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Tied Aid and Donor Generosity: How Tied Aid Affects Donor Utility and Changes Commitment Size

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Abstract
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Tied aid conditions bilateral aid packages, specifying that they must only purchase goods from the donor country. This paper offers a novel theory that tied aid policies incentivize donors to behave more generously in their aid allocations. After assessing this theory through a multiple regression analysis of donor-recipient-year level observations of DAC donors, the paper shows mixed results. While the initial regression indicates an unexpected negative relationship, later models show that tied aid and commitment size may have a non-monotonic relationship. However, the results remain inconclusive between these two possibilities. Depending on the true effect of tied aid, substantial policy implications for the tying of aid would follow, either offering a potential justification for the practice or removing that justification altogether.

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Tied Aid and Donor Generosity: How Tied Aid Affects Donor Utility and Changes Commitment Size

I. Introduction

Foreign aid is responsible for a massive flow of wealth from developed nations to less-developed countries (LDCs). In order to systematically define foreign aid, the Organization for Economic Cooperation and Development (OECD) coined the term Official Development Assistance (ODA). According to the OECD's prevalent definition, ODA must: 1) come from the public sector, 2) be granted with the goal of creating economic development, and 3) be composed of at least 25 percent grants (OECD 1985).[1] In 2015, donor countries issued over $131 Billion of net disbursements of ODA (OECD 2017). When including both official flows and private aid flows[2], the total comes closer to $315 Billion. The magnitude of ODA has risen sharply in recent years, as evidenced by statistics about the Development Assistance Committee (DAC), an international forum of the largest aid donors. The amount of ODA disbursed by DAC countries has increased from $68.5 Billion in 1986 to $131.6 Billion in 2015, as measured in USD constant prices (OECD 2017).[3] This represents a 192% jump in disbursements from the 30 DAC member nations, demonstrating a large overall shift towards a larger supply of aid.

Since foreign aid represents such a large transfer of wealth in the global economy, the question of how to maximize its effectiveness holds great importance. One influential aspect of the effectiveness of aid is the mechanism that donors use to grant aid. Examining aid

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[1] All of the following studies use this definition: Browne (1990), Burnell (1997), and Lancaster (2000). Note that after this point Official Development Assistance will be referred to as ODA and the Organisation for Economic Co-operation and Development will be referred to as the OECD.

[2] With respect to this statistic, official flows refer to a combination of Official Development Assistance and Other Official Flows, which combines to refer to grants and loans to developing countries or multilateral agencies that are undertaken by the official sector. Private flows, on the other hand, consist of flows at market terms financed out of private sector resources.

[3] Disbursements are distinct from commitments. Where commitment measures address the amount of aid promised by donor countries, measures of disbursements look at the amount of aid funding that actually gets distributed.

mechanisms offers real world implications regarding which institutions can more effectively

disburse aid and efficiently implement policy goals. One mechanism with implications on the

impact of aid is aid tying. Tied aid is defined as aid given by a donor country on the condition

that the recipient country spends the aid money on goods from the donor country **(**Easterly and

Pfuze 2008**).**[4] Today, tied aid accounts for roughly $20 Billion, or 20% of bilateral aid

commitments globally (OECD 2017).[5] As shown in Figure 1, tied aid has grown substantially as

an international practice, especially since the mid-2000s. The prevalence of tied aid, however,

varies strongly between countries. As Easterly and Pfuze (2008) note, donor countries tie their

aid in substantially different proportions. Where countries such as Norway and the United

Kingdom do not tie any aid, the United States, Greece, and Italy all tie over 70% of their aid.[6]

Thus, the practice of aid tying is highly concentrated in the foreign aid policy of some key

donors.[7]

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[4] This refers to specifically country-tied aid. Note that other forms of tied aid do exist, tied based on either the individual project or the outcomes achieved.

[5] Bilateral aid is disbursed from a donor nation to a recipient, while multilateral aid includes international organisations and non-governmental organisations (OECD 2005).

[6] Easterly and Pfuze (2008) came up with this number through a combination of old reporting data and anecdotal evidence, since the United States stopped reporting their proportion of aid tying.

[7] See Appendix C, which details the concentration of aid tying by donor countries in the dataset used by this paper.
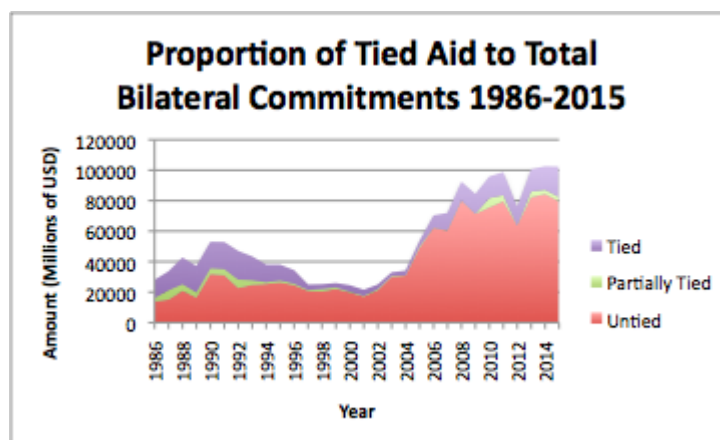
Proportion of Tied Aid to Total Bilateral Commitments 1986-2015

Amount (Millions of USD) — Year

Tied / Partially Tied / Untied

Figure 1[8]

Despite its prominence as a practice, multilateral aid organizations consistently criticize tied aid as inefficient (UNDP 2005, World Bank 2005, OECD 2005). These and other international organizations cite the lack of market optimization in product purchasing and more difficult aid distribution, claiming that these factors combine to make tied aid substantially less efficient than untied aid. Additionally, 97 donor countries signed on to the Paris Declaration on Aid Effectiveness in 2005, which committed in part to the reduction of tied aid practices (OECD 2005). Despite international consensus and agreements, however, aid tying remains prevalent. This illuminates a puzzle: countries continue to include tied aid provisions in bilateral disbursements despite the potential inefficiencies of tied aid.

Related to this puzzle, I hope to answer the following research question: how does the institutional design of aid spending, specifically the practice of aid tying, affect the size of bilateral aid disbursements from donor countries to recipients. I empirically test a new theory surrounding tied aid practices to answer this question, which hypothesizes that donor countries benefit when they tie aid and as such aid tying allows donor countries to spend more on foreign aid. While the current literature addresses the effectiveness of tied aid as well as influences on

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[8] Drawn from the OECD Development Database. This graph represents USD in constant 2010 dollars (OECD 2017).

the size of aid packages, no studies have evaluated the impact of tied aid conditions upon the willingness of donor countries to offer more substantial bilateral aid packages.This gap leaves the connection between tied aid provisions and generosity in aid allocations largely unexplored.[9] Assessing the impact of tied aid upon commitment size offers substantial policy implications, such as informing decisions of aid allocation by legislators, policy surrounding aid conditionality, and international rules surrounding tied aid practices.

This theory depends on the idea that tied aid incentivizes more sizeable packages than those that would otherwise be seen in untied aid regimes. The mechanism behind this theory lies in the utility that donor countries get when disbursing aid to a given recipient. As this paper will go on to explain, tied aid increases donor utility in both public interest and special interest considerations, theoretically allowing for larger allocations. The paper goes on to test the theory of increased disbursements with tied aid regimes through a large-N multiple regression analysis, which analyzes the relationship between tied aid and disbursement amount for all DAC member countries' bilateral allocations.

This paper proceeds as follows: first, it will lay out a review of the relevant literature surrounding aid policy and tied aid specifically. A presentation of this paper's theory follows the literature review. A section on the research methods will detail how the paper tests the hypotheses. The results section delineates the findings of the study paired with the level of inference that can be drawn from these findings. Finally, the conclusion discusses policy implications and potential areas for future study.

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[9] The term "generosity" is intentionally ironic here, as this paper indicates that generosity may be something determined by circumstances rather than motivations.

II Literature Review

II.I Donor Motivations in Bilateral Aid Allocation

A rich literature explores the question of why countries give foreign aid. In this debate, there are largely two camps: those who believe that donors allocate aid based on domestic interest and those who believe that aid allocations are responsive to recipient needs. These perspectives, however, are not mutually exclusive. Out of those who point towards donor self-interest as the largest motivation behind aid allocation, many indicate economic interests (Alesina and Dollar 2000, Fleck and Kilby 2006, Morrissey 1991, Younas 2008) while others argue for foreign policy considerations (Alesina and Dollar 2000, Boschini and Olofsgard 2001, Schraeder et al 1998). Still others claim that foreign aid generally comes from a moral vision of the world, and thus works towards improving quality of life in recipient countries (Lumsdaine 1993, Hoeffler and Outram 2011).

Donor Economic Interest

Empirical studies have indicated a pattern in foreign aid where countries tend to give based on their own economic interests. Aid is often used as a strategic mechanism to improve the economic standing of the donor country by increasing the donor's exports (Morrissey 1991). These increases in exports arguably come from the improved relations and trade networks when aid is disbursed. Specifically with respect to trade, donor countries use foreign aid to reinforce trade ties (Berthelemy 2005). Additionally, a cross-sectional time series study across French, Japanese, American, and Swedish disbursements corroborates this theory by showing that donors tend to favor growing countries and countries with trade relationships with the donor country (Schraeder et. al. 1998). Related studies offer additional circumstantial support for the theory that

donor economic interest informs aid allocation decisions, as OECD countries tend to allocate more aid to recipient nations who import goods for which the donor country has a comparative advantage (Younas 2008).

Casting a wider net, Fleck and Kilby (2006) find that donor economic interests have a strong correlation with aid allocation through panel data involving US donations to 119 donor countries, finding that especially under conservative regimes the US allocates more aid to countries with large US imports and low US exports. Other empirical studies further argue a causal relationship between donor economic interest and aid allocation, this time operationalized as access to foreign markets (Apodaca and Stohl 1999). This relationship between aid and trade grew stronger between the 1980s and 1990s, though with an arguably small magnitude (Berthélemy 2005).

A series of case studies also illustrate the way that economic interests play a role in aid disbursements, especially in the example of Japan's foreign aid policy. After a 1950s phase of foreign aid acting as World War Two reparations, Japan shifted to a regime of largely economically motivated aid disbursements. From the mid-1950s through the early 1970s, Japan used aid programs, often tied, to promote its own exports in Southeast Asia. This morphed into an especially strong concentration of aid in resource-rich countries and countries along shipping routes in the 1970s to foster economic interdependence (Brooks and Orr 1985). Though the effect has since become less pronounced, Japan's foreign aid regime still reflects donor economic interests by focusing on countries of strategic importance such as Thailand (Brooks and Orr 1985, Truman et al 2001). The United States and Soviet Union also share similar economic motivations for aid disbursement (Walters 1970).

Donor Foreign Policy Interest

The foreign policy interests of the donor country may also have an effect on its decisions of where to allocate bilateral aid money. Ideological alignment offers a strong path for this association, where donor countries offer aid to countries whose ideological positioning is strategically advantageous to the donor (Schraeder et al 1998).[10] Dunning (2004) and Meernik (1998) argue that the influence of donor foreign policy interest was especially strong after the Cold War when there was an especially stark contrast in ideology between capitalist and socialist countries. Though arguably the most extreme example of foreign policy influence upon aid disbursements, the Cold War serves as a good illustration. During the Cold War, a great proportion of aid disbursements served the purpose of expanding ideological spheres of influence and gaining strategically important footholds in varying regions to improve the donor country's ideological standing (Dunning 2004). This occurred on both the US and Soviet side of the conflict. Cold War-level foreign policy considerations in aid disbursement has since declined in prominence, without disappearing overall.

The use of foreign aid to strategically advance foreign policy interests is not just a relic of the Cold War. Through the 1960s and 1970s, foreign policy remained a strong predictor of bilateral aid allocation (McKinlay and Little 1979). This trend continued later on into the modern era, where some regression models indicate that donors continue to care more about political and historical factors, such as colonial ties, than recipient need (Alesina and Dollar 2000, McKinlay and Little 1979).[11] These studies mostly highlight ideological alignment and colonial ties as strategic predictors of aid disbursement. This tendency to support former colonies and

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[10] Schraeder et. al. lump African nations into three categories when determining ideological alignment with donor countries: 1) African-Marxist regimes; 2) African-Socialist regimes such as Kaunda's Zambia; 3) African-Capitalist regimes where the free market is emphasized.

[11] In this case, recipient need was operationalized as a recipient nation income, as measured by real per capita income at the beginning of a given period (Alesina and Dollar 2000).

ideologically similar countries further corroborates the trend of foreign policy concerns dictating aid disbursement.

Recipient Benefit

Among policymakers, a large swath of rhetoric points towards foreign aid as a means to improve conditions for the populations of recipient nations, especially through appeals to equity (Moore et al 2016). The literature largely emphasizes the effects of donor benefit on aid commitments. However, Hoeffler and Outram (2011) argue that the literature generally overemphasizes the role of donor self-interest on aid allocations, finding that self-interest only explains 16 percent of variation in allocation while recipient need explains 36 percent. Lumsdaine (1993) expands on the theory of recipient benefit in arguing that foreign aid allocations largely have a humanitarian vision behind them, using a combination of quantitative and qualitative analysis. Despite the literature's indication of donor's self-interested aid allocation practices, the theory of recipient need as a motivator for foreign aid still has support. Even generally self-interested donors tend to give larger allocations to nations with greater need (Berthélemy 2005).

Some literature also argues that donors use foreign aid for recipient benefit by enforcing human rights standards. Empirically, these claims have a good degree of support. Countries with higher respect for human rights tend to receive more bilateral aid from donor countries (Neumayer 2003). However, these results do not apply universally across donor countries. In the context of the United States, for example, respect for human rights increases economic aid allocations but not military aid allocations (Apodaca and Stohl 1999).

Weighing the Theories

The literature generally favors the donor interest model of aid giving. Mckinley and Little (1979) argue that donor interests tend to dictate aid allocations more than recipient needs in the United States and British contexts. The relationship between recipient need and aid allocation has further been challenged by other authors, who claim that there is no association between the size of aid allocations and need (Schraeder et al. 1998). Even the supporters of the recipient need model of aid allocation concede that donor interests play a role (Neumayer 2003, Apodaca and Stohl 1999, Berthelemy 2005).

Donor Country's Domestic Ideology

The domestic ideology of the donor country affects the size of aid allocations by altering the political willingness to offer foreign aid generally. This political influence follows a left-right distinction, where conservative policymakers tend to favor aid less than their leftist counterparts both in the American context as well as globally (Tingley 2010). However, this relationship is reversed for military aid specifically (Milner and Tingley 2009). Notably, the economic ideology of a donor country has a strong effect on aid in less developed countries and multilateral institutions, but varies a good deal less for wealthier developing nations, likely due to attitudes linked with altruism (Tingley 2010).

Domestic ideology's relationship with foreign aid spending extends well beyond party identification. Generally, countries with stronger welfare states domestically tend to offer larger foreign aid contributions (Lumsdaine 1993, Noel and Therien 1995). Noel and Therien (1995) argue that this stems from an ideological disposition to policies that favor wealth redistribution.

II.II Tied Aid

The Efficiency of Tied Aid

The literature heavily covers the impact of tied aid policies upon the efficiency of aid disbursements. Wide consensus points towards an argument that tied aid practices harm the overall effectiveness of aid programs by essentially making the recipient country a captive market for the donor's domestic firms. Economic models meticulously point out the theoretical inefficiencies that tied aid forces onto recipient countries (Chao and Yu 2001) This inefficiency has also been demonstrated in a number of case studies of recipient countries where the pervasiveness of tied aid caused negative outcomes (Miyamoto 1974, Mehmet 1971, Osei 2004).

The case of Ghana as a recipient illustrates the inefficiencies of bilateral aid tying. Since Ghana's implementation of the Economic Recovery Plan in 1983, total aid inflows increased from roughly 4% of GDP to roughly 11% of Ghana's GDP in 1991, a figure that has remained roughly constant (Osei 2004). In conjunction with the increase in total aid, tied aid became more prevalent in Ghana as bilateral donors increasingly took up more of the aid coming in to Ghana as part of "a search for greater influence." The United States, for example, tied all of its aid to Ghana and required that all US aid transport to Ghana on US merchant vessels. These provisions come not only with inefficiencies, but also with different prices. As Osei (2004) notes, tied aid in Ghana is marked up significantly from the prices of comparable packages under untied bilateral arrangements.

The inefficiencies of tied aid come from a number of different sources. Primarily, tied aid practices often result in the overcharging of recipients due to the increased market power of the donor country's firms, as seen in the Ghanaian example (Easterly and Pfuze 2008, Williamson

2010). To further this point, the exports of aid goods in a tied aid regime tend to be overpriced by 10 to 40 percent (Jepma 1991). Furthermore, tied aid can also harm the recipient country by competing with local industries (Kemp and Kojima 1985).

Condemnations of the inefficiencies of tied aid also echo in the international community. The World Bank (2005) claims that tying food aid can cut its efficiency by up to 50 percent. Other estimations of inefficiencies include the claim that tied aid costs a total of $5 Billion - $7 Billion in inefficiencies and that it lowers the overall effectiveness of the aid it offers by 11 percent - 30 percent[12] (Jepma 1991, UNDP 2005). Regardless of the veracity of these figures, the claims of tied aid inefficiencies resulted in a strong international condemnation of the practice, including a DAC recommendation against tied aid and the Paris Declaration on Aid Effectiveness, which called for the progressive untying of aid and boasts 97 participant nations (OECD 2005).

Why do Donors Tie Aid Despite Potential Inefficiencies?

As a supplement to the literature on why donors give foreign aid in general, the question of why donors choose to tie aid warrants examination. One such theory is the theory of domestic industry support, where countries supposedly tie aid in order to reap additional benefits for their domestic industries, as illustrated by the earlier example of Japanese aid from 1950-1970 (Jepma 1991). These potential benefits include stimulating donor employment and increasing donor exports. However, Tajoli (1999) found that donor's export shares are not correlated with the degree of aid tying. Further, tied aid practices do not have a dramatic impact on employment or exports of donor countries as a whole (Jepma 1991, Clay et al 2008). However, even though the

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[12] In this case, the distinction between efficiency and effectiveness is of note. Where efficiency refers to the dollar-for-dollar return on investment of aid, effectiveness refers to the ability of aid to accomplish its development goals. While these are related concepts, they are distinct.

full economy is rarely impacted, the incentives to tie aid remain substantial. While tied aid may not have an effect on a national level of exports or employment, tied aid provisions tend to increase exports of the agriculture industry (Pincin 2013).

Additionally, tied aid policies serve a function with respect to political economy. Tied aid policies are used to "buy" votes in especially gridlocked legislative circumstances. The degree of fragmentation[13] increases the amount of tied aid, indicating a "vote-buying" phenomenon with tied aid (Pincin 2013). This phenomenon would occur through the use of tied aid provisions as bargaining chips in order to pass controversial legislation.The use of tied aid for vote-buying is especially relevant to this paper, because the same logic could be applied with respect to donor generosity in aid tying regimes.

III. Theory

The question of whether the institutional design of aid programs affects the amount of aid that a donor supplies largely remains unstudied in the context of tied aid. Therefore, while other studies serve to inform this paper's theory, the theory itself is novel. In short, this paper proposes and assesses the theory that offering mostly tied aid to a given recipient allows donor countries to give larger aid disbursements to recipients than when the aid remains untied.

I offer this hypothesis with the model that that donor countries gain utility in foreign aid through two sources: special interest utility and public interest utility. Special interest utility in this context refers to gains in the private sector of the donor economy paired with gains experienced by interested communities of people in the donor population. On the other hand, public interest utility refers to gains that impact the donor country's constituents as a whole. An illustrative example would be a hypothetical decision to open a trading relationship with a

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[13] Fragmentation in this instance is operationalized positively by effective coalition parties and negatively with excess seats in government.

previously embargoed country. In this case, the potential new trading market would be a special interest gain through increased profit opportunities while the potential for military advantages would be a public interest gain through increased safety. Figure 2 shows a model of donor benefit through bilateral foreign aid, illustrated through a theoretical utility curve. Note that this figure displays standard aid packages and does not account for tied aid provisions. The donor country gains utility from two sources: special interest benefit and public interest benefit. Special interest benefit from aid largely arises from potential new export markets and trade deals. These benefits would theoretically be passed on to policymakers, whose desire for campaign contributions and support incentivize them to adhere to special interest preferences (Milner and Tingley 2009). The curve representing public interest utility from aid comes from economic benefits enjoyed by the populus as a whole, foreign policy benefits, and altruism.

The slope of special interest utility as a function of the amount of foreign aid given generally remains constant and linear. The potential for companies from the donor country to gain markets through foreign aid increases the utility that special interests receive in a linear
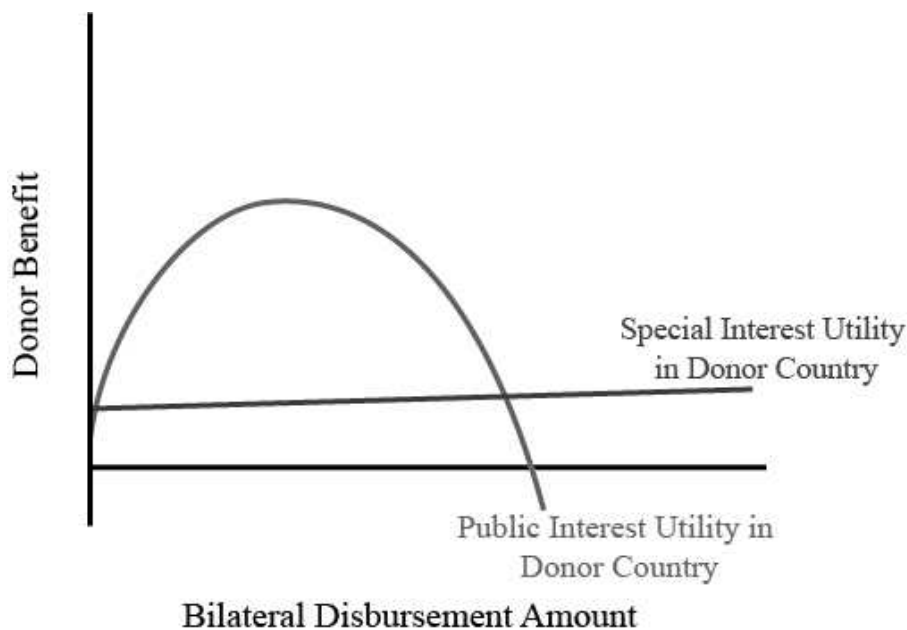
fashion. Donors often use

Figure 2: Standard Donor Utility

foreign aid to implant donor firms, thereby increasing the utility of any given firm

through a potential benefit of access to new markets (Lundsgaarde et al 2006). This slope

continues upward, as commercial interests do not share a concern of budgetary tradeoff costs.

With respect to the public interest, the donor's utility generally increases rapidly as the

disbursement amount rises initially. This initial increase in utility comes from efficient trade

avenues, diplomatic ties, the promotion of ideologically aligned countries, national security, and

recipient need (Alesina and Dollar 2000, Lumsdaine 1993, Fleck and Kilby 2006, Schraeder et

al. 2008). However, as the magnitude of the bilateral aid disbursement increases, the utility

gained by the donor country through public interest benefits diminishes in nature due to

budgetary tradeoffs with other public services upon which the donor country's government could

have spent the foreign aid money instead (Collier and Dollar 2002).

As shown in Figure 3, the introduction of tied aid conditions changes the donor utility curve with respect to both special interest effects and public interest effects. In Figure 3, the solid line shows donor utility gained from a standard bilateral disbursement, as seen in Figure 2 above. The dotted lines represent the changes to donor utility as tied aid conditions are placed upon the given bilateral disbursement package. Note that, the proportion of aid tied varies, so the gap between the solid and dotted curve theoretically fluctuate, where the gap is larger when the amount of aid tied increases.
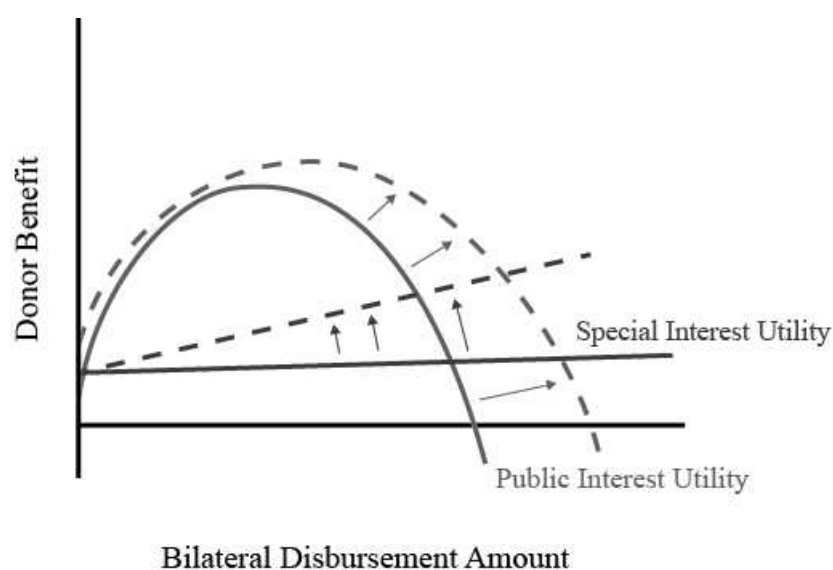
Figure 3: Effect of Aid Tying on Donor Utility

The effect of the disbursement amount on donor benefit through special interests increases under tied aid programs. Since the use of tied aid largely serves the purpose of export promotion for the donor country, domestic firms stand to gain even more from the increased exports that aid tying affords (Easterly and Pfuze 2008). Williamson (2005) further extends this logic, arguing that agricultural special interest groups have an incentive to lobby the government for more ubiquitous tied aid provisions. Where standard bilateral aid packages benefit special interest groups through *potential* avenues of export, tied aid packages create a captive market for

donor firms, increasing the positive slope of the donor utility through special interests curve. The effect of tied aid provisions on the donor benefit curve would theoretically increase at a constant rate as the proportion of tied aid is greater between a given donor and recipient, making the slope steeper (as indicated by the arrows in Figure 3).

Tied aid conditions also affect the curve for donor utility based on public interest. While the standard donor utility curve contains strong diminishing returns due to budgetary tradeoffs, the implementation of tied aid programs theoretically offsets those tradeoffs by acting as a subsidy for domestic industry (Morrissey 1993) This effect is especially strong in the agriculture industry when a donor country ties food aid (Kneteman 2009). Put simply, the diminishing effect of aid disbursement for the public is reduced since the aid funding ultimately returns to the donor country's economy. As with the effect upon the special interest curve, this effect should be more pronounced as the proportion of tied aid in a given disbursement relationship increases.

The utility curves in Figure 3 can be modeled as a mathematical formula that expresses the theoretical utility that the donor country gains as a function of the amount of aid, degree of aid tying, and the respective weight given to public interests versus special interests. For the purposes of theory illustration, this equation comes out to:

$$v{A,W,T} = W \times (T \times A) + (1-W)(A - A^2)$$

where A represents the amount of total aid given, W represents the weight given to each respective avenue of utility, and T represents the degree of aid tying. The first bracketed segment of this equation represents the utility gained from special interests, while the second accounts for public interest utility. The challenge for a given donor country would be to optimize the utility of aid by deciding how much aid to allocate (A) when given a fixed W and T value. Comparing two derivatives, we can examine how increasingly tied aid increases the amount of aid that a donor

would rationally allocate. Given a weight of .5 between special interests and public interests and comparing zero percent tied aid to one hundred percent tied aid, the derivative works out to:

$$vA,.5,0= .5\times(0\times A)+.5\times(A-A\char94 2)$$

$$= 0 + .5A + .5A\char94 2$$

$$Derivative\ (Untied) = .5 - A$$

$$vA,.5,0= .5\times(1\times A)+.5\times(A-A\char94 2)$$

$$= .5A + .5A + .5A\char94 2$$

$$Derivative\ (Fully\ Tied) = 1 - A$$

As shown by the difference in the y-intercept of the derivatives, the optimization problem changes when the degree of tied aid is altered, allowing donors to give more aid when they have a greater proportion of tied aid.

Since the incorporation of tied aid substantially increases the utility of the donor in both the special interest and public interest benefits of aid disbursement, the above theory indicates that rational donors should give more aid when a higher proportion of a given aid package is tied. If a given donor aims to maximize utility, the above curves and derivatives would indicate that this could generally be more easily done when heavily tied disbursements are larger than the less-heavily tied disbursements. As such, exogenously tied aid regimes would allow donor countries to offer larger aid disbursements.

This paper tests the theory that this increase in donor utility under donor-recipient relationships with tied aid provisions makes donors disburse more aid when the aid is tied. If true, this theory should yield a number of observable implications:

H1: Disbursements and Proportion of Tied Aid

Should the theory of increased generosity hold true, recipient countries with a higher proportion of tied aid from a given donor would receive larger disbursements and commitments from that country. This follows from the above theory through the added benefits that donors enjoy when they offer tied aid packages. Assuming that donors attempt to allocate aid in a way that maximizes the utility of the donor country, donors should respond to the incentives of tied aid by increasing disbursements when tied aid is proportionally more likely in a given aid regime. As such, if the above theory is correct, that would implicate a positive causal relationship between tied aid and the amount of aid that a donor country disburses.

IV. Methods

The ultimate goal of this study is to assess whether a causal relationship exists between aid tying and commitment size. To that end, I first conducted a multiple regression analysis of bilateral aid commitments at the donor-recipient-year level of analysis. This regression attempts to control for all of the prominently cited variables that impact commitment size, while determining the level of correlation between tied aid and the amount of bilateral aid allocated.

The sample of this regression covers annual commitment statistics from 2004 through 2015, as this represents the most recent data available for both the OECD data on aid tying as well as many of the controls. On the donor side, this sample includes commitments from Development Assistance Committee member countries, which generally represent the largest contributors of international bilateral aid (Kharas 2007). For recipients, this regression faces more practical limitations of data reporting, and as such included all recipient countries with commitments statistics reported to the OECD. A full list of donors and recipients included in this regression can be found in Appendix A and Appendix B below.

The independent variable, degree of aid-tying, is operationalized as the proportion of tied aid disbursed by a given donor country. This proportion of tied aid variable comes from the following calculation: *Tied Aid Reported + Partially Tied Aid Reported (Millions of 2010 Constant USD)Total Aid Reported (Millions of 2010 Constant USD).* The Creditor Reporting System database reports the amount of tied, partially tied, and untied aid offered in a given donor-recipient-year.[14] Since the instances of tied aid reported and total ODA reported do not align, this calculation serves as an exogenous method of calculating a proportion of aid tying based only on the reporting of aid tying specifically. While an ideal measurement would describe the proportion of aid tying as compared to total bilateral aid allocated for a given country dyad, this calculation creates a strong index given the gaps between ODA reporting and tied aid reporting, allowing me to avoid discarding tied aid data when ODA data is unavailable and vice versa.[15] The OECD defines untied aid as "Official Development Assistance for which the associated goods and services may be fully and freely procured in substantially all countries" (OECD 2008).The distinction between tied and partially tied aid, however, is more nuanced. While tied aid agreements specifically bound purchases from the recipient country to the donor country, partially tied aid agreements constrict the recipient country to purchasing goods from either the donor country or another country specified by the donor (OECD 2008). Due to the fact that both of these provisions give spending agency to the donor, however, the independent variable index lumps them together.[16]

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[14] The OECD Creditor Reporting System (CRS) is a database of aid statistics compiled by the OECD as reported by DAC member countries, multilateral donors, and other donors who report to the OECD (OECD 2005).

[15] A correlation check between total ODA and total aid reported through aid tying found a strong correlation, significant to the .01 level, indicating that they likely represent comparable totals of aid commitments.

[16] The decision to lump tied aid and partially tied aid in the "proportion of tied aid" variable also stems from the theory section. The theory section of this paper asserts that tied aid provisions increase the amount of aid offered by allowing donor countries to increase their public and private interest utility. Due to the fact that partially tied aid

The dependent variable, bilateral commitment size, draws from the OECD CRS dataset as well, this time looking at the amount of total bilateral ODA committed at the donor-recipient-year level. Studies on the causes of aid allocation amounts often use this dataset as a measure of bilateral aid magnitude (Ovaska 2003, Raffner 1999). Due to sampling disparities between reporting of total ODA and reporting of tied aid ODA, this paper uses two dependent variables in each regression to ensure that the results do not substantially skew due to sampling bias. The total ODA reported variable, referred to hereafter as "ODA," draws from the total ODA reported for a given donor-recipient-year, and follows the equation: $ln(1 + ODA),$ where ODA represents constant 2010 USD. The alternative dependant variable, "TotalTied," refers to the total ODA given as indicated by reporting of tied, untied, and partially tied aid. This follows from the same equation as the ODA variable, simply drawing from a different sample: $ln(1 + TotalTied)$, in constant 2010 USD. In addition to representing different samples of countries, the "ODAtotal" variable has some alarming outliers, warranting a second dependent variable measurement to ensure the veracity of the conclusions shown.

Given the number of factors involved in donor decisions surrounding aid allocations, some control variables are necessary. First, this regression controls for the GDP of both the donor and the recipient country. This control variable first serves to adjust for the GDP of the donor in all aid commitment measurements, factoring out the fact that donor countries with larger economies can afford to offer more aid. Similarly on the recipient side, this serves to remove bias originating from the economic size of the recipient country. Furthermore, for both the donor and recipient country, controlling for the GDP of the country makes other control

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provisions theoretically give donor countries increased utility as compared to untied aid through economic and strategic advantages, it makes sense that partially tied aid should factor in to the independent variable.

variables such as exports more meaningful by removing size bias. This follows a strong trend of controlling for donor and recipient economic size in analyses of bilateral aid (Younas 2008, Alesina and Dollar 2000).The data on GDP for both the donor and recipient country comes from the World Bank's World Development Indicators database (The World Bank 2016). Both GDP control variables measure the natural logarithm of GDP, as measured in 2010 constant US dollars.

As addressed in the literature review, recipient need acts as a potential predictor of aid commitments and disbursements. In order to get a reasonably full picture of recipient country need, this regression uses two control variables: infant mortality and GDP per capita.[17] Younas (2008) argues that infant mortality as a control variable captures the physical need of a recipient country, while GDP per capita captures the economic need of the recipient.Though physical and economic needs are correlated over the long run, they do not vary together in the short term, necessitating two separate controls (Bandyopadhyay and Wall 2007).[18] The data on infant mortality and GDP per capita both come from the World Bank's World Development Indicators database (The World Bank 2016). The infant mortality control variable measures the rate of infant deaths before reaching one year of age per 1,000 live births. The World Bank collects this statistic annually from the UN Inter-Agency Group for Child Mortality Estimation, which relies on a combination of country reporting and statistical modeling. GDP per capita, on the other hand, measures the natural logarithm of the Gross Domestic Product of a country relative to the country's population (The World Bank 2016). This measure reflects constant US Dollars in 2010

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[17] GDP per capita represents the natural logarithm of the recipient country's GDP per capita in a given year, measured in 2010 US Dollars.

[18] I also ran a Pearson correlation between the GDP per capita of the recipient and the infant mortality rate, finding a statistically significant negative correlation over the long run. However, due to Bandyopadhyay and Wall's finding that this would not necessarily indicate short term correlation, this paper still employs two separate controls.

dollars. These two measures often act as controls for recipient need in regression studies on aid allocation (Alesina and Dollar 2000, Younas 2008).

The existing literature on determinants of aid allocation also mandates a control variable for prior colonial ties between the donor and recipient countries. To do this, I created a dummy variable that indicates whether the donor and recipient countries share a colonial history. The data on colonial history comes from the Issue Correlates of War (ICOW) Colonial History Dataset, which codes for colonial relationships as well as independence dates (Hensel 2014). In the coding of colonial rulers, the ICOW dataset only considers a foreign power colonially relevant if they exert formal political power over a substantial part of what became the new state after independence (Hensel 2014). As such, private sector relationships and temporary military occupations are coded as a 0 in the dummy control variable. Additionally, formal political control of a small section of a country's territory does not constitute a colonial relationship. As the ICOW documentation notes, this disqualifies circumstances such as the Netherlands' colonial presence in the United States and the Portugal's limited presence in India and China (Hensel 2014). The use of a dyadic indicator of colonial history as a control variable has strong support in aid literature. Alesina and Dollar (2000) and Neumayer (2003) both find that donors tend to give more aid to their past colonies. Schraeder et. al. (2008) also supports this conclusion, noting that prior colonial rule serves as an especially strong predictor of French aid allocations.

This regression also controls for the ideological alignment of countries on a donor-recipient-year basis. In the literature, general consensus dictates that ideological alignment should be controlled for, though there exists some disagreement on how exactly to operationalize this alignment (Alesina and Dollar 2000, Schraeder et al 2008). Alesina and Dollar (2000) employ a measure of "UN Friend," or the degree to which two countries vote together in the UN

General Assembly. However, Schraeder et al (2008) diverges from this measure, instead using a qualitative grouping of countries into general ideological categories. These categories include African-Marxist regimes, African-Socialist regimes, and African-Capitalist regimes (Schraeder et al 2008). For the purposes of controlling for ideology, this regression more closely follows the example set out by Alesina and Dollar (2000) in their use of the "UN Friend" variable. One consideration for this decision lies simply in practicality, as it avoids potential errors and delays that would come from having to qualitatively code the entire sample by hand into ideological categories. Additionally, Alesina and Dollar (2000) find a strong association between their operationalization of ideological alignment and aid allocation, where "The UN friend variable is generally significant and, in particular, is significant for all the major players in international relations included in these regressions, namely the U.S., Japan, France, Germany, and the UK" (Alesina and Dollar 2000). In order to construct a control variable similar to "UN Friend," this regression relies upon Eric Gartzke's Affinity of Nations Index, specifically the s2un variable (Gartzke 2006). This variable places country pairs (in this case the donor and recipient countries) on a scale from -1 to 1 based on the degree to which they vote together at the UN. A score of negative one denotes the least strong affinity while a score of one denotes perfect voting affinity. This data varies annually, allowing it to map on to the donor-recipient-year unit of analysis with unique values.

The review of the literature also points towards the donor's economic interest as a potential contributing factor to the amount of aid that donor countries allocate, especially when it comes to the export and trade interests of donor countries (Berthélemy 2005, Younas 2008, Morrissey 1991, Fleck and Kilby 2006). Due to the complexity of determining the economic interests of donors, it also lends itself to multiple control variables. In order to achieve that end,

this study controls for both the donor's Foreign Direct Investment (FDI) in the recipient country as well as the amount of trade between the two countries.[19] The control for FDI from the donor country to the recipient country in a given year measures total FDI stocks in a given recipient country from a given donor country in constant 2010 US Dollars, as gathered by the OECD Creditor Reporting System dataset (OECD 2017).This pairs with the separate donor GDP control, which ensures that the measurement does not skew towards larger donors and instead accounts for the relative importance of the FDI relationship. This study chose to measure stocks of FDI instead of yearly FDI because stocks more closely represent the total investment in the recipient economy, regardless of the inception date of that investment.[20] The control variable of trade between the two economies draws from the International Monetary Fund's Direction of Trade Statistics dataset (International Monetary Fund 2016). From this dataset, the control variable uses *ln(1 +exports)*in constant 2010 US Dollars.[21] Combined, these two control variables aim to offer a fairly comprehensive measure of the donor's level of economic interest in the recipient economy.

Lastly, the literature mandates a control for the convenience of aid delivery, which has proven a significant control in other regression models (Neumayer 2003, Younas 2008). In this study, I operationalize distance between the donor and recipient as distance between capital cities, since geographical proximity varies by which part of each country is measured.To control for the distance between donor and recipient countries, this regression uses Gleditsch's dataset on distance between capital cities, measured in kilometers (Gleditsch 2001).

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[19] FDI refers to the amount of investment from resident entities in one economy in entities that reside in another, given economy (UNCTAD 2007).
[20] FDI Stocks represent total investment from one economy into another, while FDI Flows are specific to a given year (UNCTAD 2007).
[21] This does not take the total of imports + exports due to data gaps in the imports dataset.

This regression utilizes a one year lag of all of the independent and control variables that vary on a yearly basis in order to allow time for the dependent variable to react to changes in influencing factors. The multiple regression has 6 models, paired off by their treatment of incomplete data in the OECD database's reporting of the proportion of tied aid variable mentioned above. Models employ both methods of treatment of these incomplete values in order to avoid missing potentially informative data points where donors did not report values instead of going through the process of writing out zero, while covering as large a sample as possible. For the dependent variable, the natural logarithm of total ODA disbursed for a given donor-recipient-year, all non-reported data is treated as a zero point since DAC donor countries independently report their ODA commitments, making unintentional nonreporting bias less likely.

Models 1 and 2 conduct an Ordinary Least Squares (OLS) regression, varying in their treatment of unreported values in the proportion of tied aid variable. Models 3 and 4 conduct a fixed effects regression, adjusting for natural variation by donor country, recipient country, and year. Models 5 and 6 test a fixed effects Least Squares regression with a quadratic independent variable to explore the possibility of a non-monotonic relationship between the independent and dependent variables.

V. Results

For the most part, the multiple regression with linear models yielded surprising results across the board with respect to the relationship between the proportion of aid tied in a given donor-recipient-year and the amount of total bilateral ODA granted for the same dyad in the following year. Table 1 below shows the results of Models 1 through 4 of the multiple regression analysis.

Leaving the most striking results aside for a moment, an interesting trend first appears in the UN Affinity control variable, where the control gives a statistically significant negative effect in the first two models. This means that in Models 1 and 2, donor countries tend to offer less bilateral aid to recipient countries who vote with them at the UN. This result, however, reverses upon the introduction of Models 3 and 4, both of which switch UN Affinity to a positively sloped variable. The fact that the OLS regression models had UN Affinity as negative while the fixed effects models had UN Affinity as positive likely indicates the existence of some factor in either donor countries, recipient countries, or years that skewed the data towards a negative trend in the simple OLS regression. The fixed effects regression, however, seems to have picked up that variation and flipped the effect of UN Affinity on commitment size to a positive one. While discerning the exact effect of UN Affinity upon commitment size requires some speculation from Models 1 through 4, the positive coefficient in Models 3 and 4 has been largely corroborated by the literature, leading me to prefer the positive coefficients from the fixed effects models (Alesina and Dollar 2000, Schraeder et al 2008).

The first four regression models also gave puzzling results regarding the original hypothesis that they aim to assess, universally reporting a statistically significant negative relationship between the proportion of tied aid offered and the total size of the bilateral commitment offered. Interpretation of this result offers a difficult task, especially because of unexpected nature of this outcome. However, a negative linear relationship in Ordinary Least Squares and Fixed Effects models could indicate the following conclusions: a true negative relationship between the aid tying and commitment size, endogeneity in the research study, and a non-linear relationship between the variables examined.

Table 1: Multiple Regression of Commitment Size as a Function of Proportion of Tied Aid

	Model 1	Model 2	Model 3	Model 4
Dependent Variable	**ODA** *ln(1 + ODA) in Millions of 2010 USD,*	**TotalTied** *ln(1 + Total Aid) in Millions of 2010 USD,*	**ODA** *ln(1 + ODA) in Millions of 2010 USD,*	**TotalTied** *ln(1 + Total Aid) in Millions of 2010 USD*
Model Description	**OLS**	**OLS**	**Fixed Effects OLS**	**Fixed Effects OLS**
Proportion Tied *Tied + Pa tidly Tied AidTotal Aidin Millions of 2010 USD,*	**-.5789**** **(.0244)**	**-.6796**** **(.0240)**	**-.1236**** **(.0266)**	**-.2776**** **(.0264)**
UN Affinity *Index from -1 to 1*	**-.2589**** **(.0283)**	**-.2487**** **(.0279)**	**.1622**** **(.0551)**	**.0820** **(.0546)**
Capital City Distance *ln(Kilometers)*	**-.1500**** **(.0156)**	**-.1537**** **(.0153)**	**-.4061**** **(.0231)**	**-.3702**** **(.0228)**
Recipient GDP per Capita *ln(GDP per Capita) in Millions of 2010 USD*	**-.6210**** **(.0125)**	**-.5929**** **(.0123)**	**-.7292**** **(.1929)**	**-.7347**** **(.1910)**
Recipient GDP *ln(GDP) in Millions of 2010 USD*	**.1267**** **(.0074)**	**.1223**** **(.0073)**	**.1853** **(.1907)**	**.2335** **(.1889)**
Donor GDP *ln(GDP) in Millions of 2010 USD*	**.4201**** **(.0098)**	**.4126**** **(.0096)**	**1.383**** **(.1879)**	**1.599**** **(.1861)**
Foreign Direct Investment *ln(1 + FDI) in Millions of 2010 USD*	**.0543**** **(.0040)**	**.0526**** **(.0040)**	**.0514**** **(.0041)**	**.0522**** **(.0041)**
Infant Mortality *Infant deaths per 1,000 births*	**-.0502**** **(.0171)**	**-.0447**** **(.0168)**	**.1389** **(.1116)**	**.2502*** **(.1105)**
Exports *ln(1 + exports) in MIllions of 2010 USD*	**.1264**** **(.0058)**	**.1249**** **(.0058)**	**.1662**** **(.0067)**	**.1665**** **(.0067)**
Colonial Relationship *Dummy of Colonial Rule*	**1.357**** **(.0530)**	**1.460**** **(.0521)**	**1.745**** **(.0509)**	**1.800**** **(.0505)**
Constant	**-8.872** **(.3318)**	**-8.691** **(.3263)**	**-34.61** **(5.741)**	**-42.02** **(5.686)**
R² (Adjusted)	**0.3911**	**0.3939**	**0.5528**	**0.5447**
F Statistic	**1543****	**1561****	**164.6****	**161.4****
N	**24,005**	**23,998**	**24,005**	**23,998**

Coefficients reported with robust standard errors in parentheses. *Significant at the 0.05-level, **Significant at the 0.01-level. All significance values reflect a two-tailed test. Fixed effects tests adjust for donor-specific, recipient-specific, and year-specific effects. Proportion Tied, ODA, and Total Tied variables all measure bilateral commitments.

True Negative Relationship

A statistically significant negative coefficient between the dependent and independent variables across Models 1 through 4 initially offers a potential conclusion of a truly negative relationship between the dependent and independent variables. This would have the real-world implication of tied aid practices causally decreasing the amount of total aid for bilateral commitments in a given donor-recipient-year. This result would clearly contradict the theoretical model of this paper, since this paper relies upon the theories that donor countries gain utility by increasing the proportion of aid that they tie.

The findings from Models 1 through 4 could imply a true negative relationship in a number of ways, all of which require a diversion from the utility curve-based model argued in the theory section. The first potential implication could be that the donor utility model incorrectly assesses how donor countries gain utility from bilateral foreign aid. Through either a change in the effect of special interest utility or public interest utility, the relationship could be negative, indicating that the earlier theory simply missed the mark. Additionally, the donor utility model argued previously assumes that the donor country behaves rationally and cares about the utility gained from special and public interests. Individual policymaker desires could conflict with the donor country-level utility or policymakers could perceive different sources of utility.

Additionally, the negative result could result from a confounding variable that these regression models do not account for. The design of this model carefully controlled for all of the variables that the literature pointed to as potential confounding factors and used fixed effects models to pick up potential sources of bias, but no study is perfect and some bias or hidden effect could cause the negative relationship.

Should this finding reflect a true negative relationship between the proportion of tied aid and the amount of aid allocated, significant policy implications would follow. Primarily, this finding would remove a potentially large reason to tie aid despite its demonstrated inefficiencies. If, in addition to the inefficiencies of tied aid, tied aid also diminished the amount of aid allocated to countries, such a finding would significantly strengthen the argument made by international agencies against the use of tied aid (The World Bank 2005, UNDP 2005, OECD 2005).

Endogeneity

One possible reason for a negative relationship between aid tying and commitment size is endogeneity, the possibility that commitment size actually has an effect on the decision of how much aid to tie rather than the other way around. In order to evaluate the exogeneity of the proportion of tied aid in a particular donor-recipient-year, I first looked to the temporal relationship between the tying of aid and the decision of how much aid to disburse. In a majority of countries, aid tying comes in the form of a legislative rule set prior to the decision to disburse a given amount of aid. This is illustrated in the context of the United States as a donor country, where aid tying is dictated largely by a 1961 law paired with a 2012 amendment. In 1961, US law dictated that all aid is tied. That law stood until 2012, when an amendment only required the tying of food, military, and medical aid. The long-term establishment of these rules temporally separate tying decisions enough to be deemed exogenous of the decision of how much aid to allocate to a given recipient (Federal Register 2012, 22 USC 2354). In other words, it seems unlikely that commitment size influences the decision of how much aid to tie in the US context since the aid tying decision occurs earlier and remains fairly stable over time. In the British

context, tied aid also remains a stagnant exogenous part of aid policy, and has been in place since the origins of British aid in 1929, though precise amounts of tied aid to recipient countries do fluctuate by year (Kanbur 2006). These examples provide some circumstantial evidence that there is enough temporal separation to consider the independent and dependent variables exogenous to one another.

Despite some temporal separation in certain donor contexts, endogeneity remains a potentially valid interpretation of the above results. This could arise from the use of tied aid as a means to procure funding for bilateral foreign aid with little support. Donor countries may use tied aid as a mechanism to get funding to recipients who historically receive low disbursement amounts, essentially acting as a bargaining chip to get foreign aid programs passed. This theory would follow the theories of Pincin (2013), who argues that tied aid practices serve as a bargaining method to break political fragmentation. Such an interpretation would yield the theory presented in this paper partially true, though somewhat misapplied. Assuming for a moment that tied aid serves as a political bargaining method in instances where support for foreign aid to a given recipient is strained, the core of this paper's theory that tied aid increases bilateral foreign aid amounts would ring true. The application of this trend in the real world, however, would change. An endogenous relationship in the bargaining-chip theory would mean that aid tying to increase aid allocations serves as a donor's last-resort tactic rather than a consistent strategy or trend. Such a conclusion requires a degree of speculation from the results yielded in the first four models above, offering an opportunity for further research in order to determine whether this is a valid causal mechanism. Endogeneity could also occur through a simple donor aversion to tie aid in circumstances where bilateral commitments are higher, though the exact mechanism of this aversion would need to be explored in future studies.

Non-Linear Relationship

      Finally, the negative relationship indicated by Models 1 through 4 could result from a non-monotonic relationship between tied aid and the size of aid allocations. Models 5 and 6 below aim to assess this possibility by adding an independent variable: the proportion of aid tied squared. The addition of this variable allows the regression to pick up potential quadratic effects of tied aid upon the size of aid commitments across given donor-recipient-year observations. Aside from the addition of the squared independent variable, Models 5 and 6 replicate Models 3 and 4 by controlling for the same variables and fixing effects from donors, recipients, and years. I chose to conduct this analysis with fixed effects models due to the higher statistical bar that fixed effects gives, making results more precise by avoiding external factors that make certain donors, recipients, and years more likely to give increased aid commitments. Table 2 below summarizes the results from the multiple regression analysis of Models 5 and 6.

Table 2: Multiple Regression of Commitment Size as a Function of Proportion of Tied Aid with Quadratic Effects

	Model 5	Model 6
Dependent Variable	**ODA** *ln(1 + ODA) in Millions of 2010 USD,*	**TotalTied** *ln(1 + Total Aid) in Millions of 2010 USD,*
Model Description	**Fixed Effects OLS**	**Fixed Effects OLS**
Proportion Tied *Tied + Partially Tied AidTotal Aidin Millions of 2010 USD,*	.7562** (.1032)	.2536* (.1023)
Proportion Tied Squared *Proportion Tied^2*	-.9307** (.1053)	-.5612** (.1044)
UN Affinity *Index from -1 to 1*	.1261* (.0552)	.0600 (..0547)
Capital City Distance *ln(Kilometers)*	-.3950** (.0231)	-.3626** (.0229)
Recipient GDP per Capita *ln(GDP per Capita) in Millions of 2010 USD*	-.7213** (.1925)	-.7321** (.1909)
Recipient GDP *ln(GDP) in Millions of 2010 USD*	.1844 (.1903)	.2342 (.1888)
Donor GDP *ln(GDP) in Millions of 2010 USD*	1.261** (.1881)	1.527** (.1865)
Foreign Direct Investment *ln(1 + FDI) in Millions of 2010 USD*	.0507** (.0041)	.0519** (.0041)
Infant Mortality *Infant deaths per 1,000 births*	.1403 (.1114)	-.2508* (.1105)
Exports *ln(1 + exports) in MIllions of 2010 USD*	.1635** (.0067)	.1650** (.0067)
Colonial Relationship *Dummy of Colonial Rule*	1.740** (.0509)	1.796** (.0504)
Constant	-31.34 (5.742)	-40.08 (5.694)
R² (Adjusted)	0.5511	0.5452
F Statistic	164.7**	160.8**
N	24,005	23,998

Coefficients reported with robust standard errors in parentheses. *Significant at the 0.05-level, **Significant at the 0.01-level. All significance values reflect a two-tailed test. Fixed effects tests adjust for donor-specific, recipient-specific, and year-specific effects. Proportion Tied, ODA, and Total Tied variables all measure bilateral commitments.

From the results in Table 2, some evidence points to the proportion of tied aid having a positive quadratic effect on the amount of bilateral aid allocated in a given donor-recipient-year. Notably, with the introduction of the "Proportion Tied Squared" variable, the coefficient of the "Proportion Tied" variable is now positive, indicating a change from the earlier models. However, the coefficient of the "Proportion Tied Squared" variable indicates a negative effect on the dependent variables of amount of aid committed. In order to better visualise Models 5 and 6, I constructed a variable that represents the net effect of aid tying on aid commitments and plotted it below in Figure 4. This new variable, "Net," gives the combined effect of aid tying at different levels of tied aid. "Net" simply calculates the sum of "Proportion Tied" and "Proportion Tied Squared," each multiplied by their respective coefficients from the regression above. For example, the equation of "Net" for Model 5 would be: *Net = .9307 × Proportion Tied Squared + .7562×Proportion Tied*

Figure 4 below shows four different visuals. The graphs on top represent Model 5 while the graphs below represent Model 6. For each Model, the graph on the left shows a plot of the net effect of aid tying on bilateral commitments as a function of the amount of aid tied. On this right, I included a histogram for each model for the purposes of illustrating at what levels of tied aid much of the variation occurs.

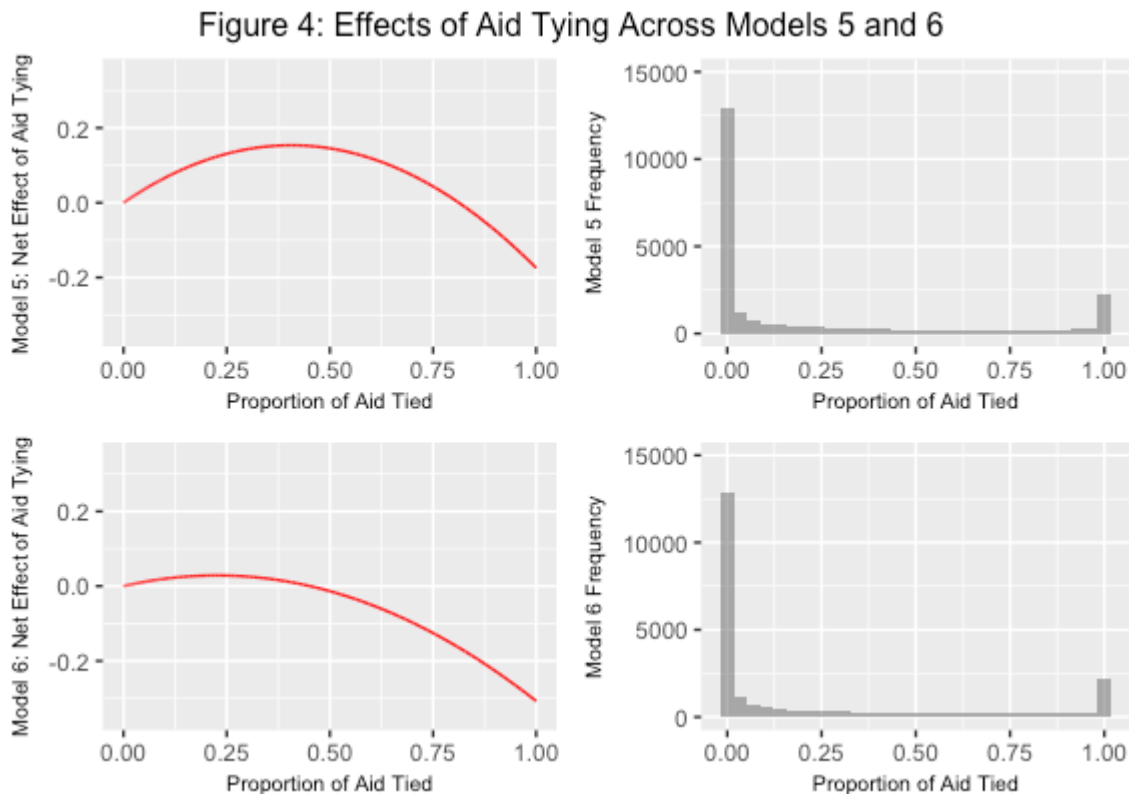Figure 4: Effects of Aid Tying Across Models 5 and 6

Figure 4 demonstrates that, according to the results of both Model 5 and Model 6, both the marginal impact and total impact of tied aid practices are initially positive. In Model 5, the positive effect of tied aid on aid commitment amount continues rising until its peak at 40.93% tied aid, representing 75.90% of observations. Immediately after this peak, the total effect of aid tying remains positive, as the net effect of aid tying does not go below zero until reaching 81.27% tied aid. In Model 5, the net effect of tied aid aid remains positive until the 86th percentile of observations, only dipping into the negatives for the highest values of aid tying. Model 6 offers a less compelling corroboration to this finding, peaking at the 69th percentile of observations and becoming negative at the 77th percentile of observations.[22]

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[22] Excluding observations of zero aid tied, the Model 5 x-intercept is at the 73rd percentile of observations, with the peak at the 53rd percentile. The Model 6 x-intercept is at the 56th percentile of observations and the peak point is at the 40th percentile.

As with the results from the earlier models, Models 5 and 6 still offer some ambiguity surrounding interpretation. The most notable limitation of Models 5 and 6 is that, due to their design, they must result in a quadratic relationship. Additionally, the R-squared value indicates some substantial variability. However, the degree of significance found in both models paired with the amount of variation that they account for indicates that the true relationship between aid tying and commitment size could be non-monotonic. In both models, tied aid appears to have a positive effect on commitment size for most proportions of aid tying, but a negative effect when aid is either fully tied or nearly fully tied. This, paired with the large number of observations in which aid is fully tied, as shown in the histograms, could offer the interpretation that cases of fully tied aid are dragging down the results in linear models when in reality the general effect of tied aid upon commitment amount is positive with the exception of aid that is almost entirely tied. Overall, Models 5 and 6 by no means conclusively prove a non-monotonic relationship between tied aid and commitment size, but they do suggest one potential interpretation of the puzzling results from Models 1 through 4.

If the relationship between tied aid and commitment amount truly follows a non-monotonic pattern as suggested by Models 5 and 6, this would lend partial support to the theory that tied aid policies incentivize increased aid allocations through donor utilities. Overall, however, due to mixed evidence between a potentially negative relationship, potential endogeneity, and indications of a non-monotonic relationship, further research into this theory would be required in order to determine whether tied aid overall has a positive impact on the amount of aid given.

VI. Conclusion

Overall, the findings of this paper are mixed in their support of the theory that tied aid allows increased aid allocations by increasing donor utility. While the initial regression models indicate a surprising negative relationship between aid tying and commitment size, Models 5 and 6 illuminate the possibility that tied aid could have a positive effect on commitment size in all cases except cases of heavily tied aid. Further research would be required to determine which interpretation of these results best reflects the actual relationship between aid tying and commitment size and ultimately whether the novel theory presented in this paper holds water.

Depending upon the accuracy of this paper's theory, a number of policy implications can be drawn regarding how best to approach the issue of aid tying. Primarily, if the relationship between tied aid and bilateral commitment size is negative, that provides more fodder for strong critiques of tied aid policies. A quadratic relationship as shown in Models 5 and 6, however, would suggest that some modest aid tying has positive impacts, while completely tied aid diminishes commitment generosity.

Additional research on this topic would serve to help fully interpret which policy implications best fit the true relationship between tied aid and commitment size. Qualitative studies of tied aid policy and disbursement size would help flesh out how the relationship between these two policy outcomes functions in the real world, and a difference-of-differences design could illuminate what exogenous factors impact tied aid practices. Donor-by-donor studies of the relationship between tied aid and commitment size would also help understand whether the effect of tied aid universally applies across the board. Overall, with more

investigation, the relationship between tied aid and generosity could become less and less of a

mystery over time.

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Appendix A: Donor Countries Included in the Multiple Regression Sample

Australia	Greece	Poland
Austria	Iceland	Portugal
Belgium	Ireland	Slovakia
Canada	Italy	Slovenia
Czechia	Japan	South Korea
Denmark	Luxembourg	Spain
Finland	Netherlands	Sweden
France	New Zealand	Switzerland
Germany	Norway	United States

## Appendix B: Recipient Countries Covered in the Multiple Regression Sample

Afghanistan	Bangladesh	Brazil
Albania	Barbados	Burkina Faso
Algeria	Belarus	Burundi
Angola	Belize	Cóte d'Ivoire
Antigua and Barbuda	Benin	Cabo Verde
Argentina	Bhutan	Cambodia
Armenia	Bolivia	Cameroon
Azerbaijan	Bosnia and Herzegovina	Central African Republic
Bahrain	Botswana	Chad

Chile
China (People's Republic of)
Colombia
Comoros
Congo
Costa Rica
Croatia
Cuba
Democratic People's Republic of Korea
Democratic Republic of the Congo
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Ethiopia
Former Yugoslav Republic of Macedonia
Gabon
Gambia
Georgia
Ghana
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
India
Indonesia
Iran
Iraq
Jamaica

Jordan
Kazakhstan
Kenya
Kyrgyzstan
Lao People's Democratic Republic
Lebanon
Lesotho
Liberia
Libya
Madagascar
Malawi
Malaysia
Maldives
Mali
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Mongolia
Montenegro
Montserrat
Morocco
Mozambique
Myanmar
Namibia
Nepal
Nicaragua
Niger
Nigeria
Oman
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru

Philippines
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Samoa
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Solomon Islands
Somalia
South Africa
South Sudan
Sri Lanka
Sudan
Suriname
Swaziland
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
Uruguay
Uzbekistan
Vanuatu
Venezuela
Yemen
Zambia
Zimbabwe

Appendix C: Average Proportion of Tied Aid by Year, 2003-2014
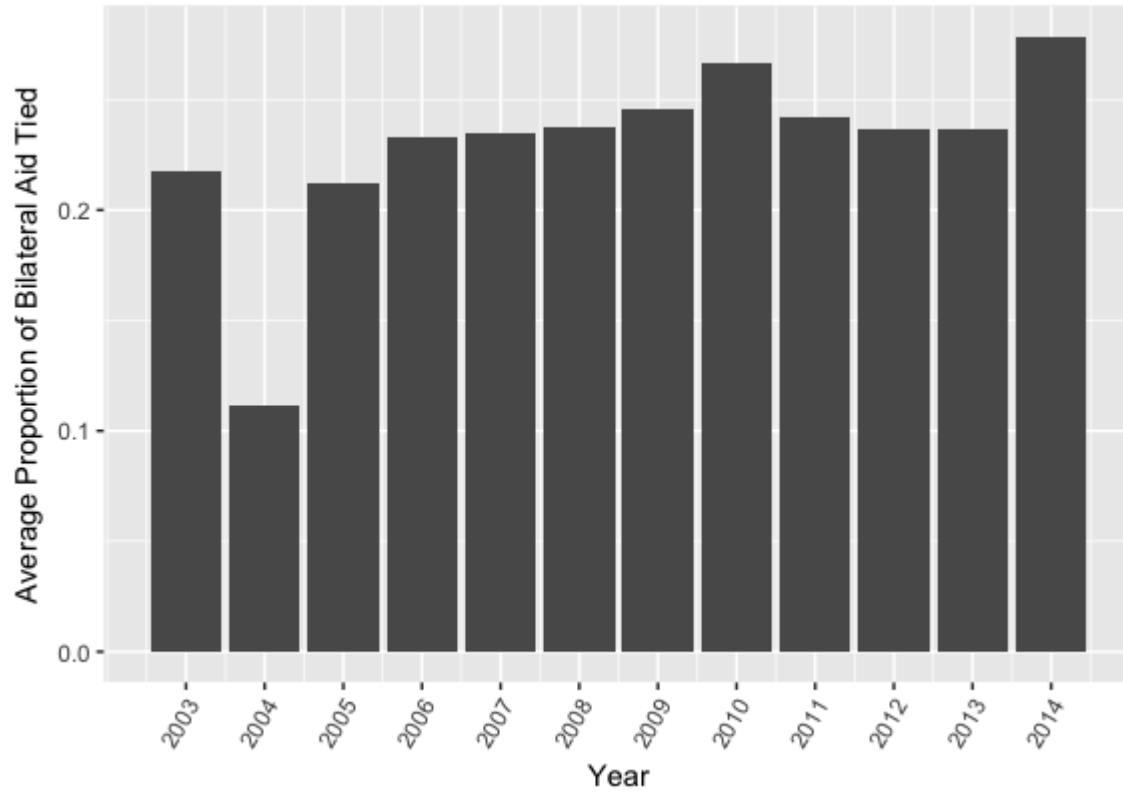
Note that Appendix C represents the sample covered in Models 1 through 6, not the entire dataset gathered.

Appendix D: Average Proportion of Tied Aid by Donor Country
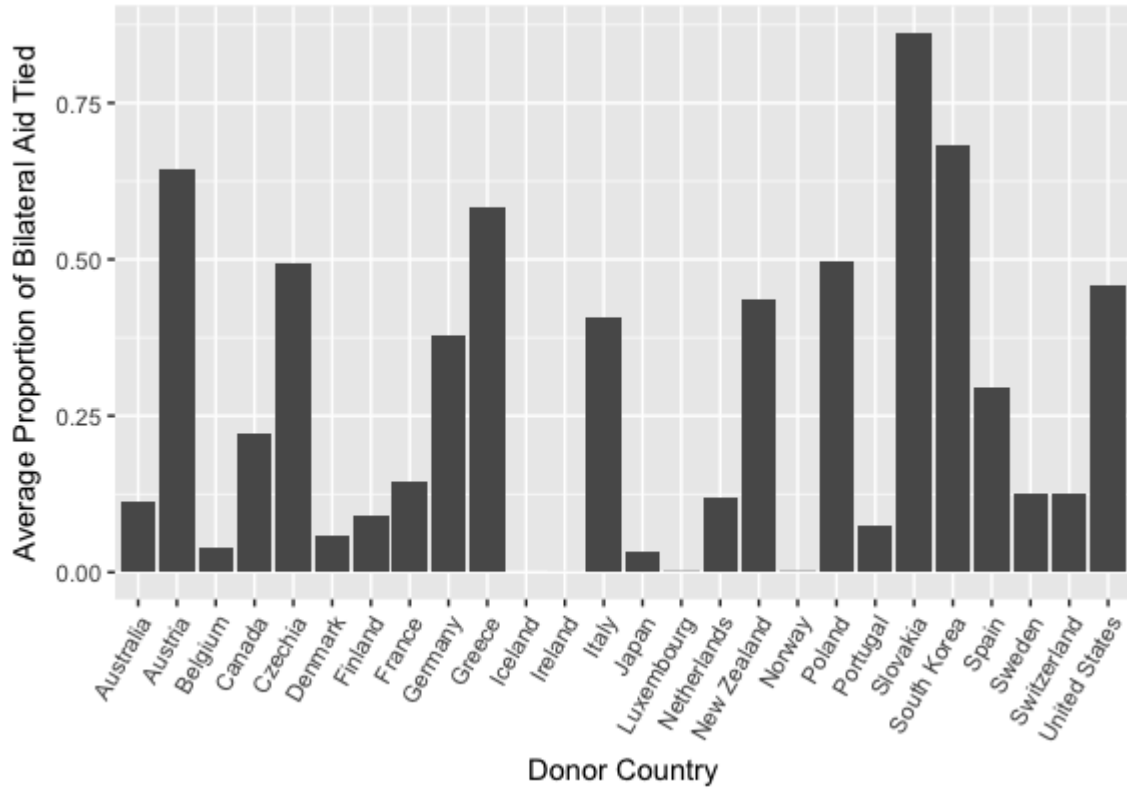
Note that Appendix D represents the sample covered in Models 1 through 6, not the entire dataset gathered.