BROTHERS IN ALMS? COORDINATION BETWEEN NGOS ON MARKETS FOR DEVELOPMENT DONATIONS

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Abstract. This paper studies the stability of coordination between mission-driven non-governmental organizations (NGOs) competing for donations. We build a non-cooperative game-theoretic model of alliance formation between NGOs that compete through fundraising activities and impose externalities on each others' output. We derive general results on the stability of full coordination under two classes of alliance-formation rules: unanimity and aggregative. If fundraising activities are strategic complements, the grandcoalition (i.e. full coordination) is always individually stable and, under the unanimity rule, coalitionally stable. When fundraising activities are strategic substitutes, the grandcoalition can be unstable and the instability is more likely, the steeper are NGOs' (negatively sloped) best-reply functions. Under the aggregative rule, the grandcoalition is stable: (i) individually, if there are negative coalitional externalities; (ii) coalitionally, if breaking an alliance requires the majority of NGOs involved in the alliance.

Keywords: NGOs, giving, coordination, endogenous coalition formation, non-distribution constraint.
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> "On 21 December 1984, unable to resist the allure of Ethiopian famine pictures, World Vision ran an Australia-wide Christmas Special television show calling on the public in that country to give it funds. In so doing it broke an explicit understanding with the Australian Council of Churches that it would not run such television spectaculars in competition with the ACC's traditional Christmas Bowl appeal. Such ruthless treatment of 'rivals' pays, however: the American charity is, today, the largest voluntary agency in Australia ..." (Hancock 1989: 17)

1. Introduction

The world has been experiencing an ongoing change in development aid paradigm, moving from bilateral aid to projects carried out by non-governmental organizations (NGOs). An illustration of this change is, for instance, the fact that the share of World Bank projects that involve NGOs went from 6% in 1980s to 70% in 2006 (Werker and Ahmed 2008). This change has been mainly motivated by the shift in geopolitical balance after the fall of the Soviet Union, the absence of credible empirical evidence on the positive effect of bilateral aid on economic performance (Rajan and Subramanian 2008, Doucouliagos and Paldam 2009), and the belief (or, at least, the hope) that NGOs suffer less from the key shortcomings of traditional bilateral-aid projects: corruption, bureaucratic inefficiency, and the lack of ownership and empowerment. There is some empirical support for this belief: Nancy and Yontcheva (2006) find, for instance, that European NGOs seem to have poverty as the main determinant of the allocation of their projects and that the funding source of NGOs does not seem to have an effect on their aid allocation decisions.

The evolution of the NGO sector over time has been spectacular. Werker and Ahmed (2008) state that the number of NGOs rose from less than 200 in the beginning of the 20th century to more than 20,000 around mid-2000s. Typically, an NGO is organized (and operated) by motivated and altruistic individuals with a particular mission (e.g. the empowerment of women in a particular country, advocacy to ban child labor, conservation of wildlife, etc.). Thus, currently this sector represents a highly decentralized and capillary system of collection and allocation of funds and development projects.

This decentralized operation of the NGO sector has its own problems. One major issue is competition between NGOs. The backbone of this competition is the fact that although NGO workers are intrinsically-motivated agents, their motivation is more of a "warm-glow" kind (à la Andreoni 1989) than pure altruism. In other words, a person working for an NGO does not simply care about increasing the welfare of people in developing countries, but would like to personally participate in this process. Therefore, founding an NGO or working for it not only increases the welfare of beneficiaries of its project, but also gives some private utility to the NGO workers. This private benefit is perhaps of psychic nature and should not be disregarded: indeed, as Paul Theroux once said, "Peace Corps probably did more for the United States than it did for Africa." However, this desire to help personally, even though laudable, feeds the competition between different NGOs for scarce resources, each NGO trying to increase the impact of its own mission.

The competition among NGOs in the North is principally for donations, and the main instrument used by NGOs in this competitive process is fundraising activities. For instance, De Waal (1997) writes in his description of the NGO sector: "[An organization that is] most determined to get the highest media profile obtains the most funds ... In doing so it prioritizes the requirements of fundraising: it follows the TV cameras, ... engages in picturesque and emotive programmes (food and medicine, best of all for children), it abandons scruples about when to go in and when to leave, and it forsakes cooperation with its peers for advertising its brand name." The opening quotation of this paper also presents an example of ruthless competition (and its consequences) between emergency relief NGOs in Australia.

Clearly, NGOs themselves realize the perils brought by this competition and try to design cooperative agreements to curb such wasteful rivalry. For example, Smillie (1995) writes: "Competition between NGOs for the hearts and minds of donors is not new. But as the years passed, with the advent of more and more NGOs, with a growing need for development money and an increasing number of disasters, and with a prolonged recession in the early 1990s, competition has increased. There are ... admirable examples of efforts to coordinate fundraising appeals. A joint Disaster Relief Agency was created by Dutch NGOs in 1993. Similar arrangements, usually of *ad hoc* nature, have been tried in other countries. The Disasters Emergency Committee (DEC) in Britain has several participating organizations, and between 1966 and 1993 they ran 35 joint appeals" (Smillie 1995: 116).

In several countries, NGOs have been successfully trying to create coordination institutions that try to curb the harmful competition for donations. In the Netherlands, non-profit organizations have engaged in an admirable self-regulation effort by establishing the Central Fundraising Bureau, or CBF (see Bekkers 2003 for the detailed description of this institution and its history). This is an accreditation system put it place in 1997 that delivers its members the right to print its quality-certifying logo (which is well-known by donor public). To qualify for it, a member NGO has to file regular annual reports and demonstrate that it spends less than 25 per cent of its funds for fundraising activities. The CBF renews the accreditation delivered to a member once every three years and organizations that fail to satisfy the 25-percent ceiling in fundraising expenses lose the right to use the quality logo. The participation of Dutch non-profit organizations in this accreditation system is almost universal: Similon (2009) states that more than 90 per cent of the Dutch donation market is covered by organizations that have the quality logo of the CBF (and thus have agreed to keep their fundraising expenses below the ceiling).

The non-profit organizations in the UK established in 2006 a similar accreditation system and the supervising body, Fundraising Standards Board (FRSB). Here, too, the condition for membership is keeping fundraising expenditures under a certain ceiling. This system also seems to be highly successful: Similon (2009) writes that currently (i.e. only three years after the establishment of the system), the number of member organizations is over 950.

Accreditation is not the only system through which NGOs try to coordinate and self-regulate their fundraising behavior. Another well-known tool is the establishment of an umbrella organization that conducts joint fundraising appeals.

One of the oldest and most well-known umbrella organizations is the American United Way (see Brilliant 1990 for a detailed history). NGOs in other countries also have been using a similar approach. In Belgium, for instance, the umbrella organization for fundraising activities of the NGO sector – the National Center for Development Cooperation, "CNCD-11.11.11" - was established in 1966 (see Similon 2009 for a brief description of this organization). The functioning of this organization is based on a point system, where a member NGO obtains a certain amount of points each year on the basis of its engagement in *joint* fundraising activities. At the end of the year, the total amount of funds raised gets distributed among the members on the basis of points accumulated. Thus, this system creates the incentives both to reduce unilateral fundraising activities and to contribute more to joint fundraising operations.

Understanding the conditions for the successful self-regulation of the NGO sector is crucial, for two reasons. First, unlike in the for-profit or public sectors, in the NGO sector there exist no external sanctioning mechanisms or structures that punish the non-compliant organizations. Second, precisely because these organizations are non-governmental, the "top-down" government intervention is unlikely to be effective, because it would perceived as undermining the very essence of these organizations. For instance, Edwards and Hulme (1996) show that the stronger are the links of NGOs with the government agencies, the less effective the NGOs are in pursuing independently their missions.

When NGOs do not manage to construct a stable coordination agreement (despite the fact that such agreements might increase the payoffs of all the NGOs concerned), there is, however, some scope for indirect public policies that might facilitate coordination. Governments have several tools that can affect the equilibrium of the competitive NGO sector. The first tool is subsidizing or taxing the fixed costs of setting up an NGO (and thus fostering or limiting entry into the donations market). Another policy instrument is matching grants that are given to NGOs in proportion of private donations that they collect. The higher is the proportionality of the matching grant, the stronger are the NGOs' incentives to exert fundraising effort (which leads to more competition). Finally, the government can influence the overall size of the donations market by varying the tax deductibility of charitable donations. Each one of these instruments affects the cost-benefit calculation of NGOs that interact on the donations market.

In this paper, we present a simple game-theoretic model that analyzes the cooperation between NGOs. To do so, we build a general model of endogenous alliance formation between NGOs. Our model exploits a game-theoretic framework used in the recent literature on endogenous coalition and alliance formation (Bloch 2003, 2009, Yi 2003, Ray 2007). In our two-stage model, at Stage 2 of the game, NGOs engage in individual fundraising activities (with the opportunity cost being working on the project that contributes to their missions). Fundraising activity of one NGO can affect the donations collected by another NGO (either positively or negatively). Thus, NGOs impose externalities on the each other's output. At Stage 1, NGOs can form alliances, i.e. credibly commit to levels of fundraising that internalize the externalities among the alliance members. The alliance formation takes place via the following process: each NGO announces an alliance to which it would like to belong; then, an alliance is formed on the basis of the profile of these announcements and according to a certain alliance-formation rule. We study two main classes of rules: *unanimity* rule (von Neumann and Morgenstern 1944, Hart and Kurz 1983) requiring that all players of the alliance unanimously agree to form *that specific* alliance, and a milder rule which we call *aggregative* rule (or *delta-rule* in Hart and Kurz 1983) which only requires, for an alliance to form, that all its members have announced the same alliance (not necessarily the one that forms). Given these rules, we investigate whether the grandcoalition of NGOs or other alliance structures (i.e. partitions of players into disjoint groups, also denoted *coalition* or *alliance structures*) are *stable* according to standard individual or coalitional equilibrium concepts, i.e. that no single NGO or a group of NGOs possess better alternatives in different alliance structures.

Our main findings are the following. Regardless of the sign of externalities, if NGO fundraising activities are strategic complements, full coordination on fundraising efforts by the grandcoalition of symmetric NGOs is in general always individually stable and, under the unanimity rule, coalitionally stable. Other alliance structures also can be stable, but they have to be *asymmetric,* i.e. formed by alliances of unequal sizes. When fundraising activities are strategic substitutes, the grandcoalition of NGOs can be stable or unstable, and the instability becomes more likely when the NGOs' (negatively sloped) best-reply functions are steeper: breaking the coordination agreement - as in the case of World Vision mentioned in the opening quotation - pays off when rival NGOs greatly reduce their fundraising efforts in response. Under the aggregative rule, the grandcoalition is Nash stable if there are coalitional synergies such that forming alliances hurts in some way the remaining NGOs (that we call negative coalitional externalities). Finally, under the aggregative rule of alliance formation, if breaking an alliance requires the majority of NGOs involved in the alliance (*majority breaking protocol*), then the grandcoalition is resistant not only to individual but also to coalitional deviations.

To the best of our knowledge, there are no papers that theoretically analyze the cooperative agreements among NGOs.[1] There is, however, a small literature that looks at the fundraising competition between NGOs and non-profits.

The most well-known paper by Rose-Ackerman (1982). She presents a model in which charities are differentiated along one dimension ("ideology") and donors are initially uninformed of charities. Charities thus inform the donors through fundraising and donors give to charities which are closest to their preferred point along the "ideology" dimension. Moreover, the managers of charities maximize revenue from fundraising and there is free entry. Rose-Ackerman finds that competition for donations leads non-profits to engage in excessive fundraising, i.e. to spend sub-optimally high proportion of their budgets for fundraising. This suggests a rationale for competition-reducing umbrella organizations such as United Way.

In the paper by Bilodeau and Slivinski (1997), charities can produce bundles of public goods. They show that competition between charities leads to specialization in production and that the equilibrium provision of public goods through competing charities is higher than the one through a monopoly charity.

Aldashev and Verdier (2010) study the long-run equilibrium of the NGO sector in the North. They use the monopolistic-competition model of Salop (1979): horizontally differentiated NGOs compete for donations from (small) donors via fundraising activities, which take away time that could be used for project implementation. NGOs are founded by "social entrepreneurs" and the analysis characterizes the long-run equilibrium number of NGOs on the donations market and compares it to social optimum. An extension of the model introduces the possibility for NGO managers to divert funds from the budget for personal use and studies the interaction between fundraising competition and diversion of funds in equilibrium.

Aldashev and Verdier (2009) study the current phenomenon of global NGOs (e.g. Oxfam, MSF, CARE) and explain why NGOs have started to globalize. The emergence of multinational NGOs (i.e. NGOs that collect donations in more than one Northern country using country affiliates; these funds are then put into the same project) is driven by the increasing returns to scale in fundraising technology. The main causes of this phenomenon are thus the humanitarian crises (during which it is easier to exploit returns to scale by showing the

[1] Gugerty (2008) and the papers in Gugerty and Prakash (2010) compare empirically the performance of several forms of NGO self-regulation.

same solicitation message to several national publics), the use of mass media in fundraising, and government policies (such as matching grants). This study also finds that despite the reduction in the number of NGO varieties, equilibrium welfare increases under globalization.

Our paper contributes to this literature by studying how NGOs coordinate their fundraising activities to reduce the negative consequences of the harmful competition for funds. We explain which factors determine the success of this coordination.

The paper is organized as follows. Section 2 illustrates the setup for both noncooperative and cooperative behavior of NGOs and also introduces the process of alliance formation and some standard game-theoretic concepts of stability of a structure of alliances. Section 3 presents the main results of the paper. Section 4 works out a simple example that illustrates the general results proven in Section 3. Finally, Section 5 discusses several promising extensions for future work and concludes.

2. Model setup

Consider an economy with a finite set $N = \{1, ..., n\}$ of non-governmental organizations (NGOs) that operate in the same development sector. The economic environment in which they operate is similar to that of Aldashev and Verdier (2010). Each NGO is founded by a social entrepreneur who builds her organization around a mission (e.g. promoting human rights, delivering education services to the poor, protecting endangered species, etc.).

In terms of her motivation, a social entrepreneur is impurely altruistic (à la Andreoni 1989): she receives a "warm-glow" utility which increases (linearly) in the output of her NGO. In other words, she likes to see the objectives of the NGO sector advanced, but only if this advancement goes through *her* NGO. This implies that the objective function of an NGO is simply to maximize the output of its project.

The production technology of the project of NGO i has two inputs: funds (money) F_i and time τ_i:

$$Q_i = Q(F_i, \tau_i).$$

The production function Q is twice continuously differentiable in both arguments. Each social entrepreneur has an endowment of 1 unit of time. She can use this time either to work on the project or to collect funds:

$$1 = \tau_i + y_i, \tag{2.1}$$

where y_i denotes the amount of time devoted to fundraising. Therefore, time is fungible and the social entrepreneur faces a well-defined trade-off: more time spent on fundraising increases the funds that can be devoted to the project; however, this comes at the cost of reducing the *time* devoted to the project.

Given that NGOs are non-profit organizations and thus cannot distribute profits (Hansmann 1980, Weisbrod 1988), the social entrepreneur has to put all the funds that she collects (net of the financial costs) into the project. Formally, this is captured by the non-distribution constraint:

$$R_i(y_i, y_{-i}) = f + cR_i(y_i, y_{-i}) + F_i,$$

where $R_i(y_i, y_{-i}) : [0,1]^N \to \mathbb{R}_+$ denotes the revenue collected through fundraising, $0 \leq c < 1$ is the financial cost of collecting a unit of donation, $f > 0$ is the fixed cost of establishing an NGO, with y_{-i} representing the fundraising efforts of all NGOs different from i, therefore $y_{-i} = (y_1, y_2, ..., y_{i-1}, y_{i+1}, ..., y_n)$.

The non-distribution constraint pins down the amount of funds that an NGO raises (and thus invests into the project):

$$F_i(y_i, y_{-i}) = (1-c)R_i(y_i, y_{-i}) - f. \tag{2.2}$$

The objective function of any NGO i can thus be expressed as a function of its fundraising effort and of the effort levels of other NGOs:

$$Q_i\left(y_i, y_{-i}\right) = Q(F_i(y_i, y_{-i}), \tau_i(y_i)). \tag{2.3}$$

We assume that (2.3) is continuous and concave in y_i, for $i = 1, ..., n$.

2.1. **Non-cooperative interaction between NGOs.** Consider first the situation in which every NGO acts individually and non-cooperatively, with the objective of maximizing its output (by choosing the amount of time it devotes to fundraising, y_i), taking as given other NGOs' fundraising efforts, y_{-i}. In other words, for every $i = 1, ..., n$, the problem is

$$\max_{y_i} Q_i\left(y_i, y_{-i}\right) = \max_{y_i} Q(F_i(y_i, y_{-i}), \tau_i(y_i)). \tag{2.4}$$

First-order conditions for an interior equilibrium of the game played among NGOs, denoted $\overline{y} = (\overline{y}_1, \overline{y}_2, .., \overline{y}_n)$, imply that for every $i = 1, ..., n$:

$$\frac{dQ_i}{dy_i} = \frac{\partial Q}{\partial F_i}\frac{dF_i}{dy_i} + \frac{\partial Q}{\partial \tau_i}\frac{d\tau_i}{dy_i} = 0. \tag{2.5}$$

Using the non-distribution and time constraints, the first-order condition (2.5) becomes:

$$\frac{\partial Q}{\partial F_i}(1-c)\frac{\partial R_i}{\partial y_i} = \frac{\partial Q}{\partial \tau_i}. \tag{2.6}$$

Intuitively, at the equilibrium each NGO equates the marginal benefit of additional fundraising (in terms of project output) to its marginal (opportunity) cost.

Suppose that the best reply of every i-th NGO with respect to other NGOs' fundraising activity is a single-valued function; let's denote it with

$$r_i(y_{-i}) = \arg\max_{y_i} Q_i\left(y_i, y_{-i}\right)$$

for every NGO $i \in N$. Implicitly differentiating the first-order condition at the equilibrium $\overline{y}$ as

$$\frac{dQ_i(r_i(\overline{y}_{-i}), \overline{y}_{-i})}{dy_i} \equiv 0,$$

we obtain the generic expression for the slope of the best-reply function of every NGO as:

$$\frac{dr_i(y_j)}{dy_j} = -\frac{\partial^2 Q_i/\partial y_i \partial y_j}{\partial^2 Q_i/\partial y_i^2} \text{ for } \forall j \neq i. \tag{2.7}$$

From (2.7), given the concavity of output in fundraising effort (i.e. $\partial Q_i^2/\partial y_i^2 < 0$), we obtain[2]

$$\text{sign}\,\frac{dr_i(y_j)}{dy_j} = \text{sign}\,\frac{\partial^2 Q_i}{\partial y_i \partial y_j} = \text{sign}\,\frac{\partial Q}{\partial F_i}(1-c)\frac{\partial^2 R_i}{\partial y_i \partial y_j} - \frac{\partial^2 Q}{\partial \tau_i \partial y_j} \text{ for } \forall j \neq i. \tag{2.8}$$

[2]Second-order condition $\partial^2 Q_i/\partial y_i^2 < 0$ is respected for $\partial^2 R_i/\partial y_i^2 < 0$ (see Appendix).

Therefore, when the marginal returns on fundraising increase sufficiently with the fundraising effort exerted by other NGOs, i.e. the revenue function exhibits sufficiently high increasing differences in $(y_i.y_{-i}) \in Y_i \times Y_{-i}$, every NGO's best-reply is non-decreasing in fundraising effort of its rival NGOs.[3] In other words, in this case, fundraising efforts of NGOs are strategic complements. Conversely, when marginal returns on fundraising are negative, by (2.8) NGOs' fundraising efforts are strategic substitutes and best-reply functions are non-increasing. Later sections of this paper will involve several examples of increasing or decreasing best-reply functions of NGOs.

The question of existence of a fundraising equilibrium $\overline{y} = (\overline{y}_1, \overline{y}_2, .., \overline{y}_n)$, either played between singletons or among alliances of NGOs (see next section), does not pose, in our setup, particular problems. Since by (2.1) NGOs choice sets are nonempty, compact and convex, and their objective functions (2.3) are continuous and strictly quasi-concave (by the assumption of strict concavity), a coalitional fundraising profile (i.e. a non-improvable equilibrium among individual or alliances of NGOs) exists. The proof is rather standard and we do not report it here, to economize on space.[4]

Concerning the uniqueness of equilibrium, note that most results of our paper are obtained with either NGOs fundraising efforts being strategic complements (Lemmata 1 and 2, Proposition 1) or strategic substitutes with best-replies that satisfy the contraction property (Lemma 4, Proposition 2). The contraction property is sufficient to guarantee the existence.of a unique (Nash) fundraising equilibrium $\overline{y}$ played among singletons or alliances of NGOs. The property of increasing differences of NGOs payoffs is sufficient to guarantee the existence, in our setup, of a greatest and a least elements within the set of fundraising equilibria (see Topkis 1998). Since in our framework one of these two elements Pareto dominates (for NGOs) all others elements, this specific unique selection will be considered in the following analysis.

2.2. **Interaction between alliances of NGOs.** Next, suppose that NGOs can organize their common actions in alliances $A \subset N$. The *grandcoalition* N is the largest possible alliance and corresponds to the maximum coordination among NGOs. Alternatively, NGOs can coordinate their actions to some intermediate levels. These can be represented as feasible alliance structures denoted with $\mathcal{S} = \{A_1, A_2, ..., A_m\}$, i.e. representing any collection of NGOs in alliances $A_k \subseteq N$, such that $A_r \cap A_h = \varnothing$ for all $r \neq h$ and $\bigcup_{k=1,..,m} A_k = \{N\}$. In other words, under any alliance structure $\mathcal{S}$ all NGOs belong to some alliance (which can also be a singleton), and none of the NGOs belongs to more than one alliance.

To obtain a well-defined interaction for NGOs forming alliances A_k in all feasible coalition structures $\mathcal{S} = \{A_1, A_2, ..., A_m\}$, we assume that NGOs inside A_k fully coordinate their individual actions, i.e. the strategy set of an alliance A_k is given by $Y_{A_k} = \prod_{i \in A_k} Y_i$ and its alliance payoff $Q_{A_k} : Y_{A_k} \rightarrow \mathbb{R}_+$ is expressed as $Q_{A_k} = \sum_{i \in A_k} Q(y_i, y_{-i})$, i.e. the sum of every NGO's project output. Note that in our setting the main benefit for NGOs to create alliances is to coordinate their fundraising effort levels, thus internalizing the externalities (negative or positive) that the NGOs can impose on each other's output. In this case, the

[3] A real-valued function $f(x, y)$ has increasing (decreasing) differences in $(x, y) \in (X \times Y)$ whenever $f(x, y') - f(x, y'')$ is increasing (decreasing) for every $y'' > y'$. When $f(x, y)$ is continuously differentiable in $\mathbb{R}^2$, it exhibits increasing (decreasing) differences if and only if $\dfrac{\partial^2 f}{\partial x \partial y} \geq (\leq)\, 0$ (see Topkis 1998).

[4] For a proof of the existence of a coalitional equilibrium see, for instance, Ray and Vohra (1997). See also Haeringer (2002).

outcome obtained by the grandcoalition is always Pareto-efficient (from the point of view of NGOs' objective functions).

Moreover, we assume for simplicity that within every alliance there is an equal-sharing allocation rule, i.e. the payoff of every NGO i in an alliance A_k is given by $Q_i = \sum_{i \in A_k} Q_i(y_i, y_{-i})/a_k$, where a_k denotes the cardinality of the alliance A_k.[5]

Finally, let every alliance of NGOs behave *à la* Nash against rival alliances of NGOs and therefore act to maximize the sum of the joint output of all its members, taking as given the actions of NGOs that do not belong to this alliance. Formally, for every $A_k \in \mathcal{S}$, the objective function is

$$\max_{y_{A_k} \in Y_{A_k}} Q_{A_k} = \max_{y_{A_k} \in Y_{A_k}} \sum_{i \in A_k} Q\left[F_i(y_{A_k}, y_{N \setminus A_k}), \tau_i(y_i)\right].$$

The first-order condition of this problem implies, for every member of the alliance, $i \in A_k$,

$$\frac{dQ_{A_k}}{dy_i} = \frac{\partial Q}{\partial F_i}\frac{dF_i}{dy_i} + \frac{\partial Q}{\partial \tau_i}\frac{d\tau_i}{dy_i} + \sum_{h \in A_k \setminus \{i\}} \frac{\partial Q}{\partial F_h}\frac{dF_h}{dy_i} = 0, \tag{2.9}$$

which, using the non-distribution and time constraints, becomes

$$\frac{\partial Q}{\partial F_i}(1-c)\frac{\partial R_i}{\partial y_i} + \sum_{h \in A_k \setminus \{i\}} \frac{\partial Q}{\partial F_h}(1-c)\frac{\partial R_h}{\partial y_i} = \frac{\partial Q}{\partial \tau_i}, \text{ for } \forall i \in A_k. \tag{2.10}$$

This expression indicates that every NGO participating in alliance A_k sets its fundraising level to equate the marginal cost of fundraising to the marginal social (coalitional) benefit. Comparing the conditions (2.9) and (2.10), we see that when NGOs' fundraising activities impose positive (negative) externalities on each other's output, the level of fundraising chosen by an NGO in an alliance is higher (lower) than that of an NGO playing non-cooperatively.

2.3. **Alliance formation between NGOs.** We need to introduce two further elements into our analysis:

(1) a process of alliance formation;
(2) a notion of stability of a given alliance structure of NGOs.

We adopt a very simple approach to the alliance formation process: a simultaneous game in which every NGO $i \in N$ announces an alliance A to which it would like to belong, where $A \in \mathcal{N}$, the set of all $2^n - 1$ non-empty alliances. For every profile of announcements $\alpha = (\alpha_1, \alpha_2, ..., \alpha_n)$ declared by the n NGOs, an alliance structure (i.e. a partition) $\mathcal{S} = (A_1, A_2, .., A_m)$, with $m \leq n$, is induced on the system. Clearly, the rule according to which an alliance structure $\mathcal{S}$ originates from a profile of announcements α is the key issue for predicting which alliances of NGOs will emerge in equilibrium. This rule depends on the institutional environment in which NGOs operate. For example, some countries (Netherlands, the UK) have introduced a quality label under which any NGO that satisfies certain minimal requirements (e.g. fundraising expenditures should not exceed a certain fraction of the total expenses of the organization). This corresponds to a relatively flexible rule, under which the fact that some organization do not satisfies the requirements of the

[5]Note that when the participants to an alliance are symmetric (as is the case of our model), the equal-sharing allocation rule can also be obtained endogenously by assigning to every participant, as in Hart and Kurz (1983), the Owen value (Owen 1977) for transferrable-utility games (i.e. the Shapley value with *a priori* coalition structures).

quality label does not imply the break-up of the entire quality label system. Another context in which, on the contrary, the fact that some organization exits the alliance leads to the break-up of the remaining alliance is the one in which NGOs put their productive assets into a common activity (e.g. during a humanitarian crisis) in a (highly) complementary fashion. In our model, this would correspond to a more restrictive rule (as explained below).

Analytically, one possibility is to assume that a particular alliance emerges if and only if all its (future) members announce exactly this particular alliance. We call this rule the *unanimity rule*.[6] Formally,

$$\mathcal{S}^U(\alpha) = \{A_1(\alpha), A_2(\alpha), ..., A_m(\alpha)\},$$

where, for every $i, j \in A_k(\alpha)$, $k = 1, ..., m$:

$$A_k(\alpha) = \begin{cases} A \text{ iff } \alpha_i = \alpha_j = A \\ \{i\}, \text{ otherwise.} \end{cases}$$

Another possibility is to assume that an alliance of NGOs emerges if and only if all its (future) members announce the same alliance A. This announced alliance may, in general, differ from the alliance that will form. We call this rule the *aggregative rule*.[7] Formally:

$$\mathcal{S}^A(\alpha) = \{A_1(\alpha), A_2(\alpha), ..., A_m(\alpha)\},$$

where, for every $i, j \in A_k(\alpha)$, $k = 1, ..., m$:

$$A_k(\alpha) = \begin{cases} A \text{ iff } \alpha_i = \alpha_j \\ \{i\}, \text{ otherwise.} \end{cases}$$

The two rules generate different partitions after a deviation from a given alliance structure by an NGO or by an alliance of NGOs. Under the unanimity rule, a deviation induces the remaining organizations in the alliance to split up into singletons. Contrarily, under the aggregative rule the remaining NGOs continue to stick together. All organizations understand this; therefore, the strategic incentives to announce a given alliance might differ under the two rules.

In our model (and, more generally, in most of the literature on coalition formation), the rules for forming coalitions of NGOs are exogenously given. In reality, however, the coalition-formation rules are themselves part of a larger collective decision-making process, and are, therefore, endogenously determined. The advantage of the *ad hoc* approach that we adopt lies in the fact that the two rules (unanimity and aggregative) correspond to the two institutional extremes and thus represent useful benchmarks.

Next, we can define the notion of stability of a given alliance structure. An alliance structure is stable when it is induced by an announcement profile that is a *Nash equilibrium*, or, alternatively, a *strong Nash equilibrium* (i.e. a Nash equilibrium profile of announcements robust to deviations by alliances) of a given game of alliance formation. With a slight abuse of notation, let $Q_i(\alpha) = Q_A(\overline{y}(\mathcal{S}(\alpha)))/a_k$ denote the payoff of every NGO at the fundraising equilibrium $\overline{y}$ played by every alliance of NGOs (which may also formed by an NGO playing as a singleton) when the alliance structure $\mathcal{S}(\alpha) = \{A_1, A_2, ., A_k, .., A_m\}$ has been induced by the profile of announcements $\alpha = (\alpha_1, \alpha_2, .., \alpha_n)$. Using this shortcut in notation, we are able to define two distinct concepts of stability of alliance structures.

[6]This rule was first introduced by von Neumann and Morgenstern (1944). Hart and Kurz (1983) denote it as the *gamma-rule*.

[7]Hart and Kurz (1983) denote it as the *delta-rule* of coalition formation.

Definition 1. *(Nash stability) The alliance structure $\mathcal{S} = \{A_1, A_2, ..., A_m\}$ is Nash-stable if $\mathcal{S} = \mathcal{S}(\alpha^*)$ for some α^*, such that there exist no organization $i \in N$ and announcement $\alpha'_i \in \mathcal{N}$ such that*

$$Q_i(\alpha'_i, \alpha^*_{N\backslash\{i\}}) > Q_i(\alpha^*).$$

Definition 2. *(Strong Nash stability) The alliance structure $\mathcal{S} = \{A_1, A_2, ..., A_m\}$ is strongly stable if $\mathcal{S} = \mathcal{S}(\widetilde{\alpha})$ for some $\widetilde{\alpha}$, such that there exists no alliance $A \subseteq N$ with an alternative profile of announcement α'_A such that*

$$Q_i(\alpha'_A, \widetilde{\alpha}_{N\backslash A}) \geq Q_i(\widetilde{\alpha}) \text{ for all } i \in A$$

and

$$Q_h(\alpha_A, \widetilde{\alpha}_{N\backslash A}) > Q_h(\widetilde{a}) \text{ for at least one } h \in A.$$

It is clear that $\alpha^* = (\alpha^*_1, \alpha^*_2, .., \alpha^*_n)$ corresponds to a Nash equilibrium of the announcement game and $\widetilde{\alpha} = (\widetilde{\alpha}_1, \widetilde{\alpha}_2, .., \widetilde{\alpha}_n)$ to a strong Nash equilibrium to the same game. Note also that the strong stability is a highly demanding stability concept. By requiring the Nash stability against every alternative profile of announcements (including the one formulated by the grandcoalition), it imposes the Pareto optimality on the resulting allocation.

3. Main Results

3.1. **Stable alliances of NGOs.** We are now ready to provide general results on the stability of given structures of alliances of NGOs. In particular, since the grandcoalition outcome is Pareto-efficient, we concentrate our analysis on the question of stability of the grandcoalition of NGOs. In other words, when do all the NGOs have an interest to coordinate their fundraising activity voluntarily, such that not even groups of NGOs have an incentive to separate away from the grandcoalition? When, on the contrary, is the grandcoalition inherently unstable?

Besides the grandcoalition, other alliance structures may also be coalitionally stable. However, since by definition a strongly stable alliance structure must be Pareto-optimal, no strongly stable alliance structures can be made of symmetric alliances only. This result is expressed in the next proposition. From this simple result, we derive two further important corollaries.

Proposition 1. *Regardless of the rule of alliance formation, no partition of NGOs $\mathcal{S}^E = \{A_1, A_2, ..., A_m\}$, such that every alliance possesses the same size (cardinality) $a_1 = a_2 = ... = a_k = ... = a_m$, can be strongly stable.*

Proof. We have assumed that, in every alliance A_k, each NGO receives the equal split payoff $Q_i = Q_{A_k}(\overline{y})/a_k$. Since in the symmetric alliance structure $\mathcal{S}^E$ the unique fundraising equilibrium profile $\overline{y} = (\overline{y}_1, \overline{y}_2, ..., \overline{y}_m)$ must be symmetric, $Q_{A_h}(\overline{y}) = Q_{A_r}(\overline{y})$ for every A_h, $A_r \in \mathcal{S}^E$ and $Q_i(\overline{y}) = Q_j(\overline{y})$ for every $i \in A_h$ and $j \in A_r$, i.e. every NGO obtains the same payoff. The efficiency of the profile y^e associated to the grandcoalition N implies, for every NGO $i \in N$,

$$Q_i(y^e) \geq Q_i(\overline{y})$$

and, for at least one $j \in N$,

$$Q_j(y^e) > Q_j(\overline{y}).$$

Note that by the continuity and strict concavity of every Q_i on y_i, compactness of every NGO's strategy set Y_i and then of $Y = (Y_1 \times Y_2 \times .. \times Y_n)$, the (efficient) cooperative profile y^e played by the grandcoalition, i.e.

$$y^e = \arg\max_{y \in Y_N} \sum_{i \in N} Q_i(F_i(y_i, y_{-i}), \tau_i(y_i)),$$

exists and is unique. Hence, $y^e \neq \overline{y}$, and since at $\overline{y}$ every NGO receives the same payoff, it must be that

$$\sum_{i \in N} Q_i\left(y^e\right) > \sum_{A_k \in \mathcal{S}^E} \sum_{i \in A_k} Q_i\left(\overline{y}\right),$$

Therefore, every NGO in $\mathcal{S}^E$ would gain by announcing $\alpha_i = \{N\}$ and forming the grandcoaliton, thus every symmetric alliance structure $\mathcal{S}^E$ different from N could be improved upon and can never be strongly stable. ■ □

Corollary 1. *The alliance structure with all NGOs as singletons is always Nash stable and never strongly stable.*

Proof. Follows directly from Proposition 1. □

Corollary 2. *Under the unanimity rule of alliance formation the grandcoalition of NGOs is always Nash stable.*

Proposition 1 helps to see that if stable confederations of NGOs different from the grandcoalition exist, they have to be made of asymmetric alliances, thus exploiting some sort of free-riding advantages in fundraising activities. Corollary 1 is an obvious consequence of proposition 1. Corollary 2 highlights the fact that since, under the unanimity rule, an individual NGO's decision to leave the grandcoalition breaks the alliance of the remaining NGOs completely, given that the grandcoalition allocation is efficient, it must also be Nash stable. What remains to be analyzed is under which circumstances the grandcoalition is *strongly* stable against asymmetric alliance structures. The sections that follow are devoted to finding the conditions that guarantee the strong stability of the grandcoalition of NGOs under both the unanimity and aggregative rules of alliance formation.

3.2. **Strong stability under the unanimity rule and strategic complements.** The first key feature for the strong stability of the grandcoalition of NGOs is the strategic complementarity of their fundraising activities. If the grandcoalition of NGOs works as a device to discipline the fundraising activity of every NGO, everyone can benefit from such a discipline. If a subcoalition of NGOs deviates from a joint agreement by increasing its fundraising activity and remaining NGOs increase their fundraising as well (strategic complementarity), then we can prove that no feasible asymmetric deviation pays off. We start by presenting a lemma that characterizes, under complementarity, the level of fundraising effort of every NGO in a Nash equilibrium of the game played between an alliance of NGOs that coordinate their activity and all remaining NGOs that act as singletons.[8]

Lemma 1. *Let the fundraising activities of NGOs be strategic complements. Then, at the fundraising equilibrium associated with any alliance structure made of one alliance and all remaining NGOs as singletons, the following condition holds: if fundraising activity of every NGO imposes negative (positive) externalities on other NGOs, then an NGO that belongs to the alliance exerts a lower (higher) fundraising effort than every singleton NGO.*

[8]The Lemmata that follow exploit the logic akin to that in Currarini and Marini (2006).

Proof. See Appendix. □

The economic meaning of Lemma 1 is the following. Let the structure of alliances that has formed at Stage 1 be formed by only one alliance with several NGOs plus all remaining NGOs acting alone. Moreover, suppose that the marginal benefit of fundraising by an NGO increases when other NGOs increase their fundraising levels. Then, at the equilibrium of the second-stage game, if fundraising by one NGO imposes a *negative* externality on the output of other NGOs, any organization inside the alliance chooses a lower level of fundraising as compared to the organizations that are outside the alliance. If, instead, fundraising by one NGO imposes a *positive* externality on the output of other NGOs, any organization inside the alliance chooses a higher level of fundraising as compared to those outside the alliance.

The intuition for this result is simple: NGOs inside the alliance choose their fundraising efforts so as to internalize the externality that they impose on each other's output. However, no such internalization of externalities occurs outside the alliance. Under negative externalities, this implies that the outsiders disregard the negative impact that their actions impose on other NGOs and thus engage in more fundraising than the alliance members. Under positive externalities, given that the actions of alliance members create positive effects also on the *outsiders*' output, the outsiders free-ride to some extent on the actions of alliance members, thus putting lower fundraising effort than the NGOs inside the alliance.

Lemma 1 also allows us to compare the payoffs of NGOs inside and outside the alliance at the fundraising equilibrium. We characterize this in the following

Lemma 2. *Let the fundraising activities of NGOs be strategic complements. Then at any alliance structure made of one alliance and all remaining NGOs as singletons, every NGO inside the alliance obtains a lower payoff than any NGO acting alone.*

Proof. See Appendix. □

Lemma 2 establishes that at the fundraising equilibrium of the second-stage game, any organization belonging to the alliance produces a lower project output as compared to an NGO that does not belong to the alliance. The intuition comes from the fact that the discipline necessary to internalize the externalities is individually costly (in terms of output) and the NGOs outside the alliance avoid bearing this cost.

We can now show that under the unanimity rule of alliance formation, strategic complementarity represents the key condition for the stability (against a deviation by any group of NGOs) of the grandcoalition of NGOs.

Proposition 2. *Let the fundraising activities of NGOs be strategic complements and alliance formation occur by unanimity rule. Then, the grandcoalition of NGOs is strongly stable.*

Proof. Suppose that a group of NGOs $A \subset N$ could deviate *profitably* from $\{N\}$ with an alternative announcement $\alpha'_i = \{A\}$ of all its members, inducing, by the unanimity rule, the alliance structure $\mathcal{S}^U\left(\alpha'_A, \widetilde{\alpha}_{N\setminus A}\right) = (\{A\}, \{j\}_{j\in N\setminus A})$. As a result, it must be that, for every $i \in A$,

$$Q_i(\overline{y}) > Q_i(y^e), \tag{3.1}$$

where $Q_i(y^e)$ indicates the payoff obtained by every NGO at the (efficient) cooperative profile y^e played by the grandcoalition, By Lemmata 1 and 2 at the fundraising equilibrium $\overline{y}$ associated with the alliance structure $\mathcal{S} = (\{A\}, \{j\}_{j\in N\setminus A})$ we have

$$Q_j(\overline{y}) \geq Q_i(\overline{y}),$$

and, by expression (3.1), for every $j \in N \backslash A$ playing as singleton

$$Q_j(\overline{y}) > Q_i(y^e). \tag{3.2}$$

Therefore

$$\sum_{i \in A} Q_i(\overline{y}) + \sum_{j \in N \backslash A} Q_j(\overline{y}) > \sum_{i \in N} Q_i(y^e),$$

which contradicts the efficiency of the grandcoalition strategy profile y^e. □

Intuitively, the argument runs as follows. A group of NGOs (or one NGO) have an interest in deviating from the grandcoalition only if by doing so it obtains a higher payoff. However, under the unanimity rule, this deviation implies that the remnant of the grandcoalition breaks down into singleton NGOs. In this case, we find ourselves in the second-stage game with the alliance structure described by Lemmata 1 and 2. Lemma 2 has shown that the non-deviant NGOs (which now find themselves as singletons) are better off than those in the deviating group. However, this would mean that the sum of payoffs of organizations in deviating and non-deviant groups must be higher than the sum of payoffs in the grandcoalition, which is impossible because the grandcoalition structure is Pareto-efficient.

Proposition 2 underlines the role that the unanimity rule and the strategic complementarity of fundraising efforts of NGOs play for the (strong) stability of the NGO coordination. The role of the unanimity rule lies in making sure that the deviation by a group from the grandcoalition automatically implies that the deviating group finds itself playing against a set of singleton organizations in the second-stage game. By itself, this is not sufficient to kill the incentive (by a *group* of NGOs) to deviate. For this, we need, in addition, strategic complementarity. It guarantees that given that the deviating group changes its behavior, the non-deviant organizations change their behavior in the same direction, and this greatly hurts the deviating group, making sure that the incentive to deviate is absent.

In terms of real-life behavior of NGOs, this result tells us the following. The NGO confederations are often organized in such a way that a break-up of a confederation would occur by several NGOs separating away and taking with them some key assets of the confederation (e.g. the brand name, the key contacts in the government or large foundations). In this case, what can prevent such break-ups is the way in which fundraising functions in the NGO sector. If the break-up would induce the remaining NGOs to increase their fundraising efforts, then the separating NGOs would be seriously hurt by such intensification of fundraising competition. This is sufficient to prevent the dissolution of the large-scale confederations of NGOs.

Proposition 2 is particularly important for the real-life applications in the NGO world, because the crucial threat for NGO confederations is not that single members might exit the confederation; it is that the break-away might be organized jointly by several member organizations. Often, this threat intensifies when there is a generational change in the leadership of one or several organizations, and the founding leaders of the confederation are no longer key decision-makers. Proposition 2 tells us that as far as there is enough strategic complementarity in fundraising efforts, the risk of such break-away is minor.

This strategic complementarity in fundraising is likely to be related to the elasticity of donations pool to the overall fundraising effort, i.e. how likely the fundraising efforts by NGOs attract new donors (as compared to competing for the existing ones). Aldashev and Verdier (2010) show that when the pool of donations is fixed, NGO fundraising efforts are strategic complements, while when fundraising attracts also new donors (e.g. by raising awareness), fundraising efforts become strategic complements. In the next sub-section, we study the stability of the grandcoalition under strategic substitutes.

3.3. **Strong stability under the unanimity rule and strategic substitutes.** What happens, instead, when the fundraising efforts of NGOs are not strategic complements but substitutes? Suppose, for instance, that the break-away group of NGOs increase their fundraising effort and each remaining NGO finds it individually optimal to decrease its fundraising? In this case, the menace of the break-up is likely to be more serious, as the break-away group is unlikely to be hurt as seriously as in the case of strategic complementarities. Nevertheless, the grandcoalition can still be strongly stable. We prove in this sub-section that under the unanimity rule of alliance formation, even after removing strategic complementarity of fundraising efforts, the grandcoalition remains strongly stable, under the additional requirement that the individual best-reply function of an NGO to any deviation in the fundraising efforts of its' rivals satisfies the contraction property.[9]

Lemma 3. *At the fundraising equilibrium associated with any alliance structure made of one alliance and all remaining NGOs as singletons, the following condition holds: for every NGO i belonging to alliance A, we have that: (i)* $r_i\left(\overline{y}_{A\setminus\{i\}}, \overline{y}_{N\setminus A}\right) \leq \overline{y}_i$ *under positive externalities, and (ii)* $r_i\left(\overline{y}_{A\setminus\{i\}}, \overline{y}_{N\setminus A}\right) \geq \overline{y}_i$ *under negative externalities, where* $r_i(.)$ *denotes the individual best-reply of every NGO* $i \in A$.

Proof. See Appendix. □

Lemma 3 makes an out-of-equilibrium statement. Take any alliance structure made of one alliance plus singletons, and consider an individual NGO inside the alliance. Given this particular alliance structure, the Lemma states that if every single NGO belonging to alliance A were to play according to its individual best-reply, then, under negative externalities, the fundraising level that it would choose in the second-stage game would be higher than the level that it chooses being inside the alliance and coordinating its behavior with the alliance members. Under positive externalities, the opposite is true: this NGO's hypothetical fundraising would be lower than the level it chooses cooperatively inside the alliance.

The economic intuition of this Lemma is relatively straightforward and similar to that of Lemma 1. The NGO playing "as if" it were alone would not internalize the externality that it imposes on the NGOs remaining inside the alliance. Thus, under negative (positive) externalities, this free-riding NGO would choose a higher (lower) fundraising level as compared to its level inside the alliance. Note that, contrarily to Lemma 1, this result does not require that NGOs' fundraising efforts are strategic complements.

Our preparatory lemma now allows us to prove the following key result.

Proposition 3. *Let every NGO's best-reply function be a contraction. Then, under the unanimity rule of alliance formation, the grandcoalition is strongly stable.*

Proof. See Appendix. □

The best reply of an NGO to a change in the strategy by any other NGO being a contraction implies, for the strategic substitutes case, that an increase in fundraising by an NGO is matched by a smaller-size decrease in fundraising by other NGOs. Proposition 3 states that

[9]The best-reply $r_i(y_{-i}) = \arg\max_{y_i} Q_i(y_{-i})$, of every NGO $i \in N$ respects the contraction property when, for every $y_{-i}, y'_{-i} \in \mathbb{R}^{n-1}$, $\left\|r_i(y_{-i}) - r_i\left(y'_{-i}\right)\right\| \leq \beta \left\|y_{-i} - y'_{-i}\right\|$, with $\beta < 1$ and $\|.\|$ defining the Euclidean norm on space $\mathbb{R}^{n-1}$. See the Appendix for more details.

in this case (and if the alliances are formed under the unanimity rule) no group of NGOs has an incentive to jointly deviate from the grandcoalition.

The economic intuition is as follows. Let a group of NGOs decide to break out of the grandcoalition. Under the unanimity rule, they find themselves playing (in the second stage) against singleton NGOs. Under strategic substitutes (and the best-reply functions being contractions), the reaction of any singleton NGO to the change in fundraising by NGOs inside the alliance (as compared to their fundraising under grandcoalition) is to change its fundraising effort in the opposite direction, but by a smaller amount. However, under such a change and under positive or negative externalities, the NGOs outside the alliance still choose their fundraising levels without internalizing their effect on the NGOs inside the alliance. Then, similarly to Lemma 2, the output of an NGO outside the alliance is still higher than that of an alliance member. This means that it is impossible for any group of NGOs to jointly increase their output as compared to that under the grandcoalition.

This finding implies that strategic complementarity is not crucial for killing the incentive of a group of NGOs to break the grandcoalition. The interests of the break-away group are damaged sufficiently by the fact that under the best-reply functions being contractions, the singleton NGOs do not change their fundraising levels sufficiently to internalize the externality that they impose on the break-away alliance members. However, it remains crucial that the groups of NGOs are formed by the unanimity rule: the break-away group must be facing the set of singleton NGOs for the damage described above to serve as a menace.

In real-life applications, sometimes an increase in one NGO's fundraising might induce other NGOs to reduce their fundraising. This occurs, for example, when an aggressive fundraising campaign by an NGO forces other NGOs to retreat or to switch to searching for other donors. In this case, the NGOs' actions are strategic substitutes. This might put the stability of grandcoalition in danger. Proposition 3 says that as far as the absolute size of such reaction by other NGOs is not bigger than the increase in fundraising by the "aggressor" NGO, the stability of the grandcoalition is not at risk.

3.4. **Stability under the aggregative rule.** What happens if the alliance formation between NGOs occurs via a rule different from the unanimity rule? A plausible alternative is the aggregative rule, under which a deviation by an NGO or a group of NGOs from a given alliance induces the remaining organizations in the alliance to continue to stick together, contrarily to the unanimity rule. Clearly, the strategic incentives to announce a given alliance differs under the two rules.

In this section, we extend some of the results obtained above for the unanimity rule of alliance formation to the aggregative rule. This can be done by noting that if the stability of the grandcoalition holds under unanimity, it must hold *a fortiori* when forming alliances hurts, for some reason, the remaining players (i.e. under what we define below more formally as negative *coalitional externalities*). When, instead, coalitional externalities are positive, the aggregative rule of alliance formation makes the full cooperation between NGOs more difficult than under the unanimity rule. Let us first define the concept of coalitional externality.

Definition 3. *Positive (negative) coalitional externalities among NGOs are present if for every feasible alliance structure* $\mathcal{S}$ *and alliance* $A \in \mathcal{S}$, $Q_i(y(\mathcal{S}')) > Q_i(y(\mathcal{S}))$ $(Q_i(y(\mathcal{S}')) < Q_i(y(\mathcal{S})))$ *for every* $i \in A$, *where* $\mathcal{S}'$ *is obtained from* $\mathcal{S}$ *by simply merging alliances of NGOs in* $\mathcal{S}\setminus\{A\}$.

In a symmetric setting what is required for coalitional externalities to hold is the presence of synergies for NGOs participating to a given alliance. This occurs, for instance, if there exist economies of scale in fundraising or in other common activities that, by reducing the alliance members' costs, hurt in some way all remaining NGOs outside the alliance. From the above definition it follows that under *negative coalitional externalities*, for every NGO $i \in A$,

$$Q_i\left(\overline{y}\left(\mathcal{S}^U\right)\right) > Q_i\left(\overline{y}\left(\mathcal{S}^A\right)\right),$$

where $\mathcal{S}^U = \left(\{A\}, \{j\}_{j \in N \backslash A}\right)$ and $\mathcal{S}^A = (\{A\}, \{N \backslash A\})$. This fact explains the natural extension of some of the results obtained above to the aggregative rule.

Corollary 3. *If negative coalitional externalities hold for all NGOs, the grandcoalition of NGOs is always Nash stable under the aggregative rule of alliance formation.*

Proof. From Corollary 2 we know that the grandcoalition of NGOs is always Nash stable under the unanimity rule. With negative coalitional externalitiees this must, *a fortiori,* holds under the aggregative rule. □

The strong stability of the grandcoalition under the aggregative rule is in general not as straightforward as the Nash stability. This is because we cannot be sure that Lemmata 1 - 3 still hold in presence of positive synergies in alliances of NGOs that, in turn, yield negative coalitional externalities. Lemmata 1-3 jointly show that NGOs operating as singletons are better off than NGOs in alliances, therefore proving that, in the absence of synergies, there are positive (rather than negative) coalitional externalities among NGOs.

However, in one case the strong stability under the unanimity rule extends to the aggregative rule. This occurs when only a majority of NGOs can deviate from the grandcoalition of NGOs. If the decision to dissolve the grandcoalition must be taken by *a majority* of its members, then every deviating alliance of NGOs by definition consists of a number of members greater or equal than $|N|/2$.[10]

Definition 4. *A majority breaking protocol holds in any arbitrary alliance of NGOs $A \subset N$ if and only if the decision to deviate from A must be taken by the majority of its members, i.e. by every $A' \subset A$ with $|A'| \geq |A|/2$.*

We can show that Lemmata 1 and 3 easily apply to every alliance structure $\mathcal{S}^A = (\{A\}, \{N \backslash A\})$, in which $|A| \geq |N|/2$. In this case, in every alliance structure $\mathcal{S}^A$ the following results hold: (i) $\overline{y}_i \leq \overline{y}_j$ under negative externalities in fundraising, and (ii) $\overline{y}_i \geq \overline{y}_j$ under positive externalities in fundraising, for every NGO $i \in A$ and $j \in N \backslash A$.[11] As a result, Lemma 2 can also be applied and, therefore, $Q_i\left(\overline{y}\left(\pi^A\right)\right) \leq Q_j\left(\overline{y}\left(\pi^A\right)\right)$, for every NGO $i \in A$ and $j \in N \backslash A$. This implies, in turn, the following

Proposition 4. *Let the fundraising activities of NGOs be strategic complements and a majority breaking protocol hold in N. Then, under the aggregative rule of alliance formation, the grandcoalition of NGOs is strongly stable.*

[10]Any game of coalition formation based on a unanimity or aggregative rule can be constrained to a majority protocol by simply restricting the coalitional payoff of every coalition $A \subset N$ to be equal to zero for $|A| < |N|/2$ as happens in majority games. A good discussion of this point can be found in Ray (2007), p. 289.

[11]To economize on space, we omit these proofs. They are available upon request.

Proof. Follows directly from Proposition 2 and Definition 4. □

Proposition 5. *Let every NGO's best-reply be a contraction and a majority breaking protocol hold in N. Then, under the aggregative rule of alliance formation, the grandcoalition of NGOs is strongly stable.*

Proof. Follows directly from Proposition 3 and Definition 4. □

Table 1 resumes the taxonomy of the results that we have obtained.

[Table 1 about here]

4. An illustrative example

Next, we present a simple specific example of the results obtained in the previous section. Let NGO revenues coming from donations be

$$R_i(y_i, y_{-i}) = p(y)D\left(y_i, y_{-i}\right). \tag{4.1}$$

Here, $D\left(y_i, y_{-i}\right)$ is the total amount that NGOs raise from donors and

$$\begin{cases} p(y) = \frac{y_i}{\sum_{i\in N} y_i} \text{ for } \sum_{i\in N} y_i > 0 \\ \quad \text{and } \frac{1}{|N|} \text{ otherwise} \end{cases} \tag{4.2}$$

represents a contest-success function typical of rent-seeking games (see Tullock 1987). Note that the (fundraising) effort of every NGO affects the possibility to access a share of the amount of donations $D\left(y_i, y_{-i}\right)$ coming from the public. This amount can either be fixed (representing thus a rival private good) or increasing in NGOs' fundraising efforts. Here, we can simply assume:

$$D\left(y_i, y_{-i}\right) = \left(\sum_{i\in N} y_i\right)^{\theta} \tag{4.3}$$

and therefore for $\theta = 0$, total donations are independent of fundraising, possessing therefore the features of a rival private good, while for $\theta > 0$, they increase in proportion of NGOs' total fundraising. Using (4.2) and (4.3), every NGO's revenue function can be expressed as

$$R_i(y_i, y_{-i}) = y_i\left(\sum_{i\in N} y_i\right)^{\theta-1} \tag{4.4}$$

and, given the non-distribution constraint, the funds that an NGO can invest into its project are

$$F_i(y_i, y_{-i}) = (1-c)y_i\left(\sum_{i\in N} y_i\right)^{\theta-1} - f, \tag{4.5}$$

with $c < 1$ and $f < (1-c)y_i\left(\sum_{j\in N} y_i\right)^{\theta-1}$.

Let's assume a Cobb-Douglas production function for each NGO's project output:

$$Q = F_i(y_i, y_{-i}) \cdot \tau_i(y_i). \tag{4.6}$$

Then, from (4.6) and (4.5) we obtain, for every $i = 1, 2, .., n$

$$Q_i = \left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{\theta-1} - f\right](1-y_i). \tag{4.7}$$

In the Appendix we show that (4.7) is concave if the value of the parameter θ is sufficiently low. Moreover, the production function exhibits negative (positive) externalities in fundraising for $\theta < 1$ (> 1). Deriving the slope of NGOs' best-reply functions is somewhat more complicated (see the Appendix).

A relatively simple case is that of constant total donations, $\theta = 0$. This is a case with negative externalities in fundraising, in which the output of an NGO is simply given by

$$Q_i = \left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_i).$$

Below, we analyze this case to check the Nash and strong Nash stability of the grandcoalition.

4.1. **Nash stability of the NGO coordination.** When NGOs play non-cooperatively, each of them pursues the following objective function

$$\max_{y_i\in Y_i} Q_i = \left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_i).$$

The first-order condition for an interior equilibrium is given by

$$\frac{\partial Q_i}{\partial y_i} = (1-c)\left(\left(\sum_{j\neq i} y_j\right)\left(\sum_{i\in N} y_i\right)^{-2}\right)(1-y_i) - \left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right] = 0,$$

for every $i \in N$. Applying the symmetry, this yields the non-cooperative fundraising level

$$\overline{y}_i = \frac{(1-c)(n-1)}{(1-c)(2n-1) - fn},$$

with a payoff of every NGO equal to

$$Q_i(\overline{y}) = \left[(1-c)\frac{1}{n} - f\right](1-\overline{y}_i). \tag{4.8}$$

Instead, in the grandcoalition, every NGOs faces the following problem

$$\max_{y_i\in Y_i} \sum_{i\in N} Q_i \quad \text{or} \max_{y_i\in Y_i} \sum_{i\in N}\left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_i),$$

where

$$\sum_{i\in N} Q_i = \sum_{i\in N}\left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_i) = ((1-c)-nf)(1-y_i).$$

Clearly, when $(1-c)\frac{1}{n} - f \neq 0$, this expression is maximized for the efficient profile $y^e = (0, 0, ..., 0)$.

This corresponds to the result that we have proven in Lemma 1, i.e. that the fully cooperative level of fundraising is lower than the non-cooperative level under negative externalities in fundraising (here, $\theta < 1$). Every NGO in the grandcoalition receives

$$Q_i(y^e) = \frac{1}{n}((1-c)-nf)(1-y_i^e) = (1-c)\frac{1}{n} - f,$$

which is clearly greater than the individual non-cooperative output (4.8). Therefore, the Nash stability of the grandcoalition holds.

4.2. **Strong stability of the NGO coordination.** To check for the strong stability under the unanimity rule, let us first imagine that a group of NGOs $A \subset N$ decides to deviate from the discipline imposed by the grandcoalition. This group of NGOs will, therefore, become the competitor to its previous allies in the donation market, thus facing the following maximization program:

$$\max_{y_A \in Y_A} Q_A\left(y_A, y_{N\backslash A}\right) = \max_{y_i \in Y_i} \sum_{i \in A} \left[(1-c)y_i \left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_i).$$

The first-order condition for every $i \in A$ is

$$\frac{\partial Q_A}{\partial y_i} = \frac{(1-c)(1-y_i)\sum_{h\neq i} y_h}{\left(\sum_{i\in N} y_i\right)^2} - \left[(1-c)y_i\left(\sum_{i\in N} y_i\right)^{-1} - f\right] - \frac{(1-c)(1-y_r)\sum_{r\in A\backslash\{i\}} y_r}{\left(\sum_{i\in N} y_i\right)^2} = 0. \tag{4.9}$$

By the unanimity rule, once A has left N, the remaining NGOs in $N\backslash A$ become singletons and maximize their individual payoffs. This implies, for every $j \in N\backslash A$,

$$\max_{y_j \in Y_j} Q_j(y_A, y_{N\backslash A}) = \max_{y_j \in Y_j} \left[(1-c)y_j \left(\sum_{i\in N} y_i\right)^{-1} - f\right](1-y_j),$$

with the first-order condition

$$\frac{\partial Q_j}{\partial y_j} = \frac{(1-c)(1-y_j)\sum_{h\neq j} y_h}{\left(\sum_{i\in N} y_i\right)^2} - \left[(1-c)y_j\left(\sum_{i\in N} y_i\right)^{-1} - f\right] = 0. \tag{4.10}$$

Given that the NGOs being in the same situation play the same strategy, (4.9) and (4.10) can be rearranged as

$$\begin{cases} \frac{\partial Q_A}{\partial y_i} = \frac{(1-c)(1-y_i)(n-a)y_j}{(ay_i+(n-a)y_j)^2} - \left[\frac{(1-c)y_i}{(ay_i+(n-a)y_j)} - f\right] = 0, \\ \frac{\partial Q_j}{\partial y_j} = \frac{(1-c)((1-y_j)((n-a-1)y_j+ay_i))}{(ay_i+(n-a)y_j)^2} - \left[\frac{(1-c)y_j}{(ay_i+(n-a)y_j)} - f\right] = 0. \end{cases} \tag{4.11}$$

Now, we can easily see that to respect (4.11), both fundraising levels - those of NGOs in the alliance A and those of NGOs acting as singletons - must be such that $y_i < y_j$. In fact, suppose, by contradiction, that either $y_i > y_j$ or $y_i = y_j$. After straightforward calculations on (4.11), we get

$$(1-y_i)(n-a)y_j > (1-y_j)((n-a-1)y_j + ay_i),$$

implying that

$$(n-a)y_j > (n-a-1)y_j + ay_i,$$

and, thus,

$$a < \frac{y_j}{y_i} < 1.$$

This leads to a contradiction, since $a = |A| \geq 1$. Equal fundraising efforts $y_i = y_j$ can obtained only when all NGOs are singletons, i.e. when $a = 1$. Therefore, in our case, under negative externalities in fundraising, it must hold that $y_i < y_j$. We therefore know that in this case, by Lemma 2, every NGO in alliance A is worse off than any NGO playing alone. By the efficiency of the grandcoalition, this makes impossible to profitably deviate from N (Proposition 2). This shows the strong stability of the grandcoaliton under the unanimity rule.

What about the strong stability of N under the more demanding aggregative rule? We can construct a simple numerical examples showing that when the number of NGOs increases, such strong stability may easily fail to exist. For instance, assuming $c = 0.1$ and $f = 0$, the strong stability of the full coordination holds for $n = 3$. It is straightforward (see Appendix) to calculate the payoff of every NGO i that belongs to the deviating alliance A when the size of the deviating alliance is $a = 2$, as

$$Q_i\left(\overline{y}_A, \overline{y}_{N/A}\right) = 0.177,$$

and when an NGO deviates as a singleton ($a = 1$)

$$Q_i\left(\overline{y}_i, \overline{y}_{N/\{i\}}\right) = 0.209,$$

while the egalitarian payoff of every NGO in the grandcoalition is given by

$$Q_i\left(y^e\right) = 0.3.$$

Contrarily, strong stability no longer holds, for instance, for $n = 7$ and $a = 1$, since in this case, under the aggregative rule, every $i \in A$ obtains a payoff higher than the amount gained in the grandcoalition

$$Q_i\left(\overline{y}_A, \overline{y}_{N/A}\right) = 0.133 > Q_i\left(y^e\right) = 0.128\,.$$

The majority breaking protocol described by definition can repair this instability. Using the intra-group symmetry of all $i \in A$ and $j \in N\backslash A$ (now playing together), the first-order conditions under the aggregative rule of alliance formation can be written as

$$\left\{\begin{array}{l} \frac{\partial Q_A}{\partial y_i} = \frac{(1-c)(1-y_i)(n-a)y_j}{(ay_i+(n-a)y_j)^2} - \left[\frac{(1-c)y_i}{(ay_i+(n-a)y_j)} - f\right] = 0, \\ \frac{\partial Q_{N\backslash A}}{\partial y_j} = \frac{(1-c)(1-y_j)ay_i}{(ay_i+(n-a)y_j)^2} - \left[\frac{(1-c)y_j}{(ay_i+(n-a)y_j)} - f\right] = 0. \end{array}\right. \tag{4.12}$$

Again, it is easy to show that if under negative externalities in fundraising $y_i > y_j$, then, by (4.12), we obtain the following expression

$$\frac{y_j}{y_i} > \frac{a}{(n-a)},$$

which contradicts the fact that, under the majority rule, $a > (n-a)$.[12] Therefore, under negative externalities in fundraising and the aggregative rule of alliance formation, it must be true that at any deviation of a given alliance A, $y_i < y_j$ for every $i \in A$ and $j \in N\backslash A$. Then, Propositions 4 and 5 apply, thus implying the strong stability of the grandcoalition. In this example we have also shown that under negative externalities and two groups of NGOs competing for donations, it is the smaller group that exerts the higher effort.[13]

5. Conclusion

This paper studies the stability of coordination between mission-driven NGOs that compete for donations via fundraising activities and, possibly, impose externalities on each other's output. Using a non-cooperative game-theoretic model of alliance formation, we derive general results on stability (individual and coalitional) of full coordination under two classes of alliance-formation rules: unanimity and aggregative. We show how this stability depends,

[12] We also obtain that $y_i = y_j$ for $a = n/2$.

[13] This result confirms the seminal contribution by Olson (1965), that postulates that in a competition for resources, smaller groups can be more effective than bigger groups. See also Esteban and Ray (2001) and Bloch (2009) for a discussion of the various cases.

on the one hand, on the rule of alliance formation, and, on the other hand, on the strategic complementarity/substitutability of NGOs' fundraising activities.

Understanding how these two features influence the stability of NGO coordination allows for the formulation of a policy framework aimed at facilitating the cooperation between NGOs. The two broad classes of alliance-formation rules that we analyze capture the institutional characteristics of the NGO self-regulation that has emerged in different countries or sectors. The policy implications of our analysis are the following. First, public policies that affect the strategic interaction between NGOs, and, in particular, the degree of strategic complementarity/substitutability of NGOs' fundraising actions (e.g. matching grants or tax deductibility of donations) can be used to enhance NGO cooperation. Second, the effectiveness of these policies crucially depend on the alliance-formation rule, i.e. on the institutional characteristics of the self-regulation of the NGO sector. The policies that work best in an environment with NGO quality labels are different from those that should be used in the case of umbrella organizations.

Two further caveats are worth mentioning. The discussion of efficiency throughout the model assumes that we look at the efficiency taking only the payoffs of NGOs into account. The beneficiaries of the NGO projects are not portrayed explicitly. It is quite possible that in more complete model (i.e. the one that includes the beneficiaries as active players), the analysis efficiency substantially differs from the one developed here. For instance, in a setting with the Samaritan's dilemma (Buchanan 1975), the efficient output level by the NGOs would be lower than the one derived here. Secondly, while the fundraising function in the example worked out in Section 4 is in reduced form, it can easily be built up from more explicit microfoundations, as is done by Aldashev and Verdier (2009, 2010) based on imperfect information story between the donors and NGOs.

Our analysis has two limitations. In line with the current literature on non-cooperative models of coalition formation, we consider the alliance-formation rules as exogenous. While this gives us substantial mileage in deriving general analytical results, we have to leave aside the questions about how these rules emerge and why NGOs in different countries and sectors agree on different forms of coordination. Another (and more technical) limit is our reliance on the ex ante symmetry between NGOs. Deriving general results with asymmetric players is a formidable task; however, studying the stability of NGO cooperation in specific settings with asymmetric NGOs might help to explore the robustness of our general findings under symmetry.

Our results call for several promising extensions. First of all, one can compare different forms of coordination (i.e. stable equilibria emerging under different alliance-formation rules). This can be done using our approach and building on the descriptive work by Gugerty (2008) and Gugerty and Prakash (2010). Such analysis should deliver novel insights on the relative performance of these coordination forms. Second, we need a more precise analysis of how different policy instruments affect the strategic incentives of NGOs and thus the stability of their coordination. Andreoni and Payne (2003) and Scharf (2010) study the effect of government policies (such as direct grants and tax deductibility of donations) on the competitive environment of the non-profit sector. Using our approach, their analyses can be extended to investigate the stability of non-profit coordination. Finally, while our paper concentrates on the NGO interaction along the fundraising dimension, there are several other key dimensions along which NGO compete and (possibly) coordinate (e.g. location of field operations (Koch 2007), emphasis on urgency versus long-run development (Brown and

Minty 2006)). Sommers (2000) provides a detailed overview. Our general framework can be easily adapted to these specific dimensions.

6. Appendix

Proof of Lemma 1

We need to show that when $Q_i(y_i, y_{-i})$ exhibits increasing differences in $(y_i, y_{-i}) \in Y_i \times Y_{-i}$, at the fundraising equilibrium $\overline{y}$ played by every alliance structure of the form

$$\mathcal{S} = (\{A\}, \{j\}_{j \in N \setminus A})$$

the following holds: (i) negative externalities in fundraising $\left(\frac{\partial Q_j}{\partial y_i} \leq 0\right)$ imply that the fundraising level of every NGO in alliance $i \in A$ and every NGO acting as singleton $j \in N \setminus A$ are such that $\overline{y}_i \leq \overline{y}_j$; (ii) positive externalities in fundraising $\left(\frac{\partial Q_j}{\partial y_i} \geq 0\right)$ imply that $\overline{y}_i \geq \overline{y}_j$ for every $i \in A$ and $j \in N \setminus A$.

Proof of (i): Suppose by contradiction that, for every $i \in A$ and $j \in N \setminus A$, $\overline{y}_i > \overline{y}_j$ under negative externalities. By strict concavity of NGO's payoff $Q_i(\overline{y})$, if one NGO in A were to switch to an effort equal to $\overline{y}_j < \overline{y}_i$, the derivative of Q_i with respect to y_i at the equilibrium would be such that

$$\frac{\partial Q_i(\overline{y})}{\partial y_i} < \frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{N\setminus A}\right)}{\partial y_i}, \tag{6.1}$$

where $\overline{y} = \left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{N\setminus A}\right)$ denotes the fundraising equilibrium level with one NGO in A exerting the fundraising level $\overline{y}_j$ of a singleton NGO $j \in N \setminus A$ instead of $\overline{y}_i$, while all remaining NGOs in A (denoted now as the alliance $A \setminus \{i\}$) playing $\overline{y}_i$ as before. Next, by the property of increasing differences assumed for $Q_i(y_i, y_{-i})$, we have that

$$\frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{N\setminus A}\right)}{\partial y_i} \leq \frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{(N\setminus A)\setminus\{j\}}, \overline{y}_i\right)}{\partial y_i}, \tag{6.2}$$

where $\overline{y} = \left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{(N\setminus A)\setminus\{j\}}, \overline{y}_i\right)$ denotes the equilibrium fundraising level with NGO $i \in A$ exerting the fundraising level $\overline{y}_j$ instead of $\overline{y}_i$ and one NGO $j \in N \setminus A$ now switching to the fundraising level $\overline{y}_i > \overline{y}_j$. Using the fact that NGOs are all identical *ex ante* and, therefore, their payoffs are symmetric,[14] we also can write

$$\frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\setminus\{i\}}, \overline{y}_{(N\setminus A)\setminus\{j\}}, \overline{y}_i\right)}{\partial y_i} = \frac{\partial Q_j\left(\overline{y}_i, \overline{y}_{A\setminus\{i\}}, \overline{y}_{(N\setminus A)\setminus\{j\}}, \overline{y}_j\right)}{\partial y_j}, \tag{6.3}$$

which, by definition, corresponds to the equilibrium first-order condition of every NGO $j \in N \setminus A$ playing as singleton,

$$\frac{\partial Q_j\left(\overline{y}_i, \overline{y}_{A\setminus\{i\}}, \overline{y}_{(N\setminus A)\setminus\{j\}}, \overline{y}_j\right)}{\partial y_j} = \frac{\partial Q_j(\overline{y})}{\partial y_j} = 0. \tag{6.4}$$

Together, the expressions (6.1)-(6.4) imply that

$$\frac{\partial Q_i(\overline{y})}{\partial y_i} < 0,$$

[14]Symmetric payoffs imply, for every $i, j \in N$, that $Q_i\left(y_i, y_j, y_{N\setminus\{i\cup j\}}\right) = Q_j\left(y_j, y_i, y_{N\setminus\{i\cup j\}}\right)$.

i.e., that

$$\frac{dQ_i(\overline{y})}{dy_i} = \frac{\partial Q}{\partial F}\frac{dF_i}{dy_i} + \frac{\partial Q}{\partial \tau_i}\frac{d\tau_i}{dy_i} < 0 \tag{6.5}$$

for every $i \in A$. Therefore, since negative externalities in fundraising imply in (6.5) that

$$\sum_{j \in A_k \backslash \{i\}} \frac{\partial Q}{\partial F_j}\frac{dF_j}{dy_i} \leq 0,$$

the condition (6.5) is contradicted.

Proof of (ii): This proof follows the same logic as in (i). Again, by contradiction, assume that, for every $i \in A$ and $j \in N\backslash A$, $\overline{y}_i < \overline{y}_j$ under positive externalities. By strict concavity of NGO's payoff (first inequality), increasing differences (second inequality) and symmetric payoffs (first equality) and the equilibrium first-order conditions of every $j \in N\backslash A$ playing as singleton (second equality), we obtain

$$\begin{aligned} \frac{\partial Q_i(\overline{y})}{\partial y_i} &> \frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right)}{\partial y_i} \geq \frac{\partial Q_i\left(\overline{y}_j, \overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right)}{\partial y_i} = \\ &= \frac{\partial Q_j\left(\overline{y}_i, \overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_j\right)}{\partial y_j} \equiv \frac{\partial Q_j(\overline{y})}{\partial y_j} = 0 \end{aligned}$$

for every $i \in A$. Therefore, since positive externalities imply in (6.5) that

$$\sum_{j \in A_k \backslash \{i\}} \frac{\partial Q}{\partial F_j}\frac{dF_j}{dy_i} \geq 0,$$

the condition (6.5) is contradicted. ■

Proof of Lemma 2

We have to prove that at a fundraising equilibrium $\overline{y} = \left(\overline{y}_A, \{\overline{y}_j\}_{j \in N\backslash A}\right)$, with some NGOs grouped in one alliance and all remaining NGOs playing alone, NGOs' payoffs respect the inequality $Q_j(\overline{y}) \geq Q_i(\overline{y})$, $i \in A$ and $j \in N\backslash A$.

Using the definition of equilibrium, we can write

$$Q_j(\overline{y}) \geq Q_j\left(\overline{y}_A, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right), \tag{6.6}$$

expressing the simple fact that if we let any NGO $j \in N\backslash A$ playing alone switch its fundraising level with that of any NGO playing in alliance $i \in A$, then its payoff, by definition, will not improve. By Lemma 1 we know that under negative externalities $\overline{y}_i \leq \overline{y}_j$ for every $i \in A$ and $j \in N\backslash A$ and, contrarily, under positive externalities, $\overline{y}_i \geq \overline{y}_j$ for every $i \in A$ and $j \in N\backslash A$. Therefore, regardless of the sign of fundraising externalities, if we let an NGO in A to play $\overline{y}_j$ instead of $\overline{y}_i$, for every NGO playing as singleton we obtain

$$Q_j\left(\overline{y}_A, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right) \geq Q_j\left(\overline{y}_j, \overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right). \tag{6.7}$$

Next, by the symmetry of all NGOs, switching strategies implies switching payoffs, and we can write

$$Q_j\left(\overline{y}_j, \overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right) = Q_i\left(\overline{y}_i, \overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_j\right) = Q_i(\overline{y}). \tag{6.8}$$

Therefore, by (6.6)-(6.8) we finally obtain that, for all $i \in A$ and $j \in N \backslash A$,

$$Q_j(\overline{y}) \geq Q_i(\overline{y}).$$

■

Proof of Lemma 3

We need to show that if every NGO in an alliance $A \subset N$ were to play according to its individual best-reply, defined as

$$r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) = \arg\max_{y_i} \; Q_i(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}),$$

against all other NGOs playing their equilibrium fundraising levels, we would have that $r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) \leq \overline{y}_i$ under positive externalities and $r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) \geq \overline{y}_i$ under negative externalities.

Let us define

$$\overline{y}_A = \arg\max_{y_A} \; Q_A(y_A, \overline{y}_{N\backslash A}) = \arg\max_{y_A} \sum_{i \in A} Q_i((y_A, \overline{y}_{N\backslash A}).$$

By the definition of profile $\overline{y}_A$ for alliance A, we have

$$Q_A\left(\overline{y}_A, \overline{y}_{N\backslash A}\right) \geq Q_A\left(y_i', \overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right), \tag{6.9}$$

for any arbitrary $y' \in Y_i$. Next, suppose, by contradiction, that under positive externalities, the best-reply $r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) > \overline{y}_i$.

By the definition of best-reply of an NGO $i \in A$, we have

$$Q_i\left(r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right), \overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) \geq Q_i\left(\overline{y}_A, \overline{y}_{N\backslash A}\right). \tag{6.10}$$

Moreover, for every NGO $k \in A\backslash\{i\}$, positive externalities imply

$$\sum_{k \in A\backslash\{i\}} Q_k\left(r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right), \overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) > \sum_{k \in A\backslash\{i\}} Q_k\left(\overline{y}_A, \overline{y}_{N\backslash A}\right). \tag{6.11}$$

Therefore, jointly (6.10) and (6.11) contradict the expression (6.9). The statement for the case of negative externalities is proven analogously. ■

Proof of Proposition 3

We have to show that, for every $y, y' \in \mathbb{R}^{n-1}$ if

$$\left\| r_i\left(y_{N\backslash\{i\}}\right) - r_i\left(y'_{N\backslash\{i\}}\right)\right\| \leq \beta \left\| y_{N\backslash\{i\}} - y'_{N\backslash\{i\}}\right\|$$

with $\beta < 1$ and $\|.\|$ defining the Euclidean norm on space $\mathbb{R}^{n-1}$, then, under the unanimity rule of alliance formation, the grandcoalition is strongly stable. Under the unanimity rule, when an alliance A of NGOs decides to deviate from the grandcoalition N, the alliance structure $\mathcal{S}^U = (\{A\}, \{j\}_{j \in N\backslash A})$ forms as a result.

Therefore, at the resulting fundraising equilibrium profile $\overline{y} = \left(\overline{y}_A, \{\overline{y}_j\}_{j \in N\backslash A}\right)$, all NGOs i in alliance A coordinate their fundraising, such that

$$\overline{y}_A = \arg\max_{y_A \in Y_A} \sum_{i \in A} Q\left[F_i(y_A, y_{N\backslash A}), \tau_i(y_A)\right].$$

Take the choice $\overline{y}_i$ of an arbitrary NGO $i \in A$ and the choice $\overline{y}_j$ of an arbitrary NGO $j \in N\backslash A$ playing as singleton. We need to show the same result of Lemma 1, i.e. that (i) under negative externalities in fundraising, $\overline{y}_i \leq \overline{y}_j$ and (ii) under positive externalities, $\overline{y}_i \geq \overline{y}_j$. Suppose not and, in particular, suppose that $\overline{y}_i < \overline{y}_j$ under positive externalities. Applying symmetry, we have that the equilibrium fundraising level of every singleton $j \in N \backslash A$ is exactly similar to the one that a singleton NGO $i \in A$ facing a fundraising profile

$$\overline{y}'_{N\backslash\{i\}} = \left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right)$$

would optimally play (using its best-reply). In other words, we can write

$$\overline{y}_j = r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A\backslash\{j\}}, \overline{y}_i\right),$$

and, therefore,

$$\overline{y}_j - \overline{y}_i = r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right) - \overline{y}_i.$$

Next, given that by Lemma 3, positive externalities imply

$$r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right) \leq \overline{y}_i,$$

we have

$$\overline{y}_j - \overline{y}_i \leq r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{(N\backslash A)\backslash\{j\}}, \overline{y}_i\right) - r_i\left(\overline{y}_{A\backslash\{i\}}, \overline{y}_{N\backslash A}\right),$$

in which both sides are positive. The latter expression contradicts the fact that the best-reply $r_i(.)$ is a contraction. The case of negative externalities, i.e. (ii), can be proven analogously. ■

Results for the example in Section 4

Using the Cobb-Douglas production function, the objective function of an NGO becomes

$$\begin{aligned} Q_i &= F_i(y_i, y_{-i}) \cdot \tau_i(y_i) = \\ &= \left[(1-c)R_i(y_i, y_{-i}) - f\right](1-y_i) = \\ &= \left[(1-c)y_i\left(\textstyle\sum_{j\in N} y_i\right)^{\theta-1} - f\right](1-y_i) \end{aligned}$$

We can compute

$$\frac{\partial Q_i(y_i, y_{-i})}{\partial y_i} = \left[(1-c)\frac{\partial R_i(y_i, y_{-i})}{\partial y_i}\right](1-y_i) - \left[(1-c)R_i(y_i, y_{-i}) - f\right]$$

and

$$\frac{\partial^2 Q_i(y_i, y_{-i})}{\partial (y_i)^2} = \left[(1-c)\frac{\partial^2 R_i(y_i, y_{-i})}{\partial (y_i)^2}\right](1-y_i) - \left[2(1-c)\frac{\partial R_i(y_i, y_{-i})}{\partial y_i}\right] \tag{6.12}$$

implying that $Q_i(y_i, y_{-i})$ is surely strictly concave in y_i when the revenue function $R_i(y_i, y_{-i})$ is strictly concave in y_i, for every $i \in N$.

Moreover, since

$$\frac{\partial R_i(y_i, y_{-i})}{\partial y_i} = \left(\textstyle\sum_{i\in N} y_i\right)^{\theta-1} + y_i(\theta-1)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-2},$$

the concavity of $Q_i(y_i, y_{-i})$ in y_i is ensured for

$$\frac{\partial^2 R_i(y_i, y_{-i})}{\partial y_i^2} = 2(\theta-1)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-2} + y_i(\theta-2)(\theta-1)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-3} < 0,$$

which clearly holds for $\theta < 1$. The concavity of $Q_i(y_i, y_{-i})$ also holds for $\theta = 0$ and is preserved for $\theta > 1$. For $\theta = 1$, NGO's revenue function becomes linear and independent of other NGOs' fund-raising activities.

Moreover,

$$\begin{aligned}\frac{\partial Q_i(y_i,y_{-i})}{\partial y_j} &= (1-c)\left[y_i\frac{\partial R_i(y_i,y_{-i})}{\partial y_j}\right](1-y_i) = \\ &= (1-c)\left[y_i(\theta-1)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-2}\right](1-y_i),\end{aligned}$$

which shows that rival NGOs' fund-raising activity generates negative (positive) externalities in fundraising for $\theta < 1$ (> 1).

Finally, from the expression

$$\frac{\partial^2 Q_i(y_i,y_{-i})}{\partial y_i \partial y_j} = \left[(1-c)\frac{\partial^2 R_i(y_i,y_{-i})}{\partial y_i \partial y_j}\right](1-y_i) - \left[(1-c)\frac{\partial R_i(y_i,y_{-i})}{\partial y_j}\right]$$

that in the example is

$$\begin{aligned}\frac{\partial^2 Q_i(y_i,y_{-i})}{\partial y_i \partial y_j} &= (1-c)(\theta-1)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-2} + \\ &+ \left[y_i(\theta-1)(\theta-2)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-3}\right](1-y_i) \\ &- \left[(1-c)\left(\textstyle\sum_{i\in N} y_i\right)^{\theta-1}\right],\end{aligned}$$

It follows that

$$\text{sign}\frac{\partial^2 Q_i}{\partial y_i \partial y_{-i}} = \text{sign}\left((\theta-1)Y^{-1} + \left(y_i(\theta-1)(\theta-2)Y^{-2}\right)(1-y_i) - 1\right)$$

where $Y = \sum_{i\in N} y_i$. Therefore, for $\theta = 0$, NGOs' best-reply functions are in general negatively sloped. For other values of θ, this slope depends on the number of NGOs.

Details for the numerical example in Section 4

By assuming $c = 0.1$ and $f = 0$, the FOCs (4.12) under the aggregative rule becomes, for $n = 3$ and $a = 2$

$$\frac{\partial Q_j}{\partial y_i} = \frac{(1-c)(1-y_j)2y_i}{(2y_i+(1)y_j)^2} - \left(\frac{(1-c)y_i}{(2y_i+(1)y_j)}\right) = 0 \tag{6.13}$$

$$\frac{\partial Q_j}{\partial y_i} = \frac{(1-c)(1-y_j)2y_i}{(2y_i+(1)y_j)^2} - \left(\frac{(1-c)y_i}{(2y_i+(1)y_j)}\right) = 0 \tag{6.14}$$

and the following interior fundraising equilibrium levels are obtained, $\overline{y}_i = 0.302$ for all $i \in A$, and $\overline{y}_j = 0.464$ for the singleton $j \in N\backslash A$. The equilibrium payoff of every $i \in A$ can be computed as

$$Q_i\left(\overline{y}_A, \overline{y}_{N/A}\right) = \frac{1}{a}\sum_{i\in A}\left((1-c)\overline{y}_i\left(\textstyle\sum_{i\in N}\overline{y}_i\right)^{-1}\right)(1-\overline{y}_i) = 0.177\,5.$$

By repeating the operation when the size of the deviating alliance is $a = 1$ and the remaining alliance is made of two NGOs ($n - a = 2$) we obtain

$$Q_i\left(\overline{y}_i, \overline{y}_{N/\{i\}}\right) = \left((1-c)\overline{y}_i\left(\textstyle\sum_{i\in N}\overline{y}_i\right)^{-1}\right)(1-\overline{y}_i) = 0.209.$$

Since the payoff of an NGO in the grandcoalition is given by

$$Q_i(y^e) = \left[(1-c)\frac{1}{n} - f\right] = (.9)\frac{1}{3} = 0.3,$$

the strong stability of the grandcoalition under the aggregative rule is guaranteed in the example for $n = 3$.

Contrarily, strong stability does not hold for a higher number of NGOs. Let, for instance, $n = 7$ and $a = 1$. Solving the FOCs we obtain an equilibrium profile $\overline{y}_i = 0.426\,1$ for the deviating NGO $i \in A$ and $\overline{y}_j = 0.204\,7$ for all remaing NGOs $j \in N\backslash A$, respectively. The payoff of the deviating NGOs can be computed as

$$Q_i\left(\overline{y}_A, \overline{y}_{N/A}\right) = \left((1-c)\overline{y}_i\left(a\overline{y}_i + (n-a)\overline{y}_i\right)^{-1}\right)(1-\overline{y}_i) = 0.133$$

and therefore the grandcoalition is unstable under the aggregative rule since

$$Q_i\left(\overline{y}_A, \overline{y}_{N/A}\right) = 0.133 > Q_i\left(y^e\right) = \left[(1-c)\frac{1}{n} - f\right] = (.9)\frac{1}{7} = 0.128\,.$$

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Properties of interaction between NGOs ⇨ Properties of interaction among alliances of NGOs and/or their internal rules ⇩	**FUNDRAISING STRATEGIC COMPLEMENTS**	**FUNDRAISING STRATEGIC SUBSTITUTES + CONTRACTION**
POSITIVE COALITIONAL EXTERNALITIES	**Grandcoalition of NGOs strongly (and Nash) stable under the *unanimity* rule**	**Grandcoalition of NGOs strongly (and Nash) stable under the *unanimity* rule**
MAJORITY BREAKING PROTOCOL	**Grandcoalition of NGOs strongly (and Nash) stable under the *aggregative* rule**	**Grandcoalition of NGOs strongly (and Nash) stable under the *aggregative* rule**
NEGATIVE COALITIONAL EXTERNALITIES	**Grandcoalition of NGOs Nash-stable under both *unanimity* and *aggregative* rules**	**Grandcoalition of NGOs Nash-stable under both *unanimity* and *aggregative* rules**

Table 1. Summary of general results.