organization fulfill its social mission. Since the 1990s, this marketization of the donations market has intensified, as donors and grantmakers alike have placed less emphasis on "good intentions" and more on accountability, results, and return on investment (among others, Behn 2005; Saxton and Guo 2011).

Coinciding with this "performance" revolution in the nonprofit marketplace has been a series of major transformations rising from the diffusion of "new media" Web platforms, such as websites, wikis, blogs, and social networking sites. Not only does the Web now play an essential role in organizations' fundraising campaigns, volunteer recruitment drives, and stakeholder relations efforts, it has become a key informational channel, with firm-relevant information diffusing rapidly through the burgeoning online networks of donors, academics, analysts, journalists, information intermediaries, and other interested parties. The Web now represents a critical component of the nonprofit *information environment* (Saxton et al. 2009), where the great majority of potential donors are now easily able to search online for information that the organization is a responsible and well governed entity.

These trends have resulted in heightened demand for information from market participants. The direct provision of information—that is, voluntary disclosure—has hence taken on greater primacy. Not only does such disclosure help organizations connect with donors who share their preferences but, in the aggregate, voluntary disclosure, as in the capital markets (e.g., Healy and Palepu 2001), plays a key role in maintaining market efficiency and reducing information asymmetries—which are considerable inasmuch as donors are generally not direct consumers of an organization's products or services and are therefore unable to directly evaluate the quality of its output. Through the voluntary disclosure of pertinent financial and performance-related information, organizations are thus able to publicize donations and signal their effectiveness to current and potential donors. Employing an analogue from the capital-markets literature, we conceptualize all forms of disclosure that are useful to donors in their decision-making as "value-relevant" disclosure, in the sense that it helps the donor community in assessing the organization's value and thus assists "... in the efficient allocation of donor capital to charitable organizations" (Parsons 2003, p. 109).[3] And our concern in this paper is on the interplay between value-relevant disclosure and charitable donations.

2.1 Example: aftermath of Haitian earthquake

We can best elucidate the relevant characteristics of the market for charitable contributions by way of example. Consider the humanitarian response to the January 12th, 2010 earthquake in Haiti. Reflecting the market transformations noted above, the Web served as a powerful donations tool and vehicle for rapid information aggregation and dissemination.[4] The overall scale of donations from online and offline sources combined was massive: within the first month, the American Red Cross alone had received $255 million to support their

[3] For more on the notion of value relevance in the nonprofit context, see Saxton et al. (2009); for an overview of value relevance in the capital-markets literature, see, among others, Barth et al. (2001).

[4] Over the first 10 days, 42% of those who gave did so through new media—23% via the Web, 5% via email, and 14% via SMS/text messaging (Pew Research Center 2010). The response to the earthquake saw a large, decentralized online network of individuals and organizations both inside and outside Haiti reporting news, spreading information, issuing pleas for help, searching for lost family members, and rallying organizational networks.

relief efforts (American Red Cross 2010), and close to $2 billion worldwide (ReliefWeb 2010) had been pledged in total support to a large, diverse collection of charities and NGOs. Given the enormity—and the importance—of the rebuilding task, it would be to the benefit of society that donors get what they think they are "paying" for, and that the programs and services delivered as a result of these donations render the greatest net societal impact on Haiti.

2.1.1 The donor's dilemma

The typical donor in this example begins with the general goal of making a donation to support the earthquake relief efforts. There are multiple organizations soliciting donations to provide humanitarian relief services—including the Red Cross, Food for the Poor, Mercy Corps, CARE, UNESCO, WHO, Americares, Share Our Strength, Oxfam, Project HOPE, Samaritan's Purse, Yéle Haiti Foundation, and numerous others—so the dilemma for the prospective donor is, "How can I decide where to send my money?" The typical donor has a clear aim to maximize the humanitarian impact from her donation, and most donors would also welcome some recognition or publicity from the organization recognizing the donor for her support (e.g., Sargeant 2001). The problem is, given the considerable asymmetry of information between the nonprofits and the donor regarding the relative effectiveness of each organization, how can the donor choose?

2.1.2 The nonprofit's dilemma

On the organization's part, one of the most notable ways an organization can differentiate itself in the market for charitable contributions is via *disclosure*. A key executive decision is how much information to make available to the general public regarding the organization's relationships with donors, the nature of its fundraising and donation activities, its internal organizational actions, and its financial, strategic, and social performance. Through disclosure the organization aims to acquire market share and maximize net levels of charitable contributions (Weisbrod and Dominguez 1986). There is a risk, however. Too much disclosure can lead to "information overload" and potentially alienate internal and external stakeholders as well as prospective donors. Poorly managed organizations, moreover, will fare badly by disclosing information, and all types of organizations could inadvertently provide information that proves valuable to competitors (Healy and Palepu 2001). Consequently, the nonprofit executive must tread waters carefully in deciding the optimal level of openness.

3 Disclosure in the literature

Our solution aims to help resolve these two dilemmas by laying out optimal levels of donations and disclosure based on the organization's level of effectiveness and the donor's preferences for social impact and personal publicity. Before presenting our model, we first lay out how our model builds on existing research. There are three streams of literature that are relevant to an examination of disclosure by non-profit organizations. First, there are studies involving formal models of the effects of disclosure in other sectors, such as in government, health care, and the financial markets. Second, there are the economics-based studies that focus on formal modeling of disclosure in fundraising campaigns. And third, there is the empirical literature from accounting and nonprofit studies on the nature of disclosure in the market for charitable contributions. We discuss these three streams of research in order.

3.1 General studies of organizational disclosure

Disclosure has become an important topic of research across disciplines. In many of the social science fields, disclosure is studied in an empirical, non-formal way. Especially relevant in this genre is disclosure research from, *inter alia*, communication and psychology, where concepts such as "impression management" have been used to examine the uses of organizational and interpersonal disclosure (see, for instance, Hancock and Toma 2009). In contrast, in operations research, economics, and related disciplines, formal game-theoretic models of disclosure have been studied in a variety of contexts. A strong example is a recent paper by Malani and Laxminarayan (2009), in which the authors present a reporting game involving infectious disease outbreaks. Another is the recent line of research on disclosure within the context of national security policies (e.g., Dighe et al. 2009; Zhuang and Bier 2007, 2011; Zhuang et al. 2010).

3.2 Studies on disclosure in nonprofit organizations

In order to discuss disclosure in the context of nonprofit organizations, it is important to understand the roles that disclosure plays as well as the types of disclosure that are typically employed. Generally speaking, disclosure is seen as a vital, multi-faceted component of nonprofit operations that fills several key roles for nonprofit organizations. To start, disclosure has been increasingly identified as an important aspect of nonprofit governance and accountability (e.g., Brody 2002; Melendez 2001; Saxton and Guo 2011). It also fills a financial reporting function. Our concern here, though, is on value-relevant disclosure—disclosure that is useful to donors and that thus has a practical effect in helping organizations solicit contributions from the public.

3.2.1 Fundraising-specific disclosure and the publicity-maximizing donor

The literature has identified two key areas of value-relevant disclosure. First, there is "fundraising" disclosure, which refers to the disclosure of information that is specific to fundraising campaigns, such as the total number of potential contributors, the names of donors who have contributed, and the amounts given. This has been the primary concern of the economics-related public goods literature, and involves studying donors' whose utility derives chiefly from publicity and social pressures and praise flowing from fundraising-related publicity.

In fact, by far the largest group of game-theoretic studies on nonprofit organizations are those that sprang out of an article written by Bergstrom et al. (1986) on the private provision of public goods. This article been highly influential, spawning dozens of articles building on their model. These papers generally employ a model with a single organization and one or more donors. The first wave of studies assumed a simultaneous-move game, with more recent studies (e.g., Romano and Yildirim 2001) looking at organizations' attempts to create sequential-move play through different forms of fundraising-related announcements.[5]

[5] For instance, in an experimental setting, Clark (2002) has looked at the effects of recognizing especially generous contributions on donations in subsequent rounds of the experiment.

3.2.2 Performance-related disclosure and the impact-maximizing donor

It is important to note that all of the studies in the above literature have only examined the effects of fundraising-related disclosures—that is, disclosures related to the progress of a fundraising campaign. Moreover, this economics literature has been dominated by assumptions of certain types of donors—those seeking publicity, the "warm glow" from donating, "snob appeal," and social norms—while the empirical and conceptual literature from the fields of accounting, nonprofit studies, social work, and public administration, among others, has overwhelmingly favored a different idea, namely, that donors wish to maximize the *impact* of their donation, which they achieve by donating to more effective and efficient organizations.

Such donors might be affected by disclosures about prior donations; for instance, a donor might compare organization A to organization B, and see higher levels of donations to organization A as an indirect indicator of organizational quality. Similarly, if organization A discloses past levels of donations while organization B does not, this might serve as a signal that A has nothing to hide or, alternatively, that B does not want something made public.

At the same time, and in line with the empirical literature, the "impact-maximizing donor" would prefer to see information related to the *effectiveness* of the organization—that is, on how well the organization is fulfilling its stated social mission—and not just information on who has already donated to the organization and how much.[6] Nonprofits' performance is evaluated in terms of the mission-related targets and *goals* the organization sets and the *results* it achieves in trying to reach those goals; performance-related disclosure hence generally comprises information on, first, what the organization is trying to achieve—such as its mission statement, history, vision, plans, values, and goals—and, second, on what it has achieved in terms of outputs, outcomes, and broader community impacts (see Brinkerhoff 2001; Saxton et al. 2009).

However, performance in both the governmental and nonprofit sectors is notoriously difficult to demonstrate. It is even more difficult to develop performance measures that are comparable across organizations. For this very reason, efficiency ratios are often taken as imperfect proxies for effectiveness that are, nonetheless, widely reported. For example, a donor can readily compare organization A to organization B in terms of the ubiquitous "program spending ratio," the proportion of spending that goes to programs rather than administration or fundraising. If organization A's expenses are only 70% devoted to programs while organization B's are 90%, it is easy to conclude to organization B is more efficient.[7]

Bringing evidence to bear on this issue is a significant existing body of empirical research on the determinants of charitable giving in nonprofit organizations, split between those published in accounting journals and those in nonprofit, public administration, and political science journals. Accounting scholars in particular have paid significant attention to the value relevance of specific forms of *financial* disclosure (see Parsons 2003, for a strong overview; see also, *inter alia*, Buchheit and Parsons 2006; Greenlee and Brown 1999; Jacobs and Marudas 2009; Khumawala et al. 2009; Tinkelman 1999; Yetman and Yetman 2003). This literature has found support for the idea that donors are

[6]It is worth noting that, unlike in for-profit organizations, where the ultimate strategic goal is to acquire profits and market share while enhancing shareholder wealth (see, for example, Porter 1980; Jensen 1998), in nonprofit organizations financial outcomes are merely a means to an end. The ultimate strategic goal is fulfillment of a *social mission*—to the creation of public value (see Moore 2000 for an excellent overview; see also Bryce 1992; Bryson 1995).

[7]Accordingly, it is this ratio that is often highlighted on third-party charity evaluation sites such as Charity-Navigator.

influenced by measures of financial efficiency, with the few studies that have studied the effects of performance measures finding mixed evidence (Parsons 2007; Reck 2001; Saxton et al. 2009). Except for Reinhardt (2009), this literature has not utilized formal game-theoretic models, nor has it looked at the effects of "fundraising" disclosures. Instead, it has been limited to empirical examinations of the voluntary disclosure of broad measures of organizational efficiency and effectiveness.

3.3 Summary: empirical findings and theoretical expectations

This paper is concerned with "value relevant" disclosure—disclosure that is useful to donors in the charitable contributions marketplace. As detailed above, prior research has examined two main forms of value-relevant disclosure: fundraising disclosure and performance-related disclosure. Fundraising disclosure has been studied via formal modeling approaches by economists interested in how donors are influenced (in the timing and amount of giving) by information related to the progress of the fundraising campaign; these studies have all generally assumed donors' utility derives from maximizing levels of personal publicity. Performance disclosure, in turn, has been studied using empirical methods in cross-disciplinary research in accounting, nonprofit studies, and public administration; this research has found that the disclosure of measures of organizational effectiveness, and especially efficiency ratios, have a positive association with donations. The clear implication of these studies is that the majority of donors have a utility function that is distinct from that supposed in the public goods literature—they derive utility from seeing their donation having a positive impact on society. However, formal models have yet to be employed to study the effects of performance-related disclosure, nor have formal models incorporated donors with "impact maximizing" utility functions. As a result, we do not have a solid understanding of the realistic interplay between organizational disclosures and donor decision-making.

4 The model

To help build a foundation for our theoretical arguments, in the present paper we focus our analysis on the case of one organization and N donors. In explaining the implications of the model, let us assume a single-service nonprofit organization that is dependent on donors' charitable contributions for a large portion of its revenues. The chief executive of the organization must decide whether to voluntarily disclose key pieces of value-relevant information. The organization wishes to maximize net levels of charitable contributions, and there are several types of information that could positively or negatively impact donations if they were to be disclosed.

We define the parameters of our model as follows:

- N: Number of donors in the game.
- $x_i \geq 0, i = 1, \dots, N$: Amount of charitable contributions made by donor i.
- $y \in [0, 1]$: Amount of value-relevant disclosure made by the organization.
- $\hat{x}_i(y) \equiv \arg\max_{x_i} U_{D_i}(x_i, y)$: Donor i's best response function.
- $\lambda \in [0, 1]$: Organization's level of effectiveness.
- $\theta \geq 0$: Organization's disclosure cost coefficient.
- $\gamma_i \geq 0, i = 1, \dots, N$: Donor i's preference for donating to an effective organization.
- $\alpha_i \in [-1, 1], i = 1, \dots, N$: Donor i's preference for personal publicity.
- $\beta_i \geq 0, i = 1, \dots, N$: Donor i's preference for retaining money.

Our model is set up based on the following assumptions:

- Players: There are two key players, one nonprofit organization and N donors.
- Options/Moves: The nonprofit organization decides whether to disclose or to not disclose, and the donors decide whether to provide funding to the organization.
- Sequence of Moves: The nonprofit organization makes the first move, followed by the donors' simultaneous decisions to provide the level of funding.
- Objectives/Payoffs: The nonprofit organization wishes to maximize net levels of charitable contributions, i.e., the amount of funding ($) it receives from the donors subtracting fundraising and disclosure costs; the donors, in turn, wish to maximize the societal impact as well as the amount of personal publicity they receive from making the donation, which should be greater than the loss accrued from making the donation;
- Information: We assume complete information in the game;
- Time: We assume a one-shot game; the ending point occurs with the donors simultaneously deciding either to fund or not to fund the organization.

The nonprofit organization moves first. The utility to the organization is a function of donations received (x_i's) from donors and the level of disclosure (y). In particular, we consider a quadratic form of fundraising costs y^2 (such that the marginal cost increases in the level of y to approximate budget constraints), weighted by the cost coefficient θ. Thus, the utility to the organization is given by:

$$U_N(x_1, \ldots, x_N, y) = \sum_i^N x_i - \theta y^2 \tag{1}$$

Next, the donors' utilities are functions of their donations to the nonprofit organization, the level of organizational disclosure, and their dis-utilities from giving away money. In the equation we also model the level of effectiveness of the organization, represented by λ. Here we posit λ as some ideal, valid measure of nonprofit effectiveness (i.e., it is not limited to the well known but indirect measure of effectiveness, the program-expense ratio). Here we account for the extent to which the donor is an "impact maximizer" by incorporating γ_i into donor i's utility function. We also assume a quadratic donation cost for the donors.

Second mover (donor i for $i = 1, \ldots, N$) donates $x_i \geq 0$, and the utility to the donor i is given by:

$$U_{D_i}(x_i, y) = \underbrace{\gamma_i \lambda x_i}_{\text{effectiveness}} + \underbrace{\alpha_i x_i y}_{\text{publicity}} - \underbrace{\beta_i x_i^2}_{\text{cost}} \tag{2}$$

As highlighted in the donors' utility functions (2), organizational effectiveness, personal publicity, and personal cost are the three components determining the donors' preferences.

Using the donors' best response functions $\hat{x}_i(y)$, our equilibrium solution is defined in Definition 1 below:

Definition 1 We call a vector $(x_1^*, \ldots, x_N^*, y^*)$ a *subgame perfect Nash equilibrium* (*SPNE*) for our model if and only if:

$$x_i^* = \hat{x}_i(y^*) = \arg\max_{x_i} U_{D_i}(x_i, y) \tag{3}$$

and

$$y^* = \arg\max_{y} U_N(\hat{x}_1(y), \ldots, \hat{x}_N(y), y) \tag{4}$$

5 Analytical solution and sensitivity analyses

5.1 Donors' best response function

By solving for donor i's optimization problem (3) and based on the objective function (2), Theorem 1 provides the best response function for donor i.

Theorem 1 *The best response function for the donor* $i = 1, \dots, N$ *is given by*

$$\hat{x}_i(y) = \begin{cases} \frac{\gamma_i \lambda + \alpha_i y}{2\beta_i} & \text{if } \alpha_i y \geq -\gamma_i \lambda \\ 0 & \text{if } \alpha_i y \leq -\gamma_i \lambda \end{cases} \tag{5}$$

Proof See Appendix A.1. □

5.2 Organizations' equilibrium strategy when $N = 2$

For simplicity, we only provide the analytical solution for the organization's equilibrium strategy for $N = 2$. In particular, we insert the two donors' best response functions (5) into the organization's optimization problem (4) based on its utility function (1), and solve for the optimal disclosure level y^*:

$$\max_{y \geq 0} = \begin{cases} \frac{\gamma_1 \lambda + \alpha_1 y}{2\beta_1} + \frac{\gamma_2 \lambda + \alpha_2 y}{2\beta_2} - \theta y^2 & \text{if } \alpha_1 y \geq -\gamma_1 \lambda \text{ and } \alpha_2 y \geq -\gamma_2 \lambda \\ \frac{\gamma_1 \lambda + \alpha_1 y}{2\beta_1} + 0 - \theta y^2 & \text{if } \alpha_1 y \geq -\gamma_1 \lambda \text{ and } \alpha_2 y \leq -\gamma_2 \lambda \\ 0 + \frac{\gamma_2 \lambda + \alpha_2 y}{2\beta_2} - \theta y^2 & \text{if } \alpha_1 y \leq -\gamma_1 \lambda \text{ and } \alpha_2 y > -\gamma_2 \lambda \\ 0 + 0 - \theta y^2 & \text{if } -\alpha_1 y \leq \gamma_1 \lambda \text{ and } \alpha_2 y \leq -\gamma_2 \lambda \end{cases} \tag{6}$$

The solution for y^*, together with the two donors' best responses $\hat{x}_1(y^*)$ and $\hat{x}_2(y^*)$, are specified in Theorem 2 below:

Theorem 2 *For* $N = 2$, *for any fixed collection of parameter values* $(\lambda, \theta, \gamma_1, \gamma_2, \alpha_1, \alpha_2, \beta_1, \beta_2)$, *there exists a unique equilibrium* (x_1^*, x_2^*, y^*), *as shown in Table 1, and the optimal conditions for each case are provided in Table 2.*

Proof See Appendix A.2. □

Remark In principle, based on positive or zero values of the three decision variables x_1^*, x_2^* and y^*, there could be eight possible optimal solutions. However, we only see seven of them at equilibrium. For the case $x_1^* = x_2^* = 0$, $y^* > 0$, since the organization will not disclose when expecting neither of the two donors to donate, it is not at equilibrium.

5.3 Sensitivity analyses for the equilibrium solutions

Figures 1 and 2 provide one-way and two-way sensitivity analyses, respectively, for the model at the baseline values $\lambda = \theta = 0.3$, $\gamma_1 = \gamma_2 = 0.4$, $\alpha_1 = \alpha_2 = -0.1$, $\beta_1 = \beta_2 = 0.5$. At the baseline values, we have case B, where $x_1^* = x_2^* = 1.2$ and $y^* = 0$.

The baseline solution is illustrated by a solid vertical line in Fig. 1 and a star in Fig. 2.

Table 1 Equilibrium solutions

Case	x_1^*	x_2^*	y^*	U_{D1}^*	U_{D2}^*	U_N^*
A	$\frac{4\gamma_1\lambda\beta_1\theta\beta_2+\alpha_1\alpha_2\beta_1+\beta_2\alpha_1^2}{8\beta_1^2\theta\beta_2}$	$\frac{4\gamma_2\lambda\beta_1\theta\beta_2+\alpha_1\alpha_2\beta_2+\beta_1\alpha_2^2}{8\beta_1\theta\beta_2^2}$	$\frac{\alpha_1\beta_2+\alpha_2\beta_1}{4\beta_1\theta\beta_2}$	$\frac{(4\gamma_1\lambda\beta_1\theta\beta_2+\alpha_1\alpha_2\beta_1+\beta_2\alpha_1^2)^2}{64\beta_1^3\theta^2\beta_2^2}$	$\frac{(4\gamma_2\lambda\beta_2\theta\beta_1+\alpha_1\alpha_2\beta_2+\beta_1\alpha_2^2)^2}{64\beta_2^3\theta^2\beta_1^2}$	$\frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta}+\frac{\gamma_1\lambda}{2\beta_1}+\frac{\gamma_2\lambda}{2\beta_2}$
B	$\frac{\gamma_1\lambda}{2\beta_1}$	$\frac{\gamma_2\lambda}{2\beta_2}$	0	$\frac{\gamma_1^2\lambda^2}{4\beta_1}$	$\frac{\gamma_2^2\lambda^2}{4\beta_2}$	$\frac{\gamma_1\lambda}{2\beta_1}+\frac{\gamma_2\lambda}{2\beta_2}$
C	$\frac{4\theta\beta_1\gamma_1\lambda+\alpha_1^2}{8\theta\beta_1^2}$	0	$\frac{\alpha_1}{4\theta\beta_1}$	$\frac{(4\gamma_1\lambda\beta_1\theta+\alpha_1^2)^2}{64\theta^2\beta_1^3}$	0	$\frac{\alpha_1^2}{16\theta\beta_1^2}+\frac{\gamma_1\lambda}{2\beta_1}$
D	$\frac{\gamma_1\lambda}{2\beta_1}$	0	0	$\frac{\gamma_1^2\lambda^2}{4\beta_1}$	0	$\frac{\gamma_1\lambda}{2\beta_1}$
E	0	$\frac{4\theta\beta_2\gamma_2\lambda+\alpha_2^2}{8\theta\beta_2^2}$	$\frac{\alpha_2}{4\theta\beta_2}$	0	$\frac{(4\gamma_2\lambda\beta_2\theta+\alpha_2^2)^2}{64\theta^2\beta_2^3}$	$\frac{\alpha_2^2}{16\theta\beta_2^2}+\frac{\gamma_2\lambda}{2\beta_2}$
F	0	$\frac{\gamma_2\lambda}{2\beta_2}$	0	0	$\frac{\gamma_2^2\lambda^2}{4\beta_2}$	$\frac{\gamma_2\lambda}{2\beta_2}$
G	0	0	0	0	0	0

Table 2 Conditions for the equilibria

Case	Feasible range F_I	Optimal range O_I
A	$\{\alpha_1\beta_2+\alpha_2\beta_1>0,\ 4\gamma_1\lambda\beta_1\theta\beta_2+\alpha_1\alpha_2\beta_1+\beta_2\alpha_1^2>0,$ $4\gamma_2\lambda\beta_1\theta\beta_2+\alpha_1\alpha_2\beta_2+\beta_1\alpha_2^2>0\}$	$F_A\cap\{\{F_C\cap(\alpha_1\beta_2+\alpha_2\beta_1)^2\beta_1+8\lambda\theta\gamma_2\beta_1^2\geqslant\alpha_1^2\beta_2\}\cup\overline{F_C}\}\cap$ $\{\{F_E\cap(\alpha_1\beta_2+\alpha_2\beta_1)^2\beta_2+8\lambda\theta\gamma_1\beta_2^2\geqslant\alpha_2^2\beta_1\}\cup\overline{F_E}\}$
B	$\{\alpha_1\beta_2+\alpha_2\beta_1\le 0,\ \gamma_1>0,\ \gamma_2>0,\ \lambda>0\}$	$F_B\cap\{\{F_C\cap 8\lambda\theta\gamma_2\beta_1^2\ge\alpha_1^2\beta_2\}\cup\overline{F_C}\}\cap\{\{F_E\cap 8\lambda\theta\gamma_1\beta_2^2\geqslant\alpha_2^2\beta_1\}\cup\overline{F_E}\}$
C	$\{\alpha_1>0,\ \alpha_1\alpha_2\le-4\theta\lambda\gamma_2\beta_1\}$	$F_C\cap\{\{F_A\cap\alpha_1^2\beta_2\geqslant(\alpha_1\beta_2+\alpha_2\beta_1)^2\beta_1+8\lambda\theta\gamma_2\beta_1^2\}\cup\overline{F_A}\}\cap$ $\{\{F_B\cap\beta_2\alpha_1^2\geqslant 8\theta\lambda\gamma_2\beta_1^2\}\cup\overline{F_B}\}\cap\{\{F_E\cap\alpha_1^2\beta_2^2-\alpha_2^2\beta_1^2\ge 8\theta\lambda\beta_1\beta_2(\gamma_2\beta_1-\gamma_1\beta_2)\}\cup\overline{F_E}\}\cap$ $\{F_F\cap\beta_1\beta_2\alpha_1^2\geqslant 8\theta\lambda\beta_1^2(\gamma_2\beta_1-\gamma_1\beta_2)\}$
D	$\{\alpha_1\le 0,\ \gamma_1>0,\ \gamma_2=0,\ \lambda>0\}$	$F_D\cap\overline{F_A}\cap\{\{F_E\cap 8\theta\lambda\beta_2(\gamma_1\beta_2-\gamma_2\beta_1)\geqslant\alpha_2^2\beta_1\}\cup\overline{F_E}\}$
E	$\{\alpha_2>0,\ \alpha_1\alpha_2\le-4\theta\lambda\gamma_1\beta_2\}$	$F_E\cap\{\{F_A\cap\alpha_2^2\beta_1\geqslant(\alpha_1\beta_2+\alpha_2\beta_1)^2\beta_2+8\lambda\theta\gamma_1\beta_2^2\}\cup\overline{F_A}\}\cap$ $\{\{F_B\cap\beta_1\alpha_2^2\geqslant 8\theta\lambda\gamma_1\beta_2^2\}\cup\overline{F_B}\}\cap\{\{F_C\cap\alpha_2^2\beta_1^2-\alpha_1^2\beta_2^2\ge 8\theta\lambda\beta_1\beta_2(\gamma_1\beta_2-\gamma_2\beta_1)\}\cup\overline{F_C}\}\cap$ $\{F_D\cap\beta_1\beta_2\alpha_2^2\geqslant 8\theta\lambda\beta_2^2(\gamma_1\beta_2-\gamma_2\beta_1)\}$
F	$\{\alpha_2\le 0,\ \gamma_1=0,\ \gamma_2>0,\ \lambda>0\}$	$F_F\cap\overline{F_A}\cap\{\{F_C\cap 8\theta\lambda\beta_1(\gamma_2\beta_1-\gamma_1\beta_2)\geqslant\alpha_1^2\beta_2\}\cup\overline{F_C}\}$
G	$\{\gamma_1=0,\ \gamma_2=0,\ \text{or}\ \lambda=0\}$	$F_G\cap\overline{F_A}\cap\overline{F_C}\cap\overline{F_E}$

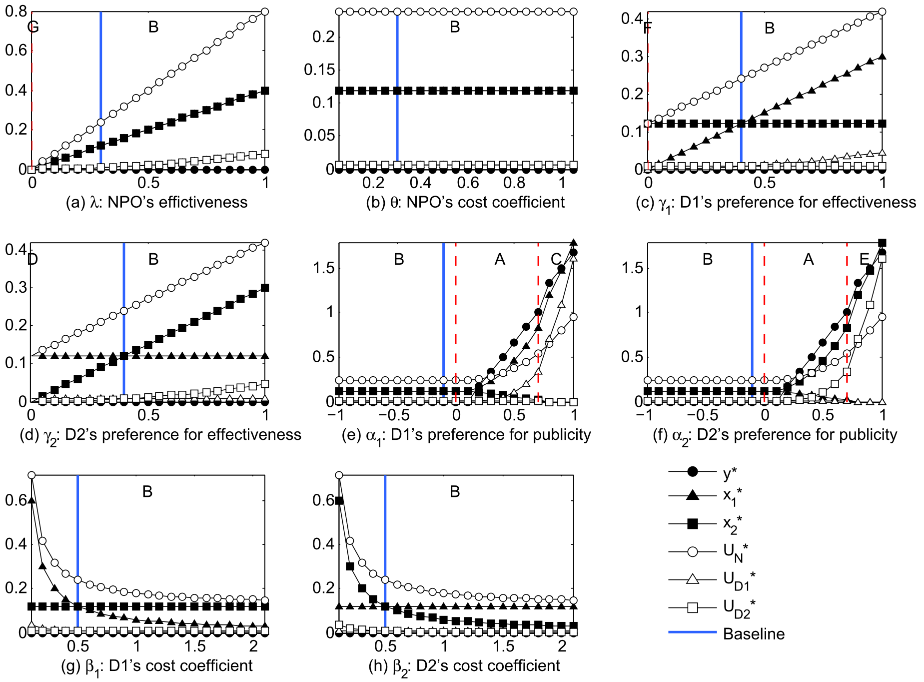

Fig. 1 Equilibrium behaviors as one-way functions of λ, θ, γ_1, γ_2, α_1, α_2, β_1, and β_2, with baseline values $\lambda = \theta = 0.3$, $\gamma_1 = \gamma_2 = 0.4$, $\alpha_1 = \alpha_2 = -0.1$, $\beta_1 = \beta_2 = 0.5$

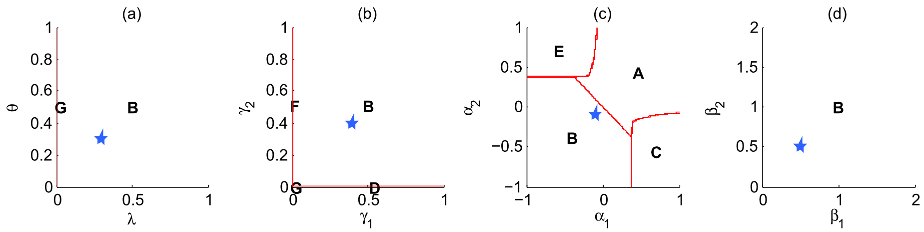

Fig. 2 Equilibrium behaviors as two-way functions of λ, θ, γ_1, γ_2, α_1, α_2, β_1, and β_2, with baseline values $\lambda = \theta = 0.3$, $\gamma_1 = \gamma_2 = 0.4$, $\alpha_1 = \alpha_2 = -0.1$, $\beta_1 = \beta_2 = 0.5$

Figures 1(a) and 2(a) show that when the organization's effectiveness coefficient λ is zero, we have case G where all players are inactive. When λ increases, both donors increase their donation, which increases the payoffs of all players. Figures 1(c–d) and 1(b) show that when both donors' preference for effectiveness, γ_1 and γ_2, are zero, we have case G where all players are inactive. When ($\gamma_1 = 0$, $\gamma_2 > 0$), we have case F where only donor 2 donates. Analogously, when ($\gamma_1 > 0$, $\gamma_2 = 0$), we have case D where only donor 1 donates.

Figures 1(e–f) and 2(c) show that when both donors' preferences for publicity, α_1 and α_2, are sufficiently small, we have case B when the organization does not disclose; when both α_1 and α_2 are sufficiently large, we have case A when all the players are active. When α_1 is small but α_2 is large, we have case E where only donor 1 does not donate. Analogously, When α_2 is small but α_1 is large, we have case C where only donor 2 does not donate. It

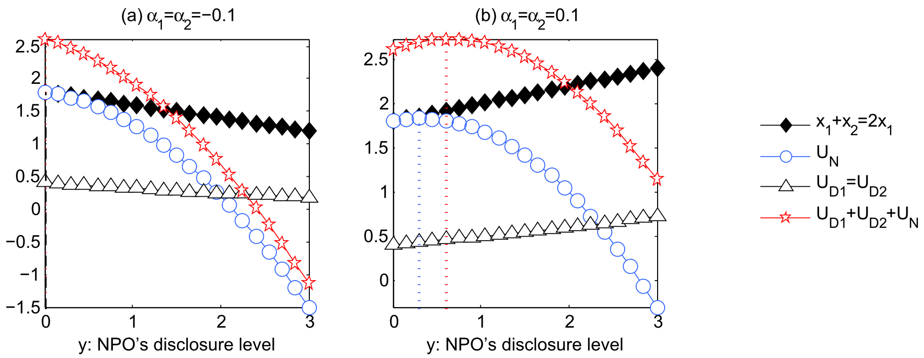

Fig. 3 Total donation and utilities as a function of the organization's disclosure level, with baseline values $\lambda = \theta = 0.3$, $\gamma_1 = \gamma_2 = 3$, $\beta_1 = \beta_2 = 0.5$

is interesting to observe from Figs. 1(e–f) that when one donor's preference for publicity becomes very large, her own donation and the organization's disclosure will increase, which deters the other donor's amount of donation. In other words, although the donors' best response donation does not directly depend on the other donor donation amount, we observe the effects of strategic substitutes among donors, which is also known as the free-rider problem. In effect, our N-donor game has accommodated the free-rider problem without including other donors' decisions in each individual donor's utility function. This is a potentially important finding worthy of further exploration.

Finally, as observed from Figs. 1(g–h), donation amounts and respective utilities decrease as the donors' cost coefficients β_1 and β_2 increase.

5.4 Discussion of other possible organizational objectives

Section 5.3 has already conducted sensitivity analyses for all the parameters of the model, including the coefficient in the organization's objective functions. In this section, we discuss the scenarios that the organization may maximize the total donation, or the total social payoffs. In particular, Figs. 3(a–b) illustrate the total donation $x_1 + x_2$, and summation of three utilities $U_{D1} + U_{D2} + U_N$, as a function of the organization's disclosure level y, for $\alpha_1 = \alpha_2 = -0.1$ and $\alpha_1 = \alpha_2 = 0.1$, respectively. Other baseline values are $\lambda = \theta = 0.3$, $\gamma_1 = \gamma_2 = 3$, $\beta_1 = \beta_2 = 0.5$. (Note that since we consider identical donors, the utilities and donation amounts are identical between the two donors.)

When the donors' preferences for publicity are negative, Fig. 3(a) suggests that a zero level of organizational disclosure, $y = 0$, will maximize the total amount of donation $x_1 + x_2$, and all the utilities U_N, U_{D1} and U_{D2}. By contrast, when the donors' preferences for publicity are positive, Fig. 3(b) suggests that: (a) in order to maximize total donation $x_1 + x_2$, the disclosure level should be infinity; (b) in order to maximize the total utility $U_{D1} + U_{D2} + U_N$, the disclosure level should be 0.6; and (c) in order to maximize the organization's utility U_N, the disclosure level should be 0.3. In effect, the findings point to a potential mismatch between organizational incentives and donor preferences with respect to optimal organizational disclosures.

6 Conclusions and directions for future research

Nonprofit disclosure often serves as a signal of organizational quality and a source of relevant information that helps reduce information asymmetries (Saxton et al. 2011). In this paper we have novelly examined how the interactions between levels of disclosure and donations impact the market for charitable contributions. Specifically, our model shows that the amount of charitable contributions made by the donors is positively dependent upon the amount of value-relevant disclosure made by the nonprofit organization. Both efforts decrease in the donors' preference for retaining money and (weakly) increase in the effectiveness of the organization and the donors' own preference for personal publicity. Our model also shows the strategic substitution that takes place between the donors in terms of the amount of their donations, and further illustrates the optimal disclosure strategies when the organization wants to maximize social welfare, or the total amount of donations.

This simple, yet informative, model captures three key donor preferences: effectiveness, publicity, and cost. Prior game theoretic models have been missing the first, and arguably the most important, of these preferences. The empirical literature, meanwhile, has yet to take into account the publicity dimension. Future research should thus aim to consider the joint impact of these two key preferences, both of which can be influenced by organizational actions.

Given the dearth of existing game-theoretic work on nonprofit organizations and the importance of disclosure for both acquiring donations and for achieving accountability and trust, this is an area especially ripe for research. The potential extensions to this line of research are many.

To start, scholars have yet to look at the effects of disclosing *fundraising efficiency ratios*. This ratio is distinct from the program spending ratio (the popular indirect measure of effectiveness noted earlier). The fundraising efficiency ratio measures the proportion of donations (often in a specific campaign) that are designated for spending on programs rather than administration. Our understanding of the realistic interplay between donor decisions and organizational disclosures would be enhanced were we to develop formal models that incorporate such commonly used forms of information.

Also worthy of exploration is the relationship between disclosure and fundraising. We provide formal evidence here that disclosure is a critical component of the nonprofit information environment, while the empirical literature has concentrated on the "informational" role of fundraising. Scholars could, for instance, model the trade-offs associated with an organization's decision to increase fundraising expenses in an attempt to reach more donors and increase donations. Such a decision must be weighed against the fact that fundraising automatically decreases an organization's program efficiency ratio; in the terms of the empirically tested "economic model of giving" (Weisbrod and Dominguez 1986), fundraising expenses increase the "price of giving," which tends to decrease subsequent donations. More fruitful, though, might be efforts to explore something that is merely implicit in the above arguments: that disclosure might be *superior* to fundraising, given that disclosure spreads relevant information throughout the market without significantly affecting an organization's efficiency ratios. Future research could hence extend the analyses by modeling whether or in what circumstances disclosure and fundraising are complements or substitutes.

This paper focuses on individual donors instead of organizational donors. It would therefore also be interesting to extend the model to organizational donors, especially given how organizational donors may look to other donors when they make donations, which might be expected to change the structure of their objective functions.

Given the nature of the transformations in the market for charitable contributions, it would also be worthwhile to study the effects of different forms of media that are employed in the disclosure decision. Specifically, we would expect that different effects might arise from the use of different forms of media—signs, placards, websites, Twitter, email, Facebook, etc.—to publicize prior donations and/or measures of organizational effectiveness and efficiency. With a "new media" approach to disclosure, for example, an organization can quickly reach a broad audience for near-simultaneous updating of donations received, which could potentially help one organization grab market share. On the downside, this could quickly lead to "information overload." An avalanche of Twitter updates would not be welcome by most followers of an organization. The fact is, individuals have a limited capacity to take in complex information, and at some point, disclosing more information may simply frustrate or overwhelm individuals rather than encourage their donations. Though our model captures this to some extent, additional modeling and empirical testing would help us discover the practical point at which disclosure yields negative benefits for charitable organizations.

The key extension to our research, however, is one that flows naturally from our initial arguments about the nature of inter-organizational competition in the market for charitable contributions. Existing studies have focused on modeling the effects of a single organizations' disclosure practices on the behavior of one or more donors. However, we posit that modeling organizations as *rivals* competing for a donor's money could better represent key aspects of donor-organization interactions. The model presented in this paper is easily generalizable to a M-nonprofit organization, N-donor game; consequently, in a future paper we could model a game with two or more competing nonprofit organizations and one donor. Such a model would tap a key element of the realistic organizational competition that takes place over charitable resources.

Appendix

A.1 Proof of Theorem 1

We can obtain the Donor i's best response as following:

$$\frac{\partial U_{D_i}}{\partial x_i} = \gamma_i \lambda + \alpha_i y - 2\beta_i x_i = 0 \quad \Rightarrow \quad \hat{x}_i(y) = \frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}$$

If and only if the $\gamma_i \lambda + \alpha_i y > 0$ and the utility of Donor i $U_{D_i}(\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}) > U_{D_i}(0) = 0$, we have $\hat{x}_i(y) = \frac{\gamma_i \lambda + \alpha_i y}{2\beta_i} > 0$. Check the utility of Donor i:

$$\hat{U}_{D_i}\left(\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}\right) = \gamma_i \lambda \left(\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}\right) + \alpha_i y \left(\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}\right) - \beta_i \left(\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}\right)^2$$
$$= \frac{(\gamma_i \lambda + \alpha_i y)^2}{4\beta_i} > 0 \tag{7}$$

which is always true. So, weather $\hat{x}_i(y) > 0$ or not only depends on if $\gamma_i \lambda + \alpha_i y > 0$ or not.

However, if $\gamma_i \lambda + \alpha_i y \leq 0$, we have $\hat{x}_i(y) = 0$. From the notation in Sect. 4, we have $x_i \geqslant 0$. If the value of $\frac{\gamma_i \lambda + \alpha_i y}{2\beta_i}$, which is the amount of donation from Donor i, is less than 0, that means the donor can not gain anymore satisfaction by donating more than 0. So, the Donor i's best response $\hat{x}_i(y)$ is equal to 0 when $\gamma_i \lambda + \alpha_i y \leq 0$.

A.2 Proof of Theorem 2

A.2.1 Equilibrium solutions

The table of Equilibrium solutions are derived by the 7 possible Cases. For each case, we denote the nonprofit organization's utility as U_N^{*I}, $I = A, \ldots, G$ and its feasible set as F_I, $I = A, \ldots, G$. We obtain the 7 possible Cases as the following

(i) When $x_1^* > 0$, $x_2^* > 0$:
If $x_1^* > 0$ and $x_2^* > 0$, based on (5), we have $x_1^* = \frac{\gamma_1\lambda+\alpha_1 y^*}{2\beta_1}$ and $x_2^* = \frac{\gamma_2\lambda+\alpha_2 y^*}{2\beta_2}$. And we have the nonprofit organization's utility function as the following:

$$U_N(y^*) = \frac{\gamma_1\lambda + \alpha_1 y^*}{2\beta_1} + \frac{\gamma_2\lambda + \alpha_2 y^*}{2\beta_2} - \theta {y^*}^2 \tag{8}$$

Solving the optimization problem of the nonprofit organization, we obtain the optimal level of organizational disclosure as follows:

$$y^* = \begin{cases} \frac{\alpha_1\beta_2+\alpha_2\beta_1}{4\beta_1\theta\beta_2} & \text{if } \alpha_1\beta_2 + \alpha_2\beta_1 > 0 \\ 0 & \text{if } \alpha_1\beta_2 + \alpha_2\beta_1 \le 0 \end{cases}$$

- When $y^* > 0$, we can have *Case A*:

$$x_1^* = \frac{4\gamma_1\lambda\beta_1\theta\beta_2 + \alpha_1\alpha_2\beta_1 + \beta_2\alpha_1^2}{8\beta_1^2\theta\beta_2}$$

$$x_2^* = \frac{4\gamma_2\lambda\beta_1\theta\beta_2 + \alpha_1\alpha_2\beta_1 + \beta_1\alpha_2^2}{8\beta_1\theta\beta_2^2}$$

$$y^* = \frac{\alpha_1\beta_2 + \alpha_2\beta_1}{4\beta_1\theta\beta_2}$$

$$U_{D_1}^* = \frac{(4\gamma_1\lambda\beta_1\theta\beta_2 + \alpha_1\alpha_2\beta_1 + \beta_2\alpha_1^2)^2}{64\beta_1^3\theta^2\beta_2^2}$$

$$U_{D_2}^* = \frac{(4\gamma_2\lambda\beta_2\theta\beta_1 + \alpha_1\alpha_2\beta_2 + \beta_1\alpha_2^2)^2}{64\beta_2^3\theta^2\beta_1^2}$$

$$U_N^{*A} = \frac{(\alpha_1\beta_2 + \alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2}$$

According to Theorem 1, we have Case A's feasible set as $F_A = \{\alpha_1\beta_2+\alpha_2\beta_1 > 0,$ $4\gamma_1\lambda\beta_1\theta\beta_2 + \alpha_1\alpha_2\beta_1 + \beta_2\alpha_1^2 > 0, 4\gamma_2\lambda\beta_1\theta\beta_2 + \alpha_1\alpha_2\beta_2 + \beta_1\alpha_2^2 > 0\}$.

- When $y^* = 0$, we can have *Case B*:

$$x_1^* = \frac{\gamma_1\lambda}{2\beta_1}$$

$$x_2^* = \frac{\gamma_2\lambda}{2\beta_2}$$

$$y^* = 0$$

$$U_{D_1}^* = \frac{\gamma_1^2\lambda^2}{4\beta_1}$$

$$U_{D_2}^* = \frac{\gamma_2^2\lambda^2}{4\beta_2}$$

$$U_N^{*B} = \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2}$$

According to Theorem 1, we have Case B's feasible set as $F_B = \{\alpha_1\beta_2 + \alpha_2\beta_1 \leq 0, \gamma_1 > 0, \gamma_2 > 0, \lambda > 0\}$.

(ii) When $x_1^* > 0$, $x_2^* = 0$:

If $x_1^* > 0$ and $x_2^* = 0$, based on (5), we have $x_1^* = \frac{\gamma_1\lambda + \alpha_1 y^*}{2\beta_1}$. And we have the nonprofit organization's utility function as the following:

$$U_N(y^*) = \frac{\gamma_1\lambda + \alpha_1 y^*}{2\beta_1} + 0 - \theta {y^*}^2 \tag{9}$$

Solving the optimization problem of the nonprofit organization, we obtain the optimal level of organizational disclosure as follows:

$$y^* = \begin{cases} \frac{\alpha_1}{4\theta\beta_1} & \text{if } \alpha_1 > 0 \\ 0 & \text{if } \alpha_1 \leq 0 \end{cases}$$

- When $y^* > 0$, we can have *Case C*:

$$x_1^* = \frac{4\theta\beta_1\gamma_1\lambda + \alpha_1^2}{8\theta\beta_1^2}$$

$$x_2^* = 0$$

$$y^* = \frac{\alpha_1}{4\theta\beta_1}$$

$$U_{D_1}^* = \frac{(4\gamma_1\lambda\beta_1\theta + \alpha_1^2)^2}{64\theta^2\beta_1^3}$$

$$U_{D_2}^* = 0$$

$$U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1}$$

According to Theorem 1, we have Case C's feasible set as $F_C = \{\alpha_1 > 0, \alpha_1\alpha_2 \leq -4\theta\lambda\gamma_2\beta_1\}$.

- When $y^* = 0$, we can have *Case D*:

$$x_1^* = \frac{\gamma_1\lambda}{2\beta_1}$$

$$x_2^* = 0$$

$$y^* = 0$$

$$U_{D_1}^* = \frac{\gamma_1^2\lambda^2}{4\beta_1}$$

$$U_{D_2}^* = 0$$

$$U_N^{*D} = \frac{\gamma_1\lambda}{2\beta_1}$$

According to Theorem 1, we have Case D's feasible set as $F_D = \{\alpha_1 \leq 0, \gamma_1 > 0, \gamma_2 = 0, \lambda > 0\}$.

(iii) When $x_1^* = 0$, $x_2^* > 0$:

If $x_1^* = 0$ and $x_2^* > 0$, based on (5), we have $x_2^* = \frac{\gamma_2\lambda + \alpha_2 y^*}{2\beta_2}$. And we have the nonprofit organization's utility function as the following:

$$U_N(y^*) = 0 + \frac{\gamma_2\lambda + \alpha_2 y^*}{2\beta_2} - \theta {y^*}^2 \tag{10}$$

Solving the optimization problem of the nonprofit organization, we obtain the optimal level of organizational disclosure as follows:

$$y^* = \begin{cases} \frac{\alpha_2}{4\theta\beta_2} & \text{if } \alpha_2 > 0 \\ 0 & \text{if } \alpha_2 \leq 0 \end{cases}$$

- When $y^* > 0$, we can have *Case E*:

$$\begin{aligned} x_1^* &= 0 \\ x_2^* &= \frac{4\theta\beta_2\gamma_2\lambda + \alpha_2^2}{8\theta\beta_2^2} \\ y^* &= \frac{\alpha_2}{4\theta\beta_2} \\ U_{D_1}^* &= 0 \\ U_{D_2}^* &= \frac{(4\gamma_2\lambda\beta_2\theta + \alpha_2^2)^2}{64\theta^2\beta_2^3} \\ U_N^{*E} &= \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \end{aligned}$$

According to Theorem 1, we have Case E's feasible set as $F_E = \{\alpha_2 > 0, \alpha_1\alpha_2 \leq -4\theta\lambda\gamma_1\beta_2\}$.

- When $y^* = 0$, we can have *Case F*:

$$\begin{aligned} x_1^* &= 0 \\ x_2^* &= \frac{\gamma_2\lambda}{2\beta_2} \\ y^* &= 0 \\ U_{D_1}^* &= 0 \\ U_{D_2}^* &= \frac{\gamma_2^2\lambda^2}{4\beta_2} \\ U_N^{*F} &= \frac{\gamma_2\lambda}{2\beta_2} \end{aligned}$$

According to Theorem 1, we have Case F's feasible set as $F_F = \{\alpha_2 \leq 0, \gamma_1 = 0, \gamma_2 > 0, \lambda > 0\}$.

(iv) $x_1^* = 0, x_2^* = 0$:

If $x_1^* = 0$ and $x_2^* = 0$, based on (5), we have the nonprofit organization's utility function as the following:

$$U_N(y^*) = 0 + 0 - \theta {y^*}^2 \tag{11}$$

We can see that if the nonprofit wants to increase its disclosure level, its utility will decrease. So the best choice of disclosure level for the organization is $y^* = 0$.

Then we can have *Case G*:

$$x_1^* = 0, \qquad x_2^* = 0, \qquad y^* = 0, \qquad U_{D_1}^* = 0, \qquad U_{D_2}^* = 0, \qquad U_N^{*G} = 0$$

According to Theorem 1, we have Case G's feasible set as $F_G = \{\gamma_1 = 0,\ \gamma_2 = 0,$ or $\lambda = 0\}$.

A.2.2 Proof of optimal region

We can have Case I ($I = A, \ldots, G$) to be optimal, when $F_I \cap \overline{F_J}$, $J = A, \ldots, G$, $J \neq I$ or when $U_N^{*I} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq I$ if $F_I \cap F_J \neq \emptyset$. So, we can define Case I's optimal range as:

$$O_I \equiv \bigcap_{I \neq J} \{F_I \cap \{\{F_J \cap \{U_N^{*I} \geq U_N^{*J}\}\} \cup \overline{F_J}\}\}, \quad J = A, \ldots, G, J \neq I \tag{12}$$

And we can obtain the optimal range for each case as the following:

Case A. For Case A, we should have $U_N^{*A} \geq U_N^{*J}$, $J = B, \ldots, G$, $J \neq A$ to confirm its optimality, if $F_A \cap F_J \neq \emptyset$. Since $F_A \cap F_B = \emptyset$, we need not to compare the U_N^{*A} with U_N^{*B}. And we will have the following set of inequalities:

$$\begin{cases} F_A \cap \{\{F_C \cap \{U_N^{*A} = \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*C}\}\} \cup \overline{F_C}\} \\ F_A \cap \{\{F_D \cap \{U_N^{*A} = \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*D}\}\} \cup \overline{F_D}\} \\ F_A \cap \{\{F_E \cap \{U_N^{*A} = \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*E}\}\} \cup \overline{F_E}\} \\ F_A \cap \{\{F_F \cap \{U_N^{*A} = \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*F}\}\} \cup \overline{F_F}\} \\ F_A \cap \{\{F_G \cap \{U_N^{*A} = \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geq 0 = U_N^{*G}\}\} \cup \overline{F_G}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_A \cap \{\{F_C \cap (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_1 + 8\lambda\theta\gamma_2\beta_1^2 \geqslant \alpha_1^2\beta_2\} \cup \overline{F_C}\} \\ F_A \cap \{F_D \cup \overline{F_D}\} = F_A \\ F_A \cap \{\{F_E \cap (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_2 + 8\lambda\theta\gamma_1\beta_2^2 \geqslant \alpha_2^2\beta_1\} \cup \overline{F_E}\} \\ F_A \cap \{F_F \cup \overline{F_F}\} = F_A \\ F_A \cap \{F_G \cup \overline{F_G}\} = F_A \end{cases}$$

So, the optimal range for Case A is $O_A = F_A \cap \{\{F_C \cap (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_1 + 8\lambda\theta\gamma_2\beta_1^2 \geqslant \alpha_1^2\beta_2\} \cup \overline{F_C}\} \cap \{\{F_E \cap (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_2 + 8\lambda\theta\gamma_1\beta_2^2 \geqslant \alpha_2^2\beta_1\} \cup \overline{F_E}\}$.

Case B. For Case B, we should have $U_N^{*B} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq B$ to confirm its optimality, if $F_B \cap F_J \neq \emptyset$. Since $F_B \cap F_A = \emptyset$, $F_B \cap F_D = \emptyset$, $F_B \cap F_F = \emptyset$ and $F_B \cap F_G = \emptyset$ we need not to compare the U_N^{*B} with U_N^{*A}, U_N^{*D}, U_N^{*F} and U_N^{*G}. And we will have the following set of inequalities:

$$\begin{cases} F_B \cap \{\{F_C \cap \{U_N^{*B} = \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*C}\}\} \cup \overline{F_C}\} \\ F_B \cap \{\{F_E \cap \{U_N^{*B} = \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*E}\}\} \cup \overline{F_E}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_B \cap \{\{F_C \cap 8\lambda\theta\gamma_2\beta_1^2 \geq \alpha_1^2\beta_2\} \cup \overline{F_C}\} \\ F_B \cap \{\{F_E \cap 8\lambda\theta\gamma_1\beta_2^2 \geq \alpha_2^2\beta_1\} \cup \overline{F_E}\} \end{cases}$$

So, the optimal range for Case B is $O_B = F_B \cap \{\{F_C \cap 8\lambda\theta\gamma_2\beta_1^2 \geqslant \alpha_1^2\beta_2\} \cup \overline{F_C}\} \cap \{\{F_E \cap 8\lambda\theta\gamma_1\beta_2^2 \geqslant \alpha_2^2\beta_1\} \cup \overline{F_E}\}$.

Case C. For Case C, we should have $U_N^{*C} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq C$ to confirm its optimality, if $F_C \cap F_J \neq \emptyset$. Since $F_C \cap F_D = \emptyset$, we need not to compare the U_N^{*C} with U_N^{*D}. And we will have the following set of inequalities:

$$\begin{cases} F_C \cap \{\{F_A \cap \{U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} \geqslant \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*A}\}\} \cup \overline{F_A}\} \\ F_C \cap \{\{F_B \cap \{U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} \geqslant \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*B}\}\} \cup \overline{F_B}\} \\ F_C \cap \{\{F_E \cap \{U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} \geqslant \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*E}\}\} \cup \overline{F_E}\} \\ F_C \cap \{\{F_F \cap \{U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} \geqslant \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*F}\}\} \cup \overline{F_F}\} \\ F_C \cap \{\{F_G \cap \{U_N^{*C} = \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} \geqslant 0 = U_N^{*G}\}\} \cup \overline{F_G}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_C \cap \{\{F_A \cap \alpha_1^2\beta_2 \geq (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_1 + 8\lambda\theta\gamma_2\beta_1^2\} \cup \overline{F_A}\} \\ F_C \cap \{\{F_B \cap \beta_2\alpha_1^2 \geq 8\theta\lambda\gamma_2\beta_1^2\} \cup \overline{F_B}\} \\ F_C \cap \{\{F_E \cap \alpha_1^2\beta_2^2 - \alpha_2^2\beta_1^2 \geq 8\theta\lambda\beta_1\beta_2(\gamma_2\beta_1 - \gamma_1\beta_2)\} \cup \overline{F_E}\} \\ F_C \cap \{\{F_F \cap \beta_1\beta_2\alpha_1^2 \geq 8\theta\lambda\beta_1^2(\gamma_2\beta_1 - \gamma_1\beta_2)\} \cup \overline{F_F}\} \\ F_C \cap \{F_G \cup \overline{F_G}\} = F_C \end{cases}$$

We noticed that $F_C \cap \overline{F_F} = \emptyset$. So, the optimal range for Case C is $O_C = F_C \cap \{\{F_A \cap \alpha_1^2\beta_2 \geqslant (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_1 + 8\lambda\theta\gamma_2\beta_1^2\} \cup \overline{F_A}\} \cap \{\{F_B \cap \beta_2\alpha_1^2 \geqslant 8\theta\lambda\gamma_2\beta_1^2\} \cup \overline{F_B}\} \cap \{\{F_E \cap \alpha_1^2\beta_2^2 - \alpha_2^2\beta_1^2 \geq 8\theta\lambda\beta_1\beta_2(\gamma_2\beta_1 - \gamma_1\beta_2)\} \cup \overline{F_E}\} \cap \{F_F \cap \beta_1\beta_2\alpha_1^2 \geq 8\theta\lambda\beta_1^2(\gamma_2\beta_1 - \gamma_1\beta_2)\}$.

Case D. For Case D, we should have $U_N^{*D} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq D$ to confirm its optimality, if $F_D \cap F_J \neq \emptyset$. Since $F_D \cap F_C = \emptyset$, $F_D \cap F_B = \emptyset$, $F_D \cap F_F = \emptyset$ and $F_D \cap F_G = \emptyset$, we need not to compare the U_N^{*D} with U_N^{*C}, U_N^{*B}, U_N^{*F} and U_N^{*G} here. And we will have the following set of inequalities:

$$\begin{cases} F_D \cap \{\{F_A \cap \{U_N^{*D} = \frac{\gamma_1\lambda}{2\beta_1} \geq \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*A}\}\} \cup \overline{F_A}\} \\ F_D \cap \{\{F_E \cap \{U_N^{*D} = \frac{\gamma_1\lambda}{2\beta_1} \geq \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*E}\}\} \cup \overline{F_E}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_D \cap \{\{F_A \cap \alpha_1\beta_2 + \alpha_2\beta_1 = 0\} \cup \overline{F_A}\} \\ F_D \cap \{\{F_E \cap 8\theta\lambda\beta_2(\gamma_1\beta_2 - \gamma_2\beta_1) \geq \alpha_2^2\beta_1\} \cup \overline{F_E}\} \end{cases}$$

Since the equation of $\alpha_1\beta_2 + \alpha_2\beta_1 = 0$ will violate F_A, so, the optimal range for Case D is $O_D = F_D \cap \overline{F_A} \cap \{\{F_E \cap 8\theta\lambda\beta_2(\gamma_1\beta_2 - \gamma_2\beta_1) \geqslant \alpha_2^2\beta_1\} \cup \overline{F_E}\}$.

Case E. For Case E, we should have $U_N^{*E} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq E$ to confirm its optimality, if $F_E \cap F_J \neq \emptyset$. Since we have $F_E \cap F_F = \emptyset$, we do not need to compare the U_N^{*E} with U_N^{*F}. And we will have the following set of inequalities:

$$\begin{cases} F_E \cap \{\{F_A \cap \{U_N^{*E} = \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*A}\}\} \cup \overline{F_A}\} \\ F_E \cap \{\{F_B \cap \{U_N^{*E} = \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*B}\}\} \cup \overline{F_B}\} \\ F_E \cap \{\{F_C \cap \{U_N^{*E} = \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*C}\}\} \cup \overline{F_C}\} \\ F_E \cap \{\{F_D \cap \{U_N^{*E} = \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*D}\}\} \cup \overline{F_D}\} \\ F_E \cap \{\{F_G \cap \{U_N^{*E} = \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} \geqslant 0 = U_N^{*G}\}\} \cup \overline{F_G}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_E \cap \{\{F_A \cap \alpha_2^2\beta_1 \geq (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_2 + 8\lambda\theta\gamma_1\beta_2^2\} \cup \overline{F_A}\} \\ F_E \cap \{\{F_B \cap \beta_1\alpha_2^2 \geqslant 8\theta\lambda\gamma_1\beta_2^2\} \cup \overline{F_B}\} \\ F_E \cap \{\{F_C \cap \alpha_2^2\beta_1^2 - \alpha_1^2\beta_2^2 \geq 8\theta\lambda\beta_1\beta_2(\gamma_1\beta_2 - \gamma_2\beta_1)\} \cup \overline{F_C}\} \\ F_E \cap \{\{F_D \cap \beta_1\beta_2\alpha_2^2 \geq 8\theta\lambda\beta_2^2(\gamma_1\beta_2 - \gamma_2\beta_1)\} \cup \overline{F_D}\} \\ F_E \cap \{F_G \cup \overline{F_G}\} = F_E \end{cases}$$

We noticed that $F_E \cap \overline{F}_D = \emptyset$. So, the optimal range for Case E is $O_E = F_E \cap \{\{F_A \cap \alpha_2^2\beta_1 \geqslant (\alpha_1\beta_2 + \alpha_2\beta_1)^2\beta_2 + 8\lambda\theta\gamma_1\beta_2^2\} \cup \overline{F_A}\} \cap \{\{F_B \cap \beta_1\alpha_2^2 \geqslant 8\theta\lambda\gamma_1\beta_2^2\} \cup \overline{F_B}\} \cap \{\{F_C \cap \alpha_2^2\beta_1^2 - \alpha_1^2\beta_2^2 \geqslant 8\theta\lambda\beta_1\beta_2(\gamma_1\beta_2 - \gamma_2\beta_1)\} \cup \overline{F_C}\} \cap \{F_D \cap \beta_1\beta_2\alpha_2^2 \geqslant 8\theta\lambda\beta_2^2(\gamma_1\beta_2 - \gamma_2\beta_1)\}$.

Case F. For Case F, we should have $U_N^{*F} \geq U_N^{*J}$, $J = A, \ldots, G$, $J \neq F$ to confirm its optimality, if $F_F \cap F_J \neq \emptyset$. Since $F_F \cap F_E = \emptyset$, $F_F \cap F_B = \emptyset$, $F_F \cap F_D = \emptyset$ and $F_F \cap F_G = \emptyset$, we need not to compare the U_N^{*F} with U_N^{*E}, U_N^{*B}, U_N^{*D}, U_N^{*G} here. And we will have the following set of inequalities:

$$\begin{cases} F_F \cap \{\{F_A \cap \{U_N^{*F} = \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*A}\}\} \cup \overline{F_A}\} \\ F_F \cap \{\{F_C \cap \{U_N^{*F} = \frac{\gamma_2\lambda}{2\beta_2} \geq \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*C}\}\} \cup \overline{F_C}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_F \cap \{\{F_A \cap \alpha_1\beta_2 + \alpha_2\beta_1 = 0\} \cup \overline{F_A}\} \\ F_F \cap \{\{F_C \cap 8\theta\lambda\beta_1(\gamma_2\beta_1 - \gamma_1\beta_2) \geq \alpha_1^2\beta_2\} \cup \overline{F_C}\} \end{cases}$$

Since the equation of $\alpha_1\beta_2 + \alpha_2\beta_1 = 0$ will violate F_A, so, the optimal range for Case F is $O_F = F_F \cap \overline{F_A} \cap \{\{F_C \cap 8\theta\lambda\beta_1(\gamma_2\beta_1 - \gamma_1\beta_2) \geqslant \alpha_1^2\beta_2\} \cup \overline{F_C}\}$.

Case G. For Case G, we should have $U_N^{*G} \geq U_N^{*J}$, $J = A, \ldots, F$, $J \neq G$ to confirm its optimality, if $F_G \cap F_J \neq \emptyset$. Since $F_G \cap F_B = \emptyset$, $F_G \cap F_D = \emptyset$ and $F_G \cap F_F = \emptyset$, we need not to compare the U_N^{*G} with U_N^{*B}, U_N^{*D}, U_N^{*F} here. And we will have the following set of inequalities:

$$\begin{cases} F_G \cap \{\{F_A \cap \{U_N^{*G} = 0 \geqslant \frac{(\alpha_1\beta_2+\alpha_2\beta_1)^2}{16\beta_1\beta_2\theta} + \frac{\gamma_1\lambda}{2\beta_1} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*A}\}\} \cup \overline{F_A}\} \\ F_G \cap \{\{F_C \cap \{U_N^{*G} = 0 \geqslant \frac{\alpha_1^2}{16\theta\beta_1^2} + \frac{\gamma_1\lambda}{2\beta_1} = U_N^{*C}\}\} \cup \overline{F_C}\} \\ F_G \cap \{\{F_E \cap \{U_N^{*G} = 0 \geqslant \frac{\alpha_2^2}{16\theta\beta_2^2} + \frac{\gamma_2\lambda}{2\beta_2} = U_N^{*E}\}\} \cup \overline{F_E}\} \end{cases}$$

We can simplify these inequalities to:

$$\begin{cases} F_G \cap \{\{F_A \cap \alpha_1\beta_2 + \alpha_2\beta_1 = 0\} \cup \overline{F_A}\} \\ F_G \cap \{\{F_C \cap \alpha_1 = 0\} \cup \overline{F_C}\} \\ F_G \cap \{\{F_E \cap \alpha_2 = 0\} \cup \overline{F_E}\} \end{cases}$$

Since the equation of $\alpha_1\beta_2 + \alpha_2\beta_1 = 0$ will violate F_A, the equation of $\alpha_1 = 0$ will violate F_C and the equation of $\alpha_2 = 0$ will violate F_E. So, the optimal range for Case G is $O_G = F_G \cap \overline{F_A} \cap \overline{F_C} \cap \overline{F_E}$.

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