INTERNATIONAL AID AND STRATEGIC INTERDEPENDENCE: HOW COMMON AND CONFLICTING FOREIGN POLICY GOALS SHAPE THE SUPPLY OF FOREIGN AID

BY

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DISSERTATION

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Abstract

In this dissertation, I study an under-appreciated reality of international aid. It has been long recognized that foreign aid is a multipurpose tool of foreign policy that wealthy countries wield to effect their designs in international politics. What is less often considered is that as countries use foreign aid to accomplish various foreign policy objectives, sometimes these goals may conflict with or support the objectives of other donors. Under the rationalist framework often adopted in the study of international aid, this fact implies strategic interdependence in the aid allocation decisions of donor governments. What are the implications of strategic interdependence in foreign aid, and how does it shape the distribution of economic assistance in developing countries?

In practice, this reality has a straightforward implication. While many studies examine patterns in international aid to draw inferences about the goals donors value in their foreign policies, how donors actually distribute foreign aid across recipients does not perfectly reflect their values. To the contrary, strategic interdependence creates incentives for donor governments deviate from giving aid purely in accordance with their objectives. Without a grasp for the role that conflicting and common foreign policy goals play in the allocation of international aid, scholars risk mis-identifying relationships between factors thought to determine aid flows and where donor governments offer more or less economic assistance.

While previous studies have addressed this issue in some shape or fashion, none adopt a theoretical perspective or an empirical strategy as comprehensive as I do in this dissertation. Taken together, the four chapters that follow make contributions to theory, measurement, and analysis, providing novel results about the implications of strategic interdependence in international aid.

In Chapter 1, I develop a mathematical model to study the implications of strategic interdependence in the political economy of aid. Analysis of the model underscores the mechanisms that drive strategic interdependence and reveals why donor governments may under or over commit resources in developing countries in pursuit of their foreign

policy goals. It specifically identifies the conditions under which empirical analysis will provide informative estimates of donor responses to the giving of others. It also yields predictions about how the comparative resource endowments of donor governments and the strategic valence of donor goals in developing countries push some donors to the top, and others to the bottom, in committing aid in recipients. The model also offers insight into the welfare implications of strategic interdependence and suggests mechanisms that may account for the repeated failure of donor countries to successfully collaborate in the allocation of aid. Analysis shows that an uncoordinated Nash equilibrium among donor governments can often have an unintiutive location relative to a Pareto improving alternative under collective optimization. Even more, the existence of a Pareto improving alternative is not guaranteed. In many instances, the adoption of a collectively optimal solution may be individually worse for at least one donor government relative to a Nash equilibrium. These results illustrate the kinds of stumbling blocks that may continue to impede donor collaboration and, thus, the kinds of factors that ought to be considered in the design of institutions.

In Chapter 2, I develop novel measures that will assist in empirical analysis of strategic interdependence in international aid. Using an approach I call SSC (sum of the squared covariances), I create composite measures of interest-based and needs-based factors that drive donor giving in developing countries. The first, which I call donor interest (DI), captures material, strategic, geographic, and social ties between donor governments and developing countries that make the latter salient targets for foreign aid to the former. The second measure, which I call recipient need (RN), captures developing country characteristics linked to greater need for donor assistance. By creating composite measures, I am able to probe how the interaction of donor-recipient ties and depth of recipient development need interact to shape donor responses to the aid given by others in developing countries with greater parsimony. To validate SSC, I compare SSC-constructed versions of DI and RN to those created by alternative methods of measurement construction and use vari-

ous modeling techniques to compare their prognostic power. The SSC derived measures consistently outperform those created via other approaches. Further, to assess what these measures can reveal about broad patterns in international aid, I perform pooled analyses and analyses for individual donor governments and years to compare and contrast donor responsiveness to interest-based and needs-based factors. The patterns in some cases align with conventional wisdom about donor motives, but in other cases support different inferences about donor motives than reported in other studies.

In Chapter 3, using the DI and RN measures created in the previous chapter, I provide confirmatory evidence that donor governments do in fact make their aid allocation on the basis of the giving of others and that these responses vary systematically with respect to the strength of interest-based and needs-based drivers of giving. Across the majority of the parameter space, donors show deference to others by giving less aid in recipients where others give more. But, there are instances where we observe interesting deviations from this response. On average, a donor gives *more* aid in recipients where others give more either when needs-based factors are low and interest-based factors for a donor are high, or when needs-based factors are high and interest-based factors are low. Conversely, a donor gives *less* aid in recipients were others give more either when needs-based factors are high and interest-based factors are high, or when needs-based factors are low and interest-based factors are low. Though many explanations may account for these patterns, they are arguably consistent with two prominent perspectives in the aid literature. One of these is called "targeted development" and the other "aid-for-policy exchange." The former is consistent with a common interest among donors for promoting development as a way to prevent transnational spillovers of developing country problems from affecting industrialized country populations. The latter is consistent with rival interests over policy concessions from recipients. Targeted development is proposed to dominate at the confluence of high interest and high need, while aid-for-policy exchange is proposed to dominate at low levels of interest and high need or high levels of interest and low need.

Beyond the specifics of donor responses, the analysis in Chapter 3 further shows that strategic interdependence does indeed lead to deviations between what donors value and how they actually distribute aid. A comparison of estimates on DI and RN with and without accounting for different responses to peer aid reveals striking differences in how interest-based and need-based factors determine patterns in aid giving. When strategic interdependence is not accounted for, regression estimates on DI and RN are attenuated in value, while second-order interactions between DI and RN are either suppressed or inflated depending on the sample of years under analysis.

Finally, in Chapter 4, I test arguments about how strategic interdependence shapes when and where donor governments come to be the dominant source of foreign aid in developing countries. Building on the theoretical analysis in Chapter 1 and insights on how donors respond to other-donor aid in different contexts from Chapter 3, we should expect a donor government to hold lead donor status at the confluence of two sets of conditions. A donor should take the lead, first, in high need recipients where interest-based factors are comparatively stronger for said donor relative to others, and second, when a donor is better resourced than its peers. The first set of conditions implies a development focus for donors (a non-rival goal) while the second confers a material advantage in financing international aid.

Building on the dataset used in Chapter 3, I construct a measure of lead donorship and find patterns in donor giving consistent with the above argument. I further take a closer look at variations in lead donorship in Latin America and Southeast Asia where I find some patterns that are consistent with proposed theoretical mechanisms, and others that suggest additional dynamics are at work as donors give foreign aid. Overall, the results in Chapter 4 reflect the first attempt to empirically model the determinants of lead donorship. The patterns I uncover have significance, not only for the support they provide for my theoretical argument, but also for informing research on the consequences of lead donorship for aid effectiveness in developing countries.

To Sarah, my love and best friend.

In loving memory of Dennis M. Williams (Dad).

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Table of Contents

Chapter 1

Strategic Interdependence and the Political Economy of Aid

1.1 Introduction

Some decades ago, Hans Morgenthau (1962) remarked that "[o]f the seeming and real innovations which the modern age has introduced into the practice of foreign policy, none has proven more baffling to both understanding and action than foreign aid" (301). In the time since his writing, IR scholars have spilled a great deal of ink attempting to make aid a little more comprehensible. These efforts have revealed both timeless and dynamic patterns in international aid, providing clues about the broader foreign policy objectives of donor governments.

The modal empirical strategy taken by scholars aligns quite well with a ubiquitous quote from US President Joe Biden: "Don't tell me what you value. Show me your budget, and I'll tell you what you value."[1] By examining correlations between a selection of covariates and flows of international aid, it is believed that we can draw inferences about what donor governments value in their foreign policies. International aid has long been a tool that powerful countries wield to effect their designs in international politics. With respect to US foreign policy alone, a cottage industry of studies has used US foreign aid allocations to test competing theories about US goals on the world stage.[2]

While valuable, most empirical work proceeds implicitly on the basis of a theoretical perspective that ignores *strategic interdependence* in the aid allocation decisions of donor governments. This is problematic, because to the extent that countries seek to accomplish

[1] "Biden's Remarks on McCain's Policies" reported in *The New York Times* on Sep. 15, 2008. Accessed on Mar. 25, 2021. https://www.nytimes.com/2008/09/15/us/politics/15text-biden.html

[2] See Fleck and Kilby (2010); Meernik, Krueger, and Poe (1998); McKinlay and Little (1977); McKinlay and Little (1979)

their foreign policy goals through international aid, they must do so in the face of the aid allocation decisions of one another. Within the rationalist framework most often adopted by scholars who study the determinants of economic assistance, the fact that donors do not operate in a vacuum implies that they have rational incentives to adjust how they distribute aid in light how others distribute theirs. What follows from this is simple: donor governments will often give foreign aid in ways that *deviate* from how they would give aid on the basis of their foreign policy objectives alone.

What are the implications of strategic interdependence in international aid? In this dissertation, I answer this question using a novel theoretical and empirical perspective. In this chapter, I focus specifically on honing theoretical understanding by analyzing a mathematical model of strategic interdependence in the political economy of aid.

The model, in its construction, is founded upon some relatively straightforward conceptions about the political economy of international aid. I start from the presumption that aid allocation is an arena in which donor states (wealthy countries that allocate aid) compete to maximize foreign policy goals realized through giving aid to recipient states (developing countries that receive aid). I introduce a two-donor, two-recipient model that captures key moving pieces of the strategic environment that donors face. In this model, countries have finite resources available to disburse in the form of aid, and they must choose how to distribute their limited aid budget between recipients. As they make this decision, donor choices are influenced (1) by the relative weight they place on realizing foreign policy interests by giving aid to a recipient and (2) by the *foreign policy externality* generated by the other donor's aid allocations. A foreign policy externality captures the impact that one donor's aid has on another donor's ability to get what it wants out of its aid allocation to a recipient. Such externalities may be either *positive* or *negative*. If the former, donors reap mutually beneficial foreign policy gains from their foreign aid. If the latter, donors obtain rival foreign policy gains. It is possible for donors to obtain rival gains with respect to one recipient, and mutually beneficial gains with respect to the other.

While I consider the substance of donor objectives in recipients more explicitly in subsequent chapters, for the sake of model building I ignore the substance of donor goals to focus exclusively on the implications that the strategic valence of donor goals has for donor best-responses. Later, particularly in Chapter 3, I will use two leading frameworks for understanding donor motivations to reason through when and where donor goals in recipients should be on net rival or common. These frameworks are "targeted development" (see Bermeo 2018) and "aid-for-policy exchange" (see Bueno de Mesquita and Smith 2009).

Analysis of the model underscores the mechanisms that drive strategic interdependence in international aid, revealing why donor governments may under or over commit resources in developing countries in pursuit of their foreign policy goals. It further identifies the conditions under which empirical analysis will provide informative estimates of donor responses to the giving of others. And, more generally, it yields predictions about how the comparative resource endowments of donor governments and the strategic valence of donor goals in developing countries push some donors to the top, and others to the bottom, in committing aid in recipients. Additionally, these findings illustrate why an empirical analysis that attempts to draw inferences about donor responses to certain proposed determinants of aid allocation will yield unreliable estimates if strategic interdependence is not accounted for.

As a normative matter, the model also offers insight into the welfare implications of strategic interdependence. Time and again, leading countries gather for high level summits on international development cooperation only to see dismal progress made toward realizing the goals established in these meetings. One analyst noted that the reason for this enduring failure is the misalignment between the stated goals of cooperation and the wide-ranging strategic foreign policy interests of donor governments (Lawson 2013). Highlighting mechanisms that lie at the source of this misalignment, this analysis shows that an uncoordinated equilibrium among donor governments can often have an unintiutive location relative to a Pareto improving alternative under collective optimization—that

is, an alternative way that donors could distribute aid that would make all better off relative to their self-interested mutual best-response. Even more, the existence of such an alternative is not guaranteed. In many instances, the adoption of a collectively optimal solution may be individually worse for at least one donor government relative to a Nash equilibrium. These results illustrate the kinds of stumbling blocks that may continue to impede donor collaboration.

1.2 A Strategic Political Economy of Aid

An enduring problem of international politics is that as one country strives to realize its foreign policy goals, this affects the extent to which other countries are able to realize their own sets of objectives. This fundamental issue is of central concern for the politics of foreign aid, since countries use aid as a means to realize wide-ranging goals vis-à-vis one another. For this reason, the aid allocation decisions of leading countries are best viewed through the lens of a strategic political economy perspective.

The proposed framework builds on conventional assumptions. Namely, that:

1. the actors of consequence (donor states) are unitary, and
2. these actors are rational—meaning they have well-defined preferences and engage in activities with the goal of maximizing their own well-being.

Strong though these assumptions may be, individual rationality provides animating force for the framework and makes general predictions about how actor priorities translate into specific choices possible. To these assumptions, the framework adds the following features:

3. as actors take steps to maximize their well-being, they operate under a resource constraint, and
4. their activities reflect efforts to realize *multiple* objectives.

These have made innumerable conjoint appearances across disciplines and contexts. One instance that IR scholars might be familiar with is the n-good theory of foreign policy proposed by Morgan and Palmer (2000). The authors contend that states' activities are best viewed in terms of policies that are directed toward multiple goals. As such, the primary decision facing country leaders is how to allot their limited resources in pursuit of their various objectives.

Of course, the constraints imposed by resource scarcity and the dynamics generated by variable preferences and technological capacity, while having interesting implications for the foreign policy choices made by state leaders, capture only a fraction of the factors that influence country decisions. Missing is a consideration of the fact that the actions countries take on the world stage generate various rival and mutually beneficial externalities for each other.

As an example, consider possible adjustments to US policy toward the Arab nations that recently normalized relations with Israel. Suppose US policymakers decided to expand sales of advanced weaponry, like F-35 fighter jets or unmanned combat aerial vehicles, to these countries given their diplomatic recognition of a critical strategic partner for the US. This action would not only have consequences for the US and this set of countries, it would also affect other major players in the region. For example, this action would pose a negative externality to China, which currently is a major supplier of cheaper, though inferior, UAVs and other military technology for this set of Gulf states.[3] China would have an incentive to respond to US arms sales with more competitively priced technology, an action that, in turn, would affect the US, prompting a counter response—and on and on the cycle would go.

Externalities, of course, need not all be negative. Luxembourg, for instance, is a long-time supporter of multilateralism generally, and of European unity specifically.[4] To

[3]For more on this example, see this opinion piece by Christian Le Miere in *South China Morning Star*: https://www.scmp.com/comment/opinion/article/3104623/how-trumps-middle-east-deal-will-affect-chinas-arms-sales-region (accessed Oct. 26, 2020)

[4]See, for example, the "Luxembourg country brief" compiled by Australia's Department of Foreign Affairs

the extent that other nations engage in efforts in line with greater influence for multilateral institutions, or for a stronger European Union (EU) in particular, this contributes to a major foreign policy goal for Luxembourg. As a result, the harder other countries work to support the EU, the less effort Luxembourg has to expend to promote the same objective.

Thus, when considering foreign policy activities, bilateral economic assistance included, accounting for strategic interdependence in the choices of countries is essential. How one country allots its resources in pursuit of different objectives has consequences for other countries as well, and vice versa. For foreign aid allocation in particular, how one country allots its own aid dollars has consequences for the goals and objectives of other aid donors. How other countries distribute aid in turn affects how hard an individual donor has to work to realize its own goals. Given this, a political economy of aid must allow that:

5. as actors take steps to maximize their goals, their actions affect and are affected by other actors' efforts to realize their own objectives. Some actions yield *rival* benefits (what helps one state hurts another), and other actions yield *common* benefits (what helps one state helps another).

Theoretical consideration of the strategic dimensions to aid allocation is not entirely absent from the literature. But, what examples do exist either ignore the choices of donors with respect to individual recipients (Dudley 1979), or suppose uniform externalities imposed by other-donor aid (Annen and Knack 2018; Annen and Moers 2017). Steinwand (2015), while allowing for possible differences in rival versus common benefits supplied by aid giving through alternative channels—aid given directly to recipient governments as opposed to non-governmental organizations—nonetheless treats aid given through a particular channel as having largely homogeneous consequences for other donors. Alternatively, the framework proposed here emphasizes both donor choices in allotting aid *between* recipients, and variable externalities posed by other-donor aid.

and Trade (accessed May 6, 2021): https://www.dfat.gov.au/geo/luxembourg/Pages/luxembourg-country-brief.

1.3 A Model of Aid Allocation

The moving parts of the strategic political economy approach laid out above are simple enough, but linking these to more concrete predictions for how countries realize their foreign policy goals through aid allocation is a fraught exercise. This is where the application of analytic tools like mathematical modeling can prove quite helpful.

To this end, I develop two-by-two model of aid allocation—two-donors, two-recipients. As countries allot resources to this or that aid recipient, it will be assumed that the level of aid they contribute supports a basket of objectives that are realized through their aid allocation. This basket, for simplicity's sake, is presumed constant between donors and over time. Further, one donor's basket is fully substitutable for the other donor's.

It will be assumed that as countries decide how to distribute aid, they will make their allocations in light of the foreign policy externality posed by other-country aid. On the whole, if more of the objectives realized by giving aid to a certain recipient are rival, then other-country aid will be a net hindrance to the realization of a given donor's goals. Conversely, if more of the objectives realized by giving aid to a certain recipient are on net common for the donor countries, then other-country aid will be a net help to the objectives of a given donor.

Though the model itself is agnostic about the goals of donors and the conditions under which aid is more likely to promote rival or common objectives, some examples from the aid literature include the extent to which aid supports a donor's geostrategic goals, promotes greater bilateral trade, combats global terrorism, garners influence over former colonies, confers prestige, complements military deployments, and addresses the root causes of discontent and instability (Bearce and Tirone 2010; Bermeo 2017; Kilby and Dreher 2010; Kisangani and Pickering 2015; Round and Odedokun 2004; and van der Veen 2011). Donor interest in a recipient might be greater when a recipient is a major trading partner, or lower if a recipient has little geostrategic value. Donor goals might be common if they care more about addressing recipient poverty, or rival if they seek

diplomatic influence. In Chapter 3 I tackle the question of when and where donor goals will be rival or common, but or now, it is more important to recognize that donors may have a mix of mutually beneficial or conflicting priorities that lead other-donor-aid to either be interpreted as a net supplement to, or cancellation of, the aid given by a single donor.

The below section introduces the two-by-two model. Though a two-donor, two-recipient world is certainty far from realistic, it is simple enough to keep the analysis tractable, while being minimally sufficient for conferring lessons about strategic donor actions.[5]

1.3.1 The Two-by-Two Model

Suppose we have two donor countries, i and j, and two recipient countries, x and y. Each of the donors is endowed with a certain relative share of resources available for allocating aid. Resources possessed by i are denoted $R_i \in (0,1)$, and resources possessed by j are given as $R_j = 1 - R_i$. R_i thus denotes the distribution of resources between i and j.

As i and j distribute resources in the form of aid to x and y, they each are able to realize certain baskets of foreign policy objectives through their allocations. $X \subseteq \mathbb{R}_+$ represents this basket of objectives with respect to recipient x, and $Y \subseteq \mathbb{R}_+$ represents this basket of objectives with respect to recipient y. Further, the quantity $X_i \in X$ denotes how much of i's total foreign policy objectives are realized by giving aid to recipient x, while the quantity $Y_i \in Y$ denotes how much of i's total foreign policy objectives are realized by giving aid to recipient y. Similar quantities exist for donor j.

As i and j allot resources between x and y, let the objectives donors are able to realize be linear functions of the amount of aid they contribute. For example, the basket of goals

[5]Though, of course, we might observe some interesting and novel behavior in a three-by-two model as well.

that i is able to realize through its aid allocations to each recipient are given as

$$X_i = x_i + \eta^x x_j \quad \text{and} \quad Y_i = y_i + \eta^y y_j, \tag{1}$$

where X poses no externality on Y, and vice versa. For each set of goals, the values x_i and y_i denote i's contribution of aid, while x_j and y_j denote j's. These quantities are strictly non-negative and bound such that $x_i + y_i \leqslant R_i$, and similarly for j. This means that i and j cannot spend more than their total endowment of resources in giving aid to both x and y.

While the effect of i's aid in support of its own goals is assumed to be constant, the effect of aid contributed by j is conditional on the net externality that j's aid poses to i's overall objectives. The externality of j's aid is represented by the terms $\eta^x, \eta^y \in (-1, 1)$. These reflect the extent to which the basket of foreign policy objectives donors realize through giving aid to each recipient are either on net rival or common. For example, if $-1 < \eta^x < 0$, then j's foreign aid to x overall subtracts from i's ability to realize the sum of its goals in giving aid to this recipient. Conversely, if $0 < \eta^x < 1$, then j's foreign aid overall helps i to realize the sum of its goals in giving aid to x. In the case that $\eta^x = 0$, the net impact of j's aid is zero.

Assuming donors have well-behaved and monotonically increasing preferences over objectives they realize through giving aid to x and y, utility for each can be represented by a function $u(\cdot)$ that is strictly increasing in quantities X and Y, is at least twice differntiable, and is quasi-concave. To keep the math simple, a convenient choice that retains these generic properties is Cobb-Douglas. Specifically, utility for i (and similarly for j) can be represented as

$$u_i(X_i, Y_i) = \sigma_i^x \log(X_i) + \sigma_i^y \log(Y_i). \tag{2}$$

In the above, σ_i^x and σ_i^y capture returns to scale for the sum of objectives i is able to realize with respect to recipients x and y. These are such that $\sigma_i^x \in (0, 1)$ and $\sigma_i^y = 1 - \sigma_i^x$. These

thus represent the relative salience i attaches to realizing certain bundles of objectives with respect to recipient countries. As $\sigma_i^x \to 1$, i places greater weight on realizing its goals by giving aid to x than it does in giving aid to y.

Assuming i and j are rational, self-interested actors, each will distribute aid between recipients in such a way that maximizes its own utility. Assuming an interior solution, this implies that for i, it will distribute its resources between x and y such that[6]

$$\frac{\sigma_i^x}{x_i + \eta^x x_j} = \frac{\sigma_i^y}{y_i + \eta^y y_j}. \tag{3}$$

The left-hand side of the above equality denotes the marginal utility of aid to x (MU_i^x), and the right-hand side denotes the marginal utility of aid to y (MU_i^y). How i allocates its aid in order to realize its ideal bundle of objectives over recipients will of course depend, not only on its prioritization of recipients, but also on the amount of aid contributed by j between recipients and the externality j's aid represents.

1.3.2 Friends, Adversaries, and Competitors

Donor i's incentives with respect to j's aid can be summarized according to three general sets of strategic relationships between donors—call these *friends*, *adversaries*, and *competitors*. A summary is given in Table 1.1.

Suppose, first, that i and j's objectives in giving aid to both x and y are overall mutually beneficial in nature. Hence, $\eta^x, \eta^y > 0$, or, in words, i and j are *friends*. If j were to make some positive transfer of resources $\Delta > 0$ from recipient y to recipient x, the resulting change in i's marginal utilities will be such that

$$\frac{\partial MU_i^x}{\partial \Delta} < 0 \quad \text{and} \quad \frac{\partial MU_i^y}{\partial \Delta} > 0. \tag{4}$$

[6]Under a fixed resource constraint, i's utility is maximized when $\partial u_i/\partial x_i = \partial u_i/\partial y_i$. $\partial u_i/\partial x_i = \sigma_i^x/(x_i + \eta^x x_j)$ and $\partial u_i/\partial y_i = \sigma_i^y/(y_i + \eta^y y_j)$

Table 1.1: A Typology of Strategic Relationships

Adversaries	*Competitors*	*Friends*
$\eta^x, \eta^y < 0$	$\eta^x < 0 \wedge \eta^y > 0$	$\eta^x, \eta^y > 0$
	$\eta^x > 0 \wedge \eta^y < 0$	

In words, j's hypothetical transfer of aid to x from y reduces the marginal utility of aid to x, and increases the marginal utility of aid to y. Donor i, in this scenario, has an incentive to give more aid where j gives less. This response is called "strategic substitution." It might also be called strategic deference.[7]

Alternatively, suppose that donors i and j receive on net rival benefits from giving aid to both x and y. That is, suppose that they are *adversaries*. Given a similar transfer Δ in the aid j gives to x from y, donor i's marginal utilities will now be such that

$$\frac{\partial MU_i^x}{\partial \Delta} > 0 \quad \text{and} \quad \frac{\partial MU_i^y}{\partial \Delta} < 0. \tag{5}$$

In short, j's transfer increases the marginal utility of aid to x, and decreases the marginal utility of aid to y. Given the hindrance j's aid poses to i, i has an incentive to give more aid where j gives more. This response is called competition.[8]

For the third scenario, i and j are rivals with respect to one recipient, but have common goals with respect to the other. In this case, they are *competitors*—a term that conveys a slightly less tense relationship than implied by *adversaries*, but not quite so copacetic as *friends*. Say, for instance, that $\eta^x > 0$ and $\eta^y < 0$. Some transfer Δ now is such that

$$\frac{\partial MU_i^x}{\partial \Delta} < 0 \quad \text{and} \quad \frac{\partial MU_i^y}{\partial \Delta} < 0. \tag{6}$$

That is, j's transfer of aid from y to x both reduces the marginal utility of aid to x, and

[7] The term free-riding could also apply, though strategic substitution could also just reflect an incentive to specialize in the recipient donor i cares most about.

[8] Though technically positive or negative reactions are forms of "competition" in the sense that they reflect actions taken out of self-interest under conditions of strategic interdependence, I choose to refer to positive reactions specifically as competition for rhetorical reasons.

reduces the marginal utility of aid to y. Donor j's aid overall contributes to the realization of i's goals in giving aid to x, giving i an incentive to reduce its own aid to x. However, at the same time, by j transferring aid away from y to x, i also has an incentive to reduce the aid it gives to y. Donor i no longer has to give as much aid to y in order to realize the sum of its objectives in giving aid to that recipient, thus freeing resources that it can give to recipient x.

What will donor i ultimately choose to do? The answer to this question hinges on i's priorities and the relative magnitude of the positive and negative externalities j's aid poses between recipients. These parameters will determine whether the rate at which the transfer Δ reduces the marginal utility of aid to x is greater than, equal to, or less than the transfer's effect on the marginal utility of aid to y. If, for example,

$$\frac{\partial^2 MU_i^x}{\partial \Delta^2} > \frac{\partial^2 MU_i^y}{\partial \Delta^2} \tag{7}$$

then as a result of the transfer, i's overall incentive will be to give more aid where j gives more aid. That is, i will seize the opportunity to compete less over rival gains with respect to recipient y to realize more of its goals in giving aid to x. In short, it will respond with strategic complementarity. Conversely, if

$$\frac{\partial^2 MU_i^x}{\partial \Delta^2} < \frac{\partial^2 MU_i^y}{\partial \Delta^2} \tag{8}$$

then i's incentive will be to give less aid where j gives more. In short, i will take advantage of the greater aid j gives to recipient x to realize more of its rival objectives in giving aid to y. That is, it will respond with strategic substitution.

In summary, the possible values of the externality parameters can be organized according to three types of strategic relationships between countries: (1) *friends*, (2) *adversaries*, and (3) *competitors*. The first and second categories denote contexts where i and j either receive net mutual benefits through their aid allocations across all recipients, or net rival

benefits. The last category denotes the case where states have a mix of rival and common goals where rival goals are predominantly realized in giving aid to one recipient, and common goals are predominantly realized in giving aid to the other. Much of the analysis that follows—especially equilibrium analysis and comparative statics—will home in on the competitors case given the greater likelihood of donors being competitors "in the wild." However, to illustrate the breadth of incentives that may arise in the model, the next section gives equal attention to all three.

1.3.3 Deriving Best Responses

The above reveals some important dynamics in donor incentives vis-à-vis one another. However, it does not provide enough to yield specific predictions. To do this, it will be necessarily to explicitly derive actors' best-response functions.

The first step is to specify each donor's utility maximization problem. For i this is given as:

$$\max_{x_i, y_i \in \mathbb{R}^2_+} u_i(x_i + \eta^x x_j, y_i + \eta^y y_j), \quad \text{subject to:} \quad x_i + y_i \leqslant R_i \text{ and } x_i, y_i \geqslant 0. \tag{9}$$

From this, because we have an optimization problem subject to inequality constraints, we form the following Lagrangian:

$$\mathcal{L}_i = u(x_i + \eta^x x_j, y_i + \eta^y y_j) + \lambda^R(R_i - x_i - y_i) + \lambda^x x_i + \lambda^y y_i, \tag{10}$$

where the Karush-Kuhn-Tucker (KKT) necessary conditions for a vector of maximizers

(x_i^*, y_i^*) are

$$\begin{aligned}
&\frac{\partial \mathcal{L}_i}{\partial x_i} \geqslant 0 \quad x_i \geqslant 0 \quad \lambda^x \geqslant 0 \quad \lambda^x x_i = 0, \\
&\frac{\partial \mathcal{L}_i}{\partial y_i} \geqslant 0 \quad y_i \geqslant 0 \quad \lambda^y \geqslant 0 \quad \lambda^y y_i = 0, \\
&R_i - x_i - y_i \geqslant 0 \quad \lambda^R \geqslant 0 \quad \lambda^R (R_i - x_i - y_i) = 0.
\end{aligned} \tag{11}$$

These are the complementary slackness conditions. For objective bundle X, the above implies that either $\lambda^x = 0$ and $x_i > 0$, or $\lambda^x > 0$ and $x_i = 0$. This is similarly true for λ^y and y_i, and λ^R and $R_i - x_i - y_i$. Given that utility is monotonically increasing, we may assume $\lambda^R > 0$ and that i expends all of its available resources in giving aid to x and y.

From the above, we derive the following solution for a system of best response equations for i:

$$\begin{aligned}
x_i^* &= \sigma_i^x \left(R_i + \eta^x x_j + \eta^y y_j\right) - \eta^x x_j, \\
y_i^* &= \sigma_i^y \left(R_i + \eta^x x_j + \eta^y y_j\right) - \eta^y y_j.
\end{aligned} \tag{12}$$

This solution holds assuming an interior solution, but it is certainly possible that states could specialize in one or the other aid recipient entirely. In such cases, it is necessary to be a little more explicit about the above equations. To ensure that corner solutions really stay bound at the corners, the best response functions will explicitly be such that $x_i^* = \min\{\max\{\sigma_i^x \left(R_i + \eta^x x_j + \eta^y y_j\right) - \eta^x x_j, 0\}, R_i\}$. This form ensures that $0 \leqslant x_i^* \leqslant R_i$. However, using the implicit functional form is notationally convenient.

We can further simplify the analysis by reducing best-responses to a single objective. This follows naturally from Walras's Law, which in this particular context implies that $\sum_i \left(x_i^* + y_i^* - R_i\right) = 0$. In words, because global resources will equal total demand, it is possible to represent i's best response with respect to only a single recipient, since an equilibrium with respect to one necessarily implies an equilibrium with respect to the

other. Simplifying for the best-response with respect to X for example yields:

$$x_i^* = \delta_0 + \delta_1 R_i + \delta_2 x_j, \tag{13}$$

with the following identities for the intercept and slope parameters:

$$\delta_0 := \sigma_i^x \eta^y, \quad \delta_1 := \sigma_i^x - \sigma_i^x \eta^y, \quad \delta_2 := \sigma_i^x (\eta^x - \eta^y) - \eta^x. \tag{14}$$

By definition, this then implies that i's optimal provision of aid to y is simply

$$y_i^* = R_i - x_i^* = (1 - \delta_1) R_i - \delta_0 - \delta_2 x_j. \tag{15}$$

By being able to express best-responses as a simple function of donors' activity with respect to a single recipient, this makes the identification of equilibrium aid allocations all the easier.

Not surprisingly, we can see clearly from the above that i's optimal provision of aid to y is not only a function of j's aid to y but also j's aid to x—by symmetry this is true also for i's aid to x. This fact can lead to a range of interesting reaction paths. We will see more about how this works in the next section, treating *friends*, *adversaries*, and *competitors* seperately.

1.3.4 Some Informative Cases

Before identifying equilibria and their welfare implications, it will be helpful to illustrate some examples of best responses, if only to provide further intuition about the incentives donors face in allotting foreign aid in service of their foreign policy goals. The below examples walk through the three general cases highlighted previously: *friends*, *adversaries*, and *competitors*.

1.3.4.1 Case 1: Friends As a first case, consider a world where states' strategic relationship is that of *friends*. That is, donors i and j pursue mutually beneficial sets of objectives in giving aid to x and y: $\eta^x, \eta^y > 0$. In this case, each donor's best response to the aid allocated by the other will be strategic substitution—to give less aid where the other gives more. For donor i, this implies that for its best-response equation,

$$x_i^* = \delta_0 + \delta_1 R_i + \delta_2 x_j, \tag{16}$$

the parameter $\delta_2 < 0$.

Figure 1.1 shows some possible reaction paths. The left panel shows i's aid allocations to x, and the right panel shows i's aid allocations to y. Red denotes an instance where i gives more weight to its foreign policy goals with respect to recipient y ($\sigma_i^x = 1/4$). The blue line denotes an alternative example where i gives more weight to its goals with respect to x ($\sigma_i^x = 3/4$). In both cases the externality parameters are such that $\eta^x = 3/4$ and $\eta^y = 1/2$.

Recall from the identity of δ_2 that its magnitude and direction will be a function of i's preference for recipient x, and the externalities of j's aid to both x and to y. In each set of examples, country i's best-response is substitution; though in the former case, i gives less aid overall to x and will defer all responsibility for giving aid to x if j's allocation is sufficiently large. However, in the latter case, where i cares more about x than y, the slope of the reaction is slightly attenuated. Also, due to the higher weight i attaches to giving aid to x, i's incentives are such that, if j gives sufficiently little aid to x, it will entirely defer responsibility for giving aid to y onto j and will give aid exclusively to x.

The emergence of corner solutions is also a function of R_i. If i's share of resources is much less than j's, it is far more likely that i has a corner solution for one of the recipients. The greater R_j relative to R_i, the farther right along the x-axis j's potential contribution of aid may go—and thus, the more likely i's best response path meets with zero. The real-

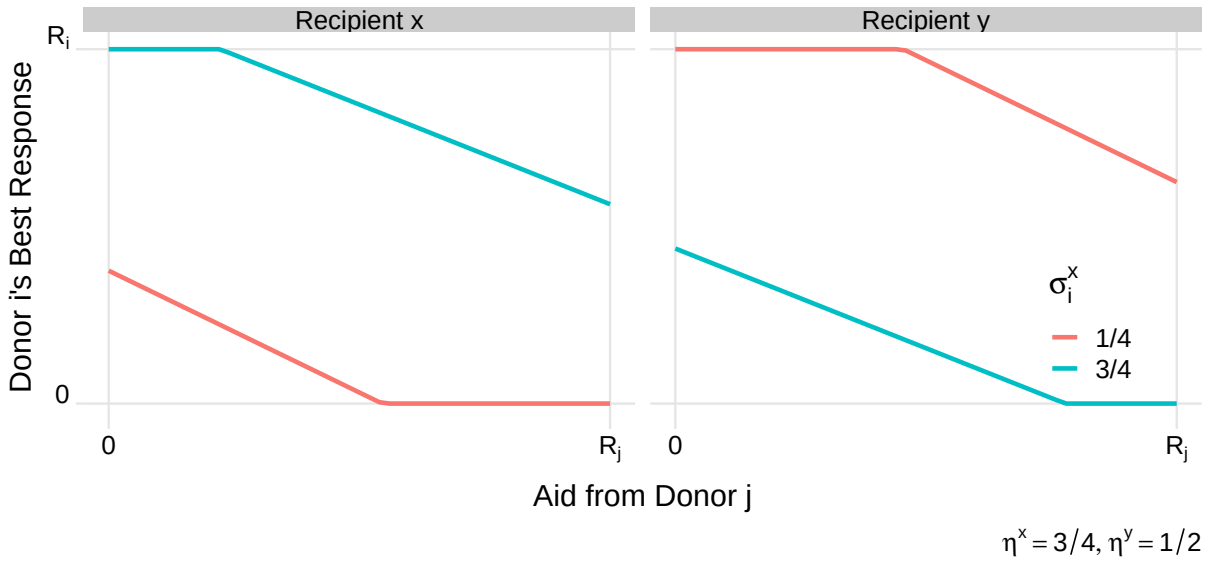

Figure 1.1: Case 1 reaction paths for donor *i* in response to *j*'s aid allocations.

world prevalence of corner solutions among smaller aid donors illustrates the implications of this quite well. Given their more limited resources, to the extent that donors have common objectives with respect to at least some recipients, smaller donors like Iceland, the Netherlands, and Greece should have a greater number of corner solutions than larger donors like the US, Japan, and the UK. This much is evident from Figure 1.2.[9] Along the x-axis the ranked total ODA expenditures of donors in 2014 across 24 key development sectors are shown. Along the y-axis the number of recipients that received zero dollars in aid across these 24 sectors from a given donor are shown. A clear relationship between total aid expenditures and the prevalence of corner solutions emerges. The top 5 donors for 2014 are Japan, the US, Germany, France, and the UK. The number of recipients in the data that receive zero aid across the 24 development sectors from each donor is 1, 6, 5, 2, and 14 respectively. Meanwhile, the bottom 5 donors—Hungary, Slovenia, Slovakia, Iceland, and Greece—have 115, 105, 70, 101, and 42 recipients that receive zero aid across these same sectors.

[9]ODA data comes from *OECD.stat*.

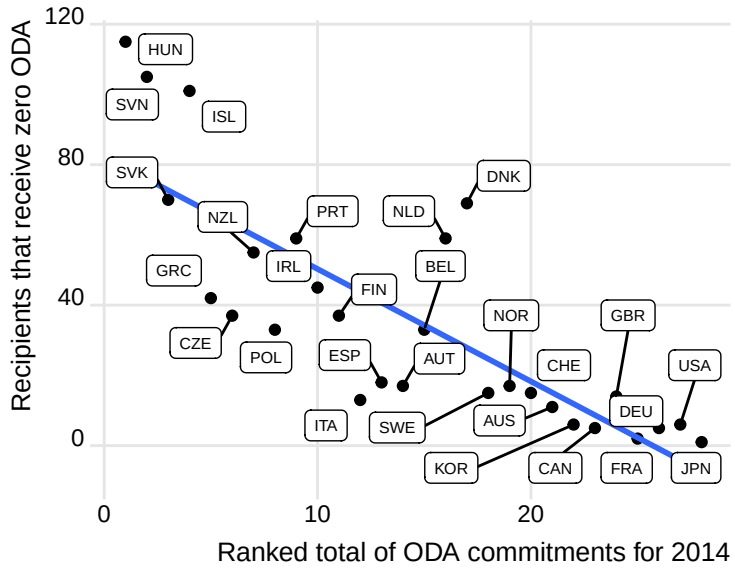

Figure 1.2: Smaller donors have a greater number of corner solutions. Example with ODA data from 2014.

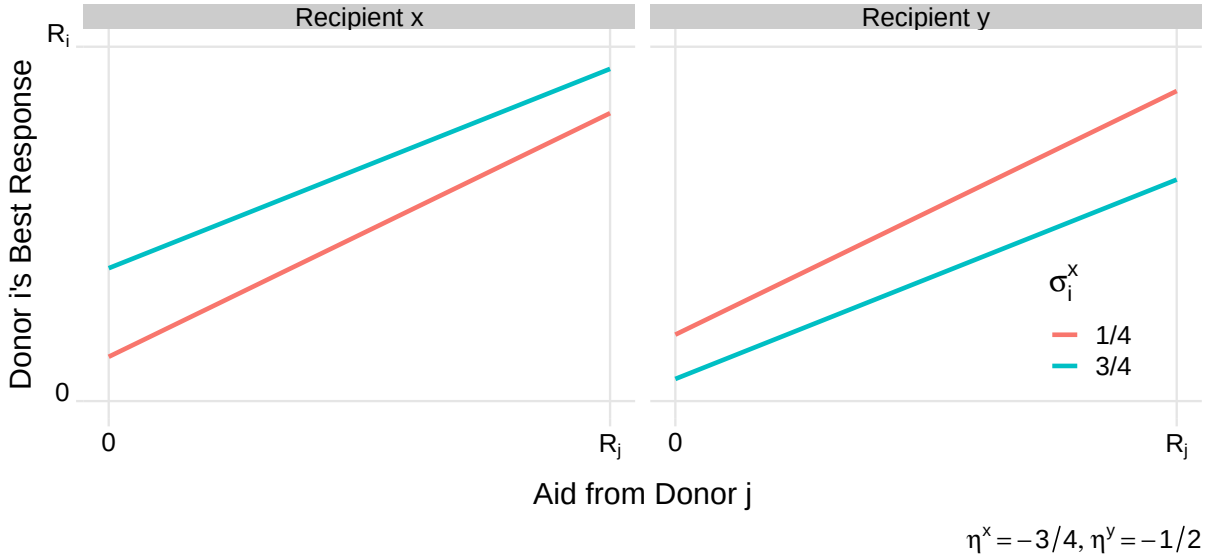

Figure 1.3: Case 2 reaction paths for donor i in response to j's aid allocations.

1.3.4.2 Case 2: Adversaries Consider an alternative case where i and j are *adversaries*. That is, $\eta^x, \eta^y < 0$. In this case, whatever the arrangement of i's preferences, its best response to j will always be strategic complementarity: e.g., $\delta_2 > 0$.

Figure 1.3 shows a set of examples similar to those given in Figure 1.1. The main difference, of course, is that the externalities posed by j's aid are now negative: $\eta^x = -3/4$

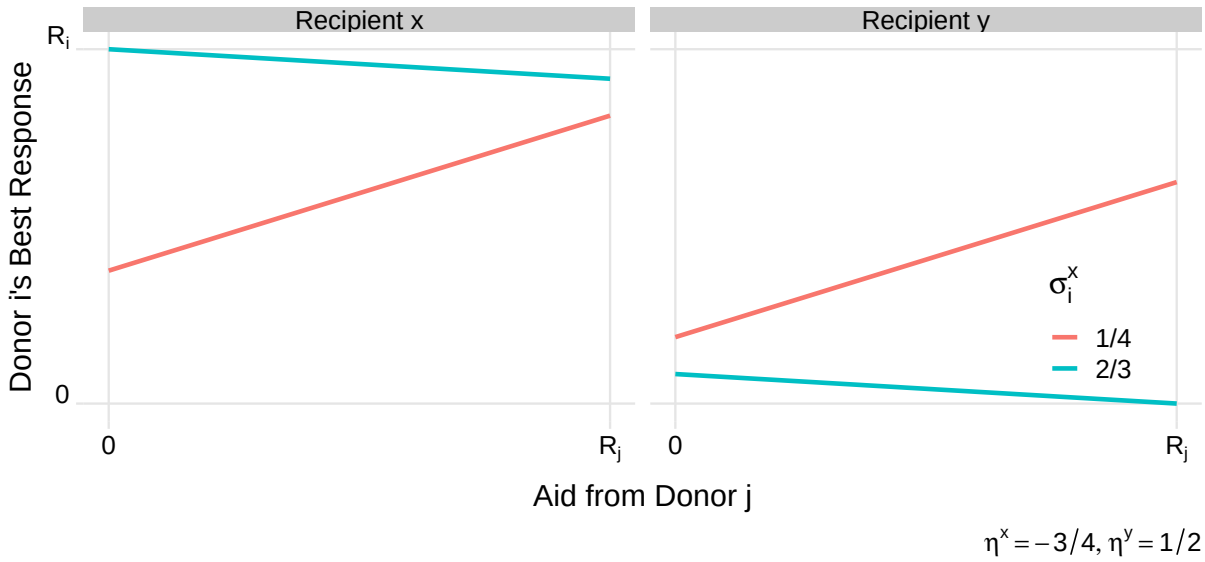

Figure 1.4: Case 3 reaction paths for donor i in response to j's aid allocations.

and $\eta^y = -1/2$. The red slope shows i's best response if it cared more about recipient y than x ($\sigma_i^x = 1/4$), and the blue slope shows i's best response if it cared more about recipient x than y ($\sigma_i^x = 3/4$). i's response is slightly attenuated in the second case, while its level of aid allocation to x (y) is overall greater (lower).

An appropriate analogue for this scenario is an arms race. As Glaser (2000) states regarding arms races, the prevailing view sees arms buildups as the product of a cycle of "action" and "reaction" where states expand their armaments in an effort to shore up their own security in the face of an adversary. In a similar way, aid donors that are adversaries respond to each other by targeting greater and greater shares of their aid where their opponent targets more of theirs in order to maintain their foreign policy interests.

1.3.4.3 Case 3: Competitors Now, consider the third scenario where i and j are *competitors*. Suppose that while i and j pursue on net rival objectives in giving aid to x, they have predominantly common objectives in giving aid to y. In this particular case, the sign of i's reaction to j may be either positive or negative. Which emerges will hinge on variation in the externality parameters and the weight i attaches to its goals in giving aid to recipients.

Figure 1.4 illustrates this point. The red line denotes a case where i cares more about its goals in giving aid to y than to x ($\sigma_i^x = 1/4$). In this instance, i's best strategic response to j's aid allocation is strategic complementarity. Alternatively, in the case where i cares more about x than y, the blue line, i's best response is strategic substitution. What accounts for this difference?

As it turns out, i's priorities over recipients plays a key role in conditioning its response to j. In the first example, i cares relatively little about recipient x, which means the competitive threat posed by j giving aid to x dominates its response. This can be seen by considering the identity of δ_2:

$$\delta_2 = \sigma_i^x(\eta^x - \eta^y) - \eta^x. \tag{17}$$

As σ_i^x approaches zero, the sign and magnitude of η^x increasingly determines how i responds to j's aid to x. In fact, it is the case that

$$\sigma_i^x \to 0 \quad \implies \quad \sigma_i^x(\eta^x - \eta^y) - \eta^x \to -\eta^x. \tag{18}$$

In words, absent substantial intrinsic interest in realizing certain goals by giving aid to a recipient country, the externality created by other-donor aid becomes the primary factor determining aid allocation. In this instance, as i places greater priority on its goals in x, the importance it places on realizing its goals in y is necessarily lower. This means that the *positive* externality of j's aid in y now plays a more outsized role in shaping i's best response in distributing aid between recipients.

A well-known real-world case of such a strategic dynamic can be seen in how Western countries dramatically cut aid to various authoritarian regimes after the collapse of the Soviet Union (Bräutigam and Knack 2004). With the negative externality posed by Soviet aid gone, Western donors had little remaining incentive to continue to give aid to recipients that had little intrinsic value absent a geostrategic rival.

A similar logic explains why there is a shift in i's strategic response from complementarity to substitution given a sufficient shift in the salience it attaches to recipients. This is seen by observing what happens to the slope of i's reaction in the limit where σ_i^x approaches one:

$$\sigma_i^x \to 1 \quad \Longrightarrow \quad \sigma_i^x(\eta^x - \eta^y) - \eta^x \to -\eta^y. \tag{19}$$

In words, the more i cares about recipient x, the more the externality created by j's aid to y shapes its strategic response. In the example shown in Figure 1.4, i's interest in recipient x is great enough (and hence its interest in y low enough) that its strategic behavior is most determined by the positive impact of j's aid to y. In short, this means that the more aid j gives to y, the more i takes advantage of j's giving to direct its resources toward realizing its goals in giving aid to x.

1.3.5 A Summary of Cases

The above cases reveal how variation in externalities and country priorities over foreign policy objectives can lead to a variety of best responses. It would be impossible to describe every possible scenario; however, it is possible to describe the range of best responses given arrangements of externality parameters and preferences. Figure 1.5 offers such a summary.

The left panel shows the range of best responses i might have to j's aid over the range of possible values of the externality parameters. For this particular example, i's preferences between recipients are held constant at $\sigma_i^x = 1/4$. The right panel shows the range of best responses i might have to j's aid over the same range of possible values of the externality parameters. In this case, i's preferences between recipients are held constant at $\sigma_i^x = 3/4$. The blue areas denote instances where a i's best response is strategic complementarity, or a positive reaction to where the other donor gives aid. The red areas denote instances

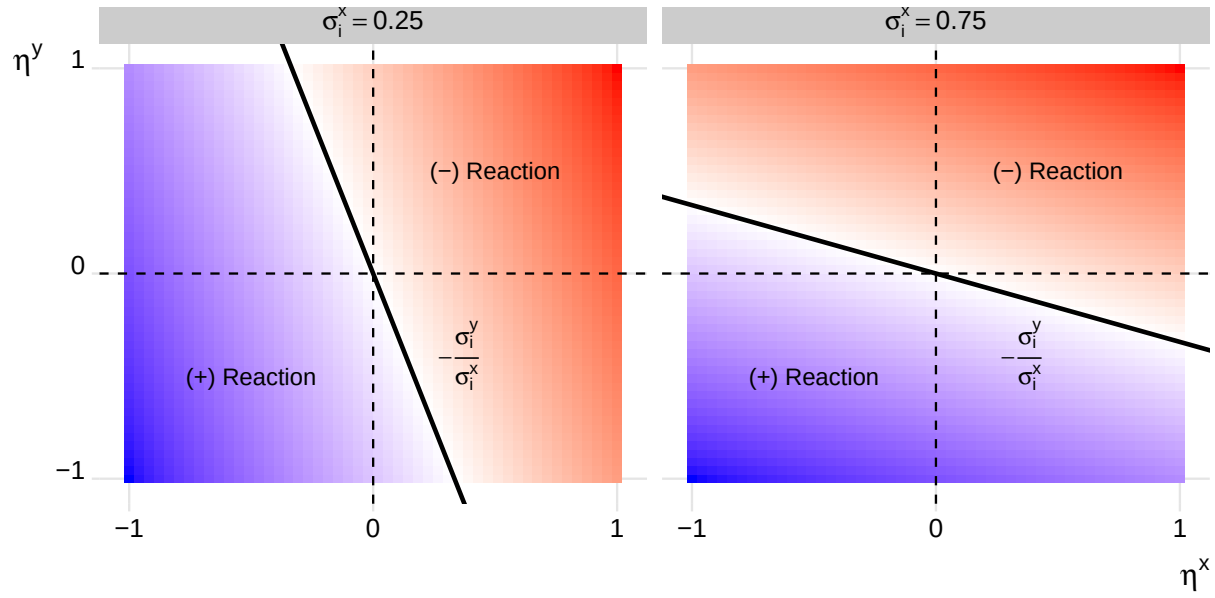

Figure 1.5: Possible directions of reaction paths.

where i's best response is strategic substitution, or a negative reaction to where the other donor gives aid. The relative lightness of the colors captures the magnitude of the strategic response—as the shade darkens, the response becomes more severe, while as the shade lightens, the response approaches zero.

Consistent with the three preceding cases, this summary aligns with the three-part typology of strategic relationships between countries i and j suggested earlier—e.g., that countries' strategic relationship may be that of *friends*, *adversaries*, or *competitors*. Recall that in cases where actors are *friends*, both actors mutually benefit from giving aid to x and y. They consequently have negatively sloped reaction paths, regardless of their preferences, for all possible values of $\eta^x, \eta^y > 0$. Meanwhile, in cases where i and j are *adversaries*, both actors are rivals with respect to x and y. Here, they have positively sloped reaction paths, no matter their preferences, for all $\eta^x, \eta^y < 0$. In both cases, the absolute magnitude of the best-responses will vary depending on the precise parameter values, but the general direction of the responses will not.

However, in cases where i and j are *competitors*—that is, when donors reap mutual

benefits with respect to one recipient, and rival benefits with respect to the other—reaction paths may be either positive or negative. And, they need not be in the same direction for both donors. The key factor determining which is the case is the relative weight donors place on realizing their foreign policy goals by giving aid to either x or y. As it so happens, the slope of the boundary between negative and positive reactions is equivalent to:

$$-\frac{\sigma_i^y}{\sigma_i^x} \equiv \frac{\sigma_i^x - 1}{\sigma_i^x}. \tag{20}$$

The slope of this line for donor i is shown in black. As $\sigma_i^x \to 1$, the slope approaches zero, while as $\sigma_i^x \to 0$ the slope approaches $-\infty$.

1.4 Analysis

With the best-responses for actors i and j defined, it is now possible to consider equilibrium distributions of aid, comparative statics, and welfare analysis. Up to now, description of the model has included the breadth of strategic relationships between donor governments. However, in the real-world, certain strategic relationships are more probable than others. Specifically, while the model allows for donors to be pure *friends* or *adversaries*, in terms of the parameter space donors are more likely to be *competitors*—having a mix of rival and common interests. Such a strategic dynamic is also most realistic for large donor governments. Industrialized countries distribute aid across more than a hundred recipients. While donor interests with respect to some of these recipients may be rival, there may be several instances where donor interests are common. To narrow the focus to cases that may be most relevant for thinking about the strategic incentives of prominent donors, I will restrict the analysis to cases where $\eta_x < 0$ and $\eta_y > 0$.

To support this exercise, of course, it will be necessary to first know with certainty that the equilibria to be analyzed exist, are unique, and are well-behaved. If equilibrium solutions do not exist, then it would make little sense to engage in equilibrium analysis.

And, if said equilibria were not unique, then this would add a great deal of complexity to the analysis and make identifying equilibrium solutions numerically unfeasible. Further, if said equilibria were not stable, or smooth with respect to the model parameters, comparative statics would prove a dangerous exercise indeed.

Thankfully, it can be shown that

Proposition 1 *There always exists a* **unique** *Nash equilibrium vector of best responses* (x_i^*, x_j^*).

See Supplemental Materials for proof. ∎

Further, it can be shown that

Proposition 2 *The Nash equilibria are smooth with respect to model parameters.*

See Supplemental Materials for proof. ∎

However, with respect to the first proposition, there are some interesting pathologies that emerge at the bounds of the externality parameters: e.g., as $|\eta^x|, |\eta^y| \to 1$. Specifically, at the bounds, *unique* equilibrium solutions do not necessarily exist. Rather, countries i and j may face a coordination problem with respect to an infinite set of pure-strategy Nash equilibria.[10] Fortunately, given that $\eta^x, \eta^y \in (-1, 1)$ (that is, the externality parameters do not include their boundaries at -1 and 1), such pathological cases do not arise in practice.[11]

[10] There are mixed-strategies as well.

[11] This is a nakedly utilitarian reason for specifying the externality parameters as such.

1.4.1 Derivation of Nash Equilibria

Knowing the above, it is possible to derive the unique Nash equilibrium. For country i, this solution with respect to recipient x is given as:

$$\begin{aligned} x_i^* &= \delta_{i0} + \delta_{i1}R_i + \delta_{i2}x_j^*, \\ x_i^* &= \delta_{i0} + \delta_{i1}R_i + \delta_{i2}(\delta_{j0} + \delta_{j1}R_j + \delta_{j2}x_i^*), \\ x_i^* - \delta_{i2}\delta_{j2}x_i^* &= \delta_{i0} + \delta_{i1}R_i + \delta_{i2}(\delta_{j0} + \delta_{j1}R_j), \\ x_i^* &= \frac{\delta_{i0} + \delta_{i1}R_i + \delta_{i2}\delta_{j0} + \delta_{i2}\delta_{j1}R_j}{1 - \delta_{i2}\delta_{j2}}. \end{aligned} \tag{21}$$

By symmetry, j's equilibrium allocation to x is

$$x_j^* = \frac{\delta_{j0} + \delta_{j1}R_j + \delta_{j2}\delta_{i0} + \delta_{j2}\delta_{i1}R_i}{1 - \delta_{i2}\delta_{j2}}. \tag{22}$$

If we replace the δ parameters with their identities, the solution expands to:

$$\begin{aligned} x_i^* = \{&\sigma_i^x\eta^y + (\sigma_i^x - \sigma_i^x\eta^y)R_i + \\ &[\sigma_i^x(\eta^x - \eta^y) - \eta^x]\sigma_j^x\eta^y + \\ &[\sigma_i^x(\eta^x - \eta^y) - \eta^x](\sigma_j^x - \sigma_j^x\eta^y)R_j\}/ \\ &\{1 - [\sigma_i^x(\eta^x - \eta^y) - \eta^x][\sigma_j^x(\eta^x - \eta^y) - \eta^x]\} \end{aligned} \tag{23}$$

From Walras' Law, an equilibrium with respect to x implies an equilibrium solution for y. Hence, whatever solution we have for x, the equilibrium aid allocations to y for i and j are simply:

$$y_i^* = R_i - x_i^* \quad \text{and} \quad y_j^* = R_j - x_j^*. \tag{24}$$

It should be repeated that while these functional forms are continuous with respect to the model parameters, the explicit functional form for these solutions is restricted to the

bounds $0 \leq x_i^* \leq R_i$.

1.4.2 Comparative Statics

Variation in model parameters reveals a considerable diversity of possible equilibrium outcomes. In this section, many such possibilities are considered using motivating examples. The goal is not only to demonstrate how predictions shift with model parameters, but also to show that the model yields predictions that it *ought* to make.

Consider, first, an example motivated by a real-world event: the collapse of the Soviet Union as a sizable threat to US foreign policy interests. During the Cold War years, the US gave disproportionately more aid to developing countries bordering communist nations. However, after the Cold War, having a communist neighbor ceased to be a significant predictor of US aid (Meernik, Krueger, and Poe 1998). This change implies recipients with a communist neighbor were not intrinsically valuable to the US, but were important targets of aid nonetheless due to possible competition from the USSR. With competition no longer active, and little intrinsic value placed on these countries otherwise, they saw a reduction in US aid.

This is precisely what the model predicts would happen, as shown in Figure 1.6. For this example, the σ and η parameters are held constant at $\sigma_i^x = 1/10$, $\sigma_j^x = 9/10$, $\eta^x = -1/2$, and $\eta^y = 1/10$ respectively. That is, i and j are rivals with respect to recipient x while they obtain common benefits from giving aid to y. In this example, the negative externality posed by aid to x is more substantial than is the positive externality of aid to y. Further, j cares much more about recipient x than y, while i cares much more about y than it does x. From the left to the right of the x-axis, i's share of resources shifts between 0 and 1.

The increase in i's relative resource endowment results in a shift in equilibrium aid allocations consistent with what occurred with the collapse of the Soviet Union. As i's resources compared to j's increase, i's contribution of aid to recipient x declines. This is

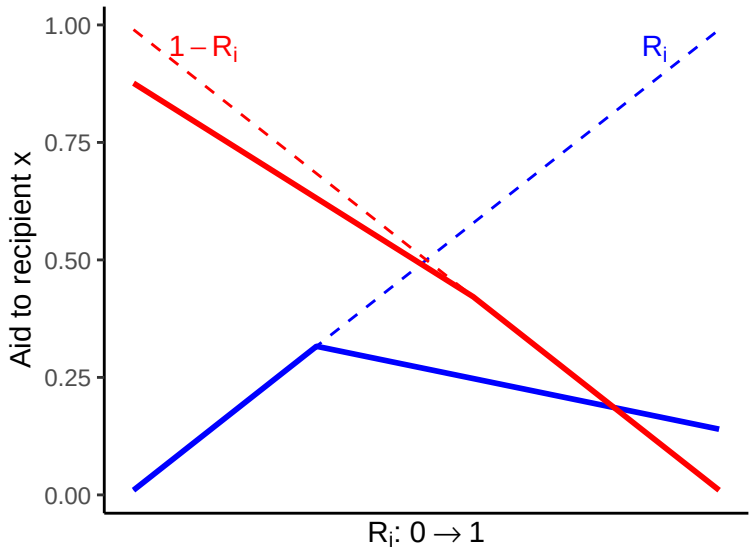

Figure 1.6: The implications of a diminished foreign aid donor. Donor i is in blue, and donor j is in red. Dashed lines show donors' share of resources. If aid expenditures overlap with these budget lines, donors have a corner solution.

due to the diminished threat to i's interests with respect to x posed by j.

The model yields other predictions that are consistent with well-documented patterns in donor giving. In a previous section, it was noted that governments of smaller donors were more likely to have corner solutions—to give zero aid to at least one recipient. Indeed, the empirical record is consistent with this view. Among *competitors*, corner solutions are likely to emerge as the smaller of the two donors is forced to sacrifice support for common interests in one recipient in order to compete over rival objectives with respect to the other. Holding the parameters at $\sigma_i = 1/10$, $\sigma_j = 9/10$, $\eta^x = -1/2$, and $\eta^y = 1/2$, Figure 1.7 shows how donors' aid to recipient x change as R_i shifts from between 0 and 1. As the balance of resources shifts from j's to i's favor, i ceases to have a corner solution (to give its entire aid budget to x to compete for rival gains), while j shifts toward having a corner solution.

The model also offers lessons for relatively new developments in aid politics. Consider the rise of China as an important aid donor. A worry among many policymakers is that differences in China's priorities relative to those of Western donors poses a threat to

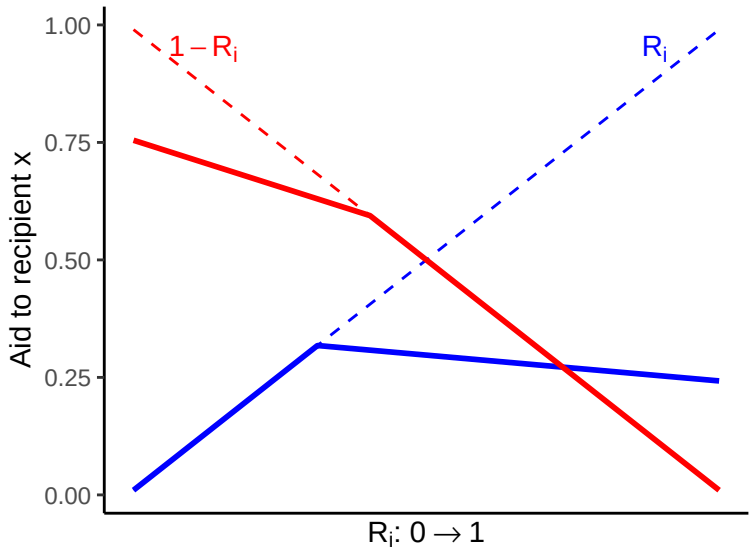

Figure 1.7: Smaller donors and corner solutions. Donor i is in blue, and donor j is in red. Dashed lines show donors' share of resources. If aid expenditures overlap with these budget lines, donors have a corner solution.

the interests of countries like the United States and Japan. A normative concern among researchers is that rivalry with China will alter the way traditional donors target their aid with negative consequences for aid recipients. Several studies have already shown how China's aid practices not only influence where DAC countries target their aid, but also the types of projects they are likely to support (Zeitz 2021).

Such negative consequences are consistent with the model. The rise of a donor that increasingly values promoting its geostrategic and selfish economic interests in targeting aid has unfortunate implications for the global distribution of aid. Consider the example shown in Figure 1.8, which depicts aid from donors i and j to recipient y—where donors' aid has mutually beneficial effects for both donors. In this instance, as the government of j enjoys an increase in its share of resources, the negative externality of its aid to x worsens. For this particular numerical example, R_i shifts from between 1 to 0 (moving in j's favor), while η^x shifts from -0.1 to -0.9 (meaning rivalry in x worsens).

The equilibrium behavior of both donor governments is consistent with many analysts' and policymakers' worst fears. Aid to recipient y, which is a site of mutual interests

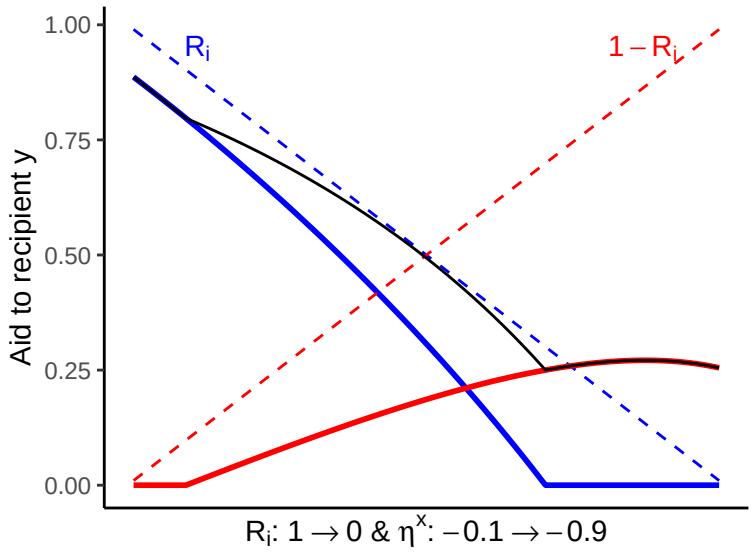

Figure 1.8: The 'rise' of China. Donor i is in blue, and donor j is in red. Black denotes the sum total of aid to y. Dashed lines show donors' share of resources. If aid expenditures overlap with these budget lines, donors have a corner solution.

between i and j, receives not only less support from i as the balance of resources moves toward j's favor, it also receives less total aid over all, denoted by the solid black line. As it so happens, in this example $\sigma_i^x = 1/10$, meaning that the government of i cares much less about x than it does y. Nonetheless, competitive pressure leads i to eventually forego giving aid to y altogether in an effort to compete with j.

In sum, the model is consistent with several observed empirical regularities while also micro-founding these patterns in mechanisms rooted in strategic interdependence. It is consistent with a decline in aid to several developing countries following the collapse of the Soviet Union, locating the reason for this decline not in a reduction of the intrinsic value of these countries to the US and its allies, but rather in the lack of intrinsic value that they had to begin with. Further, the model is consistent with a preponderance of corner solutions among smaller donors, even when donors are *competitors*. Because smaller donors are at the greatest disadvantage in competing against larger donors when and where rivalry exists, they are forced to sacrifice support for common interests in one recipient in order to compete over rival objectives with respect to the other. And, finally,

the model suggests problematic consequences due to the rise of China as a prominent donor. To the extent that Beijing's global development assistance serves geostrategic and selfish economic interests, this will lead to a new global equilibrium in the distribution of aid that neglects recipients that are sites of mutually beneficial foreign policy goals—not only among traditional donors, but also between these donors and Beijing.

1.4.3 Welfare Analysis

Among the cases considered above, the last one in particular underlines that as donors seek to maximize their own foreign policy interests, their individual best-responses may lead them to distribute aid in ways that are collectively inefficient.[12] The (in)efficiency of the equilibrium solutions the model predicts can be evaluated by comparing the sum of actors' utilities under Nash behavior relative to the sum of their utilities under some alternative maximizing principal, say:

$$\max_{x_i,x_j,y_i,y_j\in[0,1]} u_i(X_i,Y_i)+u_j(X_j,Y_j), \tag{25}$$

subject to

$$x_i+x_j+y_i+y_j \leq R_i+R_j=1. \tag{26}$$

In this formulation, the objective is to maximize the combined utility of donors i and j by finding the optimal distribution of their combined aid budgets. This can be done by forming the Lagrangian

$$\begin{aligned}\mathcal{L} = {} & u_i(x_i+\eta^x x_j, y_i+\eta^y y_j)+u_j(x_j+\eta^x x_i, y_j+\eta^y y_i) \\ & +\lambda^R(1-x_i-y_i-x_j-y_j)+\lambda_i^x x_i+\lambda_i^y y_i+\lambda_j^x x_j+\lambda_j^y y_j,\end{aligned} \tag{27}$$

[12] I use *Pareto* interchangeably with *collectively*.

with KKT conditions:

$$\begin{aligned}
&\frac{\partial \mathcal{L}}{\partial x_i} \geqslant 0 \quad x_i \geqslant 0 \quad \lambda_i^x \geqslant 0 \quad \lambda^x x_i = 0, \\
&\frac{\partial \mathcal{L}}{\partial y_i} \geqslant 0 \quad y_i \geqslant 0 \quad \lambda_i^y \geqslant 0 \quad \lambda^y y_i = 0, \\
&\frac{\partial \mathcal{L}}{\partial x_j} \geqslant 0 \quad x_j \geqslant 0 \quad \lambda_j^x \geqslant 0 \quad \lambda^x x_i = 0, \\
&\frac{\partial \mathcal{L}}{\partial y_j} \geqslant 0 \quad y_j \geqslant 0 \quad \lambda_i^y \geqslant 0 \quad \lambda^y y_i = 0, \\
&1 - x_i - y_i - x_j - y_j \geqslant 0 \quad \lambda^R \geqslant 0 \quad \lambda^R(1 - x_i - y_i - x_j - y_j) = 0.
\end{aligned} \tag{28}$$

Since, like the individual optimization problem, this collective optimization problem is concave, we are assured the existence of a unique vector of maximizers $(x_i^o, x_j^o, y_i^o, y_j^o)$.[13] This solution is Pareto improves on a Nash equilibrium if this vector yields greater payoffs for *at least one* of the actors, and leaves the other at least as well off relative to a Nash alternative.

Importantly, the collectively solution is, by definition, Pareto optimal. However, many solutions in a given game may be Pareto optimal—including a Nash equilibrium. So, for the welfare analysis, we are most interested in knowing whether an efficient collective solution Pareto improves on a Nash equilibrium solution. The condition for this is:

$$u_k^o \geqslant u_k^n \quad \forall \quad k \in \{i, j\} \quad \wedge \quad u_m^o > u_m^n \quad \text{for at least one } m \in \{i, j\} \tag{29}$$

where the o superscript denotes utility for donors when collective utility is maximized, and the n superscript denotes utility for donors in equilibrium. In words, the collective solution must improve utility for at least one of the donor governments, and at minimum not change utility for the other. If this condition fails to be met, then the Nash solution, in addition to the collective solution, is Pareto efficient.

[13] Since the returns to scale in the Cobb-Douglas utilities are diminishing, they are concave. Because the collective utility function is the sum of these concave utility functions, it also is concave.

An example of a how i's and j's equilibrium responses fare with respect to collective utility is shown in Figure 1.9. The reaction paths of countries i and j are shown with respect to recipient x (the left panel) and recipient y (the right panel). The blue line denotes i's best response, and the red line denotes j's. The Nash equilibrium solution lies at the intersection of their best responses. The collectively optimal solution is also shown. This point lies at the convergence of the concentric bands shown in the figure. These bands are isoquants denoting collective utility.

For this example, i and j have an equal share of resources ($R_i = 1/2$) and different priorities over recipients, $\sigma_i^x = 3/4$ and $\sigma_j^x = 1/4$. Further, the externalities with respect to recipient x and with respect to recipient y not only differ in magnitude, but direction ($\eta^x = -1/3$ and $\eta^y = 1/4$). Given this arrangement of parameters, the actors have *different* best-responses. While i's reaction path is positive, j's is negative. That is, i gives more aid where j gives more, but j gives more aid where i gives less. In equilibrium, however, despite the different best-responses of the donors, both nonetheless end up giving *more* aid to x and *less* aid to y than is most collectively efficient. This is shown in the left panel of the figure by the fact that the Nash equilibrium lies up and to the right of the collectively optimal solution. Further, in the right panel of the figure, the Nash equilibrium lies down and to the left of the collectively optimal solution.

The equilibrium that emerges in this particular case is intuitive. The actors receive rival foreign policy gains in giving aid to x, and common foreign policy gains in giving aid to y. As a result, their individual best-response is to give more aid to x than is collectively optimal. This leaves less available resources for giving aid to y.

This is a clear instance of the classic Prisoners' Delimma. While this behavior is individually rational, it is collectively inefficient. Both i and j could be made better off if they would mutually transfer some aid from x to y. This more efficient solution, unfortunately, is inconsistent with each donor's individual self-interest.

However, lest any wonder whether this exercise represents little more than a fanciful

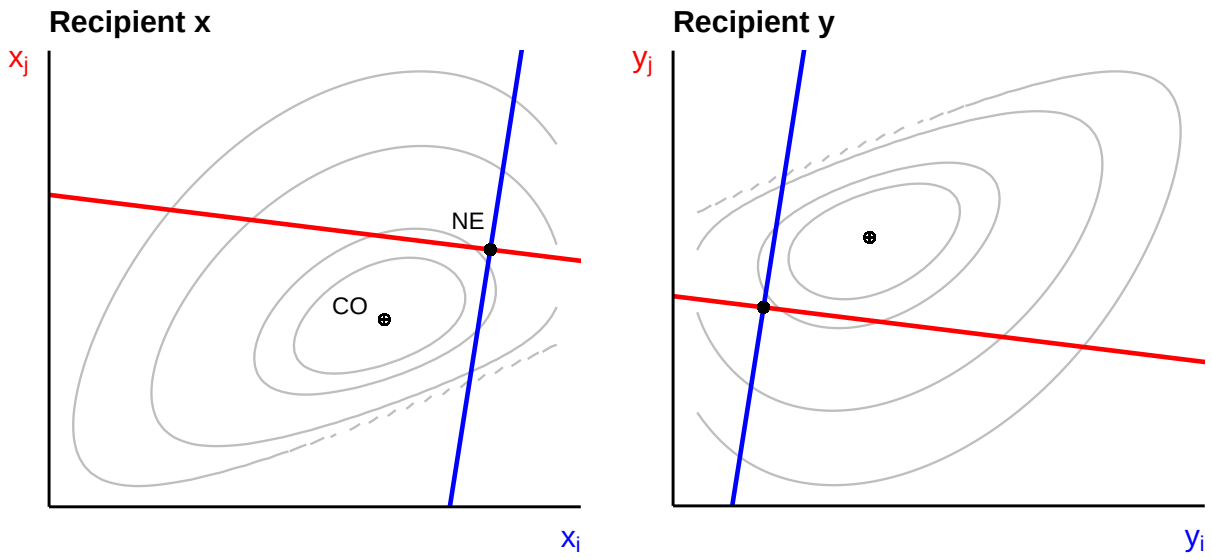

Figure 1.9: Equilibrium allocations relative to the collective optimum. Results shown for *competitors*. NE = Nash Equilibrium. CO = Collective Optimum. Blue denotes donor i, and Red denotes donor j.

technical means of arriving at a Prisoners' Delimma, the reader should note that not all cases in the parameter space are such that collective optimization Pareto improves on uncoordinated Nash equilibria. In fact, a numerical grid search over the possible parameter space shows that in just over 51% of cases is the collective solution Pareto superior to Nash equilibrium. The Supplemental Materials section at the end of this chapter shows more results from this grid search. Interested readers are encouraged to go there to see the full set of results.

Figure 1.10 highlights one such example where collective optimization fails to improve on a equilibrium solution. For this case, $\sigma_i^x = 0.2$, $\sigma_j^x = 0.1$, $\eta^x = -0.2$, $\eta^y = 0.1$, and $R_i = 0.5$. As noted in the figure, donor i does better in equilibrium while j does better under collective optimization. Such a scenario would make the choice to adopt a collaborative solution a source of conflict between the donors. Either they could adopt a collective solution at i's expense, or they could remain in equilibrium at j's.

This scenario highlights a strategic context that often goes unaddressed in debates about donor collaboration. Cooperation is not guaranteed to work to the mutual benefit of

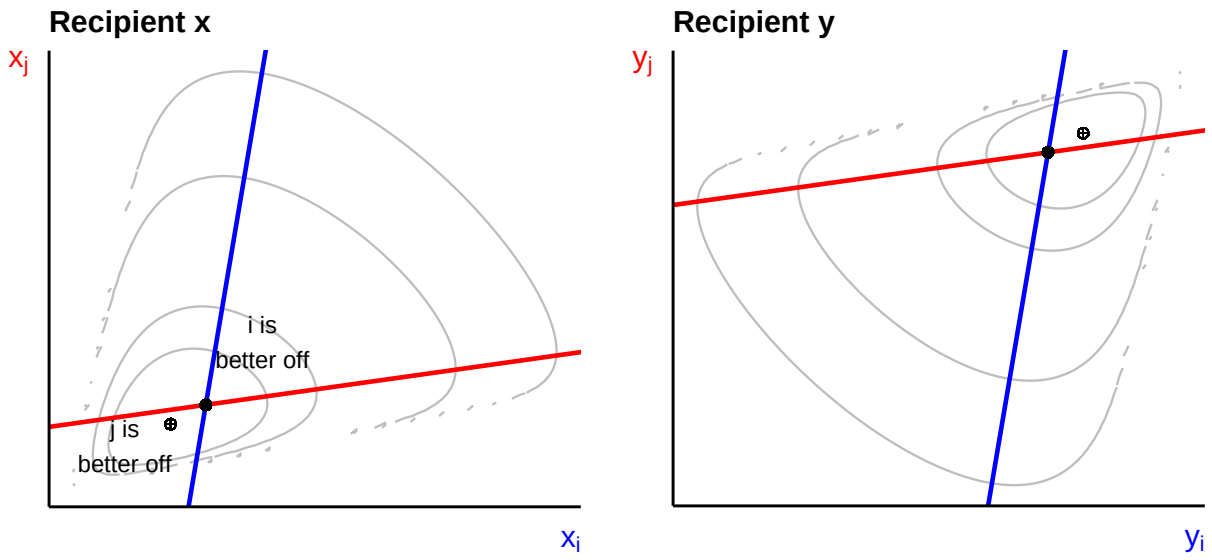

Figure 1.10: Equilibrium allocations relative to the collective optimum. Results shown for *competitors*. NE = Nash Equilibrium. CO = Collective Optimum. Blue denotes donor *i*, and Red denotes donor *j*. In this case donor *i* is better off in equilibrium while *j* is better off under collective optimization.

all parties. The implications of this are beyond the scope of this analysis, but as a normative matter it suggests that cooperation may require the application of external incentives to support. Otherwise, proposed collective solutions, whatever they are, will be as good as dead on arrival.

The numerical analysis in the Supplemental Materials section provides some additional insights. For instance, in the set of cases where collective optimization yields solutions that are better for one donor, but leave the other worse off, larger donors tend to do better under collective optimization (but not always), while smaller donors tend to do better in Nash equilibrium (but not always). This fact suggests some interesting power dynamics in efforts to spur greater donor cooperation. Perhaps this even offers some hope for future collaboration. If larger donors have a greater propensity to benefit from collective solutions, they may also have the resources necessary to make the adoption of a collective solution incentive compatible for small reluctant donors.

1.4.4 Empirical Implications

The above analyses provide valuable insight into the ways strategic interdependence shapes donor allocation decisions and relates to welfare. But for those who are more empirically minded, these results may be leave something to be desired. However, there are some empirical implications that follow from this model.

The first, and most basic, is that strategic interdependence leads donor governments to give aid in ways that deviate from their priorities. So long as the externality parameters are non-zero, donors will always have a rational incentive to adjust how they distribute aid in the face of one another. As an empirical matter, this implies two things: (1) that the aid given by other donors in developing countries plays a role in determining how much aid an individual donor commits and (2) failure to account for this can lead to mis-identification of how donors distribute aid on the basis of what they value in their foreign policies. Donors may give more or less aid in recipients than we would expect given their priorities over recipients (as captured by the σ parameters). In a regression analysis, it would be all-too-easy to over or under estimate the importance donors attribute to certain determinants of aid allocation. This is an issue that I consider in Chapter 3.

A second implication is that different kinds of objectives—whether they are rival or common in nature—imply different donor responses to other-donor aid given in developing countries. When objectives are rival, an increase in donor giving increases the marginal utility of giving aid in a recipient. Conversely, when objectives are common, an increase in donor giving decreases the marginal utility of giving aid in a recipient.

But, as the typology of donor relationships—*friends*, *competitors*, and *adversaries*—highlights, how these different incentives balance out can be complicated. When donors are either friends or adversaries, their incentives are straightforward. In the former case, they will give less aid in the recipient where the other donor gives more. In the latter case, they will give less aid in the recipient where the other donor gives less. But, when they are competitors, one might have a negative response to other-donor aid, and the other may

have a positive response. Or, both might have the same response; however, the direction of this response cannot on its own be used to draw conclusions about the strategic valence of donor goals in recipients.

This fact highlights a potential challenge in drawing inferences from donor responses in an empirical analysis. However, there are strategies that could be applied to ensure a more informative analysis. If the model is generalized to a greater number of recipients, much of the logic that applies for *friends* or *adversaries* is also localized to pairs or groups of recipients where donor goals are either common or rival. Meanwhile, the logic that applies for *competitors* also holds for donor decisions between pairs or groups of recipients where objectives are common with respect to one set, and rival with respect to another.

Suppose, for example, that i and j are *competitors*, and that they allocate aid to four recipients; not just two. In this case, i has the following marginal utilities over recipients:

$$\begin{aligned} MU_i^w &= \frac{\sigma_i^w}{w_i + \eta^w w_j} \\ MU_i^x &= \frac{\sigma_i^x}{x_i + \eta^x x_j} \\ MU_i^y &= \frac{\sigma_i^y}{y_i + \eta^y y_j} \\ MU_i^z &= \frac{\sigma_i^z}{z_i + \eta^z z_j}. \end{aligned} \tag{30}$$

Suppose $\eta^w, \eta^x > 0$, while $\eta^y, \eta^z < 0$. Any transfer that j makes to either recipient w or x will reduce i's marginal utility for giving aid to those recipients, while any transfer of aid to either y or z will increase i's marginal utility of giving aid to either of them. If this transfer is made between, say w and y, then whether i has an incentive to increase aid to one and decrease aid to the other is impossible to know without reference to i's preferences and the precise values of the externality parameters. But, if a transfer is made between w and x, or between y and z, i's incentives are far more certain. A change in j's allocation of aid between w and x would lead to substitution by i between those recipients.

Further, a change in j's allocation of aid between y and z would lead to complementarity by i between those recipients.

This observation of course falls short of identifying i's equilibrium response, but the comparative statics here are of greater consequence than precise predictions. How i distributes aid *between* recipients where j's aid generates the same type of externality—rival or common—will be consistent, even if the choice between recipients where j's aid generates different types of externalities will not. This is advantageous for large-n empirical analysis. Provided the appropriate comparisons in donor giving between recipients can be made, it is in principal possible to identify when and where donors take advantage of, or seek advantage over, one another. This again is the subject of Chapter 3.

Finally, the model offers some predictions for when and where we can expect donor governments to specialize and dominate in developing countries. This issue is taken up in Chapter 4. As was noted in earlier discussion of donor best-responses, donors with greater resources are, for obvious reasons, more apt to dominate in their aid giving. But, beyond this fact, we should particularly observe wealthier donors take the lead in developing countries where their interests are greatest. In such cases, others should struggle to compete or else be most apt to have incentives to pass the buck.

1.5 Conclusion

Despite the illumination cast by a now mammoth body of research, deep understanding of the strategic relationships that exist among donor governments has tended to elude either the grasp or interest of political scientists and economists. Much like Alesina and Dollar (2000) do in their widely cited "Who Gives Foreign Aid to Whom and Why?" the bulk of studies on this issue emphasize donors' political goals and recipients' needs and policies, leaving a gaping lacuna where donor interests vis-à-vis each other ought to go. This is problematic, because strategic interdependence leads to deviations between donor priorities and how they actually distribute international aid. Failing to account for this can

lead to mis-identification of what donors value in empirical analyses.

Efforts to untangle strategic interactions among donors exist, but none adopt such a general strategic political economy framework as that introduced here. With the help of a two-by-two model of aid allocation, the implications of donors pursuing a possibly mixed bag of common and rival objectives through their aid giving was demonstrated. Among the three possible strategic relationships in the model, donors-as-*competitors* is an especially apt analogue for interactions among donor governments. As donors compete to maximize their foreign policy goals through giving aid, they simultaneously have incentives to take advantage of a peer's generosity when they reap common benefits from their aid to one recipient, and incentives to seek advantage in giving aid to a recipient that is a site of rival objectives.

Equilibria emerge under a wide array of strategic responses. Both donors might engage in competition—giving more aid where the other donor gives more. Or they both might pass the buck—giving less aid where the other donor gives more. Or one might respond competitively to the aid of the other, while the other responds deferentially to the aid of the one. These different incentives highlight potential problems for empirical analysis of donor responses. Unless appropriate comparisons can be identified, it is not possible to reliably infer the strategic valence of donor objectives from estimated reaction slopes.

With respect to welfare, regardless of the direction of actor's best-responses, in many cases competitive waste was observed: either one or both donors gave more aid than was efficient to the recipient that was a source of rival foreign policy interests, and by extension too little aid than was efficient to the recipient where donors had mutually beneficial objectives. In these cases, the strategic environment between donors produces what is essentially a Prisoners' Delimma between donors. However, the location of a Pareto improving solution may not be intuitive. Because the direction of donors' reaction pathers is not guaranteed to provide information about the strategic valence of peer aid

in recipients, it is possible that donors might have negatively sloped reaction paths yet nonetheless over commit resources in a recipient.

Even more, Pareto improving collective solutions are not guaranteed. Rather, in a significant share of the parameter space collective optimization fails to yield Pareto improvements over equilibrium behavior. While one donor does better with a collective solution, the other does better in an uncooperative equilibrium.

These facts highlight salient stumbling blocks to donor collaboration. Though the task of institution design is beyond the scope of this chapter, the findings presented here highlight factors that any institution would need to account for if it is to succeed. Most salient among these factors is the observation that donors can have conflicting preferences between a collective and individual solution. While the model presented here provides no resources that would remedy this problem, it is possible to think of extensions to this basic framework that may permit, for example, Ricardian inspired solutions in the form of trade or exchange of aid flows. At any rate, a well designed institution in this space will not merely provide a channel of communication among donors to allow them to converge on a collectively optimal solution; it will support credible exchanges of aid flow between donor governments that ensure collective solutions are incentive compatible for all.

While this study does not answer all questions, or even provide satisfying solutions, it provides a framework for grappling with the consequences of strategic interdependence for the distribution of global development assistance. Until the problem is adequately defined, solutions will remain elusive.

In the remainder of this dissertation, I turn to consider the empirical implications that follow from this analysis. In Chapter 3 I examine patterns in strategic interdependence, what they tell us about the objectives of donor governments, and how accounting for interdependence can inform our understanding of the drivers of international aid. It is here that I flesh out with greater specificity when and where the strategic valence of donor goals should be rival or common. In Chapter 4, I turn to consider how strategic dynamics

shape when and where donor governments hold lead donorship in developing countries. But, before conducting these analyses, I first need to construct measures that will help me detect signals about the interest-based and needs-based considerations that influence donor priorities. This is the subject of the next chapter (Chapter 2).

1.6 Supplemental Materials I

1.6.1 Proof for Proposition 1

Proof Following Cachon and Netessine (2004), a sufficient condition for a unique Nash equilibrium is that, for each actor the absolute value of their best-response slope is less than 1. That is:

$$\left|\frac{\partial x_i^*}{\partial x_j}\right| < 1 \forall i : i \neq j. \tag{31}$$

It is simple enough to demonstrate that this condition holds for the two-donor, two-recipient model detailed here. Recall that δ_2 denotes the slope of i's reaction to j. We may add i and j subscripts to clarify that j has a similar parameter denoting its response to i: hence, δ_{i2} and δ_{j2}.

For country i, the identity of its reaction parameter is given as

$$\delta_{i2} = \sigma_i^x(\eta^x - \eta^y) - \eta^x. \tag{32}$$

From this identity, it follows that $-1 < \delta_{i2} < 1$ for all possible values of the parameters σ_i^x, η^x and η^y. This can be seen by observing the value of the reaction parameter at the limits of each η and at the limit of σ_i^x.

First, note that $\sigma_i^x \in (0, 1)$. This means that at the boundaries of this parameter, the identity of δ_{i2} converges to either $-\eta^x$ (as $\sigma_i^x \to 1$), or $-\eta^y$ (as $\sigma_i^x \to 0$).

From this, it then follows that the absolute magnitude of i's reaction parameter is

limited to being no greater than that of the externality parameters. These, recall, are bound such that $\eta^x, \eta^y \in (-1, 1)$. This therefore implies that, at the limits of the model parameters, $\delta_{i2} \in (-1, 1)$. By symmetry, this necessarily implies that j's reaction is similarly bound.

Together, this meets the conditions for a unique Nash equilibrium. Therefore, the model will always have a unique Nash equilibrium solution. ∎

1.6.2 Proof for Proposition 2

Proof Smoothness with respect to the model parameters is demonstrated by simply considering i's (and by symmetry j's) Nash equilibrium best-response x_i^*. The closed-form solution for this is given by

$$x_i^* = \frac{\delta_{i0} + \delta_{i1} R_i + \delta_{i2}(\delta_{j0} + \delta_{j1} R_j)}{1 - \delta_{i2}\delta_{j2}}. \tag{33}$$

From this, it is easy enough to demonstrate that x_i^* is a smooth function of the model parameters; though, an important caveat is that this smoothness is bound to best-responses such that $0 \leqslant x_i^* \leqslant R_i$. Within this range, x_i^* is differentiable with respect to the δs—and hence σ_i^x, σ_j^x, η^x, η^y—and the distribution of resources R_i. ∎

1.7 Supplemental Materials II

The parameter space allows for wide-ranging outcomes—an infinite number in fact. Nonetheless, a grid search can offer a representative view of how alternative arrangements of donor priorities, foreign policy externalities, and donor size yield efficient and inefficient outcomes.

Keeping with the focus on studying *competitor* donors, the range of parameters includes all possible combinations of:

- $R_i = (0.1, 0.2, 0.3, ..., 0.9)$;
- $\sigma_i^x = (0.1, 0.2, 0.3, ..., 0.9)$;
- $\sigma_i^y = (0.1, 0.2, 0.3, ..., 0.9)$;
- $\eta^x = (-0.9, -0.8, -0.7, ..., -0.1)$;
- $\eta^y = (0.1, 0.1, 0.3, ..., 0.9)$.

This creates a parameter grid of 59,049 possible combinations to evaluate.

Table 1.2 summarizes the percentage of examined cases by the suboptimality of the Nash equilibria. In only over 51% of the combinations of parameters explored, the Nash equilibrium solution was inefficient. In nearly 49% of cases, the equilibrium distribution of aid was also Pareto optimal.

However, the efficiency of an equilibrium solution does imply that *both* donor governments are better off in equilibrium than under the solution for the collective optimization problem. To the contrary, in many instances, one donor is better off under one and worse under the under—and vice versa.

We can see this by noting that while 51.37% of Nash equilibria are not collectively efficient, 100% of the equilibria leave at least one donor strictly worse off relative to their utility under collective optimization. In fact, in all the remaining 48.63% of cases, which are Pareto optimal, in **all** one donor is strictly better off in equilibrium, while the other is strictly worse off, relative to their payoffs under the solution for collective optimization. In

Table 1.2: Inefficiency of Nash Equilibria

Outcomes	Percent
Inefficient	51.37
Conflicting payoffs	48.63
TOTAL	100.00
Suboptimal for both	13.23
Suboptimal for *i or j*	100.00

Table 1.3: Nash Spending Relative to Collective Solution (Inefficient Equilibria)

	i over spends	*i* under spends	neither
j over spends	62.50	18.55	0.18
j under spends	18.58	0.00	0.00
neither	0.18	0.00	0.00

only a mere 13% of equilibria, both donors strictly worse off.

These findings highlight that there is a substantial area of the parameter space where donors will have conflicting preferences between individual and collective optimization. Conversely, there is a much narrower range of parameters where collective optimization yields strong Pareto improvements for donors—that is, where both donors do strictly better relative to their individually best responses.

The inefficient and efficient sets of equilibria vary in interesting ways with respect to donor spending under individual relative to collective optimization. Table 1.3 summarizes the percentage of inefficient equilibria by whether donors i and j over or under fund aid to x, or whether their spending matches what their collectively efficient supply of aid would be. In 62.5% of cases both i and j gave too much aid to x than is efficient. But, almost 38% of the time while one donor over funds aid to x, the other donor gives too little. In no case, however, do both i and j commit too little aid to x in the same equilibrium.

A similar pattern appears in the spending of donors in the set of efficient equilibria. This is shown in Table 1.4, which summarizes the percentage of efficient equilibria according to donors' spending under individual relative to collective optimization. In

Table 1.4: Nash Spending Relative to Collective Solution (Efficient Equilibria)

	i over spends	i under spends	neither
j over spends	71.90	5.79	7.42
j under spends	5.85	0.00	0.80
neither	7.42	0.80	0.00

Table 1.5: % Corner Solutions by Nash Spending (Inefficient Equilibria)

	i over spends	i under spends	neither
j over spends	31.91, 31.86	100, 0	0, 100
j under spends	0, 100	NA	NA
neither	100, 0	NA	NA

[a] (Donor j, Donor i)

71.9% of cases, donors commit more aid to x in equilibrium than they do under collective optimization. In a much smaller set of cases, while one spends more in equilibrium, the other either spends less or its spending matches its spending under collective optimization. In a narrow 1.6% of cases, while one donor gives less than under collective optimization, the other's spending matches its spending under collective optimization.

While instances of mutual over-spending on aid to x are intuitive—donors have rival interests in x—the cases where one donor either commits too little aid to x, or its spending is equivalent to what its collectively efficient supply of aid would be, are less so. The summary in Table 1.5 may help to explain what is going on. Cell entries denote the percentage of cases by donor spending among inefficient equilibria where donors have corner solutions (donor j to the left, donor i to the right). The preponderance of cases where one donor either under commits aid, or its aid is equivalent to its efficient level of allocation, involve a corner solution by one (and only ever one) donor. Among cases where j over spends and i under spends on aid to x, donor j has a corner solution (committing all its aid to x) in all cases. Conversely, in all cases where j gives too much aid to x and i's spending matches its efficient supply of aid, j has no corner solutions, while i has only corner solutions. A symmetrical pattern applies to cases where i over spends on aid to x.

Table 1.6: % Corner Solutions by Nash Spending (Efficient Equilibria)

	i over spends	i under spends	neither
j over spends	20.45, 20.38	75.41, 0	0, 100
j under spends	0, 75.43	NA	0, 100
neither	100, 0	100, 0	NA

[a] (Donor j, Donor i)

Table 1.7: Distribution of Resources by Spending (Inefficient Equilibria)

	i over spends	i under spends	neither
j over spends	0.50	0.81	0.28
j under spends	0.19	NA	NA
neither	0.72	NA	NA

A similar pattern applies to efficient equilibria, as shown in Table 1.6—however, there are some notable differences. For instance, when one donor under spends and the other's matches its spending under collective optimization, the latter has a corner solution in all equilibria. Also, when one donor over spends and the other under spends relative to collective optimization, the former has a corner solution in just over 75% of equilibria. This leaves just under a fourth of cases where donors have an interior solution.

The pattern in corner solutions with respect to the characteristics of donor spending is driven, in no small part, by the distribution of resources between donors. As Figure 1.11 shows, among the set of inefficient and efficient equilibria, the percentage where i or j have corner solutions increases monotonically with an actor's share of the global aid budget. As the summary in Tables 1.7 and 1.8 further indicate, the average distribution of resources between actors by their spending characteristics supports the role of R_i in determining over/under funding of aid relative to collective optimization.

One point worth noting about this relationship between R_i, corner solutions, and over/under funding of aid is that it appears that while smaller donor governments have an incentive to support rival foreign policy goals with their aid to the detriment of mutually beneficial goals, larger donors are left to make up for the slack in smaller donor giving to

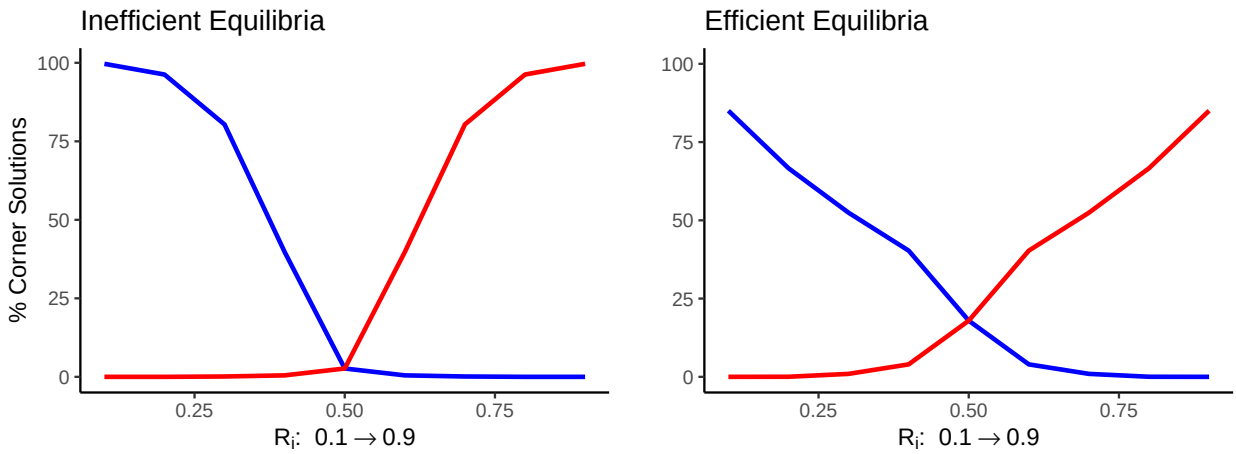

Figure 1.11: The distribution of resources and the incidence of corner solutions. The percentage of corner solutions for i is in blue. The percentage of corner solutions for j is in red.

Table 1.8: Distribution of Resources by Spending (Efficient Equilibria)

	i over spends	i under spends	neither
j over spends	0.50	0.72	0.28
j under spends	0.28	NA	0.22
neither	0.72	0.78	NA

sites of mutual interest. At first blush, this finding may strike some as inconsistent with the empirical record. Many smaller donors—i.e., Nordic countries—have a reputation for greater humanitarian motivation for allocating aid than larger donors such as the United States (Gates and Hoeffler 2004). However, these well-established donor governments may be the exception rather than the rule.[14] Many new and emerging donors—countries that have or are making the transition from aid recipient to aid donor—appear to distribute aid in decidedly less-than-humanitarian ways. These smaller donors tend to focus more on neighboring recipients, show less responsiveness to recipient need, are less likely to target aid away from poorly governed recipients, and respond with fewer resources than traditional donors to natural disasters (Dreher, Nunnenkamp, and Thiele 2011). Emerging donors, then, may be most prone to throw their aid budgets toward realizing rival foreign

[14]In addition these countries would have more corner solutions for a different reason: namely, deference to large donors in recipients where these smaller humanintarian donors care less about development.

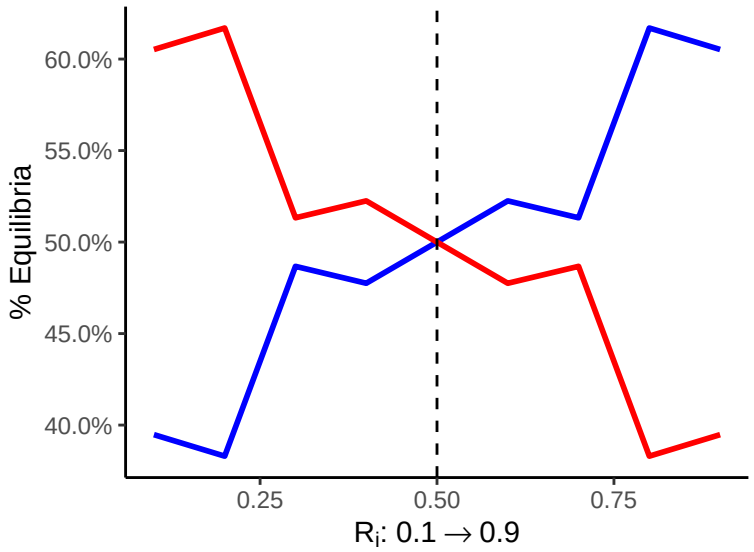

Figure 1.12: Blue denotes cases where i does better under collective optimization, while j does worse. Red denotes cases where j does better under collective optimization, while i does worse. Values denote the percentage of *Pareto efficient* equilibria.

policy objectives while giving little to no aid when and where it may yield collective benefits for the donor community—consistent with what this model would predict.

Another point worth noting centers on donor payoffs in Pareto efficient equilibria. As already stated, all of the efficient equilibria considered are characterized by conflicting preferences donors have for individual relative to collective optimization. In these cases, the solution under collective optimization, and the Nash equilibrium, are Pareto optimal. However, while one donor does better under one and worse under the other, the opposite is true for the second donor. For instance, if donor i does better in equilibrium, it will be worse off under collective optimization. Conversely, donor j will do better under collective optimization, but will do worse in equilibrium.

Figure 1.12 shows the percentage of Pareto efficient equilibria over R_i where one donor does better under collective relative to individual optimization. As the results show, smaller donors tend to do better in equilibrium relative to collective optimization. This means smaller donors, more often than not, will have a preference for remaining in equilibrium. Meanwhile, larger donors will more often have a preference for collective

optimization. This does not imply that small donors always have an aversion to collective solutions; not does it imply that large donors always prefer them. The range of percentages in Figure 1.12 is wide, but still far from the 0-100 extremes. Nonetheless, these averages demonstrate that small and larger donors tend have countervailing preferences over individual and collective solutions that are explained by the distribution of resources between actors.

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Chapter 2

What Donor Governments Value

2.1 Introduction

Research on why donor governments give foreign aid has historically oriented itself around a central tension between the strategic and material foreign policy interests of donors and the development needs of recipient countries. The conventional approach to testing the relevance of these factors has been to include numerous measures as proxies for each concept in a regression analysis and then to use the direction and significance of the estimated coefficients to adjudicate the extent to which donor governments respond to recipient need or base their giving on other foreign policy interests.[1] This approach has its advantages—it permits testing particular mechanisms driving international aid—but it has its problems, too. As Achen (2002) bluntly puts it: "garbage cans of variables from different literatures" can produce results that are difficult to validate and interpret (448). Indeed, as others note, the causal relationships that may exist under the hood of an empirical model grow in complexity *exponentially* with the number of variables.[2]

More to the point, for the purposes of empirically investigating strategic interdependence in international aid, reliance on a battery of measures poses some crippling logistical challenges. The motivating claim of the previous chapter was that donor governments may obtain a mix of rival or common benefits from their aid allocations, with some recipients operating as sites of rivalry and others as sites of common interest. Variation in the types of goals donors pursue in recipients should therefore vary with all sorts of factors, from trade to military alliances and from recipient poverty to the presence of ongoing conflict. We should expect all of these factors to condition the strategic valence of foreign aid given

[1] See, for example, Berthelemy (2006).
[2] See Pearl (2009).

by other donor governments and, by extension, how a donor responds to the aid given by others. But, in a multiple regression context, it would not be feasible to interpret the many interaction terms that would have to be included.

In this chapter I discuss the approach I take to wrangling variables often associated with the strategic and needs-based motivations for aid allocation. The product of this work is two composite measures, one of *donor interest* (DI) and the other of *recipient need* (RN). These measures will not only assist in the empirical analysis of donor responses to each other in the next chapter, but have value in their own right. As I demonstrate, the composite measures DI and RN allow for detecting clearer signals in the macro-level drivers of international aid. This allows for simpler evaluations and comparisons between donors regarding the interest-based or needs-based motivations of their giving.

In this chapter I describe the measures I created and how I made them, and then I examine both their predictive performance and their ability to uncover broad patterns in the giving of donor governments. I further cross-reference my findings with those from Berthelemy (2006), who explicitly categorizes donor governments by the degree to which they give aid for interest-based, needs-based, or mixed reasons.

The measures DI and RN are constructed using several variables historically linked to interest-based and needs-based giving, respectively. Donor interest (DI) captures bilateral factors that motivate donors to prioritize some otherwise equally needy recipients over others. It is a composite of four variables: *bilateral distance*, *volume of bilateral trade*, *former colonial status*, and *military alliances*. Physical distance between donors and recipients determines the relative salience and visibility of the latter to the former. Trade, meanwhile, captures economic incentives for a donor to maintain close ties with a recipient. Further, status as a former colony of the donor denotes political and cultural incentives to keep a recipient within a donor's sphere of influence. Finally, an alliance between a donor and recipient captures a donor's geostrategic interests in supporting a security partner.

The second measure, recipient need (RN), captures recipient-specific characteristics

that make developing countries generically deserving targets of foreign aid. It is a composite of five variables: *income* (per capita gross domestic product), *population size*, *severity of natural disasters* (the number affected or killed), *political and civil liberties*, and *incidence of civil war*. Together, these factors shape the relative neediness of a developing country, and thus the general importance of a country to the donor community. Needier countries are likelier to benefit from economic assistance and thus should be more salient recipients of aid.

To construct these measures, I devise an algorithm that finds the linear combination of a set of component measures that maximizes the sum of the squared covariances (SSC) between the components and their combination. I validate the approach by comparing SSC derived measures of DI and RN with those produced by the better-known tools of principal components analysis (PCA) and multivariate factor analysis (MFA). Using increasingly flexible modeling strategies—respectively, linear regression, generalized additive models, random forests, and neural networks—I find that SSC produces measures with greater predictive power than PCA and MFA derived measures of RN and DI.

Finally, using these measures I conduct a series of regression analyses to assess patterns in international aid. At a broad level, donor governments appear responsive to both interest-based and needs-based considerations, but not all donors are alike. Further, not all donors are the same over time. The patterns I find would have been much harder to detect without the aid of composite measures. Even more, while some inferences align with conventional wisdom, others do not. Several donor governments that I identify as having a mix of interest- and needs-based motives others have identified as solely interest-based.

Not only will these measures prove useful in the chapters that follow, they have value in and of themselves. Though there remains room for improving them, the approach itself of reducing dimensions in the study of international aid has great promise and will open new doors for research in the years to come.

2.2 Donor Interest and Recipient Need

Though political actors have used foreign aid as a policy tool for millennia (Markovits, Strange, and Tingley 2017), the modern practice of giving foreign aid has its roots in the post-World-War-II period. Writing in the mid-1970s, McKinlay and Little (1977, 1979) note in a pair of papers that as foreign aid emerged as an institutionalized practice in international relations, two views arose to explain aid's rationale. McKinlay and Little referred to these as the "humanitarian view" (recipient need) and the "foreign policy view" (donor interest). As they note more explicitly in comparing these views in their 1979 article, the former stipulates that the amount of aid a donor provides is proportional to a recipient's economic and welfare needs. Conversely, the foreign policy view holds that the amount of aid a donor provides is proportional to its level of interest in a recipient.

Much of the empirical literature on aid allocation has oriented itself around pitting these views against each other, using numerous measures as proxies for each set of motivations. McKinlay and Little (1979) set the tone for future studies, using seven covariates to model recipient need and a total of 26 to test different aspects of foreign policy interest using US aid data from 1960 to 1970. Future studies would adopt a similarly comprehensive approach. The below list summarizes for a selection of studies the total number of variables used to proxy for either recipient need or donor interest.

Study	**Variable Count**
• McKinlay and Little (1977)	25
• McKinlay and Little (1979)	33
• Maizels and Nissanke (1984)	13
• Schraeder, Hook, and Taylor (1998)	21
• Alesina and Dollar (2000)	14
• Berthelemy and Tichit (2004)	15
• Bueno de Mesquita and Smith (2009)[3]	15

[3]This is the count for main terms in model estimation. A large number of interaction terms were also

Including so many variables in a regression analysis is not difficult to do from a technical standpoint. In fact, it is quite easy with modern statistical software and is often why such regressions appear in studies. The more difficult task is interpreting so many coefficients, each of which reflects only a partial relationship in the data. A regression model that includes a measure of bilateral trade and 10 other covariates, for example, reports the relationship between trade and foreign aid after subtracting out variation in both trade and aid captured by the other 10 covariates. Not only is it not clear how such a partial relationship should be interpreted, with 10 other variables in the model it is hard to check whether nonlinearities in the other variables have created inappropriate comparisons with respect to variation in trade.

This problem is not unique to studies on the determinants of foreign aid. As Achen (2002) notes, the practice in political science is widespread. The result, as Achen (2002) goes on to state, is that "empirical findings accumulate but do not cumulate" (445). That is to say, as a field we have a slew of research findings yet have made little progress in building consensus on central questions. A survey of even the seven studies cited above illustrates the range of heterogeneous findings on why donor governments give foreign aid. Some studies conclude firmly that donor interest is the main rationale (see Bueno de Mesquita and Smith 2009), while others conclude that recipient need does indeed matter (see Berthelemy and Tichit 2004).

The problem, then, is not necessarily a lack of measures—one more proxy for donor interest will not make or break the current debate. Rather, the problem in modeling donor interest and recipient need as determinants of aid giving is saturation. More measures are not needed; a way to collapse them is. The following section outlines a proposed methodology for doing so.

However, before proceeding, a caveat on the value of collapsing measures bears noting. That is, while dimensionality reduction, if done well, offers several advantages, it

considered.

is not an appropriate choice in all circumstances. While some questions in international aid are truly about macro-level issues and thus could benefit from synthesizing a fewer number of measures out of many, other questions center on particular mechanisms that drive patterns in aid giving. For example, Bermeo and Leblang (2015) in their study test hypotheses linked to donor immigration policy and migrant political mobilization as factors driving foreign aid to migrant-sending countries. Aggregate variables would have been too blunt an instrument for testing these mechanisms.

In short, the value of this approach hinges on the types of questions being asked. It is incumbent on the researcher to weigh the utility of dimensionality reduction with the utility of isolating a single mechanism or component.

2.3 The Method in Brief

Many methods exist for reducing dimensionality in data. Shrinkage approaches, such as LASSO, can be tuned to eliminate variables that have little predictive power with respect to an outcome from a model, and methods of feature projection can be used to combine a set of covariates into a single measure. An index could alternatively be constructed. The polity index, for example, is a composite of several component measures—regime durability, regulation of chief executive recruitment, political competition, and so on (Marshall and Gurr 2020).

The method outlined here can be thought of as a blend of the feature projection and index construction approaches. Using an objective function, it finds the optimal set of weights with respect to both direction and magnitude to construct a linear combination (or index) given a set of component measures. The final product is optimized to maximally covary with its components, appropriately weighted on the basis of their variation.

More formally, define a vector of $K > 1$ covariates as $(X_{i1}, ..., X_{ik}..., X_{iK}) = X_i \in X \subset \mathbb{R}^K$ and an objective function $f : \mathbb{R}^K \to \mathbb{R}$. The subscript i indexes N units of observation. The goal is to find a set of weights $(\omega_1, ..., \omega_k, ..., \omega_K) = \omega \in \Omega \subseteq \mathbb{R}^K$ that maximize f

given X. Denote $\hat{\omega}$ as the solution set of weights where

$$\hat{\omega} = \underset{\omega \in \Omega}{\operatorname{argmax}} f(\omega; X). \tag{2.1}$$

The weights that maximize f will then be used to map X to a vector Z where $Z \in \mathbb{R}$. Specifically,

$$Z_i = X_i^\top \hat{\omega}. \tag{2.2}$$

A number of explicit forms for f could be considered, but one of the simpler to implement in practice is the sum of the squared covariances (SSC):

$$f(\omega; X) = \sum_{k=1}^{K} \operatorname{cov}(X_k; X^\top \omega)^2. \tag{2.3}$$

Squaring the covariances is required to ensure values are positive and is preferred over taking the absolute value since the latter poses some challenges to optimization—namely, it would not be continuously differentiable or linear.

In words, this approach finds a linear combination of K covariates such that said linear combination maximally covaries with each individual variable k. The end product of this procedure is a variable Z that maximally covaries with the set of components used in its construction.

Because scale may be an issue when combining covariates, in practice it is advisable to standardize each of the covariates in the set X. The most commonly applied method is to mean center and scale covariates such that they have a standard deviation of 1. After the linear combination Z is generated, it again may be desirable to standardize the final output.

Because much has been written about other existing approaches of dimensionality reduction (or linear projection), a comprehensive summary of each is beyond the scope of

this paper. However, two popular alternatives are worth mentioning: principal components analysis (PCA) and multivariate factor analysis (MFA). These approaches are applied across a range of scientific fields to produce a smaller set of covariates from a much larger set for use in regression analysis. Why develop and use SSC when these other approaches are available?

The answer to this question has both a theoretical and a practical element. With respect to the first, it is necessary to briefly discuss the intuitions behind PCA and MFA.

The goal of the former is to find a multi-dimensional ellipsoid with axes that represent "principal components." Using the notation from above, the first such component is identified for a set of covariates X by generating a set of weights where

$$\hat{\omega} = \underset{\omega \in \Omega}{\operatorname{argmax}} \sum_{i=1}^{N} \left(X_i^{\top} \omega \right)^2. \tag{2.4}$$

Subsequent components are successively identified by first subtracting the previously identified principal component and then optimizing equation 4 again.

Keeping with the first principal component (since this is what we would use to generate the composite measures of interest), this method, in words, finds a set of weights such that the variance in the linear combination of covariates is maximized. This objective obviously differs from that of SSC, which finds weights such that the linear combination of covariates maximally covaries with each component variable. This difference implies different kinds of information from the data that the resulting measures capture. SSC provides a measure that is maximized to be correlated with its components, while PCA provides a measure that has maximum variance given the component measures. The former objective, I would argue, is better aligned with the goal of measurement creation.

MFA, unlike PCA, takes into account covariances in the data in the construction of "factors." MFA models observed covariates in X as linear functions of latent factors F where the number of factors ℓ is less than the number of covariates K. The idea is that groups of

variables may move in common directions because they are the product of a smaller set of unobserved variables. For instance, variables like income, education, and employment status could be thought of as determined by a latent concept called socioeconomic status.

Formally, latent factors map to observed variables via a set of factor loadings $(l_1, ..., l_p, ..., l_\ell)_{(k)} = l_k \in L \subseteq \mathbb{R}^{\ell \times K}$. For the set of covariates X, the value of X_{ik} is given as

$$\begin{aligned} X_{i1} &= \sum_{p=1}^{\ell} l_{p1} F_{ip} + \epsilon_{i1} \\ \vdots \quad &\quad \vdots \quad \quad \vdots \quad . \\ X_{iK} &= \sum_{p=1}^{\ell} l_{pK} F_{ip} + \epsilon_{iK} \end{aligned} \tag{2.5}$$

The values of the latent factors, and their respective loadings, are identified using the correlation matrix for the set of covariates X.

In some ways MFA is closer in spirit to SSC, but it still optimizes on a different objective, namely the extent to which variables are correlated with each other. This means that using the first factor from MFA (which we might try to do in constructing measures of DI and RN from their respective components) may not capture all the variation in a concept that is of interest. If two variables are part and parcel of the same overall concept, but are not themselves strongly correlated, one of these may receive a much lower factor loading and thus contribute much less to the variation in the estimated factor.

The second reason to prefer SSC over PCA or MFA is about practical considerations. This will be covered in greater detail in the analysis, but as results will show, SSC provides measures of DI and RN that have better predictive power than their PCA and MFA derived versions. For the purpose of analyzing patterns in international aid, SSC thus provides measures that are better attuned to signals in the data—as good a practical justification as any for preferring the method over the alternatives.

2.4 Constructing Measures of Donor Interest and Recipient Need

With a proposed method for generating composite measures in hand, the next step is to use an appropriate selection of component variables to create the composites of interest. The concepts of donor interest (DI) and recipient need (RN) have some relatively well-established sets of measures that are used to proxy for each. Of course, the universe of available variables is quite large, and it would be excessive to include all possibly relevant measures. Instead, I narrow the selection of variables to four in the case of DI and five in the case of RN. My choices certainly are not the only valid options, but they capture many of the most salient dimensions thought to correspond to interest and need. Taken together, these choices reflect common measures used in the aid literature and capture a wide range of signals related to interest- and needs-based drivers of foreign aid.

The RN measure is composed of the following sub-measures:

- yearly per capita gross domestic product (GDP);
- yearly population size;
- the yearly number of individuals killed due to natural disasters;
- an indicator for whether the recipient is experiencing a civil war in a given year;
- the yearly level of political and civil liberties of a recipient.

The first two measures were drawn from version 9.1 of the Penn World Table (Feenstra, Inklaar, and Timmer 2015),[4] and were log-transformed to normalize values. The third, which captures the severity of natural disasters in a given year, is drawn from the Institute of Health Metrics and Evaluation's database on natural disaster deaths reported by countries in a given year (2021).[5] Values are transformed via the inverse hyperbolic since rather than the natural log to retain zero values. The indicator for civil war is drawn from the UCDP/PRIO armed conflict database (Gleditsch et al. 2002; Pettersson et al.

[4] Available at https://doi.org/10.15141/S50T0R.
[5] Available at https://ghdx.healthdata.org/gbd-results-tool.

2021).[6] It takes the value 1 for all years where there was a violent conflict between at least two parties that involved the deaths of at least 25 combatants and which included the government as at least one of the parties in the conflict. The final measure, recipient civil and political liberties, is the sum of the Freedom House's political rights and civil liberties scores for a given recipient country in a given year.[7] The rights and liberties scores each range from 1 to 7, with higher values denoting more violations. After summing the values, the scores were reversed so that higher values denote greater freedom.

These measures generically contribute to an overall picture of the relative need developing countries have for economic assistance. They also relate in important ways. Level of income surely should matter to donors, but the size of the country contextualizes the relative importance of income. Conflict, too, not only contextualizes poverty, but can in many ways be a driver of it and be driven by it. Limited freedoms further directly play into both poverty and conflict, and vice versa. Natural disasters, meanwhile, are exogenous, but how many people are killed by them is both a function of total population size and a country's ability to adequately respond. For all these reasons, estimating separate partial relationships in a regression analysis for all these variables poses obvious challenges for interpretation and may result in unreliable signs and magnitude of coefficients. But, by combining these measures into a single composite variable, we can gain greater insight into how the movement of need in its various manifestations predicates where donor governments give the greatest aid.

The measure of DI, meanwhile, is constructed from the following four variables:

- bilateral distance (in kilometers) between a donor and a recipient;
- bilateral trade (in dollars) between a donor and a recipient;
- an indicator for whether the donor and recipient are formal allies;
- an indicator for whether the donor and recipient share a colonial past.

[6] Available at https://ucdp.uu.se/downloads/index.html#armedconflict.
[7] Available at https://freedomhouse.org/.

Table 2.1: Correlation Matrix for Recipient Need

	RN (SSC)	RN (PCA)	RN (MFA)	Income	Population	Disaster	Freedom	Civil War
RN (SSC)	1.00	0.96	0.84	-0.51	0.84	0.69	-0.54	0.46
RN (PCA)	0.96	1.00	0.86	-0.36	0.86	0.71	-0.49	0.65
RN (MFA)	0.84	0.86	1.00	-0.16	1.00	0.63	-0.31	0.36
Income	-0.51	-0.36	-0.16	1.00	-0.16	-0.03	0.22	-0.16
Population	0.84	0.86	1.00	-0.16	1.00	0.63	-0.30	0.36
Disaster	0.69	0.71	0.63	-0.03	0.63	1.00	-0.03	0.27
Freedom	-0.54	-0.49	-0.31	0.22	-0.30	-0.03	1.00	-0.23
Civil War	0.46	0.65	0.36	-0.16	0.36	0.27	-0.23	1.00

The first and second measures were taken from CEPII. Distance comes from CEPII's gravity dataset (Mayer and Zignago 2011), and trade comes from CEPII's TRADEHIST dataset (Fouquin and Hugot 2016).[8] The former is log-transformed, while the latter is transformed via the inverse hyperbolic sine. The alliance measure is drawn from the ATOP database and takes the value 1 if the donor and recipient share an alliance (Leeds et al. 2002).[9] The colony measure comes from the same CEPII dataset as the bilateral distance measure, and takes the value 1 if the donor was a former colonizer of the recipient.

Study of the role of such strategic factors as highlighted above has a well-established tradition in the literature. Extensive research has been done to test the range of foreign policy objectives that motivate foreign aid giving (Bearce and Tirone 2010; Bermeo 2017; Kilby and Dreher 2010; Kisangani and Pickering 2015; Round and Odedokun 2004; and van der Veen 2011). These studies and others usually subdivide donor interests under various umbrellas. The four measures included in the construction of DI capture four specific dimensions of donor interest: geographic, material, strategic, and social.

Donors tend to give more aid to countries that are geographically closer, which suggests an interest in promoting influence within their sphere of influence (Bermeo 2017). Distance of course is inversely proportional to trade, a measure that captures donor's material or economic interests. The correspondence between distance and trade may explain why regression analyses that include both measures have yielded conflicting

[8] Both available at http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp.
[9] Available at http://www.atopdata.org/.

Table 2.2: Correlation Matrix for Donor Interest

	DI (SSC)	DI (PCA)	DI (MFA)	Distance	Trade	Colony	Alliance
DI (SSC)	1.00	0.83	0.70	-0.58	0.87	0.17	0.47
DI (PCA)	0.83	1.00	0.97	-0.78	0.47	0.21	0.80
DI (MFA)	0.70	0.97	1.00	-0.78	0.30	0.07	0.87
Distance	-0.58	-0.78	-0.78	1.00	-0.16	-0.03	-0.39
Trade	0.87	0.47	0.30	-0.16	1.00	0.14	0.16
Colony	0.17	0.21	0.07	-0.03	0.14	1.00	0.01
Alliance	0.47	0.80	0.87	-0.39	0.16	0.01	1.00

results about the significance of distance.[10] Alliances meanwhile reflect geostrategic objectives and security commitments between donors and recipients. Research on the specific role of alliances in predicting aid has only received limited attention from scholars, and then only in the context of total aid flows.[11] However, the existence of signed treaty agreements between donors and recipients certainly provides material evidence of strategic interests. This implies a role for aid in helping donors provide their allies assurances of their security commitments. Colonial status, finally, captures historical ties between donors and recipients. Former colonies may not only be targeted by donors as a means to perpetuate influence, but also because of the enduring social connections between colony and colonizer (Alesina and Dollar 2000; Bermeo 2017).

Of course, different measures might have been used to construct RN and DI. Further, some measures associated with need—like political freedoms or civil war—could be alternatively argued to relate to donor interest. With respect to variable selection, I chose the variables that I describe above on the basis of availability and judgments about their ability to capture as much of a particular dimension of their associated concept as possible. For example, for geostrategic interests, I considered measures other than alliances such as arms transfers or military aid. However, the first did not provide as much coverage as alliance data—it contained invalid measures for a number of dyad years for which I do have valid measures for alliances. The second, meanwhile, is a measure that only exists

[10] Bueno de Mesquita and Smith (2009) fail to identify a significant coefficient on distance once they control for trade, while Bermeo (2017) does not observe such a reversal of statistical significance.

[11] See Morgan and Palmer (2000).

in greatest detail and reliability for the United States. While some have used US military aid to proxy for the geostrategic interests of other donor governments (Bermeo 2017), I decided it was better to use measures that are, at minimum, unique to the donor-recipient level.

The choice to limit measures of donor interest to bilateral factors further relates to my decision to categorize variables like civil war and freedom as needs-based factors rather than interest-based. While the latter in particular has been argued to relate to donor foreign policy goals—such as supporting the democratic regimes of developing countries (Alesina and Dollar 2000)—it, and civil war as well, also provides substantive information about development need. Civil wars have been called by some as "development in reverse" because of the detrimental effects conflict can have on economies, security, and political stability (Stojek and Tir 2014). Civil and political freedoms, meanwhile, have been linked with long-term economic growth and societal development (Acemoglu et al. 2019). These measures, then, capture important signals about the overall development need of developing countries. Further, since they are measured at the recipient, rather than bilateral, level, it is hard to assess the unique signals they would capture about the interests of specific donor governments. As other scholars have argued, interest-based considerations imply that donor governments make their aid allocation decisions on the basis of their unique relationships with different recipient countries.[12]

I used SSC, PCA, and MFA to construct versions of these measures. Correlation matrices for how these different measures relate to each other and their various components are shown in Tables 2.1 and 2.2. For RN (Table 2.1), the different methods produce measures that are not identical, though nonetheless strongly correlated. For SSC and PCA, $\rho = 0.96$; for SSC and MFA, $\rho = 0.84$; and for PCA and MFA, $\rho = 0.86$. We can see from the bivariate correlations between these different versions of the measures and the components, each weights variables differently. All seem to give substantial weight to recipient population;

[12]See Berthelemy (2006).

however, with rounding the MFA derived measures appears to be basically identical to with population. As noted in the earlier discussion of the different methods, because MFA takes into consideration the covariances among the variables in the data, it may down-weight measures in the construction of factors. In this case, this seems to be exactly what MFA has done in the construction of RN—favoring recipient population to the exclusion of other measures. In terms of broad patterns, each measure at least moves in the direction we would have expected. Greater RN implies lower income (GDP/capita), larger population size, more severe natural disasters (in terms of deaths), lower levels of political and civil liberties, and more likely incidence of civil war.

Turning to DI (Table 2.2), again we can see that the different methods produce measures that are fairly strongly correlated—with the exception that now SSC produces a measure more weakly correlated with those generated by PCA and MFA, while the PCA and MFA versions are highly correlated with one another. For SSC and PCA, $\rho = 0.82$; for SSC and MFA, $\rho = 0.67$; and for PCA and MFA, $\rho = 0.97$. We can see from the bivariate correlations between the measures and the components that each gives different weight to each measure. While SSC seems to move most strongly with trade and then with distance, PCA and MFA give strongest weight to distance and alliances. All, however, move in the expected direction. Greater DI reflects less distance between donors and recipients, higher levels of trade, a greater likelihood that a recipient is a former colony, and a greater likelihood that donors and recipients are formal allies.

2.5 Patterns in Donor Giving

Having developed the measures of DI and RN, I now turn to a series of analyses. First, to assess the ability of the SSC derived measures to capture variation in donor giving, I randomly divide the data in training and test sets and use out-of-sample predictions of bilateral aid for 28 DAC donors from 1995 to 2014 from models trained with the SSC, PCA, and MFA versions of DI an RN. By comparing the predictive power of these different

measures, it is possible to quantify the ability of SSC to yield measures with greater explanatory power than other more common approaches to measurement construction. I find that SSC provides better measures than PCA or MFA—that is, measures that can predict more variation in how donors give aid.

Second, to illustrate the utility of these measures for answering important questions in international aid, I conduct panel analyses and analyses at the level of individual donors to test the degree to which donors are interest- and/or needs-driven in their aid giving. One of the argued benefits of using aggregate measures of DI and RN is their ability to make patterns in international aid easier to discern. Using these measures, I am able to easily confirm the view that donors give aid for a mix of interest and needs-based reasons. But, I also uncover differences between donors, some of which are consistent with prior narratives of certain donor governments, and others that are different. I use the findings of Berthelemy (2006) as a bench-mark for drawing comparisons since the author makes explicit inferences about the interest- and needs-driven behavior of different donors. Consistent with Berthelemy (2006), Nordic donors appear more needs-driven than interest-driven in their giving. This supports the reputation many Nordic donors have for humanitarianism. However, there are a number of differences between our categorizations of donors as well, which I highlight in the following analysis.

2.5.1 Measurement Performance

To test the performance of RN and DI as predictors of aid allocation, I use data on the bilateral aid commitments of 28 DAC members as reported in the OECD's Creditor Reporting System (CRS) from 1995 to 2014.[13] Aid totals are in thousands of US dollars and are held constant at 2017 values. To normalized values while still retaining zeros, I applied the inverse hyperbolic sine transformation.

After merging the aid data and the dataset of covariates highlighted in the previous

[13]Data can be obtained at: https://stats.oecd.org/Index.aspx?DataSetCode=crs1.

section, the final dataset consisted of 49,685 unique dyad-year observations, made up of 3,474 unique dyads, 28 donors, and 127 recipients. Summary statistics are included in the Supplemental Materials for this chapter.

To compare the predictive performance of DI and RN as created via the different approaches (SSC, PCA, and MFA), I first randomized observations in the dataset into training and test sets. Because the dataset is a panel, and thus dyads over time are dependent, in constructing the training and test sets I randomized on the basis of dyads rather than individual units of observation. The training set was created by randomly selecting 70 percent of the dyads in the full panel, and the test set consisted of the remaining 30 percent.[14] Prior to dividing the data, I standardized the outcome and the measures of interest by de-meaning them at the donor-year level (so that variation reflects within donor and year differences in the variables) and scaled to standard deviation of one. This approach allows me to avoid using donor and year factors in model training since some donors or years may not appear in both training and test sets.[15]

I trained four different predictive models using the training dataset: (1) a linear model estimated via OLS, (2) a generalized additive model (GAM), (3) a random forest regression, and (4) a neural network. The linear model was specified as

$$\text{Aid}_{irt} = \beta_0 + \beta_1 \text{DI}_{irt} + \beta_2 \text{RN}_{rt} + \epsilon_{irt}, \tag{2.6}$$

and the specification for the generalized model was

$$\text{Aid}_{irt} = \beta_0 + s_1\left(\text{DI}_{irt}\right) + s_2\left(\text{RN}_{rt}\right) + \epsilon_{irt}, \tag{2.7}$$

where $s(\cdot)$ denotes nonparametric smoothers. These fit local regression lines at certain levels of the predictor variables rather than imposing constant slopes as in a standard

[14] A seed of 111 was used.

[15] Predictions would be undefined for such cases.

linear regression model.

The random forest and neural network models are denoted each as

$$\text{Aid}_{irt} = \text{RF}\left(\text{DI}_{irt}, \text{RN}_{rt}\right), \tag{2.8}$$

and

$$\text{Aid}_{irt} = \text{NN}\left(\text{DI}_{irt}, \text{RN}_{rt}\right). \tag{2.9}$$

The random forest model was trained using the default tuning parameters for the `ranger` R package, and the neural net was trained using one hidden layer with two neurons and a linear output.

Random forests provide a non-parametric approach to predicting outcomes given a set of factors by bagging the predictions of multiple regression trees trained on bootstrapped samples of the training dataset and random selections of covariates. Neural networks are a deep learning method that recursively fit layers of underlying linear and/or nonlinear equations relating a set of predictors to the outcome via a series of so-called "hidden" layers of neurons.[16]

Table 2.3 reports the mean squared error (MSE) for both out-of-sample predictions (under the "Test Predictions" header) and within-sample-predictions (under the "Train Predictions" header) using each of the above modeling strategies and the different approaches to measurement. The out-of-sample predictions were performed on the 30 percent of dyads randomly excluded from the training dataset. The within-sample predictions were performed on the 70 percent of dyads randomly included in the training dataset. Across all cases, DI and RN as derived via SSC out-performs the PCA and MFA versions. However, while MFA measures do consistently do worse than SSC, the difference in performance is only statistically significant in the case of the linear model for out-of-sample predictions.

[16] More about implementing neural networks in R can be found at: https://rpubs.com/julianhatwell/annr.

Table 2.3: Prediction MSE

	Test Predictions			Train Predictions		
Model	SSC	PCA	MFA	SSC	PCA	MFA
Linear	0.725	0.75***	0.742***	0.794	0.816***	0.831***
GAM	0.732	0.748***	0.734	0.773	0.808***	0.818***
Random Forests	0.713	0.728*	0.722	0.195	0.196	0.16***
Neural Net	0.731	0.757***	0.734	0.782	0.811***	0.816***

* p < 0.05; ** p < 0.01; *** p < 0.001.
Sig. tests are from pair-wise t-tests of the squared error in predictions using SSC derived measures relative to one of the alternatives.

PCA, meanwhile, provides measures that are the least predictive, and the difference in performance is statistically significant across modeling strategies for out-of-sample predictions. For within-sample predictions, on the other hand, MFA does significantly worse than SSC across all models, while PCA does significantly worse for all except random forests.

2.5.2 Interest and Needs-driven Aid

Having established the predictive edge conferred by the SSC constructed measures of DI and RN, in this section I consider what these measures can tell us about broad patterns in international aid. Table S.2.2 in the Supplemental Materials reports regression estimates for a series of models estimated with the separate measures of donor interest and recipient need and the SSC, PCA, and MFA derived measures of DI and RN, respectively. The results shown in column 2 are worth special mention because the estimates show how the chosen measures of DI and RN relate to donor giving. The results confirm the view that donors give foreign aid for a mix of interest- and needs-based motives. The coefficients on both DI and RN are positive and statistically significant at the $p < 0.001$ level. Models were estimated with donor and year intercepts so that coefficients may be interpreted as the difference in how much aid a donor gives to one recipient relative to another in a given year. The coefficient on DI is 0.53, which given the inverse hyperbolic sine transformation

Table 2.4: OLS Estimates by Donor

Donor	RN	DI	N	Adj. R^2	Type	(Berthelemy '06)
Czech Republic	0 (0.05)	0.17 (0.06)**	460	0.11	Interest	.
Greece	-0.02 (0.04)	0.32 (0.07)***	1,534	0.30	Interest	.
Poland	0 (0.05)	0.38 (0.14)**	230	0.20	Interest	.
Portugal	0 (0.07)	0.3 (0.1)**	2,263	0.08	Interest	.
Slovak Republic	-0.02 (0.01)	0.06 (0.03)*	230	0.11	Interest	.
Australia	0.52 (0.09)***	0.94 (0.17)***	2,265	0.42	Mixed	Interest
Austria	0.33 (0.07)***	0.46 (0.1)***	2,265	0.23	Mixed	Need
Canada	0.97 (0.07)***	0.33 (0.11)**	2,265	0.37	Mixed	Mixed
France	0.76 (0.1)***	1.17 (0.17)***	2,265	0.41	Mixed	Interest
Germany	1.16 (0.07)***	0.97 (0.13)***	2,264	0.53	Mixed	Mixed
Italy	0.52 (0.07)***	0.37 (0.12)**	2,265	0.20	Mixed	Interest
Japan	0.94 (0.1)***	0.8 (0.18)***	2,260	0.41	Mixed	Mixed
Korea	0.5 (0.1)***	0.84 (0.2)***	1,057	0.34	Mixed	.
New Zealand	0.2 (0.05)***	0.23 (0.07)**	1,534	0.19	Mixed	Need
Slovenia	-0.04 (0.02)*	0.07 (0.03)*	579	0.15	Mixed	.
Spain	0.48 (0.08)***	0.78 (0.12)***	2,265	0.25	Mixed	.
Switzerland	0.75 (0.08)***	0.26 (0.13)*	2,265	0.31	Mixed	Need
United Kingdom	1.1 (0.11)***	0.39 (0.19)*	2,265	0.33	Mixed	Mixed
United States	1.33 (0.13)***	0.53 (0.14)***	2,265	0.44	Mixed	Mixed
Belgium	0.71 (0.08)***	-0.05 (0.12)	2,265	0.24	Need	Mixed
Denmark	0.71 (0.09)***	-0.19 (0.14)	2,260	0.18	Need	Need
Finland	0.55 (0.07)***	0.01 (0.07)	2,265	0.26	Need	Mixed
Iceland	0.08 (0.03)*	-0.02 (0.01)	452	0.03	Need	.
Ireland	0.57 (0.09)***	-0.2 (0.1).	1,776	0.24	Need	Need
Luxembourg	0.24 (0.07)***	-0.04 (0.05)	1,076	0.07	Need	.
Netherlands	0.81 (0.11)***	0.06 (0.18)	2,265	0.22	Need	Need
Norway	0.91 (0.08)***	0.09 (0.12)	2,265	0.32	Need	Need
Sweden	0.77 (0.09)***	0.12 (0.15)	2,265	0.25	Need	.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Year intercepts not shown.

applied to foreign aid implies that a one standard deviation unit difference in DI between two recipients corresponds to approximately 70 percent greater aid to the recipient where DI is greater.[17] The coefficient on RN is 0.2, which means that a one standard deviation unit difference in need between two recipients corresponds to 22 percent greater aid to the recipient with greater need.

The pooled estimates support the view that donors have interest-based and needs-based motives for giving foreign aid. However, individual donors may vary in the extent to which they respond to these different factors. Table 2.4 shows results for models estimated

[17]This is based on transforming the coefficient like so: $100 \times (\exp[\hat{\beta}] - 1)$. Such a transformation is consistent with the idea of using the inverse hyperbolic sine to approximate a logarithmic transformation and yields an approximate semi-elasticity. See Bellemare and Wichman (2020) for a more lengthy discussion.

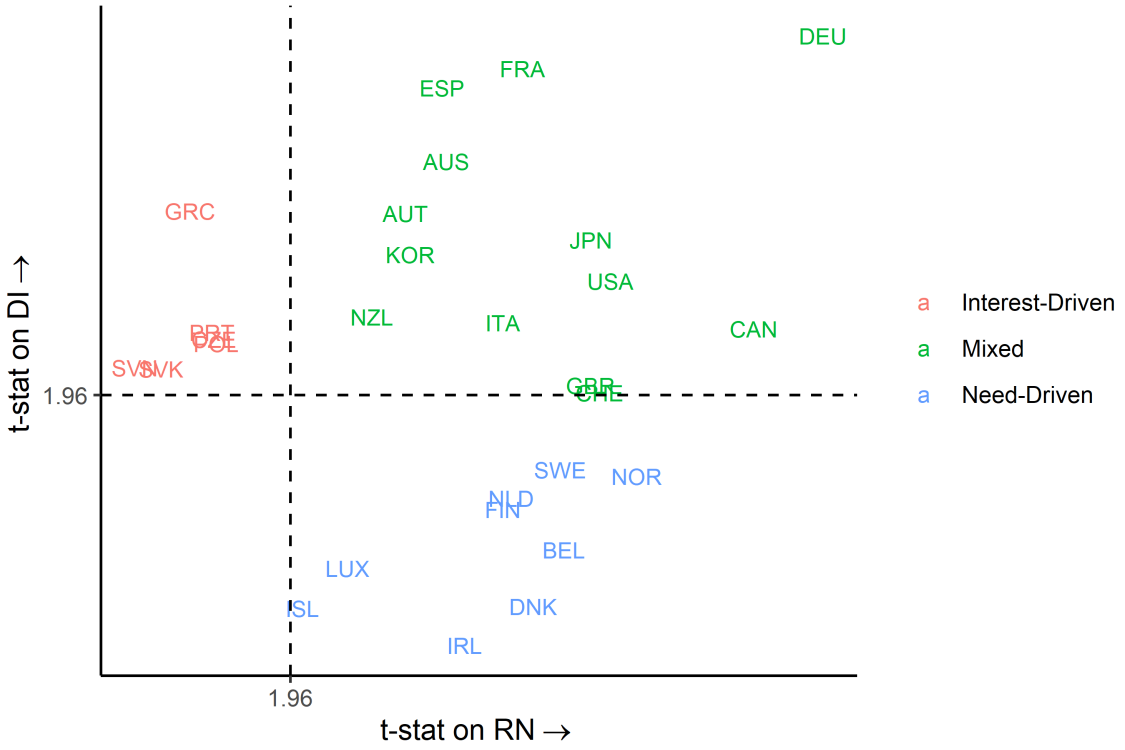

Figure 2.1: Interest-driven, needs-driven, and mixed-motives giving across donor governments. Shown are the cluster-robust t-statistics on DI and RN for donor-specific models estimated with year intercepts.

by donor, and the results highlight interesting variation in how donors give aid. For a visual summary of the differences between donors, Figure 2.1 reports the t-statistics from the donor-specific regressions for DI by RN. Dashed lines denote the critical t-values for statistical significance. Donor codes are plotted, with those in red denoting those driven primarily by interest, those in blue primarily by need, and those in green motivated by a mix.

Supporting a view established by others (Gates and Hoeffler 2004), Nordic donors appear primarily need-driven in their approach to foreign aid. RN (but not DI) is a significant predictor of aid for Nordic donors in the sample of years included in the analysis. But, the Nordic donors are not alone. Ireland, Luxembourg, and Belgium also appear to be more needs-driven in their approach to giving aid.

The donors that appear to be primarily interest-driven in their giving are the Czech

Republic, Greece, Portugal, Poland, the Slovak Republic, and Slovenia. Meanwhile, the majority of donors show some mixture of interest and need-based giving. This list includes Australia, Austria, Canada, France, Germany, Italy, Japan, New Zealand, South Korea, Spain, Switzerland, the United Kingdom, and the United States.

These findings are interesting to consider when cross-referenced with those provided by previous research. Berthelemy (2006) offers an interesting point of comparison. While analyzing a slightly older sample of cases (1980-1999) and a smaller selection of donors (22), Berthelemy makes an effort to explicitly categorize donor governments as "altruistic," "egoistic," or an "average" of the two. These categories align well with the needs-driven, interest-driven, and mixed motives framework that I apply.

Berthelemy (2006) takes a very different approach than the one I use to draw these distinctions between donor governments. The first, and most obvious, is that he uses separate measures of variables used to proxy for needs- and interest-based motives for aid allocation. Further, to infer the degree to which a donor is more altruistic or egoistic, Berthelemy homes in on a measure of the trade intensity ratio between donors and recipients to draw conclusions about donor motives. The greater the measure, the greater the ratio of donor exports to recipients than imports from recipients. The idea is that the more donors base their giving on exports relative to imports, the more they are driven by egoism—the promotion of exports is often viewed as a self-interested objective for donor governments since it obviously benefits them to support greater exports of their goods and services abroad.

The reasoning behind this choice is understandable, but one of the argued benefits of using a composite measure of interest-based factors rather than any one component is its ability to provide a clearer signal about the broad interest-based factors that may motive a donor to prioritize giving more aid in some recipients relative to others. The choice to focus exclusively on trade ultimately means that Berthelemy (2006) categorizes donors on the basis of less information than I am able to do with the composite DI measure.

As a consequence, while Berthelemy (2006) draw some similar conclusions, we also draw some different ones. I have noted in Table 2.4 the donor type based on the regression estimates for DI and RN, and in the next column I note the categorization provided by Berthelemy. Cross-referencing our findings yields the following:

1. Points of agreement: Canada, Denmark, Germany, Ireland, Japan, Netherlands, Norway, United Kingdom, United States.
2. Points of disagreement: Australia, Austria, Belgium, Finland, Italy, New Zealand, Switzerland.

Berthelemy categorizes Australia and Italy as more "egoistic" or interest-based, while I find that both donors are responsive to both interest-based and needs-based considerations. He altneratively categorizes Austria, New Zealand, and Sweden as "altruistic" or needs-based, while I again find that these donors have mixed motives. Finally, Berthelemy categorizes Belgium and Finland as "average" or a mix of interest- and needs-driven. However, I find that Belgium and Finland are responsive primarily to needs-based factors.

Turning from the average behavior of donors across the full sample of years, it is worth considering how donor responsiveness to interest-based and needs-based factors changes over time. Out of the 28 DAC donors in the sample, I selected 18 that had given aid for the entire period under study. I then estimated donor-year specific equations, regressing aid on DI and RN. Figure 2.2 reports the estimated coefficients on DI and RN for each donor over time. The the x-axis shows years, and the y-axis shows estimated coefficients with 95 percent confidence intervals. Each panel shows for a given donor its regression estimate for either DI or RN in a given year. We observe some interesting trends in giving over time.

The United States, for example, appears to become more needs-driven, and less interest-driven, over time. France and Germany, meanwhile, remain consistently responsive to need but also become more interest-driven over time. Many of the Nordic donors

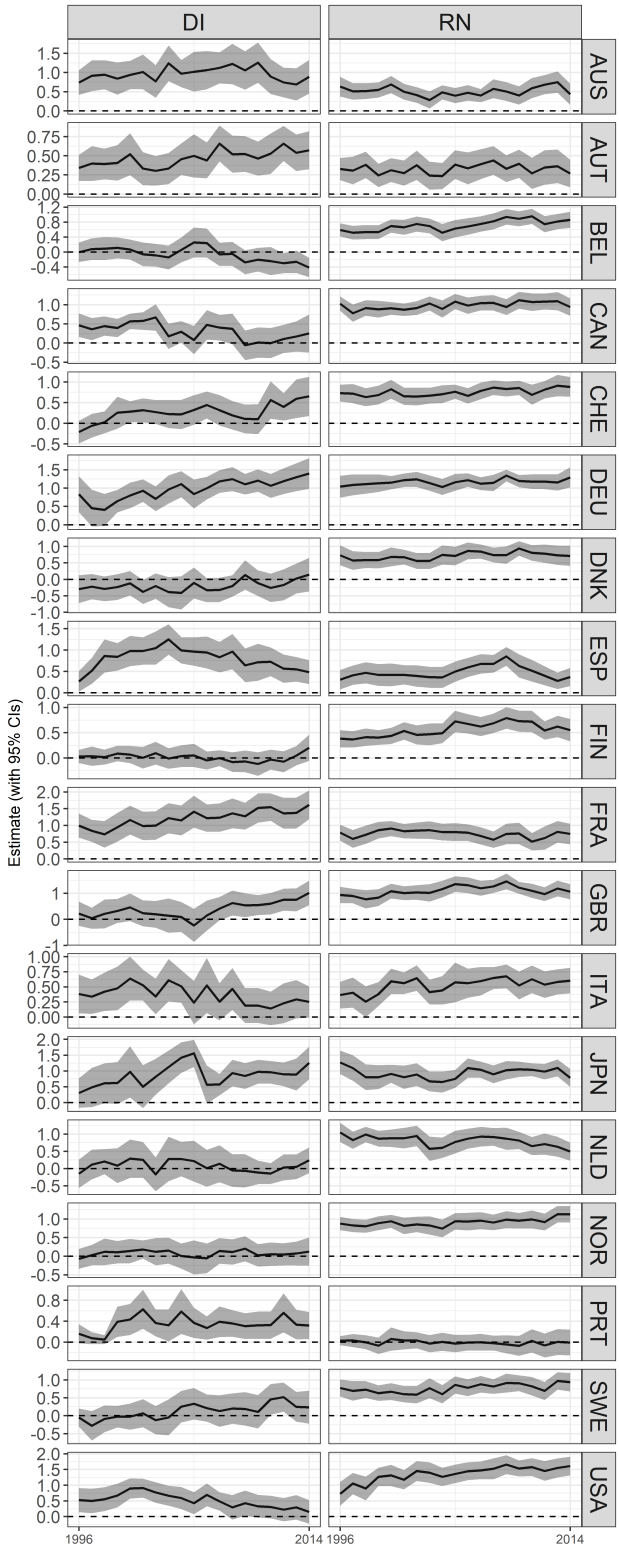

Figure 2.2: DI and RN as drivers of aid over time.

remain steadfastly needs-driven, while Portugal is uniquely interest-driven across time.

Taken together, these findings reflect patterns in international aid that would have been difficult to detect, much more to summarize, without composite measures of interest-based and needs-based drivers of foreign aid allocation. In short, there exist strong signals in the data that these measures enable us to detect. While they certainly are not suited to all research settings—for instance, if isolating the influence of civil wars or of trade is of special interest—these measures can be helpful in summarizing broad patterns in international aid. This will prove useful in the following chapters where I will need to show how the interaction of interest-based and needs-based factors influence the strategic responses of donor governments to the giving of others.

2.6 Conclusion

In this chapter, I have described the method I devised to construct composite measures of two sets of drivers of foreign aid allocation that have long been argued to motivate donor governments: donor interest (DI) and recipient need (RN). Past research often pits these factors against each other but often proceeds with a "kitchen sink" approach.[18] This makes detecting patterns in international aid difficult since different combinations of measures can yield conflicting results in regression analyses.

I propose an alternative approach. By constructing aggregate measures of the interest- and needs-based factors that motivate aid giving, we can detect clearer signals in the giving patterns of donor governments. This approach has utility in the subsequent chapters of this dissertation where interactions between such factors are hypothesized to condition donor responses to the giving of others. But even more, this approach allows us to succinctly summarize and compare the extent to which donors are interest- and/or needs-driven over time.

To construct these measures, I devised an algorithm that finds the linear combination

[18] See Achen (2002) and Achen (2005).

of a set of component measures that maximizes the sum of the squared covariances (SSC) between the components and their combination. I validate the approach by comparing SSC derived measures of DI and RN with those produced by the better-known principal components analysis (PCA) and multivariate factor analysis (MFA). Using increasingly flexible modeling strategies—respectively, linear regression, generalized additive models, random forests, and neural networks—I find that SSC produces measures with greater predictive power than PCA and MFA derived measures of RN and DI.

Next, using these measures I conducted a series of regression analyses to assess patterns in international aid. At a broad level, donor governments appear responsive to both interest-based and needs-based considerations, but not all donors are alike. Nordic donors appear primarily responsive to needs-based considerations, while newer Eastern European donors, Greece, and Portugal are primarily interest-driven. The remaining donors respond to both interest- and need-based factors. However, some donors show interesting variation in their giving over time. The United States is strongly responsive to interest-based factors in the late 1990s and early 2000s, but over time interest-based motives become less predictive of US aid while needs-based considerations become even stronger predictors. France, Germany, Japan, and the United Kingdom, meanwhile have become more interest-driven over time. A comparison with a previous effort to categorize donors on the basis of their motives shows some overlap, but also several points of disagreement between the motives identified for individual donors.

Detecting such patterns would have been much more difficult using multiple different measures. This highlights the value of DI and RN in their own right. Though there remains room for improvement, the approach itself of reducing dimensions in the study of international aid has great promise and will open new avenues of research by enabling researchers to answer new and old questions in international aid that would otherwise be prohibitively impractical to answer. Such is the case with the questions addressed in the next pair of chapters.

2.7 Supplemental Materials

Below is the script used to perform SSC in R. Table 2.5 reports descriptive statistics, and Table 2.6 shows regression estimates using the panel dataset of bilateral aid allocations.

```
## A function to standardize values
stand <- function(x) (x - mean(x)) / sd(x)

## The objective function
hat_Z <- function(X, w) {

  ## standardize values
  X <- apply(X, 2, function(x) stand(x))

  ## the linear combination
  Z <- X %*% w

  ## the squared covariances
  covs.sqrd <- apply(X, 2, function(x) cov(x, Z)^2)

  ## return the negative of the sum of the squared covariances
  opt <- -sum(covs.sqrd)
  return(opt)
}

## To optimize the objective given data 'X'
find_Z <- function(X) {

  ## optimize with BFGS
  out <- optim(
    fn = hat_Z,
    par = rep(0, len = ncol(X)),
    X = X
  )

  ## the fitted linear combination
  Z <- X %*% out$par

  ## standardize and return
  Z <- stand(Z)
  return(Z)
}
```

Table 2.5

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
ODA	49,685	25.416	216.259	0	0	7.2	17,589
RN (SSC)	49,685	−0.003	0.997	−2.233	−0.640	0.692	2.998
RN (PCA)	49,685	−0.002	1.423	−2.834	−0.960	0.903	4.449
RN (MFA)	49,685	0.008	0.998	−2.411	−0.514	0.650	2.734
DI (SSC)	49,685	0.153	0.867	−3.595	−0.324	0.637	3.488
DI (PCA)	49,685	0.082	1.187	−2.793	−0.627	0.412	6.447
DI (MFA)	49,685	0.017	0.763	−1.227	−0.426	0.110	3.684
GDP/capita	49,685	7,610.305	7,308.095	188.939	2,470.034	10,528.100	47,925.840
Population	49,685	42.834	160.234	0.070	2.709	25.174	1,382.793
Disaster Deaths	49,685	474.852	7,202.888	0	0	24	222,658
Civil War	49,685	0.176	0.381	0	0	0	1
Freedoms	49,685	−5.973	3.428	−12	−9	−3	0
Distance	49,685	7,579.113	3,600.856	117.345	4,884.964	9,620.679	19,629.500
Trade	49,685	317,126,165.000	2,984,453,246.000	0.000	1,503,269.000	73,181,776.000	131,762,000,000.000
Colony	49,685	0.039	0.193	0	0	0	1
Alliance	49,685	0.124	0.329	0	0	0	1

Table 2.6: OLS Estimates

	Model 1	Model 2	Model 3	Model 4
Income	-0.40^{***}			
	(0.02)			
Population	0.26^{***}			
	(0.01)			
Disaster	0.06^{***}			
	(0.01)			
Civil War	0.19^{***}			
	(0.05)			
Freedom	0.04^{***}			
	(0.01)			
Distance	-0.37^{***}			
	(0.04)			
Trade	0.04^{***}			
	(0.01)			
Colony	1.94^{***}			
	(0.13)			
Alliance	$-0.12^{\cdot}$			
	(0.07)			
RN (SSC)		0.66^{***}		
		(0.02)		
DI (SSC)		0.33^{***}		
		(0.03)		
RN (PCA)			0.48^{***}	
			(0.02)	
DI (PCA)			0.15^{***}	
			(0.02)	
RN (MFA)				0.70^{***}
				(0.02)
DI (MFA)				0.09^{**}
				(0.03)
Num. obs.	49685	49685	49685	49685
N Clusters	3474	3474	3474	3474

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\cdot}p < 0.1$

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Chapter 3

Strategic Interdependence and International Aid in Empirical Perspective

3.1 Introduction

The motivating theme in this dissertation is that the goals donor governments value differently shape how they respond to the aid given by others in developing countries. In the previous chapter I bracketed donor interactions to focus specifically on the creation of measures that capture determinants of donor giving. Researchers often emphasize tensions between *donor interest* and *recipient need* as drivers of international aid. To more clearly capture signals about how these sets of factors determine aid allocation in developing countries, I devised composite measures of each and then illustrated how they can be used to succinctly summarize donor giving as determined by variation in interest-based and needs-based variables. On the whole, donor governments appear responsive to both kinds of considerations, but not all donors are identical. Some seem comparatively more responsive to needs-based factors while the opposite is true for others.

While these findings were interesting, the primary conceit of this dissertation is that international aid *is not*, in fact, a perfect reflection of what donors value, and the reason for this is strategic interdependence in aid allocation. Chapter 1 made this point with the help of a game theoretic model. Depending on the degree to which donors regard the giving of others as detracting from or supporting their foreign policy objectives, they will differently adjust how they distribute aid among developing countries on the basis of how other donors distribute aid as well. The result is a general equilibrium in international aid allocation where donors may give more aid in some recipients and less in others than we might expect given their priorities. Further, this equilibrium can be suboptimal under some circumstances for the donor community, but in other cases it may benefit one donor

to the detriment of others. The fact that collective solutions may or may not yield mutual improvements on an uncooperative equilibrium poses obvious challenges for thinking about how to support successful donor collaboration.

However, whether the pattern of giving in international aid really is or is not suboptimal is not a question with an answer can be empirically confirmed. However, it is possible to draw inferences about how strategic interdependence differently influences how donors give foreign aid in developing countries. So, in this chapter I focus on answering the following question: *How does strategic interdependence lead donors to deviate from giving aid according to what they value?*

Mine is not the first study to consider this question, but it is the first to consider how the interaction of interest-based and needs-based factors shape how donors differently respond to aid given by others in developing countries. By conditioning donor reactions to the giving of others on the measures of donor interest (DI) and recipient need (RN) developed in the previous chapter, I can identify a greater variety of donor responses to aid given by others in developing countries than previous studies have been able to recover.

Using a supervised machine learner (random forests) I provide confirmatory evidence that DAC donors do in fact make their aid allocation on the basis of the giving of other DAC members, but even more, that these responses vary systematically with respect to the strength of interest-based and needs-based drivers of giving. Further, using an instrumental variables approach, I am able to identify when and where donors' responses to peer aid are positive or negative.

There are four specific patterns I identify. Across the majority of the parameter space, donors show deference to others by giving less aid in recipients where others give more. But, there are instances where we observe interesting deviations from this response. On average, a donor gives *more* aid in recipients where others give more either when needs-based factors are low and interest-based factors for a donor are high, or when needs-based factors are high and interest-based factors are low. Conversely, a donor gives *less* aid in

recipients were others give more either when needs-based factors are high and interest-based factors are high, or when needs-based factors are low and interest-based factors are low.

It is impossible to confirm with certainty the particular strategic considerations that drive these different responses; however, the theoretical analysis in Chapter 1 reminds us that positive and negative responses may follow from two different kinds of strategic relationships among donors. If donor governments have rival objectives in recipients, this implies that they will give more aid in recipients where others give more. Conversely, if donor governments have objectives that provide common benefits, this implies that they will give less aid in recipients where others give more. In subsequent sections of this chapter I discuss two perspectives on donor motives that may offer an explanation for why donors react to peer aid the way they do in different contexts. These are not the only possible accounts but reflect two prominent frameworks in the literature. One of these is called "targeted development" (Bermeo 2017, 2018) and the other "aid-for-policy exchange" (Bueno de Mesquita and Smith 2009, 2016). The first is consistent with strategic deference between donors, while the second is consistent with competition. Though the results presented here do not prove that either of these frameworks is correct, they do suggest that these frameworks are useful for understanding the complex strategic environment that confronts donor governments. But, even more, the pattern in donor responses observed in this study underscores the need to be attentive to clear scope conditions on the explanatory power of these frameworks—neither is consistent with donor responses in *all* recipients. Depth of recipient need (as measured by RN) makes the difference between when one set of objectives take precedence over the other.

Equally as important as identifying different donor responses and making sense of them is the fact that strategic interdependence does indeed lead to deviations between what donors value and how they actually distribute aid. Failure to account for this strategic interdependence leads to differing estimates of how donors value interest-based and needs-

based factors. A comparison of estimates on DI and RN with and without accounting for different responses to peer aid reveals striking differences in how interest-based and need-based factors determine patterns in aid giving. When strategic interdependence is not accounted for, regression estimates on DI and RN are attenuated in value, while second-order interactions between DI and RN are either suppressed or inflated depending on the sample of years under analysis.

Taken together, these findings reveal strategic dynamics in international aid that prior studies have failed to capture. There are myriad ways that strategic interdependence leads to deviations between interest-based and needs-based motivations for providing economic assistance and where donors actually choose to target foreign aid. While scholars often proceed as if we can look at donor governments' budgets to see what they value, the reality is not so simple.

3.2 The Difficulty of Untangling Strategic Interdependence

For some time, there has been at least some recognition that strategic interdependence in international aid can lead donors to give aid in ways that deviate from what their goals would suggest. However, drawing inferences about donor interactions has proved tricky for a host of reasons—not just due to endogeneity, but also because of the mixed motives that drive international aid.

Some of the earliest efforts to identify how major countries respond to one another when they allocate aid center on total aid giving, rather than on aid given to specific recipients. As a consequence, these studies could only speak to broad trends in international aid and could say very little about the foreign policy goals motivating aid giving in particular recipients (see Dudley 1979; Mosley 1985).[1] The conclusion of these early studies was that foreign aid donors spend more in total on aid when peers do as well, but they proposed

[1] To be fair, this choice no doubt partially reflects computational limitations at the time these studies were published.

different mechanisms for this behavior. Dudley (1979), for example, proposed competition for rival foreign policy concessions, while Mosley (1985) proposed "peer pressure."

More recent studies complicate, and in some cases contradict, these conclusions. Many of the more recent efforts to identify the strategic behavior of foreign aid donors apply both more sophisticated econometric techniques and disaggregate aid to the donor-recipient level. These approaches allow for richer analysis and hypothesis testing, but despite methodological advances and improvements in research design, these studies yield inconsistent answers. Some find evidence of competition, others of buck-passing, and some find a mix when examining individual donors or breaking the analysis down by aid delivery channel (see Barthel et al. 2014; Davies and Klasen 2019; Frot and Santiso 2011; Fuchs, Nunnenkamp, and Öhler 2015; Steinwand 2015; Mascarenhas and Sandler 2006; Rahman and Sawada 2012). More recently, some studies have focused on competition between the U.S. and China (Zeitz 2021).

Taken as a whole, these studies each assess inter-donor reactions in varied ways. However, individually, they emphasize either a constrained set of donor goals or allow for little variation in how donors react in different contexts. Steinwand (2015) stands out as a notable exception, given the his focus on how donor "leadership" and aid channels may condition responses. However, the role of recipient characteristics, and of donors' wide-ranging recipient-specific goals, remains untested.

3.3 Beyond One-Dimensional Views of Strategic Interdependence

One of the key challenges, then, in untangling strategic interdependence in international aid is that donor governments allocate economic assistance for a mix of political and humanitarian reasons. Moreover, these different reasons imply different strategic responses among donors. Importantly, certain goals will differ in relevance between aid recipients. In some cases donors will have primarily rival interests, while in others donors will have mostly common interests. *Common* goals are any objectives that are collectively beneficial—

when one country takes actions to realize a certain goal, this by extension helps another country get closer to realizing its goal as well. Aid given to support green energy projects in recipient countries, for example, might represent a mutually beneficial objective. Climate change, after all, has consequences for the entire international community, and effort taken by one government to address this challenge creates a positive externality for others.

Alternatively, *rival* goals are those where one state's gain is another's loss. For instance, French officials have considered aid given by the US to Northern African countries as motivated by competition for access to natural resources (Steinwand 2015). In this setting, more aid from the US diminishes the French government's leverage to maximize its access to these natural resources as well.

The existence of both common and rival goals among donor governments implies that international aid has negative or positive strategic valence across different aid recipients. This means that as donors give aid, either to promote their foreign policy interests or to respond to recipient development need, their pattern of giving will not always be perfectly aligned with what their motives would suggest. In some cases, strategic incentives will lead donors to give more aid when other donors give more aid and less aid when other donors give less.

This implies some straightforward regularities in the way donor governments target their foreign aid across recipient countries:

1. How donors allot aid across recipients is interdependent;
2. In recipients where donor goals yield common benefits, donors will have incentives to pass the buck (to target less aid where peers target more).
3. In recipients where donor goals yield rival benefits, donors will have incentives to compete (to target more aid where peers target more).

The first prediction can be expressed as a simple, testable hypothesis. To the extent that donor governments' aid allocations generate foreign policy externalities:

H_{int}: *Donors adjust their aid allocation decisions on the basis of how other donor governments make theirs.*

This hypothesis to some will seem vague—in fact, just vague enough to have a high likelihood of being correct. However, testing this hypothesis is a necessary pre-condition for testing subsequent predictions about *how* donors respond to the aid of peers. After all, if donors do not base their giving on the giving of others, they also do not respond differently to peer aid in different recipients.

Now, the matter of how to approach the second pair of regularities—that donors give more aid in recipients where others give more when other-donor aid conflicts with their goals, and that they give less aid in recipients where others give more when other-donor aid supports their goals—is less obvious. If interdependence in country aid allocations differs systematically with the objectives donor governments pursue, there will be some set of recipients where donors show deference to one another, and there will be another set of recipients where donors compete. The problem is, how do we identify when and where which type of response is present?

As highlighted in the previous chapter, decades of research reveals many clues about the types of objectives donor governments pursue through foreign aid. Kilby and Dreher (2010) enumerate several, such as fighting terrorism, supporting strategically valuable regimes, and promoting good relations with major trade partners. Other goals include supporting and maintaining influence over former colonies (Round and Odedokun 2004), gaining international prestige and recognition (van der Veen 2011), minimizing diffuse spillovers of recipient country problems (Bermeo 2017), and complementing and legitimizing military operations (Kisangani and Pickering 2015). Outside of the specific goals of countries, it is also possible to think of donor motives as either rooted in selfish interests or humanitarianism pending how salient strategic donor goals are relative to the need of a recipient (Heinrich 2013).

While we believe we know much about donor motives, we know comparatively

little about when these motives are rival or common. It is imaginable that objectives like gaining prestige in the international community and exercising diplomatic influence are rival. Meanwhile, responding to recipient needs may be of mutual interest. Of course, the wrinkle is that many of these goals coexist within a given aid donor's relationship with an individual developing country. Empirically, this makes it hard to tease out how countries respond to each other with respect to their specific goals. Instead, it is really only feasible to observe how countries react given the overall basket of objectives they pursue by giving aid to certain recipients. This necessitates an empirical strategy that, short of identifying specific objectives, can reliably capture variation in the factors that may make the overall basket of goals countries pursue in certain aid recipients on net *rival* or *common*.

This is where the two composite measures—donor interest (DI) and recipient need (RN)—discussed in the previous chapter will prove especially useful. To revisit the logic behind these measures, the first is composed of variables traditionally associated with interest-based motives for aid allocation. Component variables that capture variation these goals include bilateral trade, geographic proximity, colonial heritage, and alliances. These factors capture different proposed dimensions of donor interest: strategic, economic, geographic, and social. RN, meanwhile, is made up by measures of poverty, population size, the presence of ongoing violent conflict, deaths from natural disasters, and lack of political and civil liberties in aid recipients. Such factors together correspond to variation in the overall level of development need in recipient countries.

Interest-based and needs-based factors will vary in magnitude between recipients, and their unique combination in recipients will likely be associated with different foreign policy goals donors emphasize. By extension, their interaction should influence donors' strategic responses to the aid given by others. This implies the following hypothesis:

> H_{het}: *Interdependence between donors' aid allocations will vary with respect to recipient* **need** *and donor* **interest**.

However, the nature of this interaction is necessarily a matter of speculation, and thus exploratory analysis. Some alternative perspectives imply different predictions; however, two prominent views warrant special attention. These two views are: (1) targeted development and (2) aid-for-policy exchange.

The first of these views, known as *targeted development*, holds that since the turn of the century, industrialized countries have increasingly emphasized international development in their grand strategies (Bermeo 2017, 2018). As the argument goes, deepening connections between industrialized and developing countries make the former distinctly susceptible to the consequences of poverty, discontent, and violence in the latter.

As a consequence, donor governments increasingly see promoting development abroad—specifically, in developing countries whose problems pose the greatest threat to donor populations, security, and economic goals—as serving their national interest. This leads policymakers in industrialized states to prioritize giving foreign aid, not only to needy recipients, but specifically to needy recipients with strong bilateral connections to the donor. Such connections act as vectors by which recipient problems can affect donor populations. This view does not preclude other political or strategic motivations for aid allocation, but it does imply that such goals may be superseded by development promotion when recipient needs pose a threat.[2]

This view has some specific implications for how donors will adjust their aid giving on the basis of where other donors give aid. Bermeo (2018) argues that when and where development promotion is a donor priority, aid allocation has collective benefits. Donors will have greater mutual interest among recipients with greater need for aid *and* with which they share strong ties (as captured interest-based factors). As a result, in recipients where other donors give more aid, an individual donor government will have incentives to give less aid than it would otherwise. In other words, donors will have incentives to pass

[2]It is interesting to note that even development assistance for health has been shown to be subject to the targeted (self-interested) development practices. Steele (2017), for example, shows that disease characteristics influence how donor governments target health aid—they give more aid to fight diseases that have a good chance of being transmitted to donor populations (e.g., HIV/AIDs as opposed to malaria).

the buck, showing deference to others to the extent they are willing to provide a greater amount of economic assistance.

The second prominent framework for understanding international aid is the aid-for-policy exchange view presented by Bueno de Mesquita and Smith (2009). In this view, donor governments use foreign aid as a "bribe" to leverage desired policy concessions from recipient governments. The value of such concessions will vary between recipients, but are likely to be greatest when and where recipients are important to donors for economic, social, or strategic reasons. Such factors may increase the salience of developing countries to donor governments, which leads donors to especially value policy deals from these aid recipients (Heinrich 2013).

This view has some different implications for donor responses than those implied by targeted development. When and where donor giving is driven primarily by interest-based factors, we should see donors give more aid in recipients where other donors give more aid as well. The reason for this is, as Bueno de Mesquita and Smith (2016) note in some more recent work, that aid-for-policy deals are effectively more expensive to extract from recipients in a multi-donor environment. To the extent that other donors give more aid in a recipient, this diminishes an individual donor governments leverage over developing countries. To make policy deals incentive compatible a donor has to offer more aid to a recipient than it would otherwise when there are other donors present. The result is that where other donors give more aid, and individual donor will give more, too.

On the surface, these two frameworks for understanding international aid appear to be in conflict. However, these arguments need not be exclusive. While one perspective may be more relevant in some recipients, the other may be relevant elsewhere. Since both views center on variation in interest-based and needs-based drivers of aid, it seems plausible that different combinations of such factors will relate to one or the other view.

It may be helpful to speculate about when and where one view might have greater explanatory power than the other. On this front, needs-based factors will likely make the

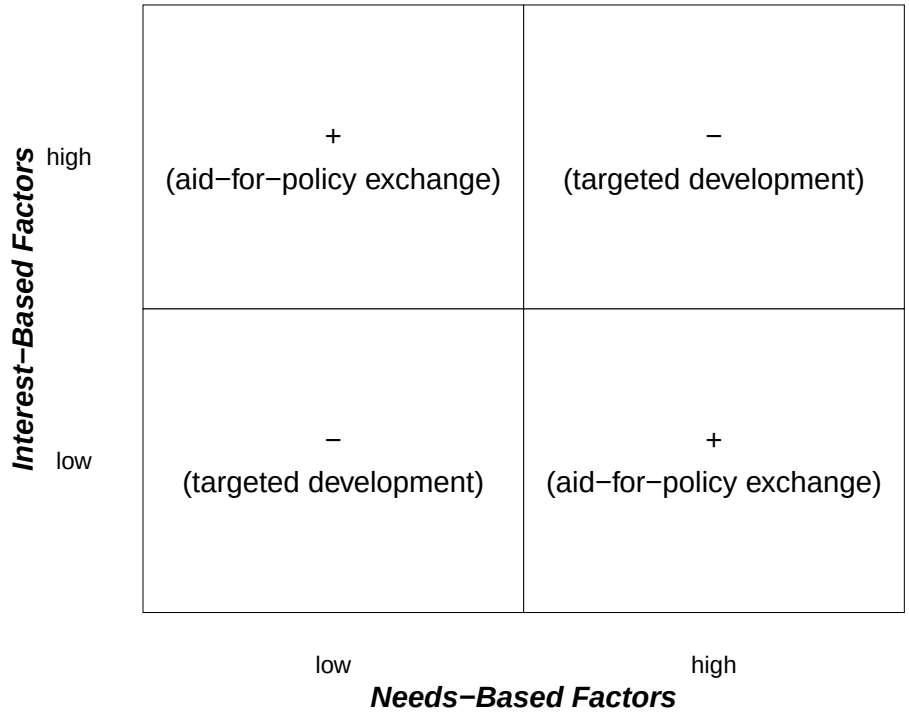

Figure 3.1: Views on donor motives and their implications for donor responses to the giving of others.

difference between competition *a la* aid-for-policy exchange and strategic deference *a la* targeted development. Figure 3.1 provides a summary of these expectations given low and high levels of interest-based and needs-based factors. The framework for explaining donor behavior is included in parentheses and the sign for donor responses to peer aid in developing countries is given as well.

Targeted development should provide the best explanation for donor behavior in both high need, high interest contexts, and in low need, low interest contexts. In the former, recipient need, by virtue of stronger bilateral interest-based factors, should pose a particularly acute threat to donor populations. This means responding to recipient needs should be a priority for donor governments. As such, this gives donor governments rational incentives to target less aid in high need, high interest recipients when other donors give more. To maximize security in the face of developing country problems, a donor should exploit the generosity of others when and where they give more aid. This

frees up resources that a donor government can then give to other developing countries that receive less attention from the donor community.

Conversely, in low need, low interest contexts comparatively weaker ties between donors and recipients mean there are fewer vectors for problems in recipients to affect donor populations. At the same time, the absence of relatively severe development need means that the problems that do exist in recipients will not pose much of a threat otherwise. Whatever value donors might attribute to providing development assistance in these recipients, they should be more than willing to let other donors take the lead in giving aid when and where these developing countries receive more foreign aid from others.

Aid-for-policy exchange, alternatively, should be more salient either when needs-based factors are low and interest-based factors are high, or when needs-based factors are high and interest-based factors are low. In the first case, donor governments should place greater value on aid-for-policy deals when interest-based factors are greater. These interest-based factors should increase the salience of developing countries to donor governments, increasing the importance of leveraging policy concessions from these recipients (Heinrich 2013). At the same, the fact that these recipients have comparatively lower need means that whatever problems interest-based factors make donors vulnerable to, these problems will be less severe. This should put donor governments in a position to prioritize aid-for-policy exchange over and above development promotion. By extension, this means donors will have rational incentives to give more aid in such recipients where other donors give more in order to maximize their leverage in making deals with developing country governments.

Conversely, when need is high, but interest-based drivers are minimal, aid-for-policy exchange also has the potential to take precedent over development promotion. While such high need developing countries certainly have comparatively severe problems that could transcend their borders, when bilateral interest-based factors are minimal this means there are fewer vectors through which recipient problems can affect donor populations.

Development promotion, then, has less obvious material and security benefit for donor governments. At the same time, deeper development need in recipients puts donor governments in a comparatively stronger position to leverage policy deals (Bueno de Mesquita and Smith 2009). To the extent that a donor uses aid to extract concessions from these recipients, we should again expect it to give more aid in recipients where other donors give more aid as well.

The analysis that follows cannot hope to prove any of the above perspectives true, but results may be more or less consistent with one than with the other.

3.4 The Data

To test the hypotheses proposed in the previous section, and to explore the specifics of donor interactions, I built upon the dataset described in the previous chapter. To quickly re-summarize, the outcome variable of interest is denoted as *aid* and is measured using the bilateral foreign aid commitments of 28 Development Assistance Committee (DAC) member countries from 1995-2014, as reported in the Creditor Reporting System (CRS), a database maintained by the Organization for Economic Co-operation and Development (OECD). The CRS database provides self-reported data on the aid committed (and disbursed) by DAC countries to individual aid recipients. It further provides data on the development sectors aid is targeted toward in a way that is consistent and comparable for all DAC members.

The choice to focus on DAC countries is made in light of a few, but salient, logistical realities. First, DAC countries are certainly not the only countries or organizations to allocate foreign aid, but they are by any objective measure the most prominent in terms of total aid contributions. This means that when they consider where to target their foreign aid, they are most apt to do so in reference to the aid allocations of fellow DAC members—though the case of China may be a notable exception (Zeitz 2021).

Second, DAC countries have committed to consistently and transparently reporting

on their aid allocations. From a measurement perspective, this puts reliance on the CRS database on solid footing. Though other databases exist that cover a wider set of donors, reporting by these other donors is not always reliable. Thanks to the work of research labs such as AidData at the College of William and Mary, information on China's development financing is readily available in ways that were previously unimaginable. But, inclusion of China in the current analysis poses some challenges due to the period under investigation. Most notably, AidData's Chinese development finance dataset was not available for nearly the entire period contained in the sample. While surely China's development finance carries strategic valence for DAC countries, there would have been limited transparency at the time about how China was disbursing its aid. Further, the most salient initiative by Beijing relevant for development financing—the Belt and Road Initiative—was not introduced until 2013. The current sample ends in 2014. While probing the strategic significance of China's aid is of paramount importance, this will be of greatest value for future studies that leverage more recent datasets.

Bilateral aid commitments across 24 key sectors from 1995 (the first year countries started reporting to CRS) to 2014 are included in the measure of *aid* and are normalized to 2017 U.S. dollar values. Further, commitments are operationalized at the level of the donor-recipient-year. Commitments are used in stead of disbursements since the latter may lag substantially behind the more immediate changes in policy revealed in donor commitments. Commitments themselves represent written assurances donors make, in dollar amounts, to contribute to recipient countries in a given year.

Like most financial data, the distribution of aid is highly skewed and censored at zero. To normalize outcomes while also retaining zero values, bilateral aid commitments are transformed using the inverse-hyperbolic sine (ihs). Much like the logarithmic transformation often applied in analyses of foreign aid, using the ihs transformation permits interpreting estimates as elasticities, or percent changes in the response given changes in the model predictors. However, unlike the log-transformation, ihs preserves zero values

without having to introduce unnecessary distortions to the data, like adding 1 dollar to all of the response values.

Aid data is used not only to construct the response, but also the sum of aid given by all other donors to a recipient. In the analysis that follows, these values are distinguished from one another in the following way: while aid_{irt} denotes bilateral aid commitments from donor i to recipient r at time t, aid_{jrt} denotes bilateral aid commitments from all donors other than i to recipient r at time t ($i \neq j$). The latter is also normalized via the ihs transformation.

Interest-based and needs-based drivers of donor giving are captured by the donor interest (DI) and recipient need (RN) measures introduced in the previous chapter. Recall that RN is constructed from:

- yearly per capita gross domestic product (GDP);
- yearly population size;
- the yearly number of individuals killed due to natural disasters;
- an indicator for whether the recipient is experiencing a civil war in a given year;
- the yearly level of political and civil liberties of a recipient.

Meanwhile, DI is constructed from:

- bilateral distance (in kilometers) between a donor and a recipient;
- bilateral trade (in dollars) between a donor and a recipient;
- an indicator for whether the donor and recipient are formal allies;
- an indicator for whether the donor and recipient share a colonial past.

The first measure captures different dimensions of development need in recipient countries, while the second measure captures different dimensions of interest-based drivers for donor governments. Both DI and RN were constructed using the sum of the squared covariances (SSC) method described in the previous chapter. The final versions of each measure are in standard deviation units and mean centered at zero.

3.5 Methods

The analysis proceeds in two parts. First, tests for the two main hypotheses are considered: (H_{int}) that countries' aid allocations are interdependent, and (H_{het}) that this interdependence is heterogeneous with respect to recipient characteristics and donor interests. After testing the hypotheses, the analysis then turns to an exploration of heterogeneity in donor responses. The below sections summarize the methods used for each set of analyses.

3.5.1 Hypothesis Testing with Random Forests

The approach I take to testing the two main hypotheses is unconventional, but nonetheless robust. Specifically, I use random forest (RF) regression and associated diagnostics to recover evidence in support of the hypotheses. RF is a workhorse machine learning technique that constructs an ensemble of decision-tree regressions computed on repeated bootstrapped samples of the data and subsets of model predictors. The overall fit of the model is the average over the individual tree predictions—hence, the name random "forest." Put more simply, one can imagine that the method, rather than finding appropriate parameters or coefficients to apply to individual variables, identifies appropriate buckets comprised of different combinations of variables that best predict variation in an outcome. The approach, then, is non-parametric. Though it is not totally assumption-less, it has the benefit of imposing no ex ante functional form on the data-generating process that underlies the data.

This approach is uniquely powerful compared to many other popular machine learners since bootstrapping and "bagging" (averaging) predictions helps to avoid overfitting and is robust to outliers (Scornet 2016). Meanwhile, because the approach is non-parametric, it is robust to a wide variety of functional forms. The method was first introduced by Breiman (2001) and has since been applied by scholars across scientific fields and disciplines, even among political scientists (see Bonica 2018; Carroll and Kenkel 2019; and Hill and Jones 2014).

The nonparametric approach for estimating RF is a relevant feature in testing for interdependence in aid allocations; although, the reason why may not appear obvious at first. For instance, with respect to the first hypothesis, why not use standard spatial econometric techniques like a linear spatial autoregressive model? To briefly summarize, the parameter of interest in such a model is often denoted ρ, where, given a matrix of weights $\mathbf{W}$, a response is regressed on a set of covariates and what is called a spatial lag (the response for other individuals in the data). Often, the model is estimated via OLS. If the recovered $\rho \neq 0$, this counts as evidence of statistically significant spatial dependence in the response—that is, the response for one individual is affected by the responses for all others, or those for which the pre-specified weights are greater than zero.

The problem with this approach in this context is that it assumes, given the appropriate weights, that ρ is constant. If, however, there is heterogeneity in the spatial dependence of the response, ρ may be biased. For example, suppose the recovered spatial lag is not statistically different from zero. This could count as evidence against significant spatial dependence, *or* it could disguise unobserved heterogeneity. Since the focus here is on how countries distribute aid across a wide range of recipients, substantial variation in spatial dependence across recipients would lead to misleading estimates of ρ.[3] After all, this is what the second hypothesis predicts. For this reason, a linear model is not the most useful approach.

Using RF side-steps this issue. Rather than estimate a single spatial lag parameter, it is possible to measure the overall prediction error of the RF model with and without using the sum of peer aid commitments to a given recipient as a covariate predicting where and how much aid an individual donor commits. A significant improvement in predictive power due to accounting for peer aid would be consistent with the first hypothesis (H_{int})—and this, without having to explicitly specify the form of the relationship between individual and other-donor aid commitments.

[3]Prior studies that examine donor interactions take some version of this approach, which may explain why they yield conflicting results.

Fox, Ver Hoef, and Olsen (2020) summarize some prior studies that have compared RF to spatial regression. In some cases, RF proved superior in terms of prediction error, while in others spatial regression was more efficient. However, the authors note that the studies that compare these methods only assess prediction performance without considering changes to model defaults. Further, they fail to take an informed approach to variable transformations or data exploration. For this reason, Fox, Ver Hoef, and Olsen caution against making too much of these prior comparisons. Their own analysis suggests that both types of approaches have value; though, RF in particular has an edge when dealing with nonlinearities that are difficult to address with data transformations alone, or when exploring complex patterns and interactions in the data. Given the anticipated, but unknown form of, complexity in donor interdependence, RF thus confers an advantage.[4]

After fitting RF models, there are several ways of calculating the predictive importance of a given factor used in model estimation. To assess the importance of peer aid, in particular, I consider two metrics:

1. Percent accuracy of out-of-sample predictions;
2. The permutation importance of model predictors.

To compute the first metric, I subset the data into what are called "training" and "test" datasets. By convention, the training set is a random sub-sample of the full dataset usually about 70 percent the size of the full sample. The test set is then the remaining 30 percent of observations. In the case of analyzing bilateral aid data, drawing random sub-samples is not so simple since donor-recipient pairs are observed repeatedly over time. To account for dyadic dependence, instead of randomly sub-sampling individual observations, the

[4]While RF is nonparametric, it does have a number of hyperparameters that are specified by the analyst prior to estimation. Some common parameters to tune include the number of trees to "grow," the number of variables to split a tree by at a given node, and the minimal tree node size. Statistical software usually specifies default values for each; however, sometimes researchers choose to perform a grid search to identify the optimal combination. This often requires doing a grid search over different values and seeing which combination best minimizes prediction error. However, the advantage of doing this is not always clear, and in the case of my own analysis, I failed to obtain a significant improvement in predictive power. Given the computational demands of hyperparameter tuning, I therefore opt for the default settings of the `ranger` R package.

training set was created by randomly sampling 70 percent of dyads while the test set consisted of the remaining 30 percent of dyads.

I then train two RF models using the training data. For one, the response is a function of

$$\text{aid}_{irt} = f(\text{DI}_{irt}, \text{RN}_{rt}, \text{Budget}_{it}), \tag{3.1}$$

where $Budget_{it}$ is the natural log of donor government GDP in a given year. This variable is meant to capture changes in donor resources over time. While we might often use donor and year indicators to capture such things, when randomly creating training and test datasets it is common to have one donor or one year only appear in one dataset but not the other. While powerful, a limitation of RF is that it cannot extrapolate predictions to categories not included in its training dataset. Donor GDP provides a continuous measure that avoids this concern about extrapolation.

The second model is like the first, except it also includes the aid commitments of other DAC countries to a given recipient in a given year as a predictor of the aid committed by an individual donor i:

$$\text{aid}_{irt} = f(\text{aid}_{jrt}, \text{DI}_{irt}, \text{RN}_{rt}, \text{Budget}_{it}). \tag{3.2}$$

After training both models, I evaluate the predictive performance of each using the test dataset. I calculate the percent accuracy of the predictions as:

$$\%\text{Accuracy} = 100 \times \text{cor}(\widehat{\text{aid}}_{irt}, \text{aid}_{irt})^2. \tag{3.3}$$

The second metric I use is called "permutation importance." It captures the increase in prediction error due to permuting the values of a given predictor. This can be calculated using an algorithm proposed by Fisher, Rudin, and Dominici (2019). The approach entails:

1. training a model,
2. calculating its mean squared error (MSE),
3. permuting a given covariate,
4. generating new predictions and calculating the new MSE,
5. calculating the difference between the original MSE and the new.

The larger the difference calculated in step 5, the more a variable contributes to the predictive power of the model. The idea is that permuting a factor breaks its relationship with the response. As a result, to the extent that said factor was important for predicting the response, the model will make more severe prediction errors when that variable is permuted. A greater loss in predictive power after permuting a factor means that it was especially prognostic of the response.

By iterating the permutation process, it is also possible to generate a distribution of permutation importance estimates. This makes it possible to do statistical inference. With respect to testing H_{int}, if the permutation importance of peer aid is statistically distinguishable from zero, this will count as evidence of interdependence in donor aid allocations.

In practice the approach to computing permutation importance can be applied either on the training dataset, or the test dataset. The major difference is that using the test set is likely to result in a noisier measure of permutation importance, and hence a more conservative estimate. I therefore opt for the latter since this will constitute a harder test of the interdependence hypothesis.

Turning to the second hypothesis, H_{het}, the approach to testing for the presence of interactions between peer aid and donor *interest* and recipient *need* is a little more involved. Friedman and Popescu (2008) propose estimating what they call an *H*-statistic. The theory behind the statistic is simple; though, in practice it can be computationally taxing to estimate. One of its key strengths, however, is that it is model-agnostic, and hence not limited in application to any one particular estimator or model.

The null hypothesis for H holds, simply, that there is no variation in the response explained by some function $f(x_{i1}, ..., x_{ik})$ that cannot be explained by the sum of factor-specific functions $f_1(x_{i1}) + ... + f_k(x_{ik})$. In other words, the whole is *not* greater than the sum of its parts. The alternative hypothesis is that there is some non-zero fraction of variation in the response that can only be accounted for by allowing for interactions among covariates. Which is to say, formally, $f(x_{i1}, ..., x_{ik}) \neq f_1(x_{i1}) + ... + f_k(x_{ik})$.

There is much more to the specific equation for H proposed by Friedman and Popescu (2008), and interested readers are directed to their paper for a summary. However, in principal their formulation is not terribly complicated. What is complicated is the process of estimating H in practice. It involves the use of partial dependence functions, usually denoted $PD_x(x_k) = N^{-1} \sum_{i=1}^{N} f(x_k, x_{-ki})$. In words, the partial dependence function captures the marginal variation in a response given a single predictor k, averaging over the prediction given all other covariates. Generating the partial dependencies demands a great deal of computational power and time, especially when calculated for a learner algorithm like RF. Even a dataset with tens of thousands of individual observations (small by big-data standards) is large enough to make the process unfeasible, or at the very least impractical.

I therefore take a slightly modified approach. Instead of averaging over all possible predictions for predictor k, given all possible values taken by other model factors, I divide the sample by donor and year, and calculate for a given variable, or set of variables in the case of allowing for interactions, predicted values over the observed variables of interest, holding all other variables at their mean. For instance, for a hypothetical variable x_k, I compute

$$f_k(x_{ik}) = f(x_{ik}; \bar{x}_{-k}). \tag{3.4}$$

This gives the predicted response over variation in x_{ik}, holding all else constant.

As an additional corrective, it helps to center the partial predictions at a value that will be consistent across all sets of partial predictions to be compared. Specifically, this means calculating

$$\bar{f}_k(x_{ik}) = \bar{f}(x_{ik}; \bar{x}_{-k}) = f(x_{ik}; \bar{x}_{-k}) - f(\bar{x}_k; \bar{x}_{-k}), \tag{3.5}$$

which demeans the prediction by the conditional predicted mean of the response holding all covariates (including k) at their mean.

Following the formulations proposed by Friedman and Popescu (2008), I begin by testing for second-order interactions between peer aid and DI and RN as well as three-way interactions among these variables. The calculated H^2 from the two-way tests denotes the fraction of the variance unexplained by the additive predictions that can be accounted for by allowing for variable interactions. The three-way H^2 denotes the fraction of variance unexplained by assuming only second-order interactions. A non-zero value in both cases means there is variance in the response accounted for by assuming interactions beyond that accounted for by assuming variables have separate additive relationships with a response.

In practice, $\bar{f}$ is significantly faster to compute than partial dependencies. This comes in handy, not only for quickly estimating the above H-statistics, but also for doing statistical inference. The H-statistic has no known distribution, meaning one must be simulated, for example via bootstrapping the predictions. Because $\bar{f}$ takes relatively little time to compute, bootstrapping a distribution for the H-statistic requires relatively little additional time as well. This is done simply by resampling the data, generating new predictions, and re-estimating H^2.

3.5.2 Identifying When Donors Compete and When They Pass the Buck

The power of the above analysis is its power to test for heterogeneous interdependence in international aid. However, it leaves much to be desired in terms of interpretation. To identify specifically when and where donors give more or less aid in recipients given the level of giving of other donors, I adopt a more conventional econometric approach. The advantage of doing this is less ambiguity in identified donor responses. But, this increase in clarity comes at the cost of stronger assumptions. Therefore, while it will be informative, a certain degree of caution should be applied in interpreting results.

To identify how the interaction of DI and RN condition donor responses to peer aid, I estimate the following interaction model via two-stage least squares (2SLS):

$$\begin{aligned}\text{aid}_{irt} = {} & \beta_1 \text{aid}_{jrt} + \beta_2 \text{DI}_{irt} + \beta_3 \text{RN}_{rt} \\ & + \gamma_1(\text{aid}_{jrt} \times \text{DI}_{irt}) + \gamma_2(\text{aid}_{jrt} \times \text{RN}_{rt}) \\ & + \gamma_3(\text{DI}_{irt} \times \text{RN}_{rt}) \\ & + \nu(\text{aid}_{jrt} \times \text{DI}_{irt} \times \text{RN}_{rt}) \\ & + \delta_i + \tau_t + \epsilon_{irt},\end{aligned} \tag{3.6}$$

where a first stage equation models peer aid (aid_{jrt}) as a function of the exogenous variables and an instrumental variable.

Identifying an appropriate instrument is a key challenge here. Aid studies that have examined reactions to other-donor aid expenditures typically rely on the aggregate GDP of other donors. This is, generally speaking, a strong instrument—it does a good job of predicting the aggregate giving of other donors and, in theory, satisfies the exclusion restriction since other-donor GDP is unlikely to directly affect how much an individual country spends on aid.

However, peer GDP is a poor instrument for identifying donor reactions in how they allocate aid between developing countries. Peer GDP provides no between-recipient

exogenous variation that we can exploit to identify how peer aid influences how an individual donor targets its own foreign aid.

An alternative choice is using aggregate peer DI. The effect of peer DI on where an individual donor targets its aid is plausibly exogenous to the extent that its relationship with where an individual donor gives aid is mediated through its effect on aggregate peer giving across recipients. Aggregate peer DI likewise should be a good predictor of aggregate peer giving.

Thus, the first-stage equation is specified as

$$\begin{aligned} \text{aid}_{jrt} = {} & \beta_1 \text{DI}_{jrt} + \beta_2 \text{DI}_{irt} + \beta_3 \text{RN}_{rt} \\ & + \gamma_1 (\text{DI}_{jrt} \times \text{DI}_{irt}) + \gamma_2 (\text{DI}_{jrt} \times \text{RN}_{rt}) \\ & + \gamma_3 (\text{DI}_{irt} \times \text{RN}_{rt}) \\ & + \nu (\text{DI}_{jrt} \times \text{DI}_{irt} \times \text{RN}_{rt}) \\ & + \delta_i + \tau_t + \epsilon_{irt}, \end{aligned} \tag{3.7}$$

where DI_{jrt} is simply the sum of other-donor interest for a given recipient in a given year.

There is no diagnostic test that can prove the above is a valid instrument; however, it is at the very least possible to assess its power to predict variation in the endogenous variable and whether estimation via 2SLS is more efficient than simply using OLS. On both of these counts, diagnostics shown in the Supplemental Materials indicate that peer DI and its interactions with DI and RN are strong instruments, and that the 2SLS estimator is more efficient than OLS.

The model is rounded off with donor and year fixed effects. The former account for slow-moving unobserved donor characteristics determining overall foreign aid giving. These also ensure that estimates reflect within donor variation in the response. The year indicators, meanwhile, account for unobserved yearly shocks that may influence overall donor giving.

To account for heteroskedasticity and dependence of observations within dyads (donor-recipient pairs), inference for model estimates is done via robust standard errors, clustered by dyad.[5]

The primary parameter of interest is the marginal relationship between peer ODA and individual donor ODA given variation in DI and RN. The range of values identified will reveal when and where donors give more or less aid in recipients whether others give more.

3.6 Results

3.6.1 Heterogeneous Interdependence

I begin by summarizing the results for H_{int}—that the giving of aid donors is interdependent. Evidence consistent with this hypothesis is shown in Figures 3.2 and 3.3. The first compares the prediction accuracy of random forest (RF) models trained to predict ODA commitments. One model was fit with peer ODA commitments as a predictor, while the other was not. Each was trained using 70 percent of dyadic observations, and predictions were made for the remaining 30 percent. The training set consisted of 2,432 dyads and 34,976 total observations. The test set consisted of 1,042 dyads and 14,709 total observations. Summary statistics for the data are shown in the Supplemental Materials.

Without accounting for peer ODA, the trained RF model is able to predict around 44% of the variation in ODA commitments in the test set. While not bad, the model that was trained using peer ODA as a predictor performs better. It is able to predict over 53% of the variation in aid commitments. While a 9 percentage point improvement may not seem substantial, it is titanic by social science standards, reflecting a nearly 20% total increase in variance explained.

The predictive importance of Peer ODA is further supported by the results shown in Figure 3. For each of the model factors, the average permutation importance after

[5]Specifically, CR1 standard errors are used.

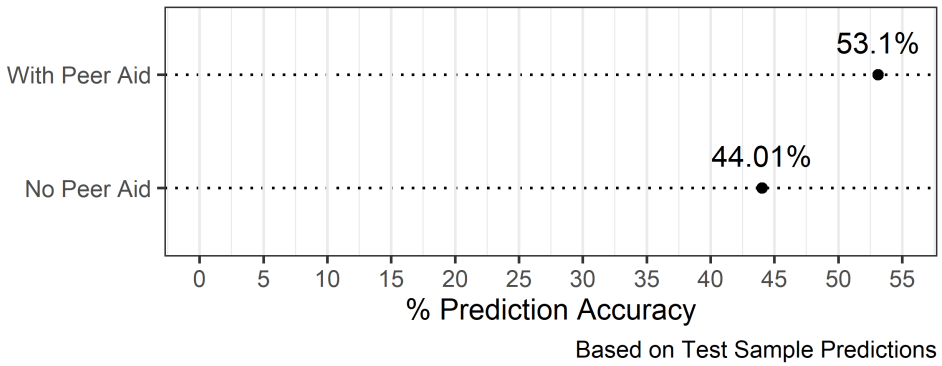

Figure 3.2: Accuracy of random forest predictions in the test sample.

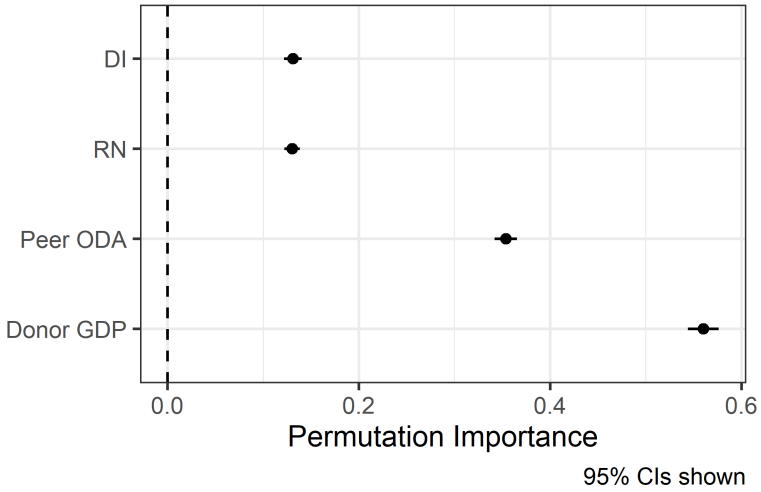

Figure 3.3: Permutation importance of model factors. Importance evaluated using the test sample.

200 iterations is shown along with 95% confidence intervals. Recall that the permutation importance measures the increase in residual mean squared error (MSE) for the model predictions due to permuting each of the factor values. Essentially, it measures the worsening of prediction error if the relationship between a factor and the response is broken.

As the results shown in Figure 3.3 suggest, peer ODA is the second most important predictor—the most important being donor GDP. Peer aid's predictive importance is more than twice that of DI or RN.

Because iteratively permuting factors generates an empirical distribution for the importance metric, we can further use the confidence bands to infer whether the importance

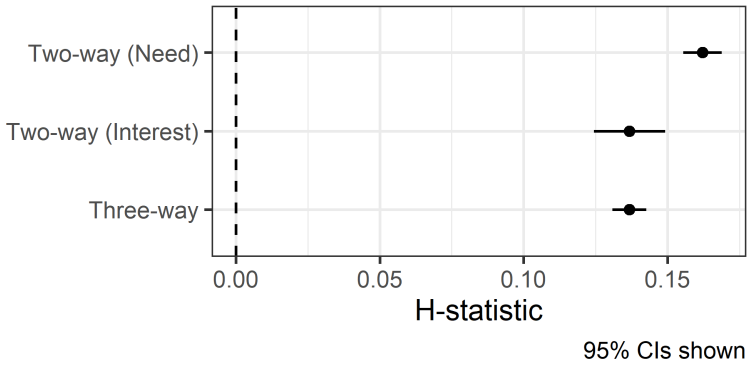

Figure 3.4: Computed H^2 values for intereaction effects, calculated using test dataset predictions.

of a factor is statistically distinguishable from zero. For all predictors, the increase in prediction error due to permuting is, indeed, statistically significant. This counts as further evidence that the aid commitments of DAC countries are influenced by the commitments of fellow DAC members.

Of course, beyond confirming interdependence in country aid allocations, we also are interested in whether this interdependence varies systematically with the factors motivating donor giving to particular aid recipients. Specifically, H_{het} holds that donors should condition their aid allocation on peer giving in reference to their political, economic, colonial, and geographic ties with recipients (captured by DI) and in reference to the development needs of recipients (captured by RN).

Figure 3.4 shows estimates of the H^2 statistic for two-way and three-way interactions described in the previous section. Recall that this statistic denotes the fraction of variance in the response that cannot be accounted for by assuming either no variable interactions or only lower-order interactions. The statistic was computed using the test sample. In all cases, the test statistic is greater than and statistically distinguishable from zero. This means we can reject the null hypothesis that the RF model can be reduced to the sum of its parts. DI, RN, and peer aid all interact in predicting how donor governments distribute aid.

Taken together, these results support the view that donors not only condition where

Table 3.1: 2SLS Estimates – Donor and Year Intercepts Not Shown

	Full Sample	1996-2001	2002-2008	2009-2014
Peer ODA	-0.65^{***}	-0.83^{***}	-0.67^{***}	-0.72^{***}
	(0.11)	(0.22)	(0.14)	(0.12)
RN	1.59^{***}	1.89^{***}	1.66^{***}	1.70^{***}
	(0.14)	(0.28)	(0.19)	(0.16)
DI	0.81^{***}	1.08^{***}	0.89^{***}	0.73^{***}
	(0.06)	(0.19)	(0.09)	(0.07)
RN × DI	0.46^{***}	-0.11	0.44^{***}	0.62^{***}
	(0.09)	(0.37)	(0.11)	(0.11)
RN × Peer ODA	-0.17^{***}	0.04	-0.13^{***}	-0.24^{***}
	(0.03)	(0.07)	(0.04)	(0.03)
DI × Peer ODA	-0.21^{**}	0.01	-0.24^{**}	-0.28^{**}
	(0.07)	(0.20)	(0.08)	(0.09)
RN × DI × Peer ODA	-0.24^{***}	-0.50^{**}	-0.32^{***}	-0.21^{***}
	(0.04)	(0.19)	(0.06)	(0.04)
N	49,685	13,508	18,751	17,426
Dyads	3,474	2,491	2,826	3,314
RMSE	1.91	2.23	1.99	1.85

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

they commit bilateral aid based on where other DAC countries commit theirs, but also that their strategic response to peer aid is conditioned by the salience of their strategic, economic, diplomatic, and geographic interests, and by the relative neediness of a given recipient.

Of course, these results do not reveal the specific ways that these factors influence donor interactions across developing countries. To gain greater clarity about how donors differently respond to peer aid in recipients, we now turn to the instrumental variables regression as specified in the previous section.

The proposed regression model included a three-way interaction among peer ODA, DI, and RN, and peer aid was instrumented using the sum of other-donor DI in a recipient in a given year. Table 3.1 shows regression estimates for the second-stage equation using different samples to highlight possible variations in donor behavior over time. The left-most column shows estimates based on the full 1996-2014 sample. The remaining columns show estimates for 1996-2001, 2002-2008, and 2009-2014 respectively.

In estimating the coefficients, I mean-centered all the predictors so that the main terms and second-order interactions can have a substantive interpretation. For peer aid, because the response and peer aid have been ihs-transformed, we can interpret the estimates as semi-elasticities, or approximately as percent changes in the response given a percent change in peer aid. Using the full sample, we can see that, holding DI and RN constant at their means, one percent greater peer ODA in one recipient relative to another is related to 0.65 percent less aid given by a donor to that recipient. This estimate is estimated with a high degree of precision and is statistically significant at the $p < 0.001$ level. This implies, then, that on average a donor gives less aid in developing countries where other donors give more.

The estimates on DI and RN are also statistically significant. Both have a positive sign, indicating that, holding all else at its mean, donor governments appear to be responsive to both interest-based and needs-based factors as they give aid—consistent with the previous chapter.

An examination of second-order terms suggests some additional interesting patterns in international aid. Notably, second-order interactions only are significant for post-2001 samples. What might this difference between periods mean? The difference observed for the second-order interaction of DI and RN is worth special consideration because variation in its significance is consistent with a framework for understanding donor motives highlighted earlier in this chapter: targeted development. Bermeo (2017, 2018), who makes the argument that donor governments have adopted a strategy of promoting development *when* and *where* doing so is in their national interest, contends that this strategy is primarily a feature of the post-9/11 era. The fact that only after 2001 we observe a positive and significant interaction between DI and RN supports this argument. Under this view, interest-based factors also serve as vectors through which developing country problems can affect the populations of donor countries. It makes sense then, that responsiveness to needs-based factors is greater when the bilateral ties captured by DI also

Table 3.2: OLS Estimates – Peer ODA Excluded from the Model

	Full Sample	1996-2001	2002-2008	2009-2014
RN	0.67***	0.66***	0.66***	0.68***
	(0.02)	(0.02)	(0.02)	(0.02)
DI	0.38***	0.42***	0.40***	0.34***
	(0.03)	(0.04)	(0.03)	(0.03)
RN × DI	0.23***	0.22***	0.23***	0.23***
	(0.02)	(0.03)	(0.03)	(0.03)
N	49,685	13,508	18,751	17,426
Dyads	3,474	2,491	2,826	3,314
RMSE	1.37	1.41	1.37	1.30

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

are stronger.

If we keep our focus on the estimates on DI, RN, and their interaction a little longer, it is worth considering how failing to account for strategic interdependence would alter our inferences about donor giving. If these estimates are cross-referenced with those in Table 3.2, which shows estimates for reduced models that exclude peer ODA from the analysis, it is clear that when peer aid is accounted for DI and RN's relationship with donor giving is substantially greater in magnitude. Even more, the pre- and post-2001 differences in the interaction term that were apparent previously now disappear when peer aid is excluded from estimation.

For those more visually inclined, Figure 3.5 is a coefficient plot that shows in red estimates when peer aid is not accounted for and in blue estimates when peer aid is included. The difference is quite stark. When peer aid is excluded, estimates of donor responsiveness to interest-based and needs-based factors are substantially attenuated. At the same time, differences in how DI conditions donor responsiveness to needs-based factors pre- and post-2001 are absent. By failing to account for strategic interdependence, then, Bermeo's (2017, 2018) argument that targeted development emerges as a donor strategy post-2001 finds less clear support.

These differences illustrate one of the points made in this dissertation: that strategic interdependence leads donors to give international aid in ways that deviate from what

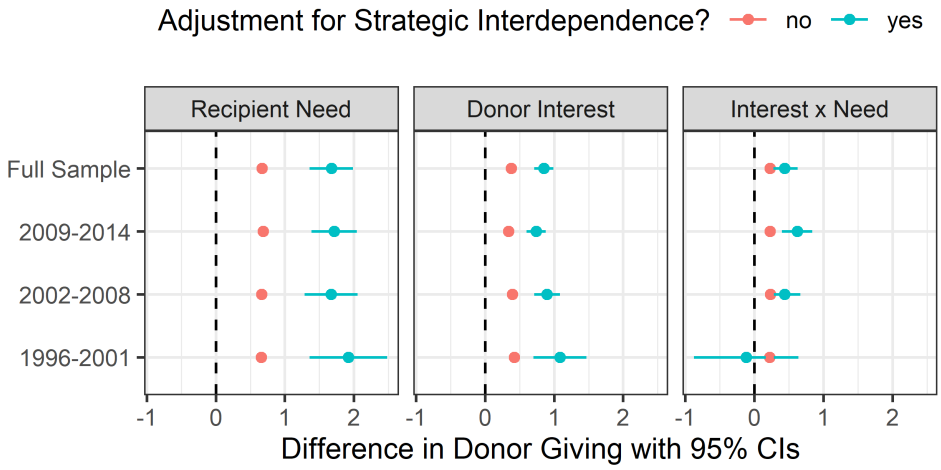

Figure 3.5: Estimates of donor responsiveness to interest-based and needs-based factors with and without accounting for strategic interdependence

they ostensibly value. While I do not wish to be accused of making too much of this—after all, all actors, individuals, institutions, and states face constraints that lead to conflicts between what they value and what they do—it bears repeating. Because, while it is plain to see that values and actions often are misaligned, it is also true that many empirical studies proceed as though what actors do provides a reliable basis for drawing inferences about what actors value. As the results shown here demonstrate, when we fail to account for other systemic constraints on actor behavior, such as strategic interdependence, we can grossly under or over estimate relationships and thus draw potentially misinformed conclusions about actor motives.

Finally, what can we say about the conditional responsiveness of donor governments to the giving of peers? Figure 3.6 reports, over the range of possible values of DI and RN, the marginal relationship between peer aid and individual donor aid. We observe patterns that, overall, appear to be consistent with the two prominent views on donor giving discussed in a previous section: (1) targeted development and (2) aid-for-policy exchange.

The top-left panel shows the marginal effect of peer aid for the full data sample. The top-right, bottom-left, and bottom-right panels show results for 1996-2001, 2002-2008,

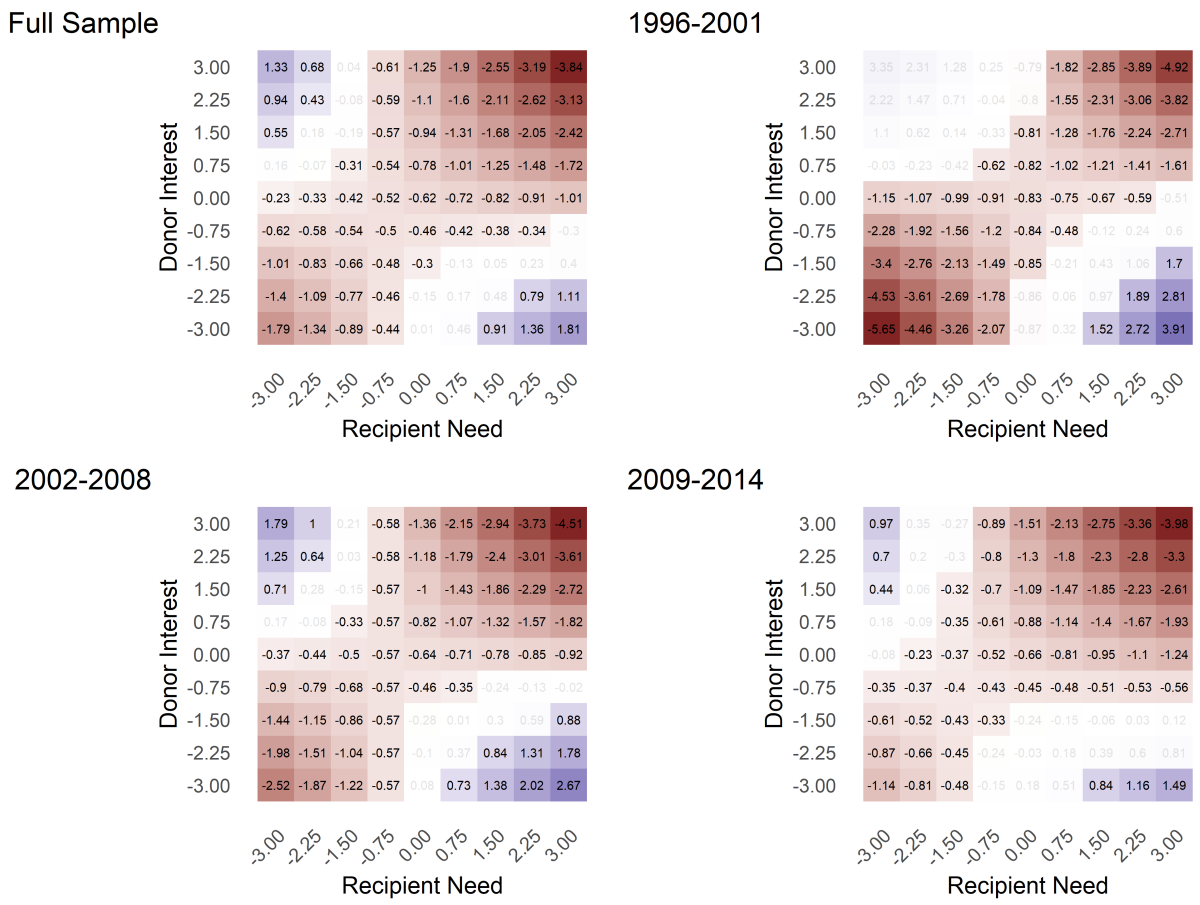

Figure 3.6: 2SLS estimates shown. Red values denote a negative sign. Blue values denote a positive sign. Faint tiles denote that the estimate is not statistically different from zero.

and 2009-2014 respectively. Red denotes *negative* responses to peer aid, and blue denotes *positive* responses. Cell entries give the marginal effect. Light, or translucent cells, denote statistical insignificance. The the grid shown in each panel summarizes marginal effects across different combinations of RN and DI. RN varies from low to high along the x-axis, and DI varies from low to high along the y-axis.

Across the range of values of DI and RN, donor responses are predominantly *negative*, though with varying intensity and most substantially in the upper right and lower left quadrants—precisely where the targeted development framework would predict. However, there are pockets of positive donor responses at the upper left and lower right quadrants where we would expect aid-for-policy exchange to have greatest relevance.

As discussed previously, these two perspectives provide a framework for thinking about when and where a donor government will perceive peer aid as a threat to, or as supportive of, its objectives in recipients. Targeted development, it was argued, should be most useful for understanding donor responses when need-based and interest-based factors are both high, or when they are both low. In the former case, the combination of high recipient need and strong interest-based factors mean donor populations and interests will be especially vulnerable to potentially severe recipient problems. This fact should increase the importance of development promotion to donor governments, a goal that Bermeo (2018) contends has collective benefits for the donor community.

Further in low need, low interest contexts, promoting development will be less important to donors, as will be the salience of recipients to donor governments. As such, donors should be more than happy to defer responsibility for giving aid to others when need-based and interest-based factors are low.

On both counts, we observe this kind of donor response to the giving of others. Conversely, the aid-for-policy exchange framework was argued to be most relevant for understanding donor motives when either interest-based factors are high and need-based factors are low, or vice versa. In the former case, interest-based factors imply that donor governments place a high value on obtaining policy concessions from recipients. At the same time, the absence of more severe development needs mean that stronger ties between donors and recipients act as vectors for relatively limited kinds of problems in recipients that would affect donors. This allows donors to focus on non-development goals in recipients.

Alternatively, when needs-based factors are high, but interest-based factors are minimal, donor governments are in a position of power relative to recipients, making it easier for them to leverage policy concessions. At the same time, weaker ties between donors and recipients mean that whatever severe problems exist in these developing countries, they pose a less material threat to donor populations and interests. This lets donors focus

on non-development objectives since development promotion is a less salient concern.

As Bueno de Mesquita and Smith (2016) highlight, aid for policy deals can be exclusive for donors, meaning that aid from peers can detract from the leverage an individual donor has in obtaining its desired concessions. This gives donor governments a rational incentive to give more aid in recipients where aid-for-policy deals are more salient when peers give more aid in these recipients as well.

This is, in fact, what we observe—albeit with less intensity in some periods when the analysis is conducted with different samples. While we observe the strongest patterns consistent with competition for policy deals in 2002-2008, in 1996-2001 we observe no significant responsiveness by donor governments to peer aid in high-interest, low-need recipients. This suggests this view as somewhat limited explanatory power across time. Nonetheless, it still has relevance for the post-2002 period.

3.7 Robustness

To address possible concerns with the main analysis, it will be useful to consider some follow-up analyses. First, one concern with testing for the presence of strategic interdependence in international aid is that the role of peer aid could be driven by omitted variable bias. To the extent that the composite measures DI and RN fail to adequately capture variation in donor giving, peer ODA may be filling in the gaps. It therefore is useful to check how the results change if we substitute for DI and RN the component measures used to construct each when training the random forest models.

Figure 3.7 shows how the prediction accuracy differs when peer aid is included in model training when using the component measures in the analysis rather than the constructed measures DI and RN. As we might expect, the prediction accuracy is much improved in both cases relative to the main analysis. This is to be expected since the choice to use composite measures necessarily comes at a cost to efficiency. Nonetheless, we still observe an improvement in prediction accuracy when peer aid is included as a predictor.

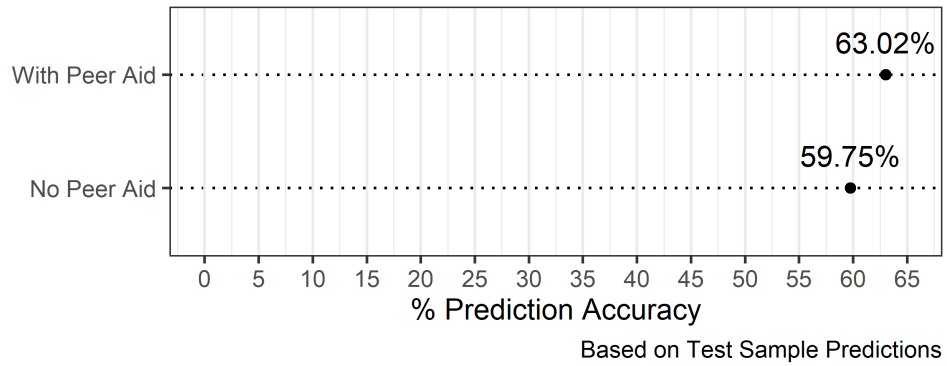

Figure 3.7: Prediction accuracy in the test sample with and without including peer aid as a predictor. Results shown using the component measures of DI and RN as predictors.

While the gap in performance is attenuated, the difference persists.

Even more, as Figure 3.8 highlights, peer aid remains an important predictor. Like Figure 3.3, 3.8 shows the average permutation importance computed per each factor along with 95 percent confidence intervals. For ease of viewing, the variables have been ordered by the magnitude of their importance. As the figure shows, Peer aid's contribution to prediction accuracy is second only to donor GDP. This provides additional assurance that, in the main specification, the predictive importance of peer aid is not entirely driven by omitted variables.

An additional concern centers on the identified donor responses in the instrumental variables regressions. What if the chosen instrument, the sum of other-donor DI, violates the exclusion restriction? This is something that is difficult to test, but is a possibility worth considering. For example, it could be argued that aspects of interest, namely bilateral trade, are endogenous to the aid allocations of DAC members.

Though it does not eliminate all concerns about exclusion, one helpful robustness check is to substitute the current instrument for a lagged version—say of five years. This may help the instrument to be far enough removed from the contemporary choices of donors to minimize endogeneity. Figure 3.9 shows 2SLS estimates using this modified instrument. Notably, an unfortunate consequence of using the 5 year lag of peer *interest* is the loss of the first five years in the dataset. We therefore cannot estimate relationships

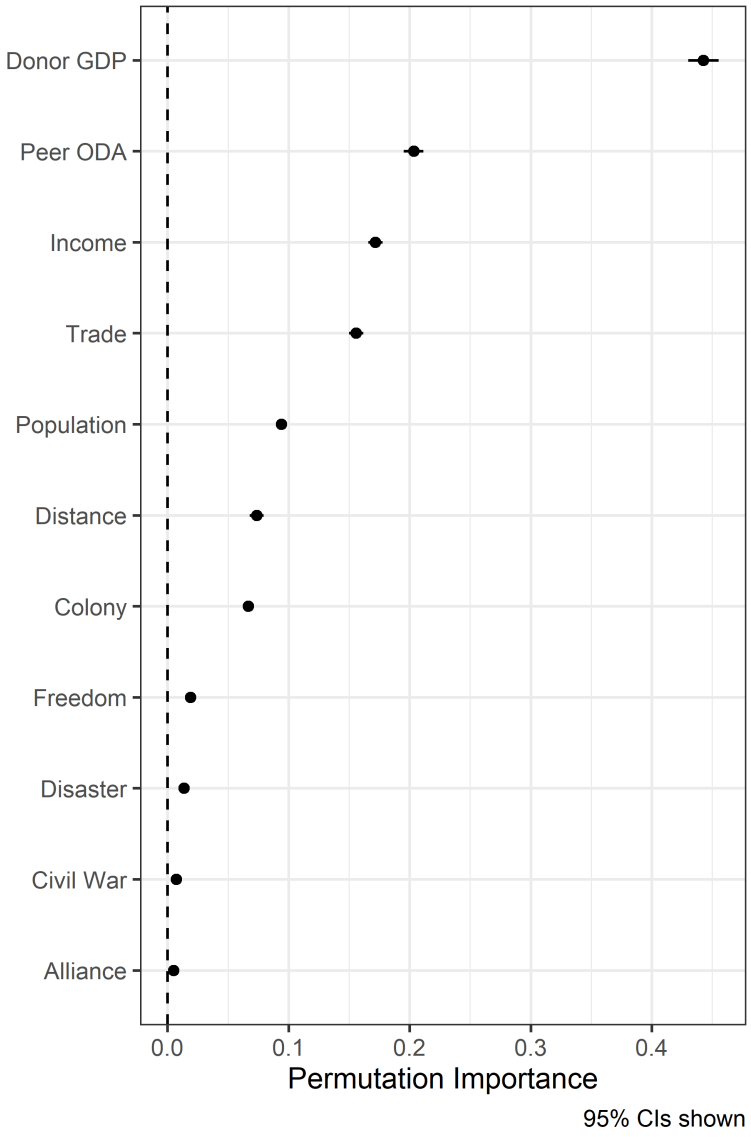

Figure 3.8: Permutation importance computed using the test sample.

using the 1996-2001 sample. However, despite this loss of data, the estimates remain mostly unchanged. While this certainly does not prove that peer DI is an appropriate instrument, it is encouraging that the patterns reported in the main analysis hold up with an alternative specification, and a slightly truncated sample.

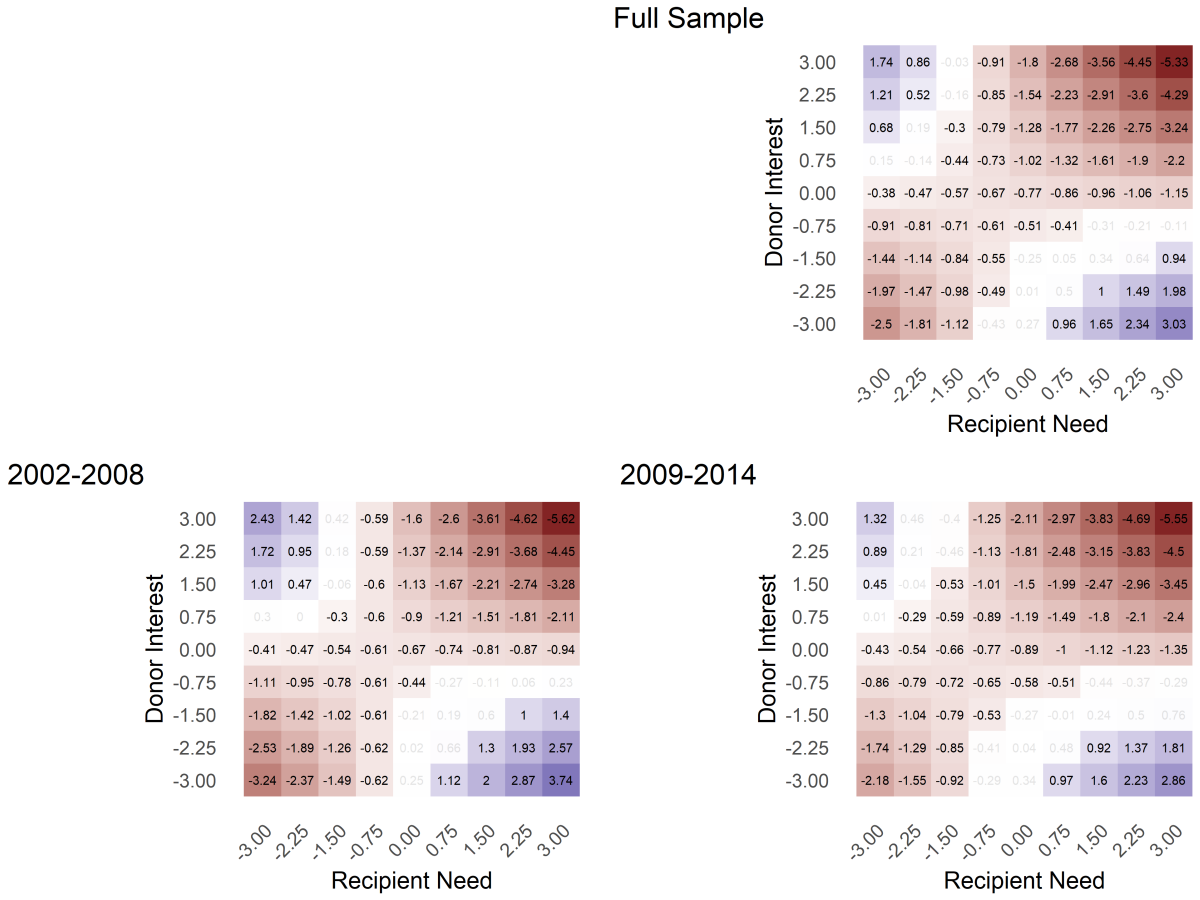

Figure 3.9: 2SLS estimates using the five year lag of peer DI as an instrument.

3.8 Conclusion

In several studies, such as in Alesina and Dollar (2000), scholars have attempted to examine patterns in international aid to learn what donor governments value. This strategy has provided many valuable insights into the foreign policy considerations that drive international aid. However, with some exceptions, many studies ignore the role of strategic interdependence in international aid. This is problematic, because, as has been a central argument in this dissertation, strategic interdependence in international aid can lead donor governments to differently target aid in developing countries than they would based on their priorities alone. Chapter 1 made this point using a game theoretic model, while this chapter explored the empirical implications of strategic interdependence.

Using novel methods, not only to I confirm that donors adjust their giving in light of where others give aid as well, they respond to other-donor aid differently given the unique combination of interest-based and needs-based determinants of economic assistance. Using an instrumental variables approach, I find that donors give more aid in recipients where others give more either when interest-based factors are high and needs-based factors are low, or vice versa. Conversely, donors give less aid in recipients where others give more when both interest-based and needs-based factors are high, or when both are low.

These patterns are consistent with two prominent perspectives on donor motivations: (1) targeted development and (2) aid-for-policy exchange. It was argued here that the former should have greatest explanatory power when both interest-based and needs-based factors are high, or when both are low. Meanwhile, the latter should have greatest explanatory power when either interest-based factors are high and need-based factors are low, or vice versa. The patterns in donor responses I identify are consistent with these expectations.

But, beyond these specific findings, an equally important finding is that accounting for this interdependence in international aid yields different conclusions about the relationships between interest-based and needs-based drivers of giving and how donors distribute foreign aid. This is not surprising. If, indeed, the foreign policy objectives of donor governments do not exist in isolation, then the ways they distribute aid will never perfectly reflect what donors value. Strategic interdependence creates incentives to deviate from the way donors would otherwise distribute resources. Unless this fact is accounted for, it is easy to draw misinformed conclusions about the foreign policy objectives donor governments value and seek to realize through international aid.

3.9 Supplemental Materials

Table 3.3 shows summary statistics. Table 3.4 shows the first-stage estimates for the instrumental variables regression. Table 3.5 shows the 2SLS diagnostics.

Table 3.3: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Bilateral ODA (ihs)	49,685	1.442	1.831	0	0	2.7	10
Peer ODA (ihs)	49,685	5.631	1.852	0.000	4.584	6.890	10.714
DI	49,685	0.153	0.867	−3.595	−0.324	0.637	3.488
RN	49,685	−0.003	0.997	−2.233	−0.640	0.692	2.998
Peer DI	49,685	3.333	12.640	−35.106	−5.160	11.004	53.757

Table 3.4: First Stage Estimates

	Peer ODA
Peer DI	0.62^{***}
	(0.04)
DI	-0.04
	(0.03)
RN	1.27^{***}
	(0.02)
DI $\times$ RN	-0.01
	(0.02)
Peer DI $\times$ DI	-0.13^{***}
	(0.02)
Peer DI $\times$ RN	-0.07
	(0.04)
Peer DI $\times$ DI $\times$ RN	-0.10^{***}
	(0.02)
R^2	0.57
Adj. R^2	0.57
Num. obs.	49685
RMSE	1.21
N Clusters	3474

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 3.5: 2SLS Diagnostics

Diagnostic	**Numerator DF**	**Denominator DF**	**Statistic**
Weak instruments (aid_{jrt})	4	3,473	68.07^{***}
Weak instruments ($\text{aid}_{jrt} \times \text{DI}_{irt}$)	4	3,473	64.18^{***}
Weak instruments ($\text{aid}_{jrt} \times \text{RN}_{rt}$)	4	3,473	94.23^{***}
Weak instruments ($\text{aid}_{jrt} \times \text{DI}_{irt} \times \text{RN}_{rt}$)	4	3,473	26.72^{***}
Wu-Hausman	4	3,473	90.01^{***}

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Chapter 4

Strategic Interdependence and Lead Donorship

4.1 Introduction

The previous chapter examined patterns in strategic interdependence in international aid. The results were consistent with the view that donor governments differently adjust how they give aid in developing countries in light of where other donors give theirs. The direction and magnitude of their response was determined by the combination of interest-based and needs-based factors in recipients. In this chapter, I examine the conditions under which donor governments rise to the top in aid recipients. Strategic interdependence, beyond how it shapes donor responses to the giving of others in developing countries, drives when and where donor governments dominate. By dominate, I simply mean the extent to which donors bear outsized responsibility for giving aid in recipients. When this occurs, scholars call it "lead donorship" (Gehring et al. 2017; Steinwand 2015).

The converse of lead donorship is a concept called "aid fragmentation." This is a condition in which a developing country receives foreign aid from a multitude of donor governments with no obvious leader contributing the largest share. A debate among scholars and policy makers currently exists over whether fragmentation (the absence of lead donorship) has detrimental consequences for development promotion in aid recipient countries. Some contend that a fragmented aid supply overburdens recipient bureaucracy and does harm to its political institutions (see Acharya, Lima, and Moore 2006; Djankov, Montalvo, and Reynal-Querol 2009; Knack and Rahman 2007). Others contend that its effects are constrained to a subset of sectors and that in some instances fragmentation may be beneficial (Gehring et al. 2017)

The possible adverse (or positive) effects of aid fragmentation were not a mechanism addressed in the discussion of inefficiency in Chapter 1. Therefore, my focus in this

chapter is not to address the validity of claims made about the normative impact of fragmentation. Nonetheless, as a descriptive reality of donor giving in recipients, the theoretical model certainly provides insight into *when* and *where* fragmentation (and conversely, lead donorship) is most apt to emerge. Despite the proposed importance of lead donorship for recipient outcomes, little empirical work specifically evaluates which donor governments take the lead and why. To provide a foundation for understanding the causal role of lead donorship on aid effectiveness, a necessary first step is to understand the process that gives rise to it. So, *when*, *where*, and *why* does lead donorship emerge?

In Chapter 1, one of the predictions that followed from the theoretical analysis was that strategic dynamics will lead donor governments to have disproportionate responsibility for giving aid under a particular set of conditions. Larger donor governments should dominate in recipients that have greater salience to them than for other donors and where donor goals are non-rival. The model illustrated that rival objectives will be felt most acutely for smaller donors and donors that place less value on realizing common goals in other recipients. The result is that, in equilibrium, smaller donors will direct the majority or all of their aid at recipients that are sites of rivalry. This leads larger donors to play a greater role in supporting objectives in recipients that are sites of common interest.

From Chapter 3, we know that donors appear to give less aid when others give more in cases where we see a confluence of high interest and high need factors. We also observe this response when interest-based and needs-based factors are minimal. Lead donorship should have the greatest likelihood of emerging in the former scenario. In such recipients we should expect donor governments to place greatest emphasis on promoting recipient development. As Bermeo (2017, 2018) argues, problems rooted in underdevelopment in these recipients pose a comparatively greater threat to donor populations and interests as the ties between donors and recipients implied by stronger interest-based factors operate as vectors for recipient problems. As she also notes, promoting development when and where it serves the interests of donors yields common benefits for the donor community.

As such, donors have rational incentives to adjust their giving in light of how other donors give theirs by targeting more resources in recipients where other donors give less.

Conversely, in recipients where bilateral interest-based factors are high and recipient needs minimal, or vice versa, non-development goals may have greater value to donor governments. Such goals often are thought to be rival among donors, which creates rational incentives to give more aid when and where other donors give more as well (Bueno de Mesquita and Smith 2009, 2016). Competition for such goals will make it harder, even for larger donors, to take the lead.

This implies, then, that a donor government will hold lead donor status (1) in high need recipients where interest-based factors are comparatively stronger for said donor relative to others and (2) when a donor is better resourced than its peers. The first set of conditions implies a development focus for donors (a non-rival goal) while the second confers a material advantage in financing international aid.

I test this argument using the dataset from the previous chapter. Building upon Steinwand (2015), I construct a measure of lead donorship. I then create a measure I call donor interest share (DI share) that captures the relative strength of bilateral interest-based factors for a donor government relative to all others in a developing country. This is constructed by simply dividing the composite measure of donor interest (DI) for one donor in a recipient by the total DI for all donors in the same recipient. I then interact this term with the composite measure of recipient need (RN) that I used in previous chapter.

Because I am more interested in confirming the likelihood of lead donorship at the confluence of greater DI share and RN rather than specific directional hypotheses tied to individual regression coefficients, I opt for a more flexible modeling strategy. Using a generalized model, I specify lead donorship as a multivariate smoothed function of DI share and RN and then evaluate model predictions. If lead donorship has the greatest likelihood of occurring in high DI share and high RN cases, this will be consistent with expectations. Further, to confirm that larger donor governments are the ones who take the

lead, I cross-reference the frequency that donors have lead donor status with donor GDP. On both counts, the results are consistent with expectations.

Following the statistical analysis, I examine patterns in lead donorship in Southeast Asia and South America. These two regions merit study as "deviant" and "extreme-on-X" cases, respectively. In the former, Japan exercises outsized dominance despite other donor governments having strong interests in Southeast Asia. In the latter, the United States stands out for its comparatively strong foreign policy interests, yet it nonetheless enjoys less preeminence than anticipated. These cases highlight additional material and political factors in donors and recipients that facilitate lead donorship. Some of these factors are related to mechanisms beyond those captured in the theoretical discussion in Chapter 1, which is why they are important to evaluate. All theoretical models have blind spots, and while they may explain average trends they cannot account for everything. By examining these cases we not only learn new details, we also gain a sense for the limitations of the theoretical perspective adopted in this dissertation.

Taken together, these findings highlight as yet unstudied determinants of lead donorship. This has the potential to support future work on the impacts of foreign aid in developing countries. Some of the latest political science research on aid effectiveness emphasizes the role of aid conditionality as a requisite for aid having a positive impact on development (Bearce and Tirone 2010; Girod 2012). Given the strategic interdependences in international aid, how does lead donorship relate to the ability of donor governments to credibly commit to conditions on aid?

In addition, these results capture patterns in *which* donor governments take the lead. This also has significance for understanding the role of lead donorship in aid effectiveness. Donor governments take different approaches in dealing with developing countries. Not only do they adopt different management styles in the implementation of development projects (Honig 2018), they also differently adjust their delivery of aid when confronted with poorly governed aid recipients (Dietrich 2016).

Thus, by having a sense for which specific donors take the lead and why, it will be possible to better evaluate connections between lead donorship and aid effectiveness. Why donors have lead donorship status is non-random but rather the result of strategic choices and incentives. Such factors may confound the effectiveness of international aid, so understanding the process that gives rise to lead donorship is essential for supporting future causal analysis of aid's effects.

4.2 Why Does Lead Donorship Matter?

Conceptually, lead donorship has a straightforward definition. According to Steinwand (2015), lead donorship is an instance where a single donor has a long-term relationship with an aid recipient and is responsible for the greatest share of foreign aid said recipient receives.

Lead donorship matters for its significance for aid effectiveness, or the extent to which receiving foreign aid maps to economic development in recipient countries. Though no consensus on the issue exists, a number of studies point to reasons that the converse of lead donorship (aid fragmentation) has a deleterious effect on economic development. Fragmentation denotes a scenario where a recipient country receives aid from more diffuse sources.[1]

Some cite costs to recipient government administrative capacity as one mechanism through which fragmentation takes its toll. In a special handbook overview of the economics of foreign aid, Kanbur (2006) writes:

> In a typical African country, there can be upwards of 20 aid agencies from different countries and multilateral agencies. The hard-pressed civil servants [of these African countries] spend much of their time managing the paper flow. At the political level, ministers have to spend a considerable amount of time in turn meeting with donor delegations (1,579).

[1] Thus, I often use aid fragmentation interchangeably with stating a lack of lead donorship.

As Kanbur (2006) goes on to note, the time it takes recipient bureaucrats to engage with donor agencies comes at the cost of listening to domestic interest groups and those most familiar with local conditions and development needs. This may increase the likelihood of mismatches between the development goals of, and types of resources provided by, donors and the actual needs of recipients.

Beyond excessive administrative burden, some scholars suggest fragmentation damages bureaucratic quality itself. Knack and Rahman (2007) demonstrate via a game-theoretic model and cross-country panel data from 1982 to 2001 that an increase in aid fragmentation results in a significant decline in bureaucratic quality, as measured by the International Country Risk Guide (ICRG). The authors cite poaching as one of the key mechanisms driving this effect. Donor agencies often have to provide tangible evidence of project effectiveness, and to do so they have incentives to supplement the pay of especially talented local bureaucrats to function as consultants. As Knack and Rahman (2007) note, this practice has incentive distorting effects in the pool of local staff and also draws the most talented civil servants away from responsibilities that arguably would have greater development impact.

Fragmentation enters the equation by way of the collective action problem poaching creates among donors: more donors equates to more poaching, leading to more poaching by individual donors to snatch up talented staff before other donors do the same. Fragmentation thereby accelerates the rate of poaching, draining the local talent pool even more than if only one or a few donors operated in a recipient.

Outside of factors on the recipient side, Anderson (2012) points to transaction costs on the donor side. He claims that fragmentation may increase the burden that donors face when interacting with recipients by preventing them from exploiting economies of scale. Results from Anderson's dyadic panel analysis of administrative costs associated with development programs by 23 DAC countries from 1984 to 2009 suggest that fragmentation leads to an estimated 2.5 billion US dollars in extra administrative burden. By reducing

the efficiency by which total development funding maps to the actual implementation of development projects, fragmentation limits the overall impact of each additional dollar of aid a donor spends.

Related to the problem of transaction costs, fragmentation may also weaken the credibility of aid conditionality. Some evidence suggests that foreign aid exercises its effect on development, not only or primarily through the development projects it supports themselves, but when donors place conditions on the receipt of funds. In this view, aid allocation functions as a form of political exchange (Bueno de Mesquita and Smith 2009). By conditioning their support on the adoption of pro-market economic and political reforms by recipients, donors can incentivize development. Though evidence remains far from conclusive, several studies provide compelling support for the view that aid conditionality in both bilateral and multilateral contexts has a positive economic impact in recipients (see Bearce and Tirone 2010; Girod 2012; Smets and Knack 2016; Moll and Smets 2018).

However, a number of intervening factors may limit the efficacy of conditionality. For instance, the so-called "Samaritan's Curse," or disutility incurred from cutting aid, can prevent donors from making credible commitments to impose conditions. These might result from bureaucratic incentives to move money out the door (Svensson 2003), or when donors' strategic goals supersede their interest in promoting development (Bearce and Tirone 2010; Girod 2012; Kanbur 2000; Kilby 2009). Conditionality further only has bite to the extent that recipient governments lack alternative sources of revenue (Girod 2012).

Aid fragmentation has direct links to both the Samaritan's Curse and recipient dependence. On both counts, the presence of donor competition implied by fragmentation is the chief culprit. This issue has taken on special relevance in light of China's expanding international development finance activities. China has a reputation for imposing few conditions on its aid relative to traditional DAC donors, and as a consequence multilateral development institutions such as the World Bank and bilateral donors such as the United States have reduced the number of conditions they impose, and changed the types of

projects they support, in order to compete (Hernandez 2017; Zeitz 2021). However, while much of the literature centers on the competitive challenge posed by China, traditional DAC donors remain far from united in their priorities and often harbor concerns about maintaining their interests and influence *vis-à-vis* each other as well (Steinwand 2015). Indeed, in the multi-donor environment DAC countries have inhabited for decades, aid from the United States in Northern Africa can represent just as much a source of competitive pressure for France as infrastructure projects financed by the People's Republic of China in Sub-Saharan Africa.

Competition, then, makes conditionality difficult to enforce for donors. Not only may donors suffer disutility from cutting aid by losing out on their foreign policy goals to competitors, but also the presence of many donors likely mitigates the economic cost to the recipient if a donor cuts aid.[2] Thus, to the extent that it suggests greater donor competition in a recipient, aid fragmentation will limit the economic impact of foreign aid.

In sum, lead donorship should have direct relevance for international development. By reducing fragmentation in the aid supply to a given recipient, lead donorship may result in less administrative burden and damage to recipient bureaucratic capacity, reduced transaction costs for donors, enhanced credibility and bite of conditionality, and less waste due to donor competition.

4.3 What Is Lead Donorship?

As a matter of observation, identifying clear cases of lead donorship (narrowly defined in terms of high donor concentration) should be easy enough—so, too, with identifying clear cases of its absence. To illustrate, consider Figure 4.1, which shows the share of aid committed by the top DAC donor in a given year to two aid recipients: Mexico (left) and

[2]On the point of recipient dependence, it bears noting that a lack of fragmentation could be a double-edged sword. While it may improve a donor's leverage with a recipient government, research points to a possible link between aid fragmentation, aid volatility, and political violence. Gutting and Steinwand (2015) find that greater fragmentation limits exposure to negative aid shocks (sudden and substantial declines in aid revenue) and, hence, to the impact that such shocks can have on the incidence of violent conflict.

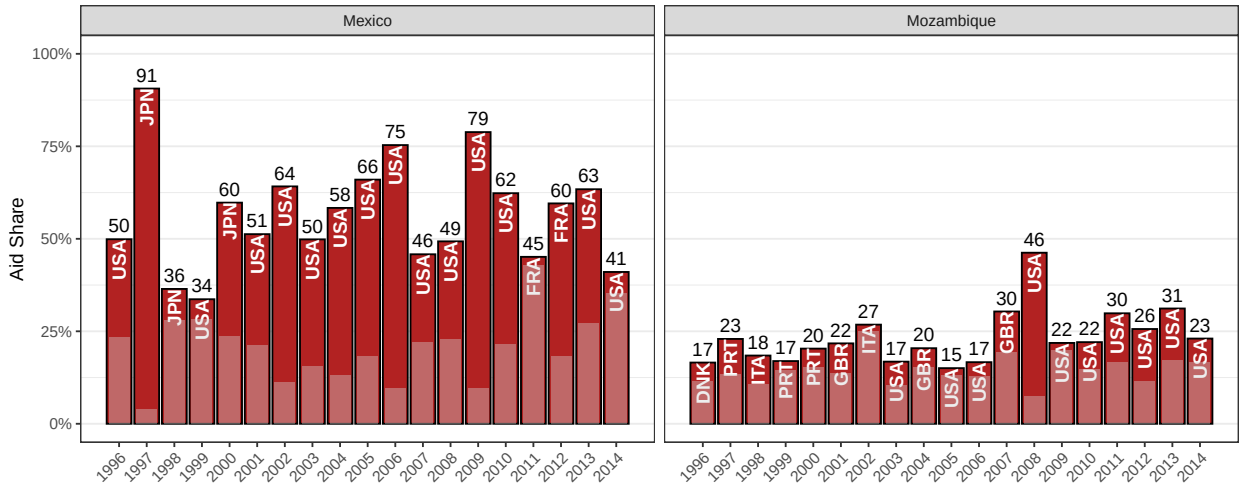

Figure 4.1: Aid shares of top donors to Mexico and Mozambique.

Mozambique (right). The x-axes of each panel in the figure denote years from 1996 to 2014. The y-axes show the percent of total aid going to a recipient that the top donor is responsible for. These data come from the OECD's Creditor Reporting System (CRS) and reflect the total of bilateral Official Development Assistance (ODA) commitments in 2017 constant US dollars across the 24 main development sectors as defined by the OECD. Abbreviated country names are included so it is clear which donor is responsible for committing the top share of aid. Also, lighter columns have been added that indicate the share of aid committed by the donor responsible for the second greatest amount in a given year. This provides a point of reference for how much more the top donor in a given year committed relative to the next most generous donor.

Among the 29 DAC countries committing foreign aid across 24 development sectors to Mexico, the United States held top donor status for 14 out of 19 years from 1996 to 2014. The US further bore responsibility for, not just the plurality, but the majority of aid for eight of those years. This comes as little surprise. Mexico shares a border with the United States and has greater long-term security, diplomatic, and migration policy importance for the US government than for other DAC members.

Conversely, over this same period the share of aid committed by the top DAC donor

per year to Mozambique was 23% on average, declining to as low as 15% in 2005, and only climbing as high as 46% in 2008 before falling to 22% the next year. While the United States committed the largest share of aid for several years, top donor status fluctuated among a group donors from 1996 to 2007. And, even though the US committed the most aid to Mozambique from 2008 to 2014, in nearly all of those years (2008 being the exception), the second most generous donor did not fall far behind.[3] While Portugal formerly colonized Mozambique—making it a plausible contender for lead donor given the role of colonial legacy in driving aid giving (Chiba and Heinrich 2019)—it only held top-donor status in 1997 and again in 1999 and 2000.

The United States arguably qualifies as a lead donor in the first case (Mexico), while no obvious lead donor exists in the second (Mozambique). Of course, not all cases can be categorized so decisively. The question of where to draw the line is unavoidably subjective and arbitrary, which poses a challenge to setting down criteria for lead donorship. Thankfully, prior research points to helpful metrics and benchmarks.

One such metric is donor concentration, which captures the degree to which the supply of aid given to a recipient comes from concentrated or diffuse sources. The Herfindahl index (HI) is the most commonly applied such measure in the aid literature (see Djankov, Montalvo, and Reynal-Querol 2009; Gehring et al. 2017; Knack and Rahman 2007; Steinwand 2015), and for good reason. HI has a simple formulation and intuitive interpretation. With respect to a recipient r in year t HI is given as

$$\text{HI}_{rt} = \sum_{i=1}^{N} \pi_{irt}^2, \tag{4.1}$$

where π_{irt} is the share of aid given to recipient r in year t that donor i is responsible for. The final measure is equal to the probability that two randomly drawn dollars from the

[3]The sizeable and rapid jump in US support in 2008 coincided with the onset of a devastating flood in Mozambique in early 2008 that killed several and displaced tens of thousands. Total DAC giving to Mozambique increased to 1.78 billion from 1.5 billion 2017 constant US dollars this same year. It is interesting to note that the US was responsible for much of this increase. However, in the following years, in addition to aid totals slowly declining, the US clearly began to bear less responsibility for the total amount given.

overall aid given to a recipient in a given year come from the same donor. The higher this probability, the more concentrated the donor pool.

However, while HI offers simplicity and interpretability, it lacks specificity. While it summarizes how concentrated donorship to a recipient is, it does not reveal which donor, or set of donors, bears responsibility for the greatest share.

Alternatives to this measure exist that have their own strengths and weaknesses. Gehring et al. (2017) summarize some, including a class of indices called concentration ratios (CR) and a simple count of the number of donors giving aid to a recipient in a given year. The latter is straightforward and the simplest of all the measures. But, the cost of this simplicity is an inability to distinguish between a case where, say, 10 donors give aid to a recipient but one gives 50 percent of the total supply and a case where 10 donors give aid in equal proportion to each other.

The former, CR, has the benefit of capturing aid shares with respect to a top donor or set of donors, but it does require some user discretion in how the ratios are defined. CR entails summing up the shares of aid contributed by a set of the largest donors. However, whether this set should consist of only the top donor or top five, there is no objectively correct answer. Further, depending on the overall distribution of aid shares across donors, CR can provide very different answers about the degree of donor concentration depending on how many donors are factored into the equation. That said, CR does provide specificity with respect to the top donor or set of donors giving aid, which cannot be said for the other measures.

Given the pros and cons of these indices, it is no surprise that Steinwand (2015), who provides the first set of empirical criteria for identifying a lead donor, uses a mix of measures to take advantage of their strengths while overcoming their weaknesses. In particular, Steinwand codes lead donorship as present when:

1. The HI for a given recipient in a given year is greater than the median HI for the data sample;

2. The difference between the total amount of aid given by the top donor relative to the next largest donor to a recipient in a year is greater than the sample median of this difference;
3. The share of aid to a recipient in a given year from the top donor is greater than the sample median of aid shares.

This measure takes into account not only the degree of donor concentration, but also the absolute and relative amount of aid given to a recipient from the top donor. To further capture the temporal dynamic of lead donorship, Steinwand (2015) adds the following longitudinal criteria:

4. A donor must have top donor status for at least 5 out of 9 consecutive years;
5. A donor must not drop from top donor status for more than 2 consecutive years in that 9 year time span.

In devising a measure of lead donorship for this study, I adopt some, but not all, of these decision rules. In particular, I rely on the first three while I opt for a slightly more flexible approach to deal with the longitudinal dimension of lead donorship. Instead of the year-based criteria, I use a simple lagged rolling average of lead donorship:

> *For a given year, I calculate the proportion of times a donor meets the criteria specified in points 1-3 in that year and the two previous.*

With this approach, if a donor met criteria 1-3 in 1999 and 2000, but fell short in 2001, its lead donor status would be 2/3 in 2001. This strategy adds a fuzziness to lead donorship that Steinwand's measure lacks. Rather than being entirely present or absent, lead donorship may wax and wane with a certain degree of granularity.

This choice has a practical, in addition to metrological, purpose. Namely, it helps me to avoid having to drop the first nine years from my panel dataset in order to construct a valid measure. By Steinwand's longitudinal criteria, no observations in the first nine years

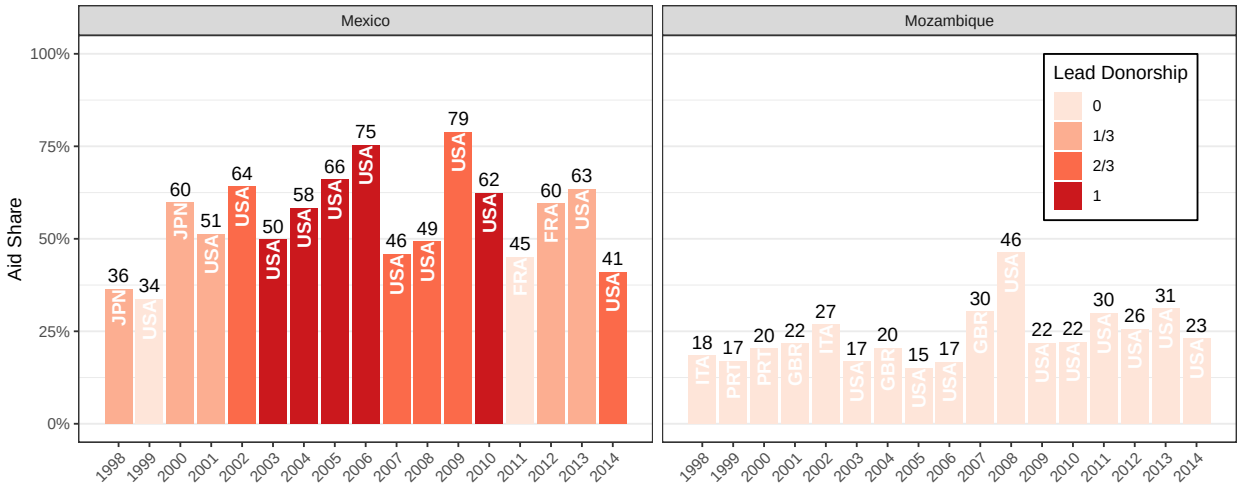

Figure 4.2: Lead donorship of top donors to Mexico and Mozambique.

of the the CRS panel I am using would be coded as lead donor, making them unusable in analysis—a significant loss of data. In contrast, by basing lead donorship on a three-year lagged running average, I only have to drop the first two years.

These selected cut-offs (sample medians and number of years) is unavoidably arbitrary, but it does a fair job of identifying cases where, on its face, lead donorship is present. Consider again the aid recipients Mexico and Mozambique. Figure 4.2 reports the aid shares of the top donors to each recipient per year from 1998 to 2014—1996 and 1997 now have to be dropped. In addition, it reports the lead donorship status of the top aid donors by the column shades. The darker the shade, the stronger the measure of lead donorship.

As it turns out, the measurement strategy does a fair job of identifying lead donorship. In the case of Mexico, the leadership of the United States is strongest precisely when it should be, based on its giving. Further, when its giving wanes, this is reflected in the US having a weaker measure of lead donorship or even being supplanted by other donors in a few years. Japan, for example has a modest degree of lead donorship in 1998 and 2000 (1/3), as does France in 2012 (1/3). Even so, as we would intuitively expect, the United States has non-zero lead donorship status for 12 of the 17 years from 1998 to 2014 and has full lead donorship status from 2003 to 2006 and again in 2010.

Conversely, no donor rises to even a modest level of lead donorship status in Mozambique for the entire period from 1998 to 2014. Even from 2008 to 2014 when the US consistently holds the position of top donor, its level of giving is insufficient to earn it the lead donorship title. This is as would be expected given the historical widespread attention Mozambique receives from the donor community. In such a fragmented donor environment, lead donorship remains elusive.

4.4 Where and Why Does Lead Donorship Emerge?

We have a conceptual and empirical classification of lead donorship, and we have a sense for its material importance for international development. That leaves only the question of when, where, and why lead donorship emerges. What kinds of recipients have a greater probability of having a lead donor? Which donors have a greater probability of holding lead donor status?

Two sets of donor goals have relevance in answering these questions. The first set of goals consists of objectives that yield common benefits for donors. These include economic development and promoting political stability (Bermeo 2017, 2018). The second consists of rival objectives where one donor's gain comes at a cost to others. These include policy alignment, trade, influence over former colonies, prestige, and geostrategic considerations (Bearce and Tirone 2010; Kilby and Dreher 2010; Kisangani and Pickering 2015; Round and Odedokun 2004; and van der Veen 2011). The first set of goals should lead to buck-passing incentives among donors, while the second set should spur donor competition.

From Chapter 3, we know that donors give less aid in recipients when others give more in cases where we see a confluence of high donor interest and high recipient need need. As highlighted there, this finding is consistent with a view called targeted development. This view holds that donors care most about responding to recipient development needs when and where developing country problems threaten donor populations and interests (Bermeo 2017, 2018). The threat of such problems will be most accute for donors, not only

when need is severe, but also when interest-based factors between donors and recipients are strong. Such factors act as vectors for recipient problems, making responding to these problems a material concern for donor governments.

As Bermeo (2018) also notes, the promotion of development when and where it serves the interests of donors yields common benefits for the donor community. This gives donors rational incentives to adjust their giving in light of how others give theirs by targeting more resources in recipients where other donors give less. Consistent with this view, the analysis in Chapter 3 revealed that at the confluence of high bilateral interest-based factors and high needs-based factors, donors give less aid in recipients where others give more.

Conversely, in recipients where bilateral interest-based factors are high and recipient needs minimal, or vice versa, non-development goals may have greater value to donor governments. Such goals often are thought to be rival among donors, which creates rational incentives to give more aid when and where other donors give more as well (Bueno de Mesquita and Smith 2009, 2016). Again, the analysis in Chapter 3 reveals that donors do indeed give more aid in developing countries that receive more from other donors when either interest-based factors are high and needs-based factors are low, or when interest-based factors are low and needs-based factors are high.

While these findings reveal important patterns in donor responses, they also should translate to variation in when and where donor governments take the lead in developing countries. Among the various insights drawn from the theoretical analysis in Chapter 1 was the finding that strategic dynamics will incentivize donor governments to have disproportionate responsibility for giving aid under a particular set of conditions. Namely, larger donor governments should dominate in recipients that have greater salience to them than for other donors and where donor goals are non-rival. The model illustrated that rival objectives will be felt most accutely for smaller donors and donors that place less value on realizing common goals in other recipients. The result is that, in equilibrium, smaller donors will direct the majority or all of their aid at recipients that are sites of rivalry. This

forces larger donors to play a greater role in supporting objectives in recipients that are sites of common interest.

Based on the patterns observed in the previous chapter, this implies that a donor government will hold lead donor status (1) in high need recipients where interest-based factors are comparatively stronger for said donor relative to others and (2) when a donor is better resourced than its peers. The first set of conditions implies a development focus for donors (a non-rival goal) while the second confers a material advantage in financing international aid.

While the above argument is most consistent with the theoretical framework adopted in this dissertation, it bears noting that others have speculated about the determinants of lead donorship as well—often from the basis of different theoretical assumptions.

Steinwand (2015) provides one such alternative account for how these goals relate to lead donorship. He enumerates four scenarios. In cases where donors share common goals, a lead donor emerges due to uncoordinated activity, while cooperation reduces the likelihood of single donor leadership. Conversely, in the case of rival goals, lead donorship emerges as a consequence of collusion, while uncoordinated competition for rival goals precludes lead donorship.

The key difference between this perspective and the one I adopt is the allowance for donor collaboration as an explanatory variable. While the argument itself is internally consistent, there are reasons to be skeptical that collaboration among donors is at work in practice. First, material evidence of cooperation remains elusive. Gehring et al. (2017) provide a helpful discussion on this issue. To summarize, the chief concern in capturing co-operation is that it lacks a formal measure. Neither donors nor international organizations provide a database of donor cooperation, and transparency from donors is limited. Though some indirect measures exist, they have features that make it difficult to disentangle their relationship with cooperation from other effects.

Second, the consensus among policymakers and scholars to date is that international

Table 4.1: Where does lead donorship emerge?

	Low Comparative Interest	High Comparative Interest
High Need	*None*	**Lead Donor**
Low Need	*None*	*None*

development remains a quagmire of cooperation failure. Fuchs, Nunnenkamp, and Öhler (2015) cite several instances where, time after time, high level summits yield dismal progress on their established benchmarks for cooperation. The fact that the donor community bears a facade of frustration over the issue is telling. Tangentially, the purported systemic failure of cooperative efforts might explain the dearth of reliable measures of cooperation—it is hard to devise a measure for something that hardly exists.

An explanation of what drives lead donorship, therefore, must rest on the assumption that donor governments behave in decidedly uncooperative ways. Rather than the product of collusion in the face of rivalry, or of self-interested deference in the face of collective benefits, lead donorship should arise in a purely uncoordinated general equilibrium among donors. Such is the view adopted in this dissertation.

So, in sum, under what conditions would lead donorship align with the individual incentives of donor governments? On the basis of the theoretical findings in Chapter 1 and results in Chapter 3, donors will have the greatest likelihood of holding lead donor status in *high need* developing countries where that donor government has *outsized non-development foreign policy interests* relative to other donors. This argument is summarized in Table 4.1 for reference.

4.5 Data and Methods

The above discussion provides clear and observable predictions for when and where lead donorship emerges. As donors seek to maximize their wide-ranging foreign policy goals through their aid allocation, lead donorship emerges in an uncoordinated general

equilibrium among donor governments. Specifically, a donor has the greatest likelihood of leading in high need recipients where said donor has greatest comparative foreign policy interest relative to other donors. Additionally, donors with greater resource endowments will have a material advantage in supplying aid and so, when lead donorship does emerge, it is more likely to be a donor with comparatively more resources than others.

To test this argument, I build on the dataset used in the previous chapter. I construct a measure of lead donorship from the bilateral aid commits of DAC countries across 24 aid sectors to more than 120 aid recipients using the method described in a previous section. To reiterate, lead donorship is coded as the average number of years (from $t-2$ to t) where

1. In a recipient the HI (measure of donor concentration) for a given recipient in a given year is greater than the median HI for the data sample;
2. The difference between the total amount of aid given by the top donor relative to the next largest donor to a recipient in a year is greater than the sample median of this difference;
3. The share of aid to a recipient in a given year from the top donor is greater than the sample median of aid shares.

Figure 4.3 reports how the yearly average of lead donorship within aid recipients compares to the yearly average of HI. Interestingly, while HI—which measures the probability that two randomly drawn dollars of aid given to a recipient originate from the same donor—slightly declined from 1998 to 2014, lead donorship saw a relatively steady increase in recipients over this same period. This pattern runs counter to that reported by Steinwand (2015). Though he summarizes lead donorship over a slightly different period, 1970 to 2010, even for the years that overlap with the results presented here, we identify opposite trends in lead donorship.

Part of the incongruence between these results lies in the choice of aid variable. While Steinwand (2015) uses aid disbursements, I use aid commitments. The former often closely

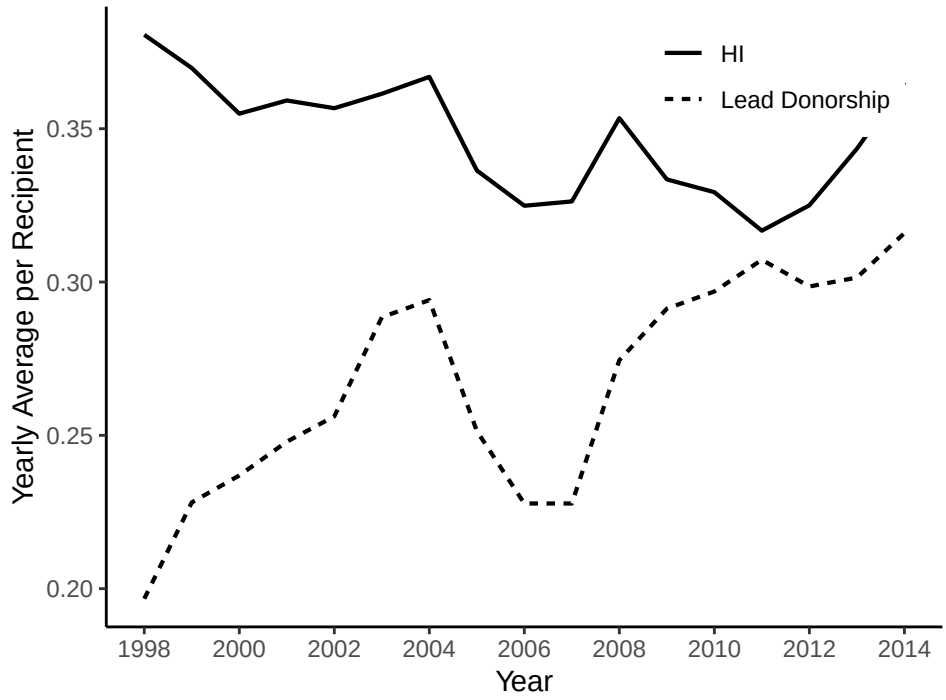

Figure 4.3: Values computed using the giving of 29 DAC countries across 24 development sectors to 127 recipient countries.

reflects the latter but with varying lags since commitments most closely match immediate changes in donor policy while disbursements represent downstream realizations of that policy over time. In a given year, Germany may commit a certain amount of aid to Indonesia, but that aid may be disbursed in installments over several years, for instance.

An additional difference is my choice to use the OECD's Creditor Reporting System (CRS) to isolate aid dollars committed specifically toward the 24 development sectors defined by the OECD. The total package of aid donors give often includes funds for overhead, staffing, administration, etc. I exclude such costs since they can be highly idiosyncratic to donors and across recipients and do not capture the types of budget support, debt relief, and sector-specific resources that have greatest material relevance for recipient outcomes. That Steinwand (2015) observes a decline in lead donorship over time may follow from the inclusion of overhead in aid totals—which will have increased across donors over time as aid agencies and start-up costs for projects grow. Including these

funds, then, may have obscured the degree to which lead donorship across development sectors has, in fact, increased over time.

Donor interest (DI) and recipient need (RN) are again key explanatory variables in the analysis. To re-summarize, DI and RN are composite measures that capture variation in the strength of donors' foreign policy interests and the depth of recipient need for aid, respectively. RN is comprised of the following variables, each measured at the level of aid recipients:

- yearly per capita gross domestic product (GDP);
- yearly population size;
- the yearly number of individuals killed due to natural disasters;
- an indicator for whether the recipient is experiencing a civil war in a given year;
- the yearly level of political and civil liberties of a recipient.

DI was constructed from the following four variables:

- bilateral distance (in kilometers) between a donor and a recipient;
- bilateral trade (in dollars) between a donor and a recipient;
- an indicator for whether the donor and recipient are formal allies;
- an indicator for whether the donor and recipient share a colonial past.

DI and RN, of course, were constructed using the sum of the squared covariances method outlined in Chapter 2.

While RN requires no additional modification for this analysis, because *relative* donor interest has greatest theoretical importance, modify the measure of DI to reflect the share of interest-based factors for one donor relative to all others in a recipient in a given year:

$$\tilde{\text{DI}}_{irt} = \frac{\text{DI}_{irt} - \min_{rt}\left(\text{DI}_{irt}\right)}{\sum_i \left[\text{DI}_{irt} - \min_{rt}\left(\text{DI}_{irt}\right)\right]}. \tag{4.2}$$

The resulting measure denotes a donor i's comparative share of foreign policy interest in a

recipient r in a given year t relative to other donors.

Using the above measures, to test the prediction that lead donorship emerges at the confluence of high need and high comparative donor interest, I specify lead donorship as a joint smooth function of RN_{jt} and $\tilde{\text{DI}}_{ijt}$ using a generalized additive model (GAM):

$$\text{Lead Donor}_{ijt} = s\left(\text{RN}_{rt}, \tilde{\text{DI}}_{irt}\right) + \delta_i + \gamma_t + \sigma_{ir} + \varepsilon_{irt}. \tag{4.3}$$

The terms δ_i and γ_i denote donor and year intercepts, respectively, to account for unobserved donor characteristics (resource endowments for example) and yearly shocks. The term σ_{ir} denotes a set of random dyadic intercepts that explicitly model within-dyad dependence and between dyad heterogeneity. The function $s(\cdot)$ denotes a multivariate smoother. This is a set of summed smooth linear basis functions which together accommodate non-linearities in the joint relationship between predictors and an outcome.[4]

I adopt a this more flexible non-linear approach because the argument I seek to test is not a simple directional linear hypothesis. Rather, it centers on a set of conjoint conditions under which lead donorship will emerge. A multivariate smoother is not only sufficient to test this prediction, it has the advantage of not being sensitive to the parametric assumptions that would attend a more conventional linear regression with a second order interaction term. Since lead donorship is bound to the unit interval, a linear regression would potentially yield predictions outside this range. While this could be accommodated using either a logistic transformation of the response or a fractional logit, such approaches would still involve the estimation of parameters that are linear in the logit. A generalized modeling approach (GAM) will account for the bounds in the response without the need to resort to methods that have stronger parametric assumptions.

Finally, to confirm that larger, or better resourced, donor governments are most apt to hold lead donorship status when it emerges, I cross-reference average levels of lead donorship with donor's gross domestic product (GDP) as measured by the Penn World

[4]The analysis is performed in R using `gam` in the `mgsv` package. See Wood (2017).

Table 4.2: GAM EDF Values with (Degrees of Freedom)

	(1)	(2)
	Full Sample	Only Lead Donors
Joint Smoother	27.241***	26.721***
	(28.777)	(28.629)
Donor FE	Yes	Yes
Year FE	Yes	Yes
Dyad RE	Yes	Yes
N	45,282	22,214
Dyads	3,421	1,364
Deviance explained	0.119	0.116

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table.[5]

4.6 Results

So what does the analysis reveal? GAM estimates are shown in Table 4.2. Column 1 shows results estimated using the entire data sample, and column 2 shows results limiting the sample to only donors that have ever held lead donor status (more on this later). The first model was estimated using a total of 45,282 dyad-year observations, composed of 28 donors and 124 recipients, which comprise 3,421 unique dyads. For reference, the Supplemental Materials include summary statistics.

The entries shown in the table are not regression coefficients but instead effective degrees of freedom (EDF) over degrees of freedom in parentheses. The p-values are for a chi-squared test for the joint smoother applied to DI share and RN. In both the full sample and the restricted sample, the chi-squared is statistically significant at $p < 0.001$, meaning we can reject the null that DI share and RN do not predict variation in lead donorship.

These estimates are useful, because they are consistent with DI share and RN jointing predicting variation in when and where a donor holds lead donorship status. However, to see whether the relationship between these variables and the outcome is as the theoretical argument predicts, we need to obtain predicted values for the response.

[5]See Feenstra, Inklaar, and Timmer (2015). The data is available at https://doi.org/10.15141/S50T0R.

Figure 4.4 shows the predictions for the model summarized in column 1. The figure presents the predictions as a heat map where darker red denotes a greater probability of lead donorship. Correspondence between shades of red and probabilities is given in a legend in the figure. Along the x-axis, RN varies from low to high, and along the y-axis DI share varies from low to high. Because the specification included donor and year fixed effects and random dyadic effects, it was necessary to select a discrete value for each when generating predictions. For this particular set, I have fixed the donor as the United States, the year to 2005, and the dyad to US-Malawi. This choice is purely illustrative, and different selections do not significantly alter the predictions. The results offer clear support for the prediction that lead donorship emerges at the confluence of high comparative donor interest and high recipient need. The highest probabilities of lead donorship cluster at high RN and high DI share values. At the confluence of high values of each, the probability of lead donorship is greater than 80%. Meanwhile, when RN is high, but DI share is low, the probability of lead donorship drops below 20%. Conversely, when DI share is high, but RN is low, the probability of lead donorship is less than 40%.

Of course, the theoretical argument holds that lead donorship is more than just a function of DI share and RN. It also is contingent upon donor resources. Figure 4.5 reports the rates of lead donorship per donor. The United States most often holds lead donor status in recipients. This comes as little surprise. In terms of total ODA, the US regularly outpaces other donors in absolute spending. This gives it an advantage in rising to the top when and where its foreign policy interests are strongest, both in absolute and comparative terms. Japan historically has come in second in terms of ODA spending, so it follows that the frequency with which it holds lead donor status is second only to the US. France comes in second, Japan third, followed by Germany, the United Kingdom, and the Netherlands.

This pattern correlates quite cleanly with donors' available resources. Figure 4.6 plots rates of lead donorship over the average of donor GDP (in trillions) for the 1998-2014 period. A clear relationship exists between GDP and frequency of lead donorship. This

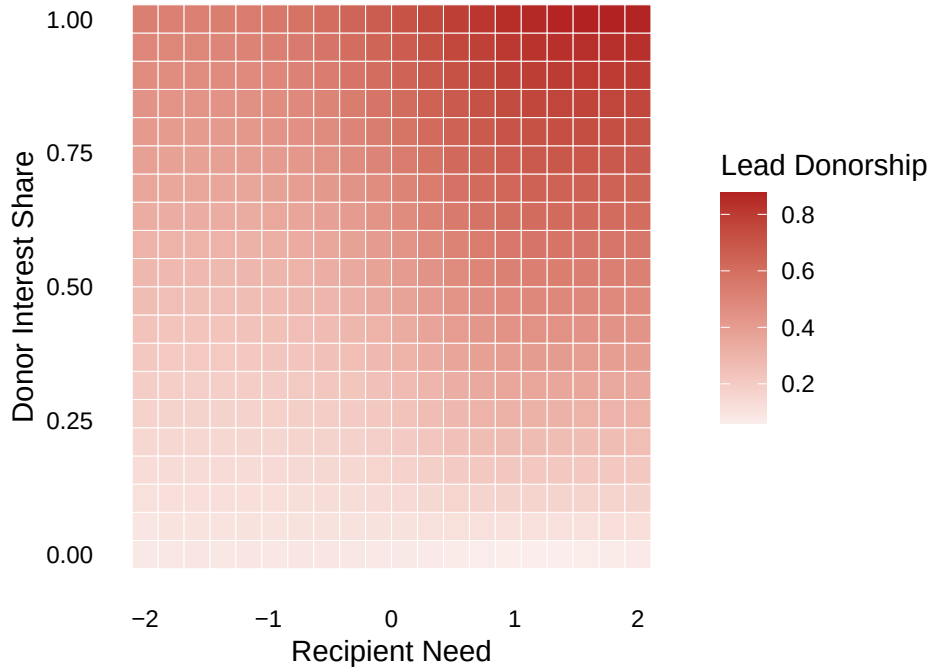

Figure 4.4: Predicted level of lead donorship status in a recipient for a given donor. Results shown for United States in 2005 to illustrate.

supports the argument that lead donorship status follows not only from more motivated donors taking the lead in high need recipients, but also from the fact that better resourced donors will most often be placed in a position to support collectively beneficial goals. As smaller donors pass the buck in order to direct more resources in support of rival non-development goals or in recipients where development needs are more important for them, larger donors are forced to contribute an outsized share of aid where common interests are most salient.

On this point, it bears noting that a number of donor governments never actually achieve non-zero lead donor status. Figure 4.7 brings this fact into sharper relief by using a donor by year grid to indicate years where a donor has non-zero lead donor status in at least one recipient. The donors are in descending ordered by their average GDP from 1998 to 2014. While larger donors—the US, the UK, Japan, Germany, and France—stand out for their enduring leadership, many other donors never approach such a level of dominance

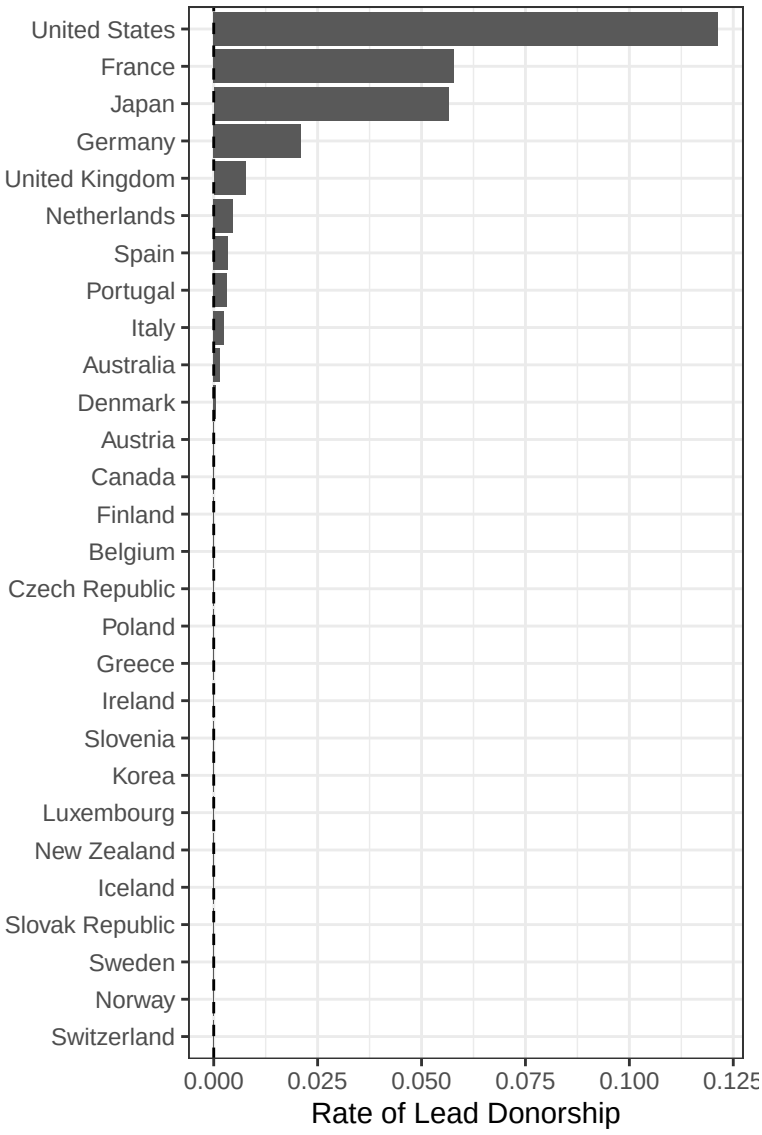

Figure 4.5: Who leads most frequently?

in any recipient country. In a list that includes Austria, Canada, Finland, and Switzerland, many of the donors in the sample never achieve non-zero lead donorship.

This fact, in addition to being normatively interesting, points to a number of donors in the dataset that provide no variation in the dependent variable. The largest donors, therefore, are the ones driving the main results. Indeed, the output from the analysis changes little if the analytical sample is restricted to only those donors that ever achieve lead donorship. Column 2 of Table 4.2 reports the EDF for the joint smoother on DI

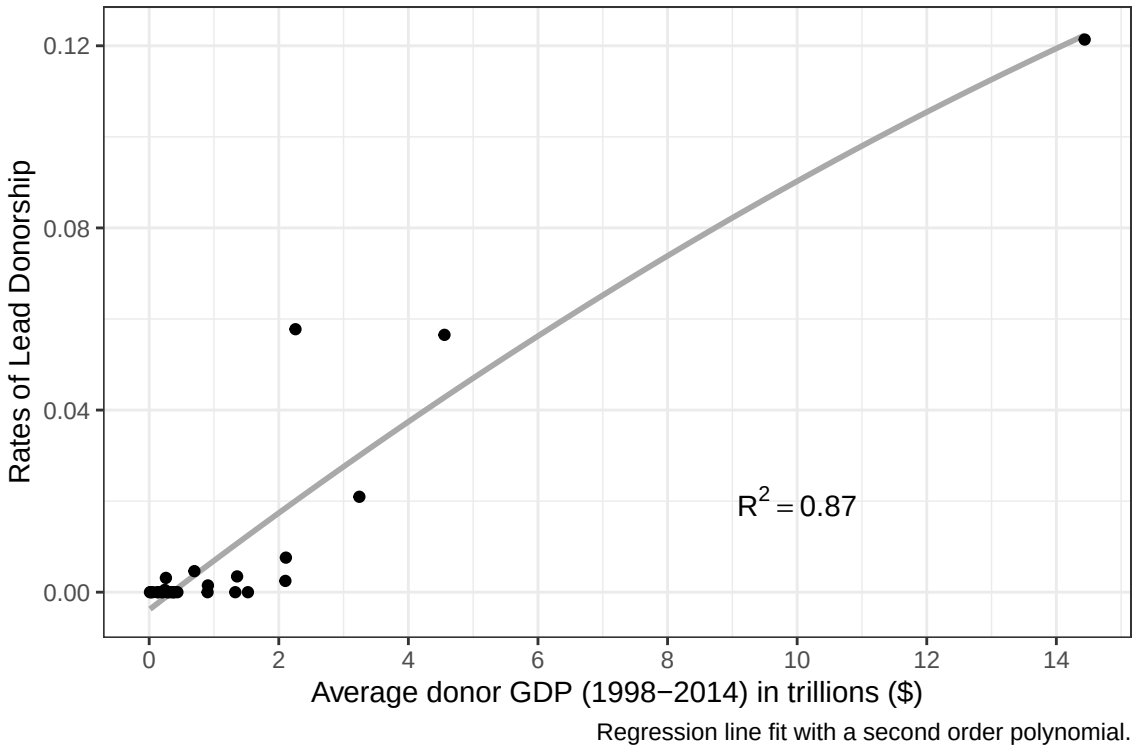

Figure 4.6: Donors with larger economies have a greater likelihood of holding lead donor status.

share and RN with this more constrained sample. The smoother is similarly statistically significant. Though not shown here, the model predictions do not change substantially with this restricted sample.

4.7 Lead Donorship in Souteast Asia and South America

The patterns identified in the previous analysis support the view that lead donorship follows from an uncoordinated general equilibrium among donor governments. A donor has the greatest likelihood of holding lead donor status in high need recipients where its ties with said recipients are comparatively stronger than for other donors. At the same time, better resourced donors are the ones that take the lead when lead donorship does emerge.

The confluence of these factors characterizes a set of conditions where one donor has

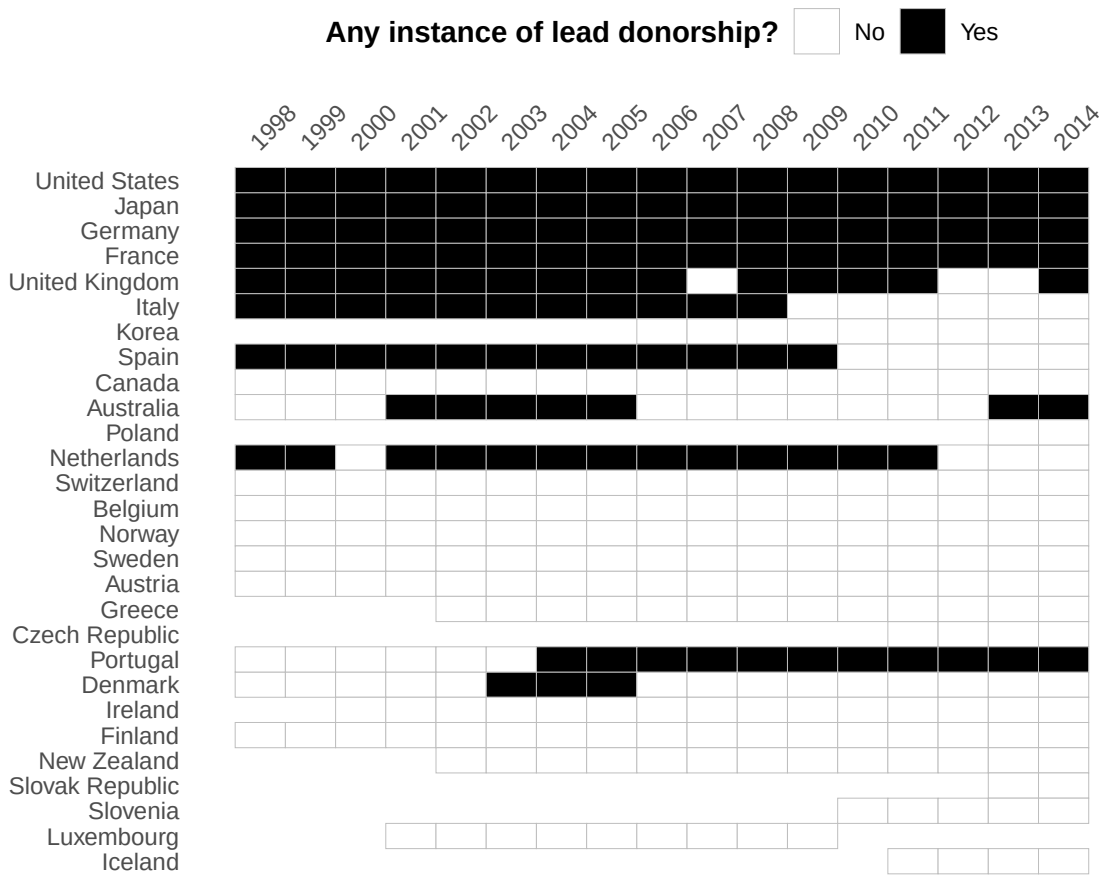

Figure 4.7: Years where a donor is coded as having non-zero lead donorship in at least one recipient.

the greatest incentive to support its goals in an aid recipient while others have the greatest incentive to show deference as they enjoy the development-promoting effects of aid from the lead donor without having to contribute as much or any aid themselves.

Data, of course, are noisy. The sample collected for this analysis is no exception. Some error is to be expected, but as long as the overall averages are calculated with a high level of statistical precision, this is no serious problem. However, it would be premature to write off all deviant cases as the product of random error. Sometimes, taking a closer look provides unanticipated qualitative insights. Perhaps additional mechanisms need to be considered, or maybe cases that on their surface are outliers are exceptions that prove the rule.

Seawright (2016) enumerates two useful criteria for selecting cases for qualitative examination. The first is deviant case selection. This approach involves identifying cases that deviate most substantively from their prediction given their values on explanatory variables of interest. As Seawright (2016) notes, these cases provide an opportunity to, more narrowly, identify omitted variables and to, more broadly, find sources of measurement error in an outcome. Additionally, deviant cases provide a chance to identify new causal pathways that connect explanatory variables to a response.

The second is "extreme-on-X" case selection. These are cases that have extreme values for an explanatory variable. Seawright (2016) argues such cases represent "a powerful, underappreciated approach to choosing cases for in-depth analysis" (92). Extreme-on-X case selection can support the same objectives as selecting deviant cases, but from a slightly different angle—one that leverages the extremity of explanatory variables to consider other factors that make the case itself extreme.

With these strategies in mind, in this section I briefly take a closer look at lead donorship in two regions: Southeast Asia and South America. The first provides an opportunity to examine deviant cases. As will be summarized below, Japan stands out for its clear role as lead donor in this region. However, other donors—the United States and France—have comparative foreign policy interests in the region on par with, or that exceed, Japan's. So why does Japan dominate?

The second case, South America, represents an extreme-on-X set of cases—specifically for comparative foreign policy interest. Relative to other donor governments, this region has outsized foreign policy importance for the United States. However, despite this, the US's dominance as lead donor is less prevalent than we would expect.

In the first set of cases, examination of Japan's dominance reveals an important role for relative strength of foreign policy interests *within* donors. While the measure of donor interest (DI) share captures the importance of a recipient to one donor relative to others, it fails to characterize the importance of a recipient to a donor relative to its foreign policy

priorities elsewhere. In the case of Southeast Asia, both France and the United States have interests nearly as strong or stronger than Japan's in absolute terms. However, compared to its other priorities, Japan's interests are heavily concentrated in Southeast Asia relative to other regions. At the same time, the US and France have stronger foreign policy interests elsewhere. This suggests an additional dimension of donor interest that has relevance for lead donorship.

The second set of cases highlight the role of other, unmeasured political and material forces at work in donors and recipients. Specifically, the lower-than-expected leadership by the US in South America can be traced to economic conditions in the US, changes in recipient need in South America, and hostility by recipient governments toward US economic assistance. At the same time, the factors that make the US an exception help to prove the rule in other donors in the region. In response to changes in US giving, the remaining top donors in the region respond as theory would predict by giving more aid in the face of a contracting supply of financing from the US.

4.7.1 Southeast Asia

Japan has near unrivaled dominance in its foreign aid giving in Southeast Asia. While this will come as no surprise to many, on paper such unequaled leadership is not a foregone conclusion. Due to its colonial and economic ties with the region, France has strong interests in many of the countries in Southeast Asia as well. To a lesser extent, so does the United States. Though its priorities primarily lie in the Philippines, the United States has interests on par with Japan and France in Thailand as well. What explains Japan's unparalleled role as lead donor in the region?

Aid recipients in Southeast Asia include Cambodia, Indonesia, Laos, Myanmar, the Philippines, Thailand, and Vietnam. According to the composite RN measure, each has above average need for aid. Figure 4.8 reports for these seven countries where their RN value falls in standard deviation units relative to the sample mean. This same metric is

reported for the component measures of RN with poverty and political freedoms adjusted so that higher values indicate higher poverty and greater restrictions on liberty.

While these countries have above average need for aid, they lack uniformity in the sources of this need. Indonesia has a large population, a disproportionately high loss of life from natural disasters, and a higher than average frequency of civil war years. At the same time, its poverty level falls just below the sample average, as does its limits on political and civil liberties. Laos, conversely, has near or slightly below average levels of poverty, population size, deaths from natural disasters, and incidence of civil war, while its citizens face comparatively more political and civil restrictions.

In terms of the foreign policy importance of these countries to donors, we observe considerable variation in the degree and sources of donor interest in the region. As in the previous figure, Figure 4.9 reports the measure of donor interest (DI) for each donor in each recipient in standard deviation units relative to the sample mean. In most cases, Japan has stronger interests compared to the other two donors, especially in Indonesia and Myanmar. However, France does not fall too far behind Japan in Cambodia, Laos, and Vietnam. The US, meanwhile, has only modestly weaker interests than both Japan in the Philippines.

The figure also reports the values of the component measures of DI. Though a number of common drivers of donor interest reveal themselves, the pattern that immediately catches the eye is that France and the United States have their strongest interests in former colonies. However, despite the appearance of an outsized influence for colonial status, in the construction of the DI measure colonial past is given comparatively less weight relative to distance and alliances. Other factors, like trade, track quite consistently across donors and recipients as well. The most obvious difference in drivers is proximity. Given their location in Southeast Asia, Japan has closest geographic proximity to each of the aid recipients.

While the data would predict that Japan has incentives hold top donor status in the

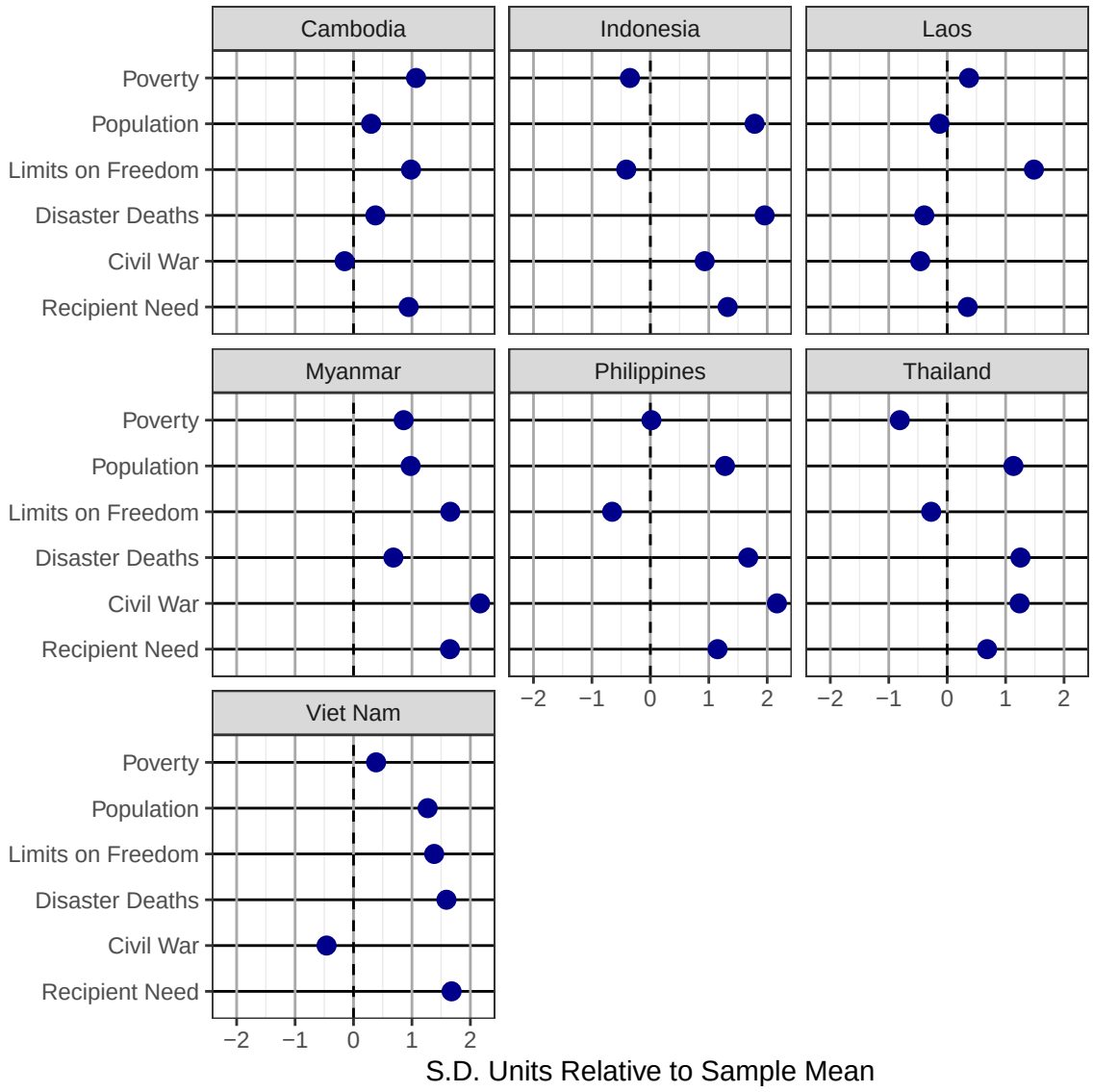

Figure 4.8: Characterizing need in Southeast Asia relative to the sample.

region, there is little indication why either France or the United States would care to let Japan take a disproportionate lead. To the contrary, they have reasons to value supporting development goals in recipients as well. Nonetheless, when it comes to giving aid to these countries, Japan's ODA commitments far exceed those of the other two donors.

The disparity in aid giving is stark. Figure 4.10 reports total ODA commitments across the 24 key development sectors defined by the OECD from these three donors from 1996 to 2014 in millions of 2017 constant US dollars. While Japan's giving ranged from around 500

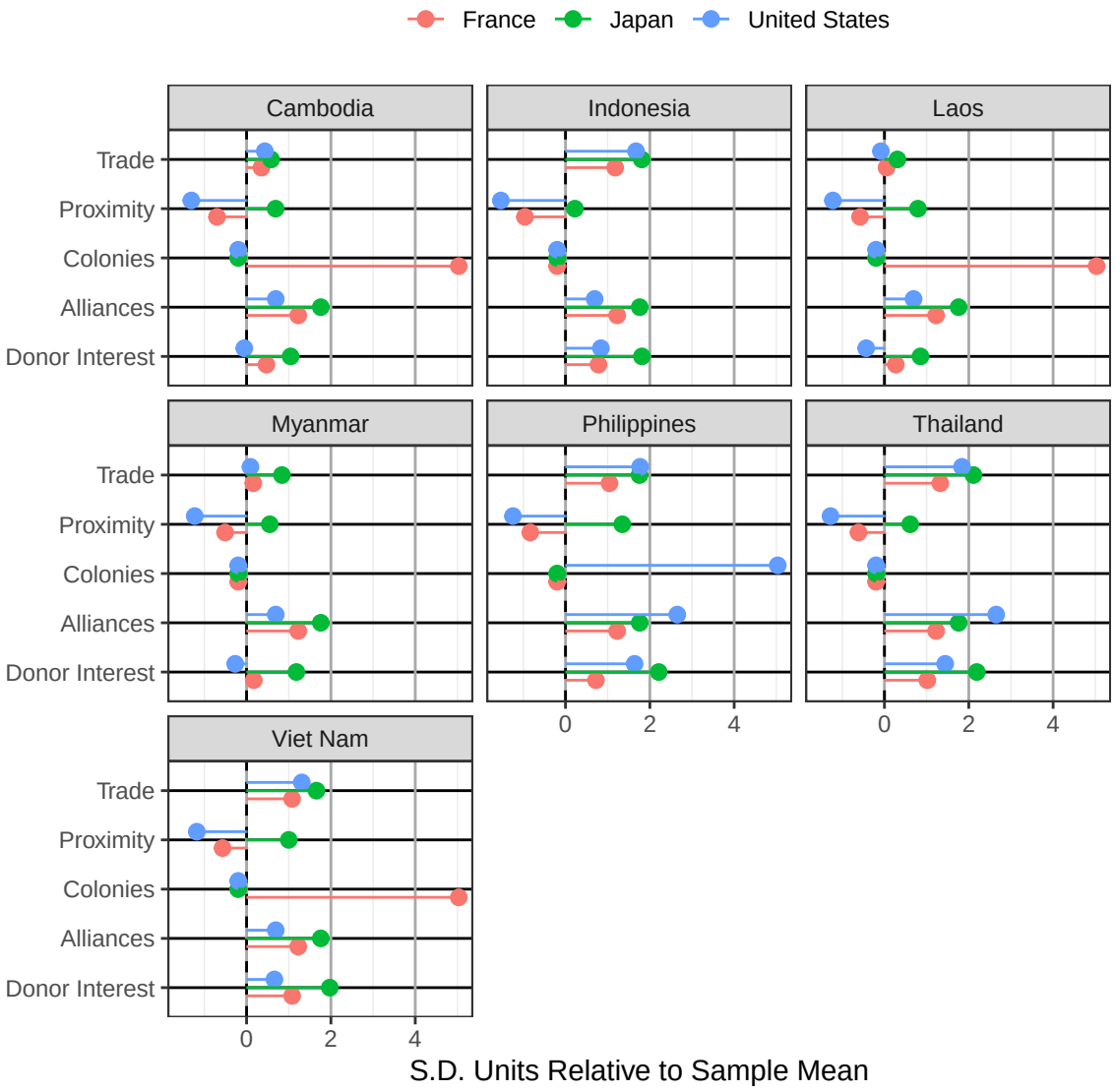

Figure 4.9: Characterizing donor interests in Southeast Asia relative to the sample.

million to well over 2 billion dollars, the giving of France and the United States barely ever came close to 250 million dollars in total. The 2013 spike in Japanese aid is driven almost entirely by debt forgiveness to Myanmar (Burma) as a reward for progress on liberalizing reforms.

This outsized contribution of aid is consequently captured in the measure of lead donorship. Figure 4.11 shows the average aid shares contributed by donors to each recipient. Diagonal lines denote whether a donor ever held non-zero lead donorship in at

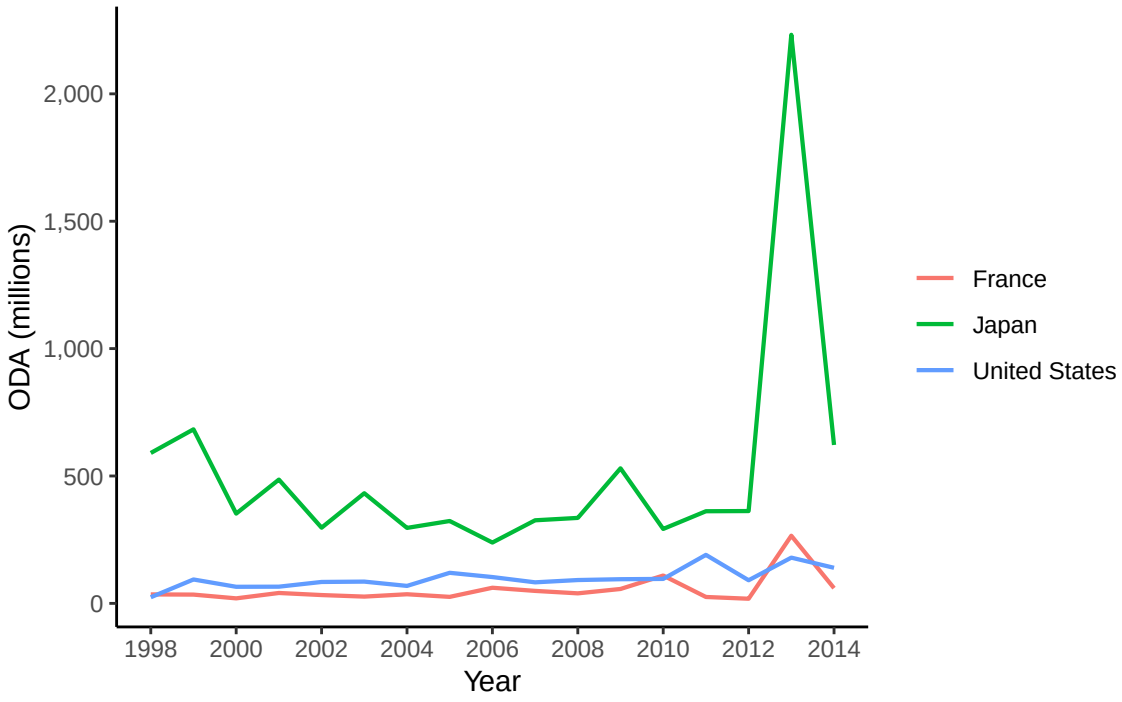

Figure 4.10: ODA across 24 sectors to countries in Souteast Asia.

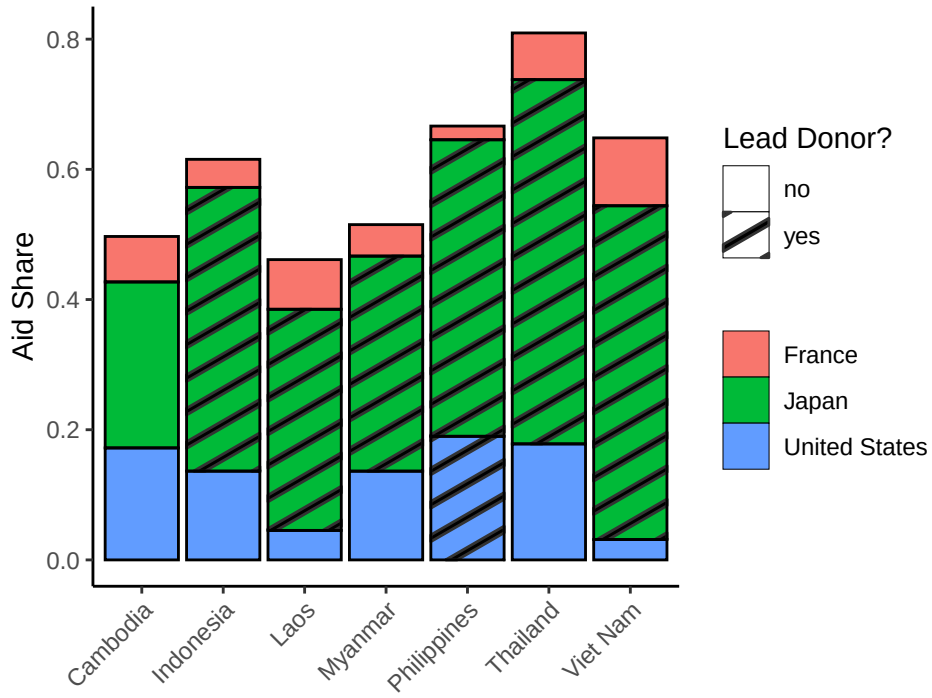

Figure 4.11: Who leads in Southeast Asia?

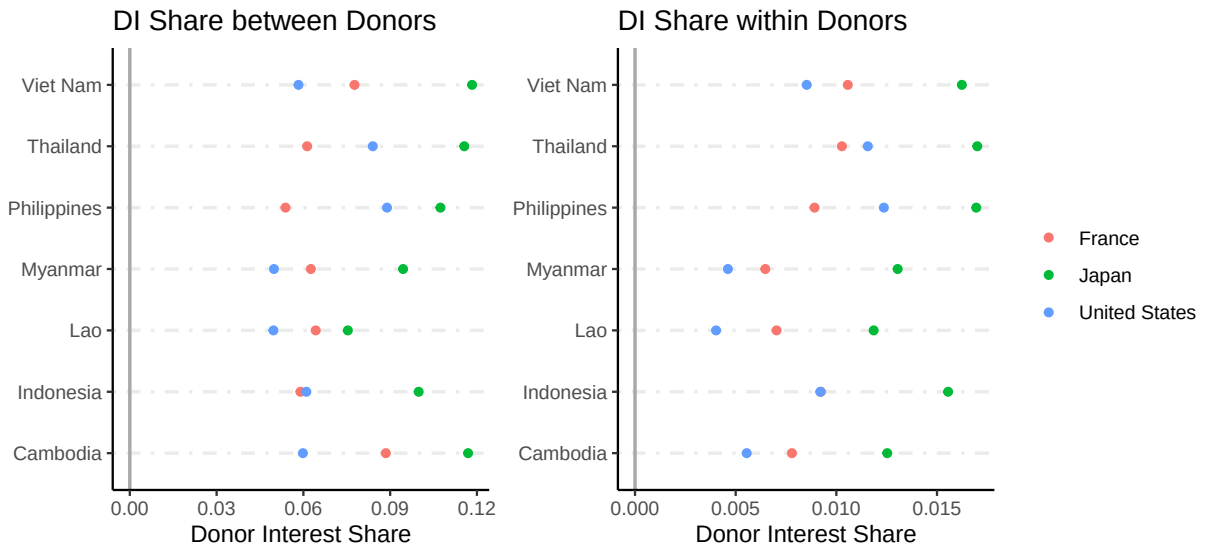

Figure 4.12: Comparative donor interest in Southeast Asia.

least one year in the period under study. Out of the seven recipient countries, Japan has maintained lead donor status in six. The US is the only other donor to hold lead donor status in the region, namely, in the Philippines. Though not captured by Figure 4.11, the United States' role as lead donor was short lived. Examination of lead donorship over time indicates that the US only held lead donor status in the Philippines from 2011 to 2013.

Many possible explanations may account for Japan's dominance. As noted in the forgoing analysis, resource constraints play a role in facilitating lead donorship. However, this explanation has little currency in the case of Southeast Asia. The United States holds lead donor status with the greatest frequency across all developing countries worldwide relative to other DAC members and has the largest reserve of resources to do so as measured by GDP. Further, while Japan's average GDP from 1998 to 2014 was nearly double that of France, France nonetheless maintains lead donor status across all recipients with a frequency nearly equal to Japan.

Alternatively, geographic proximity might have special relevance. Southeast Asia garnered unique attention from Japan dating back to Tokoyo's post-war reparations to countries in the region in the 1950s (Rudner 1989). More recently, scholars cite *Kokueki*

(or national interest), as the critical motivating factor of [Japan's] foreign aid policies," especially with respect to trade in Asia and the Indo-Pacific (Schraeder, Hook, and Taylor 1998, 300).

However, tempting as it is to credit to geography previously unrecognized explanatory power, a notable pattern in the data bears mention.[6] Figure 4.12 shows *comparative* donor interest in each recipient country with respect to two different points of reference. The left panel shows the measure of comparative DI used in the main empirical analysis. This captures the relative strength of a donor's foreign policy interests in a recipient compared to other donors. Here, we clearly see that while Japan has comparatively stronger interests in the region, the gap is not massive in absolute terms. However, the right panel shows comparative DI, not with respect to all donors in a given recipient, but for a given donor relative to its priorities elsewhere. Here, Japan stands out for its stronger interests in Southeast Asia compared to other areas of the world. France and the United States, alternatively, have comparatively stronger interests in different developing countries.

This captures an overlooked dimension of donor interest in the main analysis. While it in part matters for lead donorship which donor has stronger interests in a recipient relative to other donor governments, it also matters how interested a donor is in a recipient compared to its interests in other recipients. This finding is actually consistent with the theoretical model analyzed in Chapter 1. Donors will economize by prioritizing developing countries on the basis of the *relative* benefit they receive from promoting foreign policy and development objectives in recipients. Japan's interests concentrate most in Southeast Asia. This means that Japan has the greatest incentive to dedicate the plurality of its aid budget to countries in the region. This confers it with a comparative advantage in supporting its objectives in Southeast Asia and, thus, seems a sensible explanation for its observed dominance.

[6] The "stopping power of water" has fewer teeth when it comes to financial flows in a globalized world (Mearsheimer 2001).

4.7.2 South America

In contrast with Southeast Asia, where Japan's unrivaled dominance was the puzzle, in South America the puzzle is the *lack* of dominance by the United States. Though there is no contemporary equivalent to the Monroe Doctrine in international development, for historical, material, and strategic reasons South American countries have special importance for US foreign policy. Yet, in terms of the measure of lead donorship used in this study, a number of donor governments rival the United States in terms of foreign aid giving. Why does the US not dominate in South America in the same way that Japan dominates in Southeast Asia?

The 11 developing countries in South America in the dataset are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Suriname, Uruguay, and Venezuela. Relative to Southeast Asia, these countries vary substantially in their relative need for aid, as shown in Figure 4.13. At one extreme is Suriname, which has comparatively low need for aid as measured by RN. In terms of the component measures of need, relative to the total sample, Suriname stands out for lower levels of poverty, its small population, comparatively few limits on political and civil liberties, lower death toll from natural disasters, and infrequent instances of political violence. At the other extreme, Colombia has the highest average value on the RN measure out of countries in South America. Its values on the component measures reveal that Colombia has greater need for aid due to its relatively large population, yearly average of natural disaster deaths, and frequency of civil war.

A number of DAC members give aid to countries in South America, but the top five donors in terms of total contributions are France, Germany, Japan, Spain, and the United States. However, among these donors, only the US stands out for its interest-based drivers of international aid in the region, as indicated by Figure 4.14. In terms of the component measures of DI, all of the donor governments have above average levels of trade with countries in South America, but the US engages in the highest volume of trade across all

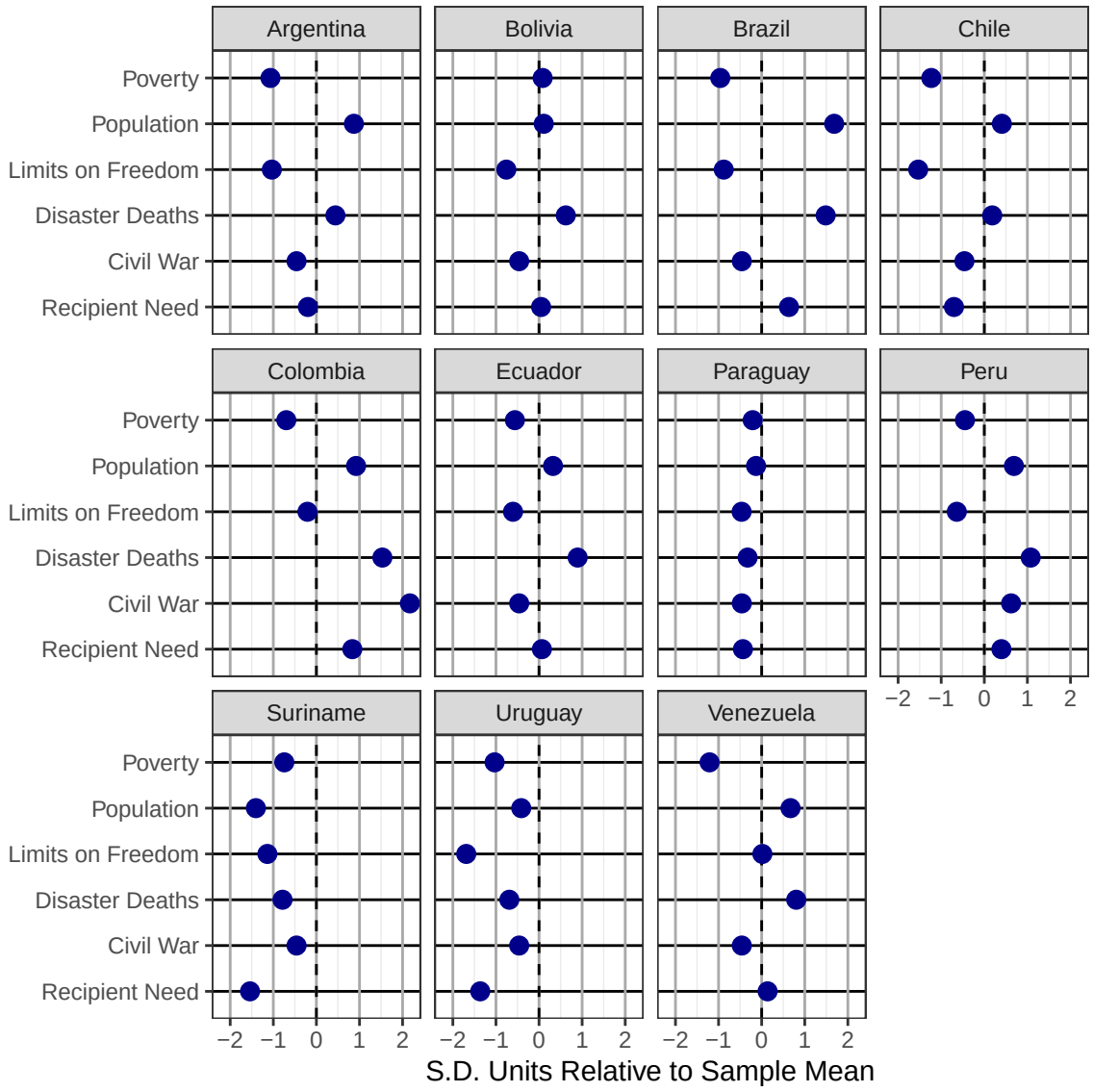

Figure 4.13: Characterizing need in South America relative to the sample.

aid recipients. These countries also have comparatively greater importance for the US by virtue of their proximity. However, much of the difference in importance these recipients have for donors lies in the former colonial status of all but two South American countries for Spain and in the alliance status between all the recipients and the United States.

By all accounts given the spread of recipient need in South America and the uniquely strong foreign policy interests of the US, it follows that the US should have unequaled lead donor status in the region, particularly in the highest need recipients.

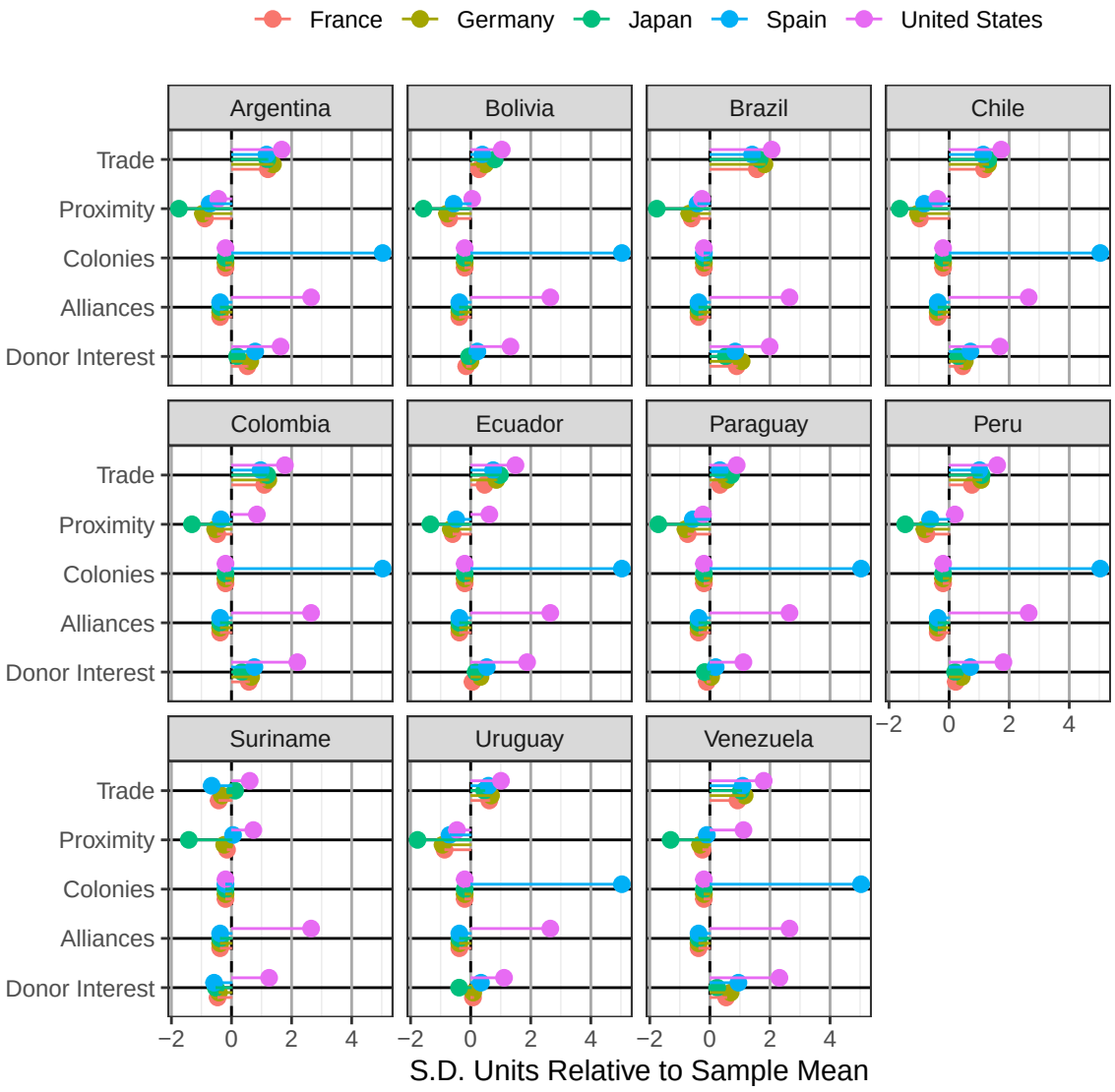

Figure 4.14: Characterizing donor interests in South America relative to the sample.

Nonetheless, as Figure 4.15 highlights, in terms of average aid shares in each recipient, not only does the United States not comprise the largest share of total aid giving in several recipients, it also has held non-zero lead donorship in only three of the 11 countries in South America in the dataset. At the same time, the other four top donors to the region have held lead donor status for at least a year in one or several recipients.

Unlike with Japan in Southeast Asia, an explanation that relies on comparative interests in the region does not apply in the case of South America. Figure 4.16 shows in the

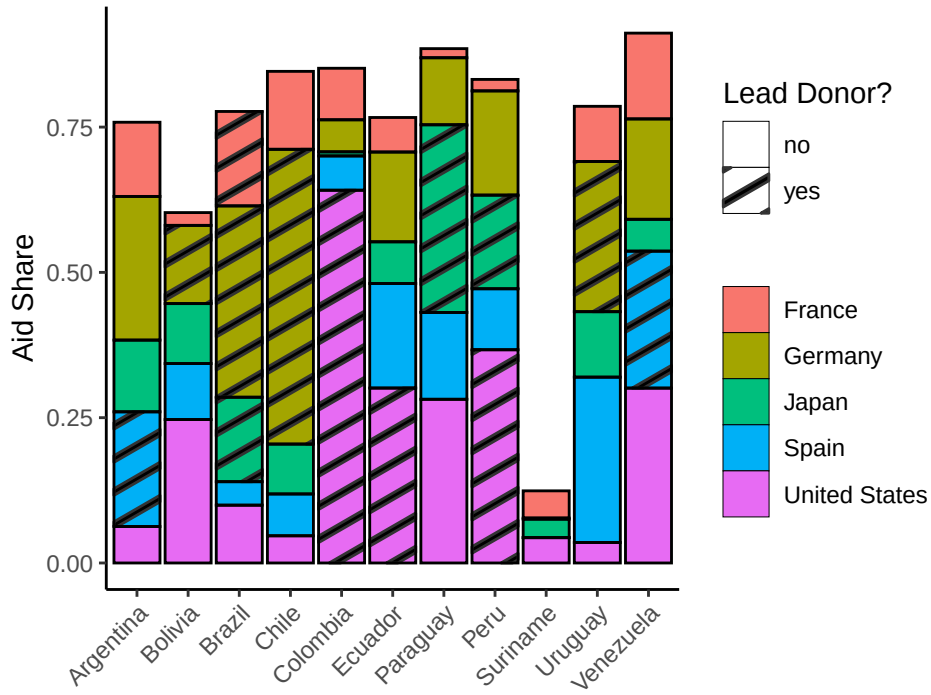

Figure 4.15: Who leads in South America?

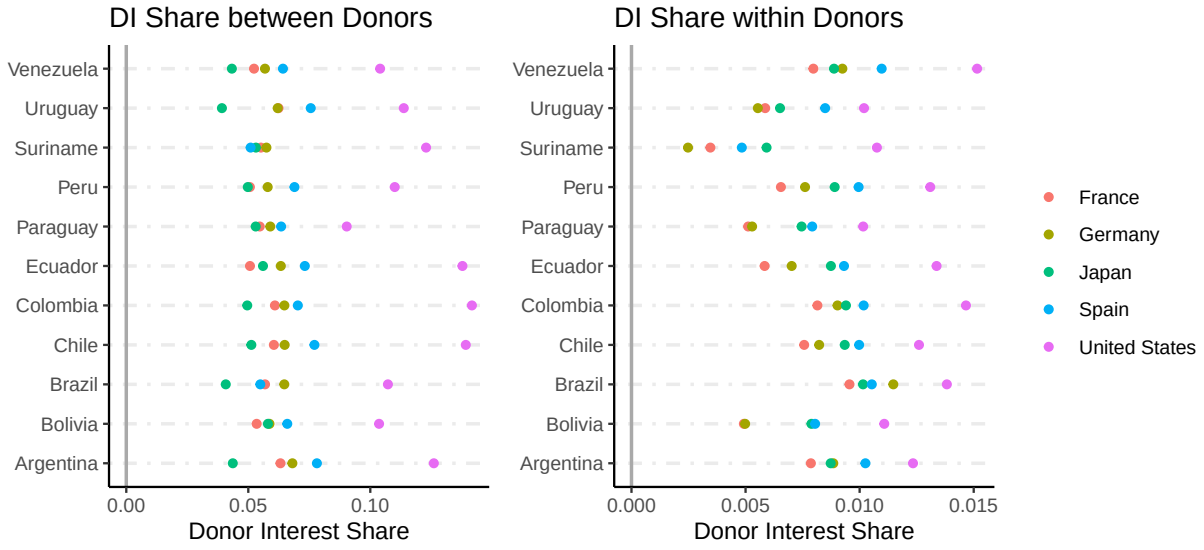

Figure 4.16: Comparative donor interest in South America.

left panel the average comparative DI measure used in the main empirical analysis for each donor in each recipient. The right panel shows average comparative DI, but with respect to a donor's interest in a recipient relative to its interests elsewhere. In both cases,

Figure 4.17: ODA across 24 sectors to countries in South America.

the United States has comparatively strong interests in South America.

Some clues begin to emerge by inspecting the total contributions of donors to the region over time. Figure 4.17 shows total ODA commitments across the 24 development sectors in millions of US dollars to the 11 aid recipients in South America included in the data. Between 2000 and 2008, the United States' contributions to the region vastly exceed those of the other four donor governments. This trend starts to change after 2008, and by 2012 France, Germany, and Japan's giving either exceeds or approaches the United States'. This shift coincides not just with the decline in US aid, but also with an increase in aid from these other donors.

This change cannot be linked to particular covariates in the dataset. Instead, it can be traced to shifts in other political and material factors at work in the United States and in South America.[7] Throughout much of the 2000s the US prioritized combating drug trafficking and putting and end to conflict, particularly in Colombia, but also in several

[7]Details come from the Congressional Research Service Report titled "US Foreign Assistance to Latin America and the Caribbean: FY2021 Appropriations" published Jan. 7, 2021. Accessed Feb. 23, 2022.

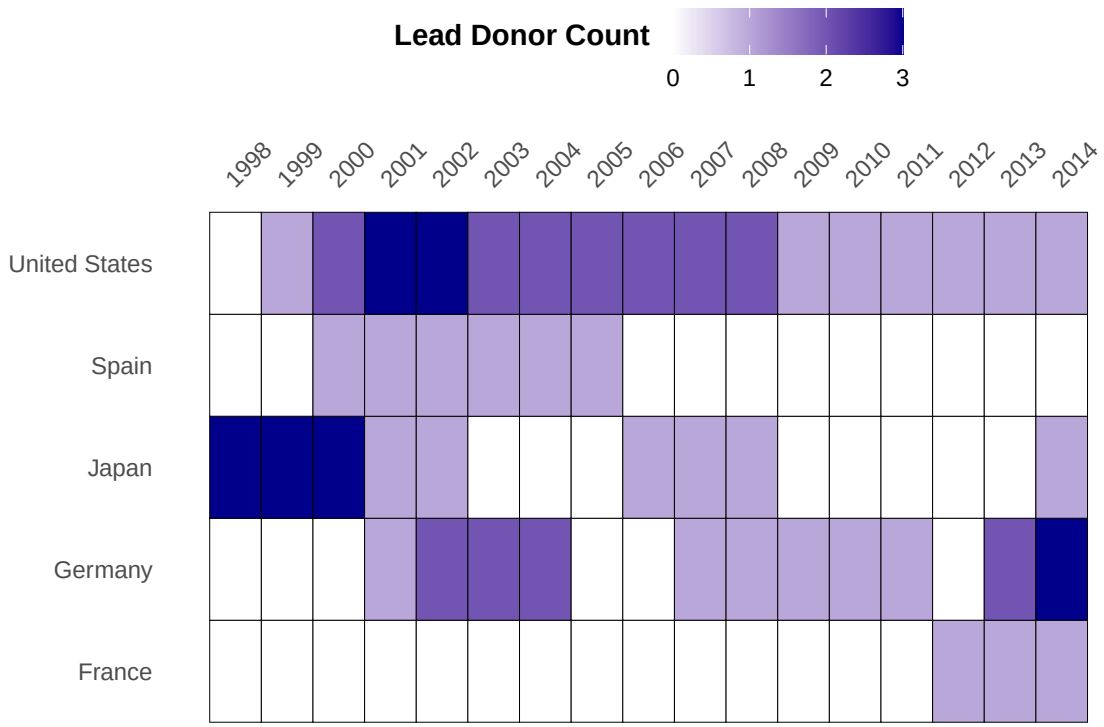

Figure 4.18: Frequency of non-zero lead donorship in South America per year.

of its neighbors. Starting with the Clinton Administration and continuing under Bush, a succession of initiatives and resources were allotted in support of this goal, which accounts for the outsized ODA commitments to the region by the US during this period.

However, in the wake of the 2008 financial crisis and subsequent recession, Washington made widespread cuts in its foreign assistance, not only in South America, but globally. At the same time, the twenty-first century saw several South American countries experience economic growth. Some aid recipients even became aid donors, sending assistance to other countries in the region. Perhaps most notably, beginning in 2011 some recipient governments, including Bolivia's, effectively boycotted US assistance in their countries by rejecting aid projects and expelling US personnel. Leaders of these countries cited US "meddling and conspiring against the government" as their reason for proscribing US aid.[8]

These changes, in turn, map to shifts in lead donorship in South America over time.

[8] "Bolivian President Evo Morales orders expulsion of USAID." Published by *CNN* on May 1, 2013. Accessed Feb. 23, 2022.

Figure 4.18 notes the yearly count of recipients per donor where said donor has non-zero lead donor status. The height of US leadership is 2001 and 2002, with sustained leadership in at least two recipients from 2000 to 2008. This period of relative dominance coincides with lower levels of lead donorship among the other four donors. We then witness a shift after 2008 where the US dominates in only one recipient (Colombia) while Japan, Germany, and France—the donors with the least foreign policy interests in the region—hold lead donorship with progressively greater frequency.

The surprising lack of sustained and widespread lead donorship by the United States in South America, then, highlights an obvious role for political and material factors beyond those captured in the main analysis in determining when and where lead donorship emerges. But, to be sure, the economic growth experienced by several South American countries plays a role, too—one that is in fact consistent with the expectation that lead donorship arises in higher need contexts. However, growth alone does not explain the decline in US leadership, as the other political and economic factors highlighted above indicate.

Nonetheless, changes in US giving provide other donor governments an opportunity to prove the rule. Consider Figures 4.17 and 4.18 in tandem and note, not only how US aid shifts over time, but also how the other donor governments' aid shifts in parallel. We can witness France, Germany, and Japan—four of the top aid donors in the data sample worldwide—increase their giving in the region in the wake of shortfalls in US giving.

This pattern is precisely what is predicted by theory. As a donor with more resources and strong interests in responding to recipient needs gives less aid, other donors that could previously defer responsibility to the US while they prioritize goals elsewhere now cannot rely so heavily on US giving. This creates rational incentives to substitute for some of the supply of aid that the US once provided.

4.8 Conclusion

In this final chapter, I tested the argument that donor governments will hold lead donor status (1) in high need recipients where interest-based factors are comparatively stronger for said donor relative to others and (2) when a donor is better resourced than its peers. The first set of conditions implies a development focus for donors (a non-rival goal) while the second confers a material advantage in financing international aid. These factors create rational incentives for smaller, less interested donor governments to defer responsibility for giving aid to better resourced peers. This allows smaller donors to give more aid elsewhere—either in recipients that receive less attention from larger ones or that are sites of rival non-development foreign policy objectives.

The findings from the statistical analysis are consistent with expectations. Better resourced donors are most likely to hold lead donorship status. Further, when these donors do take the lead they are most apt to do so in recipients where needs-based factors are high and their interest-based bilateral ties are comparatively strongest.

Following the statistical analysis, I examined patterns in lead donorship in Southeast Asia and South America. These two regions merit study as "deviant" and "extreme-on-X" cases, respectively. In the former, Japan exercises outsized dominance despite other donor governments having strong interests in Southeast Asia. In the latter, the United States stands out for its comparatively strong foreign policy interests, yet it nonetheless enjoys less preeminence than anticipated. These cases highlight additional material and political factors in donors and recipients that facilitate lead donorship. Some of these factors are related to mechanisms beyond those captured in the theoretical discussion in Chapter 1, which is why they are important to evaluate. But, other observed patterns support the strategic mechanisms proposed to explain variation in lead donorship.

Taken together, these findings highlight heretofore unexamined determinants of lead donorship. This has the potential to support future work on the impacts of foreign aid in developing countries. Some of the latest political science research on aid effectiveness

emphasizes the role of aid conditionality—conditions donors place on aid that a recipient government must enact in exchange for receiving funds—as a requisite for aid having a positive impact on development (Bearce and Tirone 2010; Girod 2012). When donor governments hold lead donorship status, does this affect their ability or incentives to impose conditions?

In addition, these results capture patterns in *which* donor governments take the lead. This also has significance for understanding the role of lead donorship in aid effectiveness. Donor governments take different approaches in dealing with developing countries. Not only do they tend toward different management styles in the implementation of development projects (Honig 2018), they also differently adjust their delivery of aid when confronted with poorly governed aid recipients (Dietrich 2016). Thus, a key contribution of this study is that it uncovers the data-generating process that determines not only when lead donorship emerges, but also which specific donor governments hold lead donor status.

Thus, a key question that should interest researchers in the future centers on the role of lead donorship in determining the ability of donor governments to credibly commit to conditionality. By having a sense for which specific donors take the lead and why, it will be possible to better evaluate connections between lead donorship and aid effectiveness. The factors that drive lead donorship may confound the effectiveness of international aid, so understanding the process that gives rise to lead donorship is essential for supporting future causal analysis of aid's effects.

Beyond the question of lead donorship, in light of the broader theme of this dissertation, the evidence presented here underscores all the more the implications of strategic interdependence in international aid. Not only does the strategic valence of donor objectives shape how they distribute foreign aid in and between developing countries, the general equilibrium that emerges from these interactions drives certain donors to the top in aid recipients. With this framework for understanding the dynamics that give rise to

Table 4.3: Summary Statistics

Variable	Mean	Median	S.D.	Min.	Max.
ODA	25.416	0.434	216.259	0.000	17,589.437
Lead Donor	0.012	0.000	0.092	0.000	1.000
DI share	0.046	0.045	0.023	0.000	0.250
RN	-0.003	0.059	0.997	-2.233	2.998
Income	7,610.305	5,688.651	7,308.095	188.939	47,925.836
Population	42.834	8.832	160.234	0.070	1,382.793
Disaster	474.852	1.000	7,202.888	0.000	222,658.306
Freedom House	-5.973	-6.000	3.428	-12.000	0.000
Civil War	0.176	0.000	0.381	0.000	1.000
Distance (km)	7,579.113	7,439.631	3,600.856	117.345	19,629.504
Trade	317.126	11.247	2,984.453	0.000	131,762.000
Colony	0.039	0.000	0.193	0.000	1.000
Alliance	0.124	0.000	0.329	0.000	1.000

lead donorship, it may be possible to consider institutions that promise more efficient distributions of global development assistance.

4.9 Supplemental Materials

Table 4.3 shows summary statistics for the full data sample used in the main empirical analysis. ODA and trade are in millions of 2017 US dollars.

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