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ELITE CAPTURE THROUGH INFORMATION

DISTORTION: A THEORETICAL ESSAY

JEAN-PHILIPPE PLATTEAU, VINCENT SOMVILLE

& ZAKI WAHHAJ

UNIVERSITY OF NAMUR

Elite Capture Through Information Distortion: A Theoretical Essay

Jean-Philippe Platteau, Vincent Somville* and Zaki Wahhaj†

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Abstract

Common wisdom as well as sound analytical arguments suggest that stronger punishment of deviant behavior meted out by a principal typically prompts the agents to better conform with his objectives. Addressing the specific issue of donor-beneficiary relationships in the context of participatory development programs, we nevertheless show that greater tolerance on the part of donors may, under certain conditions, favor rather than hurt the interests of the poor. Also, greater uncertainty surrounding the donor's knowledge regarding the poor's preference may have the same paradoxical effect.

Critical features of our framework are: (i) communities are heterogeneous and dominated by the local elite in dealing with external agencies, (ii) the elite choose the project proposed to the donor strategically, knowing that the latter has a certain amount of tolerance toward elite capture and an imperfect knowledge of the poor's priorities.

Keywords: community-driven development, aid effectiveness, elite capture, preference targeting, information distortion.

*Centre of Research in the Economics of Development (CRED), Department of economics, University of Namur, Rempart de la Vierge, 8 B-5000 Namur, Belgium. Corresponding author: J.-P. Platteau. Tel.: +3281724860; fax: +3281724840; e-mail address: jean-philippe.platteau@fundp.ac.be.

†Department of International Development, University of Oxford, 3 MansÖeld Road, Oxford OX1 3TB, United Kingdom.

1

1   Introduction

Of late, following great disappointment with conventional aid approaches based on a hierarchical relationship between donors and beneficiaries, there has been a growing emphasis within the international donor community on the importance of ownership of aid budgets and decisions by the receiving agent. Such a move has been reflected in the rapid emergence of decentralised or participatory development as a concept guiding aid strategies and efforts. Bilateral and multilateral agencies alike have thus given more importance to participation in the design of their development assistance programmes, and have channeled substantial amounts of aid money through local partner associations and municipalities or through Non-Governmental Organizations (NGOs). The World Bank, for example, has made the so-called Community-Driven Development (CDD) approach one of the cornerstones of its Comprehensive Development Framework, as reflected in the World Development Report 2000/2001 devoted to poverty alleviation. The share of Bank's projects with some degree of "civil society" involvement thus increased from 6 percent in the late 1980s to over 70 percent in 2006 (cited from Werker and Ahmed (2008), p. 75). On the other hand, aid in the form of budget support to central governments has gained increasing currency, particularly in the perspective of achieving the Millenium Development Goals. In some countries such as Tanzania, no less than 40% of the state budget is financed by foreign aid.

It is a much boasted advantage of all decentralised aid programmes that the beneficiaries possess much more precise information than an external donor about what people want and how best they can achieve their objectives. In addition, their active participation in the aid process motivates them to exert effort and contribute their own resources to an aid project or programme.

A major problem nevertheless appears as soon as it is reckoned that populations are highly heterogeneous and that local elites -at the level of the village, the municipality, the regional or central government- are often guided by their selfish interest. Because they often succeed in monopolising the attention of the donor community thanks to their better education and greater exposure to the external world, they are typically in a position to speak on behalf of the poor who are the intended beneficiaries of aid programmes (Esman and Uphoff (1984); Bierschenk et al. (2000); Kumar and Corbridge (2002); Platteau (2009)). In actuality, the poor often expect the village elite to manage aid projects and to make their own interests predominate as a sort of remuneration for their leadership role (Kumar and Corbridge (2002); Platteau and Abraham (2002); Platteau and Gaspart (2003)). To sum up, power asymmetry between the elite and the commoners is bound to cause the preference of the former to prevail over the preference of the latter, thereby giving rise to a problem of elite capture in the presence of strong preference divergence between the two components of society.

This possibility has aroused much concern among social scientists during recent years. When adressing it, economists often represent the local decision mechanism as a form of representative democracy with (probabilistic) voting in which the poor, who have different preferences from the rich, have a relatively small weight (see Bardhan and Mookherjee (2000, 2005, 2006)). There is no clear-cut conclusion from this quickly expanding literature and the empirical testing of its theoretical predictions (see Mansuri and Rao (2004, 2010); Platteau (2009) for recent surveys). Differences in results may be partly explained by methodological difficulties and partly by genuine variations between local environments. None the less, a general proposition that emerges from quite a few systematic empirical studies is that in more socially and economically unequal village communities the participatory mechanism tends to unduly favor the rich (Rosenzweig and Foster (2003); Galasso and Ravaillon (2005); Rao and Ibáñez (2005); Bardhan et al. (2008); Araujo et al. (2008); Labonne and Chase (2009)). Economists have also recently analysed the impact of participation on the effectiveness of project outcomes and the distribution of benefits, leading to sometimes very contrasted conclusions (Chattopadhyay and Duflo (2004); Khwaja (2004); Besley et al. (2005); Reinikka and Svensson (2005); Olken (2007); Banerjee et al. (2008); Bjorkman and Svensson (2009); Khwaja (2009)). Especially worth singling out is the finding that better information of the ultimate beneficiaries regarding the nature of the benefits they can expect from an aid programme significantly reduces the risk of aid embezzlement by the elite.

A moot problem that nevertheless remains concerns the very definition of the objectives of the programme. Here, donors are confronted with a tricky dilemma: on the one hand, in participatory programmes this definitional task is typically considered the prerogative of the target community but, on the other hand, it is vulnerable to the risk of elite capture as has been argued above and well documented in the general literature (Chabal and Daloz (1999); Bierschenk et al. (2000); Blair (2000); Bardhan (2002); Conning and Kevane (2002); de Haan et al. (2002); Eversole (2003); Tembo (2003); Abraham and Platteau (2004); Platteau (2004); Nygren (2005); Ban et al. (2010)).

In this paper, we want to probe into this issue by examining the case where the donor does not accept to finance a project or a programme just because it has been presented to him by a potential beneficiary group (more precisely, by the elite speaking on its behalf).

The donor allocates some resources with a view to forming an idea about the preference of the poor. This idea is necessarily imprecise as in general the needs expressed by the poor do not necessarily correspond to the way they are assessed by a benevolent rich. Futhermore, the needs of the poor tend to be highly location-specific, depending on the particular environment in which they live. Finally, the poor do not easily express dissenting preferences in the front of outsiders since outsiders are just passing while elite people are there to stay. Note that, if the donor could easily gather a perfect information regarding the poor's preferences (or needs), he could act in a centralised manner.

On the other hand, the donor has some degree of tolerance regarding the extent to which a project (or programme) may differ from his own perception of what the poor need. If the local elite acting as representative of the community propose a project which falls outside of this tolerance interval, the donor rejects it altogether. In our context, this rebuttal is taken to mean that the donor refuses to establish a "partnership" relationship with that community. The elite, who has no knowledge about the donor's information regarding the real needs of the poor, have a strategic choice to make which involves a trade-off between the probability of project acceptance by the donor and the distance between the proposed project and that reflecting its own (elite's) preference. If accepted, a project is implemented according to plan: enforcement problems are assumed away. In many instances, indeed, it is easier for a donor agency to check the proper execution of a project (especially so if it is embedded in visible infrastructures) than to identify the poor's preferences in the presence of severe power imbalances.[1] How the above trade-off is affected by the donor's outside option and the quality of the information he possesses about the poor's preferences is the major question that we want to dwell upon.

The problem is not as trivial as it may look at first sight. One central, almost paradoxical, result of our foray is that reduced tolerance on the part of the donor may hurt the interest of the poor and, conversely, greater tolerance may end up better disciplining the elite. Far from being a mere curiosity, such a result may be actually obtained in other contexts exhibiting the same basic informational structure as that used in this paper (see Putterman (1987); Putterman and Skillman (1988)).

The outline of the paper is as follows. In Section 2, we provide a short informal description of the context that will be modeled, and we clarify and justify some key assumptions behind our modelling effort. In Section 3, the model is presented in detail, while in Section 4, the main analytical results are derived and discussed. Section 5 concludes.

2 Preliminary clarifications

2.1 A description of the context

We begin by providing an informal description of the context to be modelled. The formal setup is described in the next section. Since we are interested in the effect of preference divergence in decentralised development programmes, we focus our attention on heterogeneous communities. More precisely, we assume that a community is comprised of two groups, the target group which the donor agency wants to support through an aid flow, and the elite group. In fact, the term 'elite' need not be interpreted in a restrictive sense. It may stand for the median voter, while the target group represents minority groups or marginal sections of the population, such as women, low-caste people, strangers, herders, etc. In line with the objective of poverty reduction or emancipation of weak groups, the donor's utility function duly reflects the interests of the target group. Towards that end, the donor relies on a participatory process aimed at determining the nature of the needs of the target group. However, because the elite may interfere with the consultation mechanism, an information gap subsists and prevents the donor from assessing with certainty the genuine needs of this group. What the donor maximises, therefore, is the expected utility derived by the target group from the aid flow. The decision to be taken is simply to accept or refuse to finance a project submitted by

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[1]If the project proposed by the elite is accepted by the donor, we are in the situation described by a village chief from Burkina Faso: *"if I give you a hen free, you won't start examining the ass to determine whether it is fat or thin. You just accept it."* (Guéneau and Lecomte (1998), p. 100).

the community (in fact, by the elite group). If the proposed project is refused, then the available funds can be considered for alternative projects, perhaps in a different community and probably involving a different elite group. These alternatives reflect the donor's outside option.

The elite influence the participatory process in a decisive manner, and choose the project to submit to the donor's approval with the purpose of maximising their own selfish utility. This involves a trade-off between two kinds of considerations: on the one hand, the elite would like a project that is as close as possible to their own preference; on the other hand, proposing a project that deviates from what the donor perceives as being most beneficial for the target group, lowers the likelihood that it will be approved by the donor.

Although numerous types of projects can obviously be carried out in the community, we keep our analysis as simple as possible by assuming that the aid fund is to be split between only two projects, named A and B. Preference heterogeneity is represented by the assumption that the elite and the target groups prefer different mixes of the two projects.

In order to keep our focus on the issue of strategic manipulation of preferences, we abstract away from any problem arising at the level of enforcement of the project once approved. In other words, the elite has no possibility to embezzle the aid fund or to modify the nature or the destination of the project. It is easy to understand that if the project, once accepted, could not be enforced by the donor, the trade-off at the heart of the problem of elite capture through preference distortion would vanish, and the prediction derived from our analytical framework would be straightforward. As a matter of fact, if the donor is unable to monitor the use of the disbursed funds, the elite would propose the project that stands the best chance of being accepted by the donor and would actually implement their own preferred project.

2.2   Key assumptions

Some assumptions underlying our modelling effort and set-up need further clarification and justification.

To begin with, we take decentralised aid as given in the sense that we do not explore the question as to why and when it is superior to centralized aid (on this aspect, see Bardhan and Mookherjee (2000)). What amount of information is available to the donor is only one factor determining the relative advantage of decentralised aid compared to centralized aid (ownership of aid, for example, has several beneficial effects that may not all be related to information). However, by positing that aid is decentralised (a common pattern of aid distribution nowadays), we implicitly and realistically assume that the donor's actual and potential knowledge about the preferences of local people or groups is limited.

Our second point concerns the dichotomous nature of the donor's decision. Since this is a key feature of our model, it is important to stress the kind of situation that we have in mind. The issue in which we are interested is the screening task which a donor organisation must perform when it is overwhelmed by a flurry of project proposals emanating from potential "partner" communities, municipalities, or other forms of local governments in poor countries.[2] Once a proposal is accepted, the donor organisation establishes a partnership relationship with the community or local government concerned. A negotiation may then start with a view to making more precise (i) the methods and the timing for the execution of the agreed-upon project (the project proposed by the partner and accepted by the donor); (ii) the process of disbursement of aid money ; and (iii) the follow-up, monitoring, and evaluation of the project. All these operations are not modelled since we want to keep the focus on the partner selection issue.

Let us now turn to our third clarification. In the model, the elite choose which project to submit to the donor. Because the donor will either accept or reject the proposal, and since the project is implemented as planned if it is accepted, the elite's proposal determines the payoffs of both agents. This feature of the game makes it intrinsically different from "cheap talk" games (Crawford and Sobel (1982) and the following literature) where, by definition, the message has no implication for the future game except in the manner that it is interpreted by the players. If the recommendation is too far-fetched, then the donor will be compelled to reject it. By contrast, in a cheap-talk game, if the sender sends an implausible signal, then the receiver would simply ignore it.[3] Whether the donor could

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[2]It is not rare, as we could observe from our own involvement with NGOs, that aid organisations may receive tens of proposals in a week.

[3]The same point can be made regarding the so-called "biased experts" problem, which is actually derived from the "cheap talk literature", as discussed by Austen-Smith (1994); Krishna and Morgan (2001, 2004) among others. In this framework, too, the advice

be better off by revealing his signal about the poor's preference to the elite, is an interesting question which is addressed when we start solving the model.

Four, even if they have information regarding the poor's preferences, donors are usually not able to fully assess the magnitude of the divergence between the poor's and the elite's preferences. Moreover, donors often do not have the means to assess the sincerity of a group that claims to represents the interest of the poor. To take this into account, we assume that the donor's perception of the needs of the poor and the elite's preference are independent. For example, if the donor thinks that the poor prefer project A, this does not give him any information on wether the elite prefers project A or project B. And vice versa, the fact the elite prefers project A does not give the elite any information on the donor's perception of the poor's needs. In our understanding, what the elite do is not potentially informative for the donor. An approach using Bayesian updating of the donor's beliefs on the basis of the project proposed by the elite is therefore ruled out.

Five, in order not to add another source of uncertainty to our problem, the outside option of the donor is assumed to be known by the elite.

3 The model

3.1 Setup

Formally, we analyse a game consisting of two agents represented by the letters D (the donor agency) and E (the elite group).

A project mix (henceforth called simply a 'project') is a variable $\theta \in [0, 1]$ which indicates the share of the aid fund allocated to project A. We let θ^e denote the preferred project of the elite group, and θ^t that of the target group. In addition, D receives a signal $\theta^s \in [0, 1]$ which is correlated with θ^t and unobserved by E. Specifically, we assume that θ^s and θ^t have a joint distribution described by the joint cumulative distribution function $F(\theta^s, \theta^t)$ and θ^e is distributed according to the function $G(\theta^e)$. The functions $F(.)$ and $G(.)$ are common knowledge; but E observes only the realisations of θ^e and θ^t and D observes only the realisation of θ^s.

The precise steps in the game are specified below.

1. Nature draws $\theta^e, \theta^t, \theta^s$. We have θ^e and θ^t revealed to E and θ^s revealed to D.

2. E proposes a project, $\theta^r \in [0, 1]$ which is revealed to D.

3. D must choose to accept or decline the recommended project. The decision is represented by the variable $a \in \{y, n\}$

If the recommended project is accepted (i.e. $a = y$), then D receives a payoff of $U^d(|\theta^r - \theta^t|)$, and E receives a payoff of $U^e(|\theta^r - \theta^e|)$. If the project is rejected, then D receives $\underline{U}^d$ and E receives $\underline{U}^e$.

Thus, if the recommended project is approved, then the utility of the donor depends on the 'distance' between the approved project and that preferred by the target group; similarly, the utility of the elite group depends on the 'distance' between the approved project and its own preferred project. The constants $\underline{U}^d$ and $\underline{U}^e$ represent the outside options of the donor and the elite group respectively.

We assume that the utility functions $U^d(.)$ and $U^e(.)$ have the following properties:

Assumption 1. $U^i(x)$ *is continuous, differentiable and* $\frac{dU^i(x)}{dx} < 0$ *for* $i = d, e$

Assumption 2. $U^d(x)$ *is twice differentiable and* $\frac{d^2U^d(x)}{dx^2} < 0$

Assumption 1 simply means that both the donor and the elite prefer a project mix closer to their respective target points, θ^t and θ^e. Assumption 2 ensures that the donor dislikes uncertainty.

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from an expert is an element of information that the receiver may well choose to ignore and that does not directly affect his payoffs.

3.2 Case A: The elite observes the donor's signal

For illustrative purposes, we first solve for the equilibrium in the game in the case that θ^s is observed by E; i.e. the elite group has full knowledge of any information that the donor agency has about the preferred project of the target group.

At stage 3 of the game, the donor approves a project θ^r if and only if

$$E\left[U^d\left(\left|\theta^r - \theta^t\right|\right)|\theta^s\right] \geq \underline{U}^d \tag{1}$$

We can use this condition to compute a subset $\sigma\left(\theta^s\right) \subset [0,1]$ defined as

$$\sigma\left(\theta^s\right) = \left\{\theta \in [0,1] : E\left[U^d\left(\left|\theta - \theta^t\right|\right)|\theta^s\right] \geq \underline{U}^d\right\} \tag{2}$$

The donor would accept the recommended project if and only if $\theta^r \in \sigma\left(\theta^s\right)$. Therefore, at stage 2 of the game, under the assumption that θ^s is observable to E, the elite group would recommend

$$\theta^r = \begin{cases} \theta^* \text{ if } U^e\left(\left|\theta^* - \theta^e\right|\right) \geq \underline{U}^e \\ \theta^e \text{ otherwise} \end{cases} \tag{3}$$

where

$$\theta^* = \arg\max_{\theta \in \sigma(\theta^s)} U^e\left(\left|\theta - \theta^e\right|\right) \tag{4}$$

It follows that, if $U^e\left(\left|\theta^* - \theta^e\right|\right) \geq \underline{U}^e$ and $\theta^e \notin \sigma\left(\theta^s\right)$, we have

$$E\left[U^d\left(\left\|\theta^r - \theta^t\right\|\right)|\theta^s\right] = \underline{U}^d \tag{5}$$

i.e. the elite always recommends a project that is just acceptable to the donor agency, provided that the elite group prefers this project to its own outside option, and its own preferred project would be rejected by the agency.

Therefore, if the donor agency has no private information, then it can do no better than its own outside option unless, unusually, full elite capture (i.e. selection of a project $\theta^r = \theta^e$) is better than its outside option.

Moreover, in the case where θ^r is given by (5), it is easy to verify that, as the donor's outside option improves, the approved project moves closer to that preferred by the target population. We will see that this relationship may be inverted when the elite does *not* observe the signal received by the donor.

3.3 Case B: The elite does not observe the donor's signal

Next, we consider the more interesting case where the donor has private information about the preferred project of the target population. As before, the donor would approve a project proposal θ^r at stage 3 of the game if and only if $\theta^r \in \sigma\left(\theta^s\right)$, where $\sigma\left(\theta^s\right)$ is as defined in the previous section.

Without observing θ^s, the elite cannot know what is the set $\sigma\left(\theta^s\right)$. However, he can compute $\Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)$ for each $\theta \in [0,1]$. Therefore, at stage 2 of the game, he chooses θ^r to maximise his expected utility as follows

$$\theta^* = \arg\max_{\theta \in [0,1]} V^e\left(\theta, \theta^e, \theta^t\right) \tag{6}$$

where

$$V^e\left(\theta, \theta^e, \theta^t\right) = \Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right) U^e\left(\left\|\theta - \theta^e\right\|\right) + \Pr\left(\theta \notin \sigma\left(\theta^s\right)|\theta^t\right) \underline{U}^e \tag{7}$$

The trade-off described above is evident from (6) and (7): by recommending a project closer to θ^e, the elite will obviously improve its payoff from project approval. However, by choosing a project further from θ^t, he may lower the probability that the project is approved by the donor.

We would like to know how this trade-off is affected by the donor's outside option and the quality of his information about the preferred project of the target group. In particular, would the elite recommend a project that is closer to that of the target group when the donor has better information or more attractive alternatives to the proposal being considered? To answer these questions, we need to impose additional structure on the nature of information in the model. This we do in the following section.

3.4 Imposing a structure on the donor's signal

The idea underlying the donor's signal is that the agency is able to gather information about the needs of the target group, yet is never in a position to ascertain them in a completely reliable manner. For instance, he has a correct perception of what the poor need in general, but cannot assess accurately how the nature of such needs varies from one community to another. Such an assumption is warranted since it is precisely when the needs of the poor or marginal groups are community-specific that participatory or decentralised development programmes are justified.

For the subsequent analysis, we assume that, through its own research into the community, independent of the elite group, the donor agency is able to identify an interval of length $2m$, in the unit interval, that contains θ^t. Without loss of generality, we take θ^s to be the midpoint of this interval. Thus, given θ^s and m, the interval discovered by the donor, known to contain θ^t, is given by

$$I(\theta^s; m) = [\theta^s - m, \theta^s + m] \tag{8}$$

Note that, for the donor's information to be valuable, we must have $m < \frac{1}{2}$. An improvement in the quality of the donor's information would correspond to a decrease in m.

For each value of θ^t, there is a range of possible values of θ^s for which the interval defined in (8) would contain θ^t. For ease of notation when referring to these ranges, we introduce the following functions:

$$a(\theta; m) = \begin{cases} \theta - m \text{ if } \theta > 2m \\ m \text{ otherwise} \end{cases} \tag{9}$$

$$b(\theta; m) = \begin{cases} \theta + m \text{ if } \theta < 1 - 2m \\ 1 - m \text{ otherwise} \end{cases} \tag{10}$$

Then, given $\theta^t \in [0, 1]$, any signal θ^s in the interval $[a(\theta^t; m), b(\theta^t; m)]$ would be 'feasible' in the sense that $I(\theta^s; m)$ would be a subset of the unit interval and contain θ^t.

We denote by $f_s(\theta^s | \theta^t; m)$ the p.d.f. of θ^s conditional on θ^t. By construction, the conditional distribution has finite support over the interval $[a(\theta^t; m), b(\theta^t; m)]$. But its exact shape depends on the donor's information technology. For example, if, given θ^t, any 'feasible' signal is equally probable, then $f_s(\theta^s | \theta^t; m)$ has a uniform distribution over this interval. However, if the information gathering process is more likely to produce signals close to the true value of θ^t, then the distribution will be bell-shaped.

We denote by $f_t(\theta^t)$ the marginal p.d.f. of θ^t. This function describes the common prior beliefs regarding the value of θ^t, known to both the elite and the donor. For the following analysis, we impose no additional structure on the distribution functions except, where indicated, the following:

Assumption 3. $f_s(\theta^s | \theta^t; m) = \lambda(\theta^t, m) g(|\theta^s - \theta^t|)$ if $\theta^s \in [a(\theta^t; m), b(\theta^t; m)]$ and $f_s(\theta^s | \theta^t; m) = 0$ otherwise, where $g : [-1, +1] \longrightarrow \mathbb{R}^+$ is continuously differentiable, $g' < 0$ and $g'' < 0$, and $\lambda(\theta^t, m) = \left[\int_{a(\theta^t, m)}^{b(\theta^t, m)} g(|\theta^s - \theta^t|) d\theta^s \right]^{-1}$.

Assumption 4. For some $\bar{m} \in \left[0, \frac{1}{4}\right]$, we have $f_t(\theta^t) = 0$ for $\theta^t < 2\bar{m}$ and $\theta^t > 1 - 2\bar{m}$.

Assumption 5. $E(\theta^t | \theta^s; m) = \theta^s$

Assumption 6. $E\left[U^d(|\theta^s - \theta^t|) | \theta^s\right] > \underline{U}^d$

Assumption 3 says that conditional on θ^t, the likelihood of different signals depends on the distance of the signal from θ^t. Moreover, the conditions on the function $g(.)$ implies that the conditional distribution $f_s(\theta^s | \theta^t; m)$ is unimodal with its mode at θ^t, and ensures that the elite's optimisation problem is globally concave. The function $\lambda(\theta^t, m)$ simply ensures that the conditional probabilities add up to 1 as we vary the parameter m.

Assumption 4 says that extreme values of θ^t are not possible. This assumption is convenient because if θ^t is very close to 0 or 1 then, given our information structure, this severely restricts the possible values that θ^s can take. For instance, if $\theta^t = 0$, then this is consistent only with the signal $\theta^s = m$. These cases lead to considerable analytical complexity without providing any additional insights. Assumption 5 says that the distribution functions $f_t(\theta^t)$ and $f_s(\theta^s | \theta^t; m)$ are such that when the donor receives a signal θ^s, he expects that θ^t is equal to θ^s on

average. Assumption 6 says that the donor would prefer to pursue a project which corresponds to its signal over its outside option. The last assumption will be used to ensure that the set of possible projects that are acceptable to the donor is monotonic in θ^s.

Using Assumptions 3 and 4, the distribution of the donor's beliefs given a signal θ^s takes a relatively simple form, described in the following lemma:

Lemma 1. *Under Assumptions 3 and 4 and $m < \bar{m}$, the donor's beliefs about the preferred project mix of the targeted population, as expressed in the conditional distribution $f_t\left(\theta^t|\theta^s;m\right)$, is as follows: $f_t\left(\theta^t|\theta^s;m\right) = \hat{\lambda}\left(\theta^s,m\right)g\left(|\theta^s - \theta^t|\right)f_t\left(\theta^t\right)$ if $\theta^t \in [\theta^s - m, \theta^s + m]$ and $f_t\left(\theta^t|\theta^s;m\right) = 0$ otherwise; where $\hat{\lambda}\left(\theta^s,m\right) = \left[\int_{-m}^{+m} g\left(|x|\right)f_t\left(x+\theta^s\right)dx\right]^{-1}$*

It is evident from Lemma 1 that the donor's beliefs are directly related to his prior beliefs about θ^t (as represented by the marginal distribution $f_t\left(\theta^t\right)$) and to the technology for generating the signal (which depends on the function $g\left(|\theta^s - \theta^t|\right)$ as previously discussed). The term $\hat{\lambda}\left(\theta^s,m\right)$ is a scaling factor which ensures that the conditional probabilities, $f_t\left(\theta^t|\theta^s;m\right)$, add up to 1.

We have now completely defined the nature of the donor's signal and are now in a position to address the question how the extent of elite capture varies with the donor's outside option and the quality of the donor's information.

3.5 Relationship between information quality, the donor's outside option and the donor's tolerance

Under Assumptions 1 and 2, we can derive a number of useful characteristics of the donor's expected utility from a particular project mix which are summarised in the following lemma.

Lemma 2. *Under Assumptions 1 and 2, the expression $E\left[U^d\left(\|\theta - \theta^t\|\right)|\theta^s\right]$ is maximised at some $\theta^* \in (\theta^s - m, \theta^s + m)$, is increasing in θ for $\theta < \theta^*$ and decreasing in θ for $\theta > \theta^*$. The set $\sigma\left(\theta^s;m,u\right)$ corresponds to the closed interval $[\kappa_a\left(\theta^s;m,u\right), \kappa_b\left(\theta^s;m,u\right)]$, where the functions $\kappa_a\left(.\right), \kappa_b\left(.\right) > 0$ are given implicitly by the following equations:*

$$E\left[U^d\left(\|\theta^* - \kappa_a\|\right)|\theta^s\right] = u, \kappa_a < \theta^* \tag{11}$$
$$E\left[U^d\left(\|\theta^* - \kappa_b\|\right)|\theta^s\right] = u, \kappa_b > \theta^* \tag{12}$$

The functions $\kappa_a\left(\theta^s;m,u\right)$ and $\kappa_b\left(\theta^s;m,u\right)$ are defined in such a way that if the donor receives a signal θ^s (and the quality of information and the outside option are given by parameters m and u), then the donor would accept a project θ if and only if it lies between $\kappa_a\left(\theta^s;m,u\right)$ and $\kappa_b\left(\theta^s;m,u\right)$. In the following discussion, we shall speak about the "donor's tolerance of elite capture" by which we mean some measure of the donor's willingness to accept a project recommendation when it deviates from its own received signal. The following definition provides a ranking of the donor's tolerance under different parameter values:

Definition 1. We say that the donor is <u>more tolerant</u> for parameters (m_1, u_1) than for parameters (m_2, u_2) if $\sigma\left(\theta^s;m_2,u_2\right) \subset \sigma\left(\theta^s;m_1,u_1\right)$ and $\sigma\left(\theta^s;m_1,u_1\right) \neq \sigma\left(\theta^s;m_2,u_2\right)$. The concepts of <u>less tolerant</u>, <u>increasing tolerance</u>, and <u>decreasing tolerance</u> are defined accordingly.

We would like to know how the donor's tolerance is affected by the donor's outside option, and the quality of the donor's information about θ^t. This is the subject of the following lemma.

Lemma 3. *Under Assumptions 1, 2 and 5 the donor's tolerance of elite capture is decreasing in m and $\underline{U}^d$.*

The intuition behind Lemma 3 is as follows. By assumption, the donor is averse to uncertainty about the distance between a recommended project and the preferred project of the target population. An increase in m leads to increased uncertainty about θ^t (more precisely, under Assumption 5, an 'elementary increase in risk'), and therefore increased uncertainty about the distance of any recommended project from θ^t. Therefore, the donor is more inclined to choose his outside option when m is larger. Similarly, for any given project mix, the donor is more inclined to choose his outside option when $\underline{U}^d$ is larger. Both of these effects translate into a decrease in the donor's tolerance.

3.6 The elite's optimal response

Given the structure imposed on the donor's information in Section 3.4, we can reconsider the strategic decision of the elite group at stage 2 of the game. The optimal choice for the elite, as in the general case, is given by the solution to the maximisation problem in (6). Using Lemma 2, we can rewrite the probability of any proposed project being accepted by the donor as follows:

$$\Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right) = \Pr\left(\kappa_a\left(\theta^s\right) \leq \theta \leq \kappa_b\left(\theta^s\right)|\theta^t\right)$$

(where we suppress the variables m and u, which are assumed to be constant in this section, for ease of notation). We can show that if $f'_t\left(\theta^t\right)$ is small over its support, then under Assumptions 3-6, the functions $\kappa_a\left(\theta^s\right)$ and $\kappa_b\left(\theta^s\right)$ are invertible (see Appendix B). Hence, we can define $\mu_a\left(.\right) = \kappa_b^{-1}\left(.\right)$ and $\mu_b\left(.\right) = \kappa_a^{-1}\left(.\right)$, and thus obtain

$$
\begin{aligned}
\Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right) &= \Pr\left(\mu_a\left(\theta\right) \leq \theta^s \leq \mu_b\left(\theta\right)|\theta^t\right) \\
&= \int_{\mu_a}^{\mu_b} f_s\left(\theta^s|\theta^t\right) d\theta^s \\
&= F_s\left(\mu_b\left(\theta\right)|\theta^t\right) - F_s\left(\mu_a\left(\theta\right)|\theta^t\right)
\end{aligned}
\tag{13}
$$

In words, $\mu_a\left(\theta\right)$ and $\mu_b\left(\theta\right)$ indicate the smallest and largest values of θ^s for which the donor would accept the project θ. For ease of exposition, and without loss of generality, we shift the utility of the elite group by a constant such that $\underline{U}^e = 0$. Then, using (13), we can rewrite (7) from Section 3.3 as follows:

$$V^e\left(\theta, \theta^e, \theta^t\right) = \left[F_s\left(\mu_b\left(\theta\right)|\theta^t\right) - F_s\left(\mu_a\left(\theta\right)|\theta^t\right)\right] U^e\left(\|\theta - \theta^e\|\right)
\tag{14}$$

By varying θ, the elite can raise the probability that the recommended project is accepted by the donor, but this may involve moving further from the elite group's own preferred project mix. It should be clear that if the distance between its own preferred project and those likely to be provided by the donor (represented by the set $\sigma\left(\theta^s\right)$) is very large, then the elite may be better off pursuing its outside option (which is equivalent to recommending a project with zero probability of acceptance).

If not, we can show that, under Assumption 3, the elite's optimal value of θ lies between θ^e and the mode of the conditional distribution, θ^t. The reason is as follows. Suppose $\theta^e > \theta^t$. Then, for any $\theta > \theta^e$, we have, under Assumptions 1 and 3, that $U^e\left(\|\theta - \theta^e\|\right) < U^e\left(\|\theta^e - \theta^e\|\right)$ and $\Pr\left(\theta \in \sigma\left(\theta^s\right)\right) < \Pr\left(\theta^e \in \sigma\left(\theta^s\right)\right)$. So, the elite would do better by choosing θ^e than by choosing θ. For any $\theta < \theta^t$, we have, under Assumptions 1 and 3, that $U^e\left(\|\theta - \theta^e\|\right) < U^e\left(\|\theta^t - \theta^e\|\right)$ and $\Pr\left(\theta \in \sigma\left(\theta^s\right)\right) < \Pr\left(\theta^t \in \sigma\left(\theta^s\right)\right)$. So the elite would do better off by choosing θ^t than by choosing θ. The same type of reasoning applies if $\theta^e < \theta^t$.

Furthermore, under Assumptions 2 and 3, the function $V^e\left(\theta, \theta^e, \theta^t\right)$ is concave in θ between θ^e and θ^t, and therefore if the maximisation problem has an interior solution, it is uniquely defined by the following first-order condition:

$$\left[f_s\left(\mu_b\left(\theta\right)|\theta^t\right) - f_s\left(\mu_a\left(\theta\right)|\theta^t\right)\right] U^e\left(|\theta - \theta^e|\right) + \left[F_s\left(\mu_b\left(\theta\right)|\theta^t\right) - F_s\left(\mu_a\left(\theta\right)|\theta^t\right)\right] \frac{\partial U^e}{\partial \theta} = 0
\tag{15}$$

or

$$\frac{\partial \Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)}{\partial \theta} U^e\left(|\theta - \theta^e|\right) + \Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right) \frac{\partial U^e}{\partial \theta} = 0
\tag{16}$$

Equation 15 completes our characterisation of the optimal strategy of the elite group. It contains the important insight that the choice of the agent – in this case, the elite group – depends not only on the probability $\Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)$, but also on how this probability changes with θ. Consequently, the donor's outside option and quality of the donor's information affect the extent of elite capture not only because they determine the donor's tolerance, but also because they affect the *slope* of the probability curve, $\frac{\partial \Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)}{\partial \theta}$.

Intuitively, it would seem that if the donor had a stronger outside option or better quality information about the preferences of the target population, then this would induce the elite to recommend a project closer to θ^t and thus lower elite capture. However, we shall see in the next section that this is not necessarily so.

4 Results

4.1 Comparative statics

We can deduce the effect of an improvement in the donor's outside option from the first-order condition in (15) or (16). According to Lemma 3, the donor's tolerance declines with $\underline{U}^d$. It follows that the probability that a project θ is accepted (denoted by the term $\Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)$) also declines with $\underline{U}^d$. From (16), we can see that this lowers the elite's reward from recommending a project close to θ^e and therefore discourages elite capture.

But an increase in $\underline{U}^d$ also affects how the probability of project acceptance changes with θ (denoted by $\frac{\partial \Pr\left(\theta \in \sigma\left(\theta^s\right)|\theta^t\right)}{\partial \theta}$). In particular, under Assumption 3, this slope becomes flatter, and thus lowers the 'marginal cost' (in the sense of a decrease in the probability of project acceptance) to the elite of recommending a project further from θ^t. This effect goes in the opposite direction of the one mentioned earlier. We can summarise these results in the form of the following proposition which is formally shown in Appendix A.

Proposition 1. *Under Assumptions 1, 2, and 3, the effect of an increase in the donor's outside option on elite capture is composed of two opposing effects: (i) a decline in the donor's tolerance, which discourages elite capture, and (ii) decreased sensitivity of the likelihood of project acceptance to changes in the recommended project, which encourages elite capture.*

Under certain conditions, namely if the conditional density of θ^s, $f_s\left(\theta^s|\theta^t\right)$ declines or rises sharply over some interval, or if the elite gains little additional utility from capture beyond a certain point (i.e. $\frac{\partial U^e}{\partial \theta}$ is small), then the second effect noted in Proposition 1 can dominate the first. Consequently, an improvement in the donor's outside option can, paradoxically, lead to an increase in elite capture.

Next, consider how an improvement in the quality of the donor's information would affect elite capture. According to Lemma 3, the donor becomes more tolerant as the quality of information improves (i.e. as m declines). Then, as we established previously, an increase in the donor's tolerance would tend to increase the probability that a project θ is accepted, and thus *encourage* elite capture.

Improved tolerance also affects how the probability of project acceptance changes with θ; in particular, under Assumption 3, it causes the slope to become steeper, and thus raises the 'marginal cost' (in the sense of a decrease in the probability of project acceptance) to the elite of recommending a project further from θ^t. This would discourage elite capture.

As the quality of the donor's information improves, the elite also becomes more confident about the actual signal received by the donor. More precisely, according to Assumption 3, θ^s has a smaller support and a higher density around θ^t as m declines. This has an ambiguous effect on elite capture. But if the initial level of elite capture is sufficiently high, then we can show that this will discourage elite capture. The following proposition, formally proven in Appendix A, summarises these results and provides the specific conditions.

Proposition 2. *Under Assumptions 1-6, and $m < \bar{m}$, the effect of an increase in the quality of the donor's information (i.e. a decline in m) is composed of three effects: (i) an increase in the donor's tolerance, which encourages elite capture, (ii) increased sensitivity of the likelihood of project acceptance to changes in the recommended project, which discourages elite capture, and (iii) increased accuracy in the donor's signal (and the elite's perception of it), which, if the initial level of elite capture is sufficiently high (specifically $[\mu_a\left(\theta^r;m,u\right),\mu_b\left(\theta^r;m,u\right)] \subsetneq [a\left(\theta^t;m\right),b\left(\theta^t;m\right)]$ and $\Pr\left(\theta^r \in \sigma\left(\theta^s\right)|\theta^t\right) < \frac{1}{2}$), discourages elite capture.*

4.2 Discussion

The above result looks counter-intuitive. The intuition suggests, indeed, that higher tolerance or laxity on the part of a donor agency should incite the elite to take advantage of it by making a project proposal closer to their own preference. This prediction is obviously correct when the elite know with certainty the information that the donor has acquired about the preference of the group targeted by the aid programme. This is the case in which the elite observe the donor's signal. The greater the tolerance of the donor regarding the distance between the project proposal and his signal (that is, the donor's idea about what the targeted group prefers), the more the elite will choose to propose a project that departs from this signal.

However, as soon as one considers a situation in which the donor's signal is not precisely known by the elite (instead of being fixed, the domain of project acceptability is sliding along the rail of possible values of the project mix), so that the latter cannot know for sure whether their proposal will be accepted or rejected, the prediction may be invalidated. The key point is that greater tolerance of the donor manifests itself on both sides of the signal received: the domain of project acceptance extends itself to the right and to the left of the point corresponding to this signal. Since the probability of project acceptance is always higher in the area closer to the target group's preferred project, the effect of this extension is to create a larger potential for increasing the acceptance probability by moving closer to the target group's preferred project rather than moving in the opposite direction. Such a pro-poor move has the evident consequence of decreasing the elite's intrinsic utility derived from the project, but our result shows that the net effect may be favourable.

The argument can be easily illustrated with the help of a simple version of the problem as depicted in Figure 1 below. The graph shows the elite's beliefs regarding the distribution of θ^s, the signal received by the donor for a particular realisation of θ^t. Suppose the quality of the donor's information and the donor's outside option are such that the elite recommends the project mix θ^r shown in the figure (θ^r is larger than θ^t but smaller than θ^e). The points μ_a and μ_b denote, respectively, the smallest and largest values of θ^s for which the donor would approve the recommendation θ^r.

What would happen if the donor now becomes more tolerant (which, according to Lemma 3, occurs if his outside option becomes weaker or the quality of his information improves) ? The points μ'_a and μ'_b in the figure denote the smallest and largest values of θ^s for which the donor would approve of θ^r following such a change. Greater tolerance implies that $\mu'_a < \mu_a$ and $\mu'_b > \mu_b$.

The elite now enjoys a higher probability of project acceptance if he recommends θ^r (the probability is now represented by the area under the curve between μ'_a and μ'_b as opposed to the area between μ_a and μ_b before the change). This higher probability would increase the temptation of elite capture and encourage the elite to recommend a project mix even higher than θ^r. This effect matches our intuition.

But it is important to note that whenever the elite adjusts the recommendation towards his own preferred point, the probability that it will be accepted by the donor declines. And the marginal decline is *greater* when the donor is more tolerant. Visually, this can be verified by observing that the distance between the heights x' and y' is greater than that between x and y. This increased sensitivity of the probability of acceptance to changes in the recommended project mix would lower the temptation of elite capture and encourage the elite to recommend a project mix lower than θ^r. This effect lies at the heart of the paradox highlighted in this paper.

It should be evident from the figure that if the probability curve is sufficiently steep in the interval $[\mu'_a, \mu'_b]$ (and the distance $x' - y'$ is sufficiently greater than that between $x - y$), then the second effect will dominate the first.

Distribution of θ^s

Probability that θ^r is accepted by the donor

x'

x

y
y'

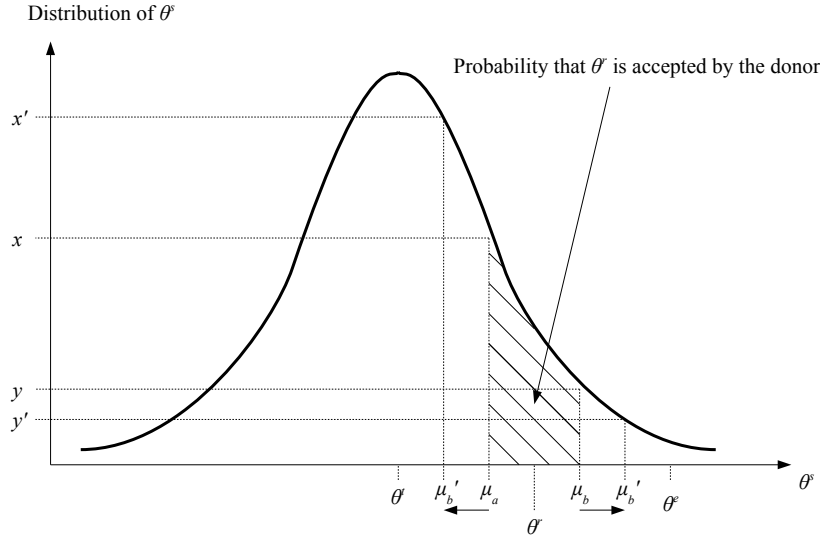θ^i $\mu_b{}'$ μ_a μ_b $\mu_b{}'$ θ^e θ^s

θ^r

Figure 1: The effect of increased donor's tolerance on the probability of project acceptance

5   Conclusion

Participatory development is highly vulnerable to the risk of elite capture. Among the two main forms of elite capture, embezzlement and information distortion, the latter has been best documented empirically and worked out theoretically. However, the influence of the elite is typically assumed to exert itself through the local collective decision-making process without the donor being able to constrain it. In this contribution, we have followed a different approach in which the donor pursues the explicit objective of poverty alleviation and has an imprecise idea of what the priorities of the poor look like. This idea can only be guessed by the elite. The donor also exhibits a certain degree of tolerance regarding the distance between his signal and the actual proposal made by the elite on behalf of the poor. The elite then face a trade-off between two types of considerations: the probability of acceptance of their project proposal by the donor, on the one hand, and its degree of congruence with their own preference, on the other hand.

In this particular framework, a paradoxical result may obtain. An improvement in the donor's outside option that results, say, from reduced competition between donors for access to target communities, may end up encouraging elite capture. Similarly, an improvement in the quality of the donor's information about the poor's preference may induce the elite to propose a project that is farther away from the poor's preferred outcome.

It bears emphasis that this sort of paradoxical effect is not a mere curiosity arising in the specific context of donor-elite strategic relations. It has a much wider scope since it can be obtained in other principal-agent settings exhibiting characteristics similar to those mentioned above. Revealingly, Putterman (1987) and Putterman and Skillman (1988) have shown, in the context of sharecropping contracts, that different assumptions regarding the information available to a principal who monitors the work of a worker lead to different responses of labor effort to monitoring. In some cases, the worker will in fact exert less effort when the monitoring improves.

Since the paradox is now well understood on the theoretical plane, research effort should be devoted to gathering empirical evidence on whether and under what circumstances it arises. In particular, one would like to know to what extent the mis-targeting of aid resources is attributable to the sort of information distortion analysed in this paper.

6   Appendix A

1. Proof of Lemma 1: Using Bayes' Rule,

$$
\begin{aligned}
f_t\left(\theta^t|\theta^s\right) &= \frac{f\left(\theta^s,\theta^t\right)}{f_s\left(\theta^s\right)} \\
&= \frac{f_s\left(\theta^s|\theta^t\right)f_t\left(\theta^t\right)}{\int_0^1 f_s\left(\theta^s|\theta\right)f_t\left(\theta\right)d\theta}
\end{aligned} \tag{17}
$$

By construction, if $\theta \notin [\theta^s - m, \theta^s + m]$, then $\theta^s \notin [a\left(\theta;m\right), b\left(\theta;m\right)]$. By Assumption 3, if $\theta^s \notin [a\left(\theta^t\right), b\left(\theta^t\right)]$, then $f_s\left(\theta^s|\theta^t\right) = 0$. Therefore, we obtain from (17),

$$
f_t\left(\theta^t|\theta^s\right) = \begin{cases} \frac{f_s\left(\theta^s|\theta^t\right)f_t\left(\theta^t\right)}{\int_{\theta^s-m}^{\theta^s+m} f_s\left(\theta^s|\theta\right)f_t\left(\theta\right)d\theta} & \text{if } \theta^t \in [\theta^s - m, \theta^s + m] \\ 0 & \text{otherwise} \end{cases} \tag{18}
$$

Using Assumption 3, we obtain, for $\theta^t \in [\theta^s - m, \theta^s + m]$,

$$
f_t\left(\theta^t|\theta^s\right) = \frac{\lambda\left(\theta^t;m\right)g\left(|\theta^t - \theta^s|\right)f_t\left(\theta^t\right)}{\int_{\theta^s-m}^{\theta^s+m} \lambda\left(\theta;m\right)g\left(|\theta - \theta^s|\right)f_t\left(\theta\right)d\theta} \tag{19}
$$

Let $\lambda_0 = \left[\int_{-m}^{+m} g\left(|x|\right)dx\right]^{-1}$. If $\theta^t \in [2m, 1 - 2m]$, then $a\left(\theta^t;m\right) = \theta^t - m$ and $b\left(\theta^t;m\right) = \theta^t + m$. Then,

$$
\lambda\left(\theta;m\right) = \left[\int_{\theta-m}^{\theta+m} g\left(|\theta^s - \theta|\right)d\theta^s\right]^{-1} \tag{20}
$$

Using the substitution $x = \theta^s - \theta$ in (20), we obtain

$$
\lambda\left(\theta;m\right) = \left[\int_{-m}^{+m} g\left(|x|\right)dx\right]^{-1} = \lambda_0 \tag{21}
$$

If $m < \bar{m}$, then, using Assumption 4, we have $f_t\left(\theta^t\right) = 0$ whenever $\theta^t \notin [2m, 1 - 2m]$. Therefore, we have

either $\lambda\left(\theta;m\right) = \lambda_0$ (when $\theta^t \in [2m, 1 - 2m]$) or $f_t\left(\theta^t\right) = 0$ (when $\theta^t \notin [2m, 1 - 2m]$). Thus, we can write $\lambda\left(\theta;m\right)f_t\left(\theta\right) = \lambda_0 f_t\left(\theta\right)$. Therefore, using (19) and (21), we obtain, for $\theta^t \in [\theta^s - m, \theta^s + m]$,

$$
\begin{aligned}
f_t\left(\theta^t|\theta^s\right) &= \frac{\lambda_0 g\left(|\theta^t - \theta^s|\right)f_t\left(\theta^t\right)}{\int_{\theta^s-m}^{\theta^s+m} \lambda_0 g\left(|\theta - \theta^s|\right)f_t\left(\theta\right)d\theta} \\
&= \frac{g\left(|\theta^t - \theta^s|\right)f_t\left(\theta^t\right)}{\int_{\theta^s-m}^{\theta^s+m} g\left(|\theta - \theta^s|\right)f_t\left(\theta\right)d\theta}
\end{aligned}
$$

Using the substitution $x = \theta^s - \theta$, we obtain

$$
\begin{aligned}
\int_{\theta^s-m}^{\theta^s+m} g\left(|\theta - \theta^s|\right)f_t\left(\theta\right)d\theta &= \int_{-m}^{+m} g\left(|x|\right)f_t\left(x + \theta^s\right)dx \\
&= \left[\hat{\lambda}\left(\theta^s,m\right)\right]^{-1}
\end{aligned}
$$

Therefore,

$$
f_t\left(\theta^t|\theta^s\right) = \begin{cases} \hat{\lambda}\left(\theta^s,m\right)g\left(|\theta^t - \theta^s|\right)f_t\left(\theta^t\right) & \text{if } \theta^t \in [\theta^s - m, \theta^s + m] \\ 0 & \text{otherwise} \end{cases}
$$

13

2. Proof of Lemma 2: By construction,

$$E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]=\int_{\theta^s-m}^{\theta^s+m}U^d\left(\left\|\theta-\theta^t\right\|\right)f\left(\theta^t|\theta^s\right)d\theta^t$$

Differentiating throughout w.r.t. θ, we obtain

$$\frac{d}{d\theta}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]=\int_{\theta^s-m}^{\theta^s+m}\frac{dU^d}{d\theta}\left(\left\|\theta-\theta^t\right\|\right)f\left(\theta^t|\theta^s\right)d\theta^t \tag{22}$$

Note that, if $\theta\leq\theta^s-m$, then the right-hand side of (22) is greater than or equal to zero. If $\theta\geq\theta^s+m$, then the right-hand side of (22) is less than or equal to zero. So, the optimal value of θ lies in the interval (θ^s-m,θ^s+m). For $\theta\in(\theta^s-m,\theta^s+m)$, we obtain

$$\frac{d}{d\theta}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]=\int_{\theta^s-m}^{\theta}\frac{dU^d}{d\theta}\left(\theta-\theta^t\right)f\left(\theta^t|\theta^s\right)d\theta^t+\int_{\theta}^{\theta^s+m}\frac{dU^d}{d\theta}\left(\theta^t-\theta\right)f\left(\theta^t|\theta^s\right)d\theta^t \tag{23}$$

By Assumption 1, the first integral is negative and the second integral is positive. We wish to show that, as θ increases, the first integral becomes more negative while the first integral becomes less positive. Differentiating the first integral w.r.t. θ, we obtain

$$\int_{\theta^s-m}^{\theta}\frac{d^2U^d}{d\theta^2}\left(\theta-\theta^t\right)f\left(\theta^t|\theta^s\right)d\theta^t+\frac{dU^d}{d\theta}\left(\left\|\theta-\theta^t\right\|\right)|_{\theta^t=0}f\left(\theta^t|\theta^s\right) \tag{24}$$

Differentiating the second integral w.r.t. θ, we obtain

$$\int_{\theta}^{\theta^s+m}\frac{d^2U^d}{d\theta^2}\left(\theta^t-\theta\right)f\left(\theta^t|\theta^s\right)d\theta^t-\frac{dU^d}{d\theta}\left(\left\|\theta-\theta^t\right\|\right)|_{\theta^t=0}f\left(\theta^t|\theta^s\right) \tag{25}$$

From (24) and (25), we obtain

$$\frac{d^2}{d\theta^2}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]=\int_{\theta^s-m}^{\theta}\frac{d^2U^d}{d\theta^2}\left(\theta-\theta^t\right)f\left(\theta^t|\theta^s\right)d\theta^t+\int_{\theta}^{\theta^s+m}\frac{d^2U^d}{d\theta^2}\left(\theta^t-\theta\right)f\left(\theta^t|\theta^s\right)d\theta^t \tag{26}$$

Then, using Assumption 2 and equation (26), we obtain $\frac{d^2}{d\theta^2}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]<0$. Therefore, the term $\frac{d}{d\theta}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]$ is monotonically decreasing in θ in the interval (θ^s-m,θ^s+m). Therefore, there exists a unique value $\theta^*\in(\theta^s-m,\theta^s+m)$ such that $\frac{d}{d\theta}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]=0$. Moreover, $\frac{d}{d\theta}E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]\gtreqless0$ for $\theta\lesseqgtr\theta^*$. It follows that the expression $E\left[U^d\left(\left\|\theta-\theta^t\right\|\right)|\theta^s\right]$ is maximised at $\theta=\theta^*$, is increasing in θ for $\theta<\theta^*$ and decreasing in θ for $\theta>\theta^*$. Therefore, the set $\sigma\left(\theta^s\right)$, defined by (2), is a closed interval. Therefore, we can write $\sigma\left(\theta^s\right)=\left[\kappa_a\left(\theta^s,m,u\right),\kappa_b\left(\theta^s,m,u\right)\right]$, where the functions $\kappa_a\left(.\right),\kappa_b\left(.\right)>0$ are given implicitly by the following equations:

$$E\left[U^d\left(\left\|\theta^t-\kappa_a\right\|\right)|\theta^s\right]=u,\kappa_a<\theta^*$$
$$E\left[U^d\left(\left\|\theta^t-\kappa_b\right\|\right)|\theta^s\right]=u,\kappa_b>\theta^*$$

3. Proof of Lemma 3:

   (i) Let

$$\tilde{U}^d\left(\theta^t;\theta\right)=U^d\left(\left\|\theta-\theta^t\right\|\right) \tag{27}$$
$$V^d\left(\theta,\theta^s,m\right)=E\left[U^d\left(\left\|\theta-\theta^t\right\|\right);\theta^s,m\right] \tag{28}$$

Therefore, we have

$$V^d\left(\theta,\theta^s,m\right)=\int_{\theta^s-m}^{\theta^s+m}\tilde{U}^d\left(\theta^t;\theta\right)f_t\left(\theta^t|\theta^s;m\right)d\theta^t$$

14

$$\implies \frac{\partial V^d}{\partial m} = \int_{\theta^s - m}^{\theta^s + m} \tilde{U}^d\left(\theta^t; \theta\right) \frac{\partial f_t\left(\theta^t | \theta^s; m\right)}{\partial m} d\theta^t + \left[\tilde{U}^d\left(\theta^s + m; \theta\right) + \tilde{U}^d\left(\theta^s - m; \theta\right)\right]$$

Note that if $E\left(\theta^t | \theta^s\right) = \theta^s$, then an increase in m constitutes an 'elementary increase in risk'[4]. Note also that an 'elementary increase in risk' implies secondary-order stochastic dominance (Mas-Collel, Whinston and Green, 1995; chapter 6). Therefore, if the donor's utility function is strictly concave (Assumption 2) and $E\left(\theta^t | \theta^s\right) = \theta^s$ (Assumption 5), we have

$$\frac{\partial V^d}{\partial m} < 0 \tag{29}$$

By construction, we have

$$V^d\left(\kappa_b\left(\theta^s; m, \underline{U}^d\right), \theta^s, m\right) \equiv \underline{U}^d \tag{30}$$

where $\kappa_b\left(.\right)$ is as defined in the statement of Lemma 2. Differentiating throughout (30) w.r.t. m, we obtain

$$\frac{\partial V^d\left(\kappa_b\left(.\right), \theta^s, m\right)}{\partial m} + \frac{\partial \kappa_b}{\partial m} \frac{\partial V^d\left(\kappa_b\left(.\right), \theta^s, m\right)}{\partial \theta} = 0 \tag{31}$$

Using Lemma 2, $\frac{\partial V^d\left(\kappa_b\left(.\right), \theta^s, m\right)}{\partial \theta} < 0$. Therefore, using (29) and (31), we obtain $\frac{\partial \kappa_b}{\partial m} < 0$. Similarly, we can show that $\frac{\partial \kappa_b}{\partial m} > 0$. It follows that $\sigma\left(\theta^s; m_2, u\right) \subset \sigma\left(\theta^s; m_1, u\right)$ and $\sigma\left(\theta^s; m_2, u\right) \neq \sigma\left(\theta^s; m_1, u\right)$ for $m_2 > m_1$. Therefore, the donor's tolerance of elite capture is decreasing in m.

(ii) Differentiating throughout (30) w.r.t. $\underline{U}^d$, we obtain

$$\frac{\partial \kappa_b}{\partial \underline{U}^d} \frac{\partial V^d\left(\kappa_b\left(.\right), \theta^s, m\right)}{\partial \theta} = 1 \tag{32}$$

Since $\frac{\partial V^d\left(\kappa_b\left(.\right), \theta^s, m\right)}{\partial \theta} < 0$, we obtain, using (32), that $\frac{\partial \kappa_b}{\partial \underline{U}^d} < 0$. Similarly, we can show that $\frac{\partial \kappa_a}{\partial \underline{U}^d} > 0$. It follows that $\sigma\left(\theta^s; m, u_2\right) \subset \sigma\left(\theta^s; m, u_1\right)$ and $\sigma\left(\theta^s; m, u_2\right) \neq \sigma\left(\theta^s; m, u_1\right)$ for $u_2 > u_1$. Therefore, the donor's tolerance of elite capture is decreasing in $\underline{U}^d$.

4. Proof of Proposition 1: By construction, $\mu_b\left(\theta; m, u\right)$ is decreasing and $\mu_a\left(\theta; m, u\right)$ is increasing in u. If $\theta^e > \theta^t$, then, by Assumption 3, $f_s'\left(. | \theta^t\right) < 0$ for $\theta \in \left(\theta^t, \theta^e\right)$. Therefore, we have $\left[f_s\left(\mu_b\left(\theta; m, u\right) | \theta^t\right) - f_s\left(\mu_a\left(\theta; m, u\right) | \theta^t\right)\right]$ increasing in u (i.e. becoming less negative) for $\theta \in \left(\theta^t, \theta^e\right)$. From the first term in (15), it is evident that this lowers the *cost* to the elite of choosing a higher value of θ. However, the term $\left[F_s\left(\mu_b\left(\theta; m, u\right) | \theta^t\right) - F_s\left(\mu_a\left(\theta; m, u\right) | \theta^t\right)\right]$ is decreasing in u. From the second term in (15), this decreases the *reward* to the elite of choosing a higher of θ.

If $\theta^e < \theta^t$, then, by Assumption 3, $f_s'\left(. | \theta^t\right) > 0$ for $\theta \in \left(\theta^e, \theta^t\right)$. Therefore, we have

$\left[f_s\left(\mu_b\left(\theta; m, u\right) | \theta^t\right) - f_s\left(\mu_a\left(\theta; m, u\right) | \theta^t\right)\right]$ decreasing in u (i.e. becoming less positive) for $\theta \in \left(\theta^e, \theta^t\right)$. From (15), this lowers the *cost* to the elite of choosing a lower value of θ. However, as previously mentioned, the term $\left[F_s\left(\mu_b\left(\theta; m, u\right) | \theta^t\right) - F_s\left(\mu_a\left(\theta; m, u\right) | \theta^t\right)\right]$ is decreasing in u. From (15), this decreases the *reward* to the elite of choosing a lower value of θ.

5. Proof of Proposition 2: For analytical clarity, denote by m_1 the parameter which determines the elite's perception of the donor's tolerance; and denote by m_2 the parameter which determines the elite's beliefs about θ^s. Thus we write the tolerance interval as $\left[\mu_a\left(\theta^t; m_1, u\right), \mu_b\left(\theta^t; m_1, u\right)\right]$; and the conditional distribution as $f_s\left(\theta^s | \theta^t; m_2\right)$. If the elite has full knowledge about any improvement in the quality of the donor's information, then this will of course imply a decline in both m_1 and m_2.

(i) & (ii) Following the reasoning in the proof of Lemma 3, we have $\mu_b\left(\theta; m_1, u\right)$ is decreasing and $\mu_a\left(\theta; m_1, u\right)$ is increasing in m_1. If $\theta^e > \theta^t$, then, by Assumption 3, $f_s'\left(. | \theta^t\right) < 0$ for $\theta \in \left(\theta^t, \theta^e\right)$. Therefore, we have

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[4]Given two lotteries defined by the distributions $F\left(.\right)$ and $G\left(.\right)$, we say that '$G\left(.\right)$ constitutes an elementary increase in risk from $F\left(.\right)$ if $G\left(.\right)$ is generated from $F\left(.\right)$ by taking all the mass that $F\left(.\right)$ assigns to an interval $\left[x', x''\right]$ and transferring it to the endpoints x' and x'' in such a manner that the mean is preserved.' Mas-Colell, Whinston and Green (1995), page 198.

$[f_s\left(\mu_b\left(\theta;m_1,u\right)|\theta^t;m_2\right)-f_s\left(\mu_a\left(\theta;m_1,u\right)|\theta^t;m_2\right)]$ increasing in m_1 (i.e. becoming less negative) for $\theta\in\left(\theta^t,\theta^e\right)$. From the first term in (15), it is evident that, as m_1 declines, this raises the *cost* to the elite of choosing a higher value of θ. However, the term $[F_s\left(\mu_b\left(\theta;m_1,u\right)|\theta^t;m_2\right)-F_s\left(\mu_a\left(\theta;m_1,u\right)|\theta^t;m_2\right)]$ is decreasing in m_1. From the second term in (15), it follows that, as m_1 declines, this increases the *reward* to the elite of choosing a higher of θ.

Following the reasoning in the proof of Proposition 1, it can be shown that the same incentives are present when $\theta^e<\theta^t$.

(iii)(a) Consider, first, the case where $\theta^e>\theta^t$. And suppose the values of θ,θ^t,m_1,m_2 and u are such that

$$\mu_a\left(\theta;m_1,u\right),\mu_b\left(\theta;m_1,u\right)\in\left[a\left(\theta^t;m_2\right),b\left(\theta^t;m_2\right)\right]$$

We have

$$\frac{d}{dm_2}\left[f_s\left(\mu_b\left(\theta;m_1,u\right)|\theta^t;m_2\right)-f_s\left(\mu_a\left(\theta;m_1,u\right)|\theta^t;m_2\right)\right]$$

$$=\left[\frac{\partial\lambda\left(\theta^t,m_2\right)}{\partial m_2}\left\{g\left(\left|\mu_b-\theta^t\right|\right)-g\left(\left|\mu_a-\theta^t\right|\right)\right\}\right]$$

Using Assumption 4, we have $\theta^t\in\left[2\bar{m},1-2\bar{m}\right]$. Since we have also assumed that $m_2<\bar{m}$, this implies $\theta^t\in\left[2m_2,1-2m_2\right]$. Therefore, using (9) and (10), we have $a\left(\theta^t,m_2\right)=\theta^t-m_2$ and $b\left(\theta^t,m_2\right)=\theta^t+m_2$. Therefore $\lambda\left(\theta^t,m_2\right)=\left[\int_{\theta^t-m_2}^{\theta^t+m_2}g\left(\left|\theta^s-\theta^t\right|\right)d\theta^s\right]^{-1}$, which implies that $\lambda\left(\theta^t,m_2\right)$ is decreasing in m_2. Since $\theta^e>\theta^t$, using Assumption 3, we have $g\left(\left|\mu_b-\theta^t\right|\right)<g\left(\left|\mu_a-\theta^t\right|\right)$. Therefore we have

$$\frac{d}{dm_2}\left[f_s\left(\mu_b|\theta^t;m_2\right)-f_s\left(\mu_a|\theta^t;m_2\right)\right]$$

$$=\frac{\partial\lambda}{\partial m_2}\left[g\left(\left|\mu_b-\theta^t\right|\right)-g\left(\left|\mu_a-\theta^t\right|\right)\right]>0$$

Thus, a decline in m_2 (i.e. an improvement in the quality of the donor's information) would cause the probability of project acceptance to fall more sharply with increasing θ. Similarly, we can show that if $\mu_b\left(\theta;m_1,u\right)>b\left(\theta^t;m_2\right)$ and $\mu_a\left(\theta;m_1,u\right)\in\left[a\left(\theta^t;m_2\right),b\left(\theta^t;m_2\right)\right]$, then $\frac{d}{dm_2}\left[f_s\left(\mu_b|\theta^t;m_2\right)-f_s\left(\mu_a|\theta^t;m_2\right)\right]=\frac{d}{dm_2}\left[-f_s\left(\mu_a|\theta^t;m_2\right)\right]>0$. If $\mu_b\left(\theta;m_1,u\right)>b\left(\theta^t;m_2\right)$ and $\mu_a\left(\theta;m_1,u\right)<a\left(\theta^t;m_2\right)$, then $\frac{d}{dm_2}\left[f_s\left(\mu_b|\theta^t;m_2\right)-f_s\left(\mu_a|\theta^t;m_2\right)\right]=0$. Note that we cannot have $\mu_a\left(\theta;m_1,u\right)<a\left(\theta^t;m_2\right)$ and $\mu_b\left(\theta;m_1,u\right)\in\left[a\left(\theta^t;m_2\right),b\left(\theta^t;m_2\right)\right]$, because, in this case, given that $\theta^e>\theta^t$, an increase in θ would both increase the probability of acceptance and the utility to the elite from the recommended project mix.

Furthermore, if the initial level of elite capture is sufficiently high, we must have $\mu_b\left(\theta;m_1,u\right)>b\left(\theta^t;m_2\right)$ and $\mu_a\left(\theta;m_1,u\right)\in\left[a\left(\theta^t;m_2\right),b\left(\theta^t;m_2\right)\right]$. We argued previously that, given $m<\bar{m}$ and Assumption 4, $b\left(\theta^t;m_2\right)=\theta^t+m_2$. Then

$$\begin{aligned}\Pr\left(\theta\in\sigma\left(\theta^s\right)|\theta^t;m_2\right)&=F_s\left(b\left(\theta^t;m_2\right)\right)-F_s\left(\mu_a\left(\theta^t;m_1,u\right)\right)\\&=\lambda\left(\theta^t,m_2\right)\int_{\mu_a\left(\theta;m_1,u\right)}^{\theta^t+m_2}g\left(\left|\theta^s-\theta^t\right|\right)d\theta^s\\&=\frac{\int_{\mu_a\left(\theta;m_1,u\right)}^{\theta^t+m_2}g\left(\left|\theta^s-\theta^t\right|\right)d\theta^s}{\int_{\theta^t-m_2}^{\theta^t+m_2}g\left(\left|\theta^s-\theta^t\right|\right)d\theta^s}\end{aligned}$$

Therefore,

$$\begin{aligned}\frac{\partial\Pr\left(\theta\in\sigma\left(\theta^s\right)|\theta^t;m_2\right)}{\partial m_2}&=\lambda\left(\theta^t,m_2\right)g\left(m_2\right)-2g\left(m_2\right)\left[\lambda\left(\theta^t,m_2\right)\right]^2\left[\int_{\mu_a\left(\theta;m_1,u\right)}^{\theta^t+m_2}g\left(\left|\theta^s-\theta^t\right|\right)d\theta^s\right]\\&=\lambda\left(\theta^t,m_2\right)g\left(m_2\right)\left[1-2\Pr\left(\theta\in\sigma\left(\theta^s\right)|\theta^t;m_2\right)\right]\end{aligned}$$

16

Therefore, if the probability of acceptance is initially below $\frac{1}{2}$, then this probability is increasing in m_2. Then, a decline in m_2 would cause this probability to decrease, and therefore decrease the marginal reward of recommending a project θ further from θ^t.

In sum, if $\theta^e > \theta^t$, the initial level of elite capture is sufficiently high, and the probability of project acceptance is below $\frac{1}{2}$, then a decrease in m_2 would discourage elite capture.

(iii)(b) Next, consider the case where $\theta^e < \theta^t$. And suppose the values of θ^t, m_1, m_2 and u are such that

$$\mu_a\left(\theta; m_1, u\right), \mu_b\left(\theta; m_1, u\right) \in \left[a\left(\theta^t; m_2\right), b\left(\theta^t; m_2\right)\right]$$

As before, we have

$$\frac{d}{dm_2}\left[f_s\left(\mu_b\left(\theta; m_1, u\right) | \theta^t; m_2\right) - f_s\left(\mu_a\left(\theta; m_1, u\right) | \theta^t; m_2\right)\right]$$

$$= \left[\frac{\partial \lambda\left(\theta^t, m_2\right)}{\partial m_2}\left\{g\left(|\mu_b - \theta^t|\right) - g\left(|\mu_a - \theta^t|\right)\right\}\right]$$

Since $\theta^e < \theta^t$, using Assumption 3, we have $g\left(|\mu_b - \theta^t|\right) > g\left(|\mu_a - \theta^t|\right)$. Therefore we have

$$\frac{d}{dm_2}\left[f_s\left(\mu_b | \theta^t; m_2\right) - f_s\left(\mu_a | \theta^t; m_2\right)\right]$$

$$= \frac{\partial \lambda}{\partial m_2}\left[g\left(|\mu_b - \theta^t|\right) - g\left(|\mu_a - \theta^t|\right)\right] > 0$$

Thus, a decline in m_2 (i.e. an improvement in the quality of the donor's information) would cause the probability of project acceptance to fall more sharply with *decreasing* θ. Similarly, we can show that, if $\mu_a\left(\theta; m_1, u\right) < a\left(\theta^t; m_2\right)$ and $\mu_b\left(\theta; m_1, u\right) \in \left[a\left(\theta^t; m_2\right), b\left(\theta^t; m_2\right)\right]$, then $\frac{d}{dm_2}\left[f_s\left(\mu_b | \theta^t; m_2\right) - f_s\left(\mu_a | \theta^t; m_2\right)\right] = \frac{d}{dm_2}\left[f_s\left(\mu_b | \theta^t; m_2\right)\right] > 0$. If $\mu_b\left(\theta; m_1, u\right) > b\left(\theta^t; m_2\right)$ and $\mu_a\left(\theta; m_1, u\right) < a\left(\theta^t; m_2\right)$, then $\frac{d}{dm_2}\left[f_s\left(\mu_b | \theta^t; m_2\right) - f_s\left(\mu_a | \theta^t; m_2\right)\right] = 0$. Note that we cannot have $\mu_b\left(\theta; m_1, u\right) > b\left(\theta^t; m_2\right)$ and $\mu_a\left(\theta; m_1, u\right) \in \left[a\left(\theta^t; m_2\right), b\left(\theta^t; m_2\right)\right]$, because, in this case, given that $\theta^e < \theta^t$, a decrease in θ would both increase the probability of acceptance and the utility to the elite from the recommended project mix.

Furthermore, if the initial level of elite capture is sufficiently high, we must have $\mu_a\left(\theta; m_1, u\right) < a\left(\theta^t; m_2\right)$ and $\mu_b\left(\theta; m_1, u\right) \in \left[a\left(\theta^t; m_2\right), b\left(\theta^t; m_2\right)\right]$. We argued previously that, given $m < \bar{m}$ and Assumption 4, $a\left(\theta^t; m_2\right) = \theta^t - m_2$. Then

$$\Pr\left(\theta \in \sigma\left(\theta^s\right) | \theta^t; m_2\right) = F_s\left(\mu_b\left(\theta; m_1, u\right)\right) - F_s\left(a\left(\theta^t; m_2\right)\right)$$

$$= \lambda\left(\theta^t, m_2\right) \int_{\theta^t - m_2}^{\mu_b(\theta; m_1, u)} g\left(|\theta^s - \theta^t|\right) d\theta^s$$

$$= \frac{\int_{\theta^t - m_2}^{\mu_b(\theta; m_1, u)} g\left(|\theta^s - \theta^t|\right) d\theta^s}{\int_{\theta^t - m_2}^{\theta^t + m_2} g\left(|\theta^s - \theta^t|\right) d\theta^s}$$

Therefore,

$$\frac{\partial \Pr\left(\theta \in \sigma\left(\theta^s\right) | \theta^t; m_2\right)}{\partial m_2} = \lambda\left(\theta^t, m_2\right) g\left(m_2\right) - 2g\left(m_2\right)\left[\lambda\left(\theta^t, m_2\right)\right]^2 \left[\int_{\mu_a(\theta^t; m_1, u)}^{\theta^t + m_2} g\left(|\theta^s - \theta^t|\right) d\theta^s\right]$$

$$= \lambda\left(\theta^t, m_2\right) g\left(m_2\right)\left[1 - 2\Pr\left(\theta \in \sigma\left(\theta^s\right) | \theta^t; m_2\right)\right]$$

Therefore, once again, if the probability of acceptance is initially below $\frac{1}{2}$, then this probability is increasing in m_2. Then, a decline in m_2 would cause this probability to decrease, and therefore decrease the marginal reward of recommending a project θ further from θ^t.

In sum, if $\theta^e < \theta^t$, the initial level of elite capture is sufficiently high, and the probability of project acceptance is below $\frac{1}{2}$, then a decrease in m_2 would discourage elite capture.

7   Appendix B

In this appendix, we show that the $\kappa_a(\theta^s)$ and $\kappa_b(\theta^s)$ are monotonically increasing in θ^s, and therefore the inverse of these functions exist. By construction,

$$E\left[U^d\left(\left|\theta^t - \theta\right|\right)|\theta^s\right] = \int_{\theta^s - m}^{\theta^s + m} U^d\left(\left|\theta^t - \theta\right|\right) f_t\left(\theta^t|\theta^s\right) d\theta^t$$

Differentiating throughout w.r.t. θ^s, we obtain

$$\frac{d}{d\theta^s} E\left[U^d\left(\left|\theta^t - \theta\right|\right)|\theta^s\right] =$$

$$U^d\left(\left|\theta^s + m - \theta\right|\right) f_t\left(\theta^s + m|\theta^s\right) - U^d\left(\left|\theta^s - m - \theta\right|\right) f_t\left(\theta^s - m|\theta^s\right) + \int_{\theta^s - m}^{\theta^s + m} U^d\left(\left|\theta^t - \theta\right|\right) \frac{df_t\left(\theta^t|\theta^s\right)}{d\theta^s} d\theta^t \qquad (33)$$

Using Lemma 1, for $\theta^t \in [\theta^s - m, \theta^s + m]$, we have

$$f_t\left(\theta^t|\theta^s\right) = \hat{\lambda}\left(\theta^s\right) g\left(\left|\theta^s - \theta^t\right|\right) f_t\left(\theta^t\right)$$

Therefore,

$$\begin{aligned} f_t\left(\theta^s + m|\theta^s\right) &= \hat{\lambda}\left(\theta^s\right) g\left(|m|\right) f_t\left(\theta^s + m\right) \\ f_t\left(\theta^s - m|\theta^s\right) &= \hat{\lambda}\left(\theta^s\right) g\left(|m|\right) f_t\left(\theta^s - m\right) \end{aligned}$$

If $\frac{df_t\left(\theta^t|\theta^s\right)}{d\theta^s}$ is sufficiently small, then the right-hand side of (33) should have the same sign as

$$\left[U^d\left(\left|\theta^s + m - \theta\right|\right) - U^d\left(\left|\theta^s - m - \theta\right|\right)\right] \hat{\lambda}\left(\theta^s\right) g\left(|m|\right) f_t\left(\theta^s + m\right) \qquad (34)$$

If $\theta > \theta^s$, then, using Assumption 1, $U^d\left(\left|\theta^s + m - \theta\right|\right) > U^d\left(\left|\theta^s - m - \theta\right|\right)$. Then, the expression in (34) is greater than zero. Then, $E\left[U^d\left(\left|\theta^t - \theta\right|\right)|\theta^s\right]$ is increasing in θ^s. From Assumption 6 and the definition of $\kappa_b\left(\theta^s\right)$, it follows that $\kappa_b\left(\theta^s\right) > \theta^s$. Therefore, $E\left[U^d\left(\left|\theta^t - \kappa_b\left(\theta^s\right)\right|\right)|\theta^s + \varepsilon\right] > \underline{U}^d$ for some small increment $\varepsilon > 0$. It follows that $\kappa_b\left(\theta^s + \varepsilon\right) > \kappa_b\left(\theta^s\right)$. Thus, $\kappa_b\left(\theta^s\right)$ is monotonically increasing in θ^s. Similarly, we can show that $\kappa_a\left(\theta^s\right)$ is monotonically increasing in θ^s. Therefore, the inverse of the functions $\kappa_a\left(\theta^s\right)$ and $\kappa_b\left(\theta^s\right)$ exist.

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