US Disaster Aid and Bilateral Trade Growth

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Abstract

Previous research demonstrates that the decision to issue international disaster aid depends in part on the political relationship between donor and recipient countries. However, the reverse case – the impact of disaster aid on subsequent relationships – remains largely unexamined. In this paper, I argue that disaster aid promotes reconstruction, reduces investors' risk perception, and improves disaster victims' perceptions of the donor state. Together, these factors suggest a subsequent increase in trade between donors and disaster victims. I use error correction models (ECMs) to assess the short- and long-term influence of US disaster aid on trade growth over the 1973-2008 period. My results suggest that an increase in disaster aid often leads to a subsequent increase in bilateral trade considerably larger than the initial aid commitment. I also find, controlling for other determinants of disaster aid, that preexisting trade with the US is not associated with a victim's likelihood of receiving US aid. My findings are important for policy-makers, suggesting the presence of a material incentive to complement humanitarian imperatives to grant disaster assistance.

1 Introduction

Disasters can take a large material and human toll on affected states, particularly among vulnerable populations with low levels of development and weak political institutions (Kahn 2005; Strömberg 2007; Raddatz 2007; Raschky 2008; Noy 2009; Drury and Olson 1998). Given the potential for humanitarian assistance to ameliorate the human suffering and economic damage stemming from disasters, several studies have examined the conditions leading donors to grant disaster assistance (e.g., Drury et al. 2005; Strömberg 2007; Fink and Redaelli 2011). However, there has been less focus on the consequence of disaster assistance for the future relationships between aid donors and recipients.

In this paper, I examine the link between disaster aid and subsequent bilateral trade. I argue that disaster aid lessens the degree to which disasters damage the recipient's economy, reduces investors' perception of risk associated with recipient-donor commerce, and fosters improved perceptions of the donor state among recipient citizens. Together, these factors suggest that disaster aid promotes increasing recipient-donor trade over time. Using error correction models with data on United States disaster aid and bilateral trade spanning 1973 to 2008, I find support for my hypothesis that disaster aid correlates with higher subsequent bilateral trade flows. Furthermore, results are substantively larger when looking only at US exports to disaster victims. Subsequent tests confirm that my main results are not an artifact of the strategic use of aid, as I find no relationship between preexisting trade levels and the US decision to grant disaster aid.

My findings have important implications for policy-makers, particularly given the increase in the number and severity of disasters in recent years (Strömberg 2007). First, I find that increased trade volumes following from the provision of disaster aid outweigh the cost of this aid in many cases. While one might view it as an exaggeration to say that aid "pays for itself" because higher trade volumes do not deposit directly into the US Treasury, grants of disaster assistance nonetheless serve as a long-term investment promoting continued eco-

nomic activity to strengthen the US economy. This facilitation of trade could be interpreted as a positive consequence of US soft-power (Nye 2005),[1] and could even promote increased US political leverage over time, as recipients with whom the US trades more in the future could be more cooperative with the US out of concern for maintaining these trade ties.

I proceed with a discussion of the literature examining the varying consequences of disasters, as well as the impact of US aid on trade. Then, I present my argument linking disaster assistance to a subsequent increase in trade. Next, I present my research design, in which I specify error correction models, using data on country-years in the aftermath of disasters. I present the results of my analysis and conclude with a discussion of the relevance of my findings for scholars and policy-makers.

2 Disasters and Disaster Aid

Although the incidence of disasters is essentially random, the toll disasters inflict on populations is not (e.g., Kahn 2005; Strömberg 2007).[2] Higher human and physical costs from disasters are likely in states with a larger total population (Kahn 2005) or affected population (Raschky 2008), less economic development (Strömberg 2007; Kahn 2005), higher income inequality (Kahn 2005; Anbarci et al. 2005), and weak political institutions (Kahn 2005; Raschky 2008). To illustrate the stark cross-national differences in disaster consequences, Kahn (2005) compares earthquakes in the United States and India between 1980 and 2002, noting that despite a similar frequency and magnitude of incidents, the death toll in India was more than 200 times higher: 32,117 Indian deaths relative to 143 deaths in the United States. Other research examines the political consequences of this variation in disaster tolls. For example, Drury and Olson (1998) demonstrate that citizens tend to

[1] This expectations follows from a strict adherence to Nye's definition of soft power as *attraction* rather than capacity for economic inducement. Disaster aid typically is not intended as part of a *quid pro quo*; rather, recipient states observing the generosity and wealth of the US could seek to increase commerce in order to emulate US prosperity.

[2] Kahn (2005) notes that economic development is not associated with the incidence of disaster. Furthermore, although there is a connection between geography and the type of disaster experienced (for example, earthquakes and tsunamis are more common in the "ring of fire" region of the Pacific Ocean), there is only a minor link between geographic location and the incidence of *any* disaster.

blame political leaders for failure to prevent deaths and destruction resulting from disasters. Accordingly, as the toll of a disaster increases, so too does citizens' dissatisfaction with their government, the result of which is a higher frequency of political unrest.

Research examining the economic impact of disasters finds, similarly, that their consequence varies. For example, Raddatz (2007) demonstrates that climate disasters reduce GDP per capita particularly among less developed states. Noy (2009) notes that the economic impact of disasters can be mitigated through education, strong political institutions, and higher degree of trade openness, all of which could facilitate quicker reconstruction. More optimistically, Skidmore and Toya (2002) find that frequent disasters could promote investment in human capital and overall increased productivity over time, potentially fostering long-run growth. Research on the link between disasters and trade are rarer; however, a recent study finds that climate disasters harm victims' trade, an effect more pronounced as political risk increases (Oh and Reuveny 2010). Although the authors use an aggregated index of political risk, this measure is constructed from indicators of government institution stability and economic conditions fostering discontent, suggesting that the same factors associated with reduced economic growth in the wake of disasters also lead to diminished trade.

Given the high human and economic consequences of disasters, a number of studies have examined the determinants of disaster aid, which could presumably mitigate disaster tolls.[3] Notably, several studies in this area address the extent to which humanitarian need drives the allocation of foreign aid generally (e.g., Alesina and Dollar 2000; Fleck and Kilby 2010; Fink and Redaelli 2011; Kevlihan et al. ming). While humanitarian need, as indicated by poverty levels and disaster severity, appears to be a primary determinant of the decision to grant disaster aid (Kahn 2005; Fink and Redaelli 2011),[4] studies have shown that disaster aid is at least in part politically motivated. For example, Drury et al. (2005) demonstrate

[3] Drury and Olson (1998) find that disaster assistance is not associated with a decline in subsequent political unrest, suggesting (indirectly) that aid fails to mitigate disaster tolls. However, the authors also note that disaster aid tends to correlate with disaster severity. Accordingly, this null result may be an artifact of the positive association between disaster severity and political unrest.

[4] Fink and Redaelli (2011, p 742) note that most disasters are classified as "rapid onset," allowing little time to donors to negotiate conditions.

that, because disaster aid could help governments to maintain order, the United States is more likely to grant aid to friendly governments, leaving disfavored governments to face a relatively higher risk of instability. Similarly, studies have shown that many donors favor former colonies and states with a common language, (Strömberg 2007), as well as closer states, (Strömberg 2007; Fink and Redaelli 2011), oil exporters and politically less similar states (Fink and Redaelli 2011), and democratic states (Drury et al. 2005).

Given that disaster aid appears, with some caveats, to be directed towards states where disaster tolls are most severe, it stands to reason that emergency aid could mitigate the potential human and physical cost of the disaster, thereby promoting relatively more commerce within states suffering disasters as well as between disaster victims, donors, and third parties. While a number of studies have examined the consequences of foreign aid generally for economic growth (e.g., Frankel and Romer 1999; Easterly 2003; Raddatz 2007; Noy 2009; Bearce and Tirone 2010; Skidmore and Toya 2002) and recipient trade (e.g., Helble et al. 2012; Bearce et al. 2013), there has been relatively little study of the economic impact of disaster aid, and even less inquiry into the impact of disaster aid on subsequent economic relationships between donor and recipient.

3 Disaster Aid and Trade Growth

Although the time sensitive nature of disasters leaves less room for donors to negotiate concessions from recipients (Fink and Redaelli 2011), the studies noted above demonstrate that the decision to grant disaster aid is nonetheless subject to political and economic considerations. It stands to reason that disaster aid could influence subsequent relations between donors and recipients, yet this relationship is not well understood. By synthesizing the findings of prior studies on the consequences of disaster aid, I argue that this aid will facilitate donor-recipient trade growth over time, potentially to the extent that increases in trade outweigh the cost to donors of granting aid.

I begin with a model of disaster aftermath, in which damage to infrastructure, along with injury, death, and displacement of citizens, reduces both the capacity to produce commodities for export as well as the economic activity needed to generate wealth that pays for imports. All else equal, the extent to which trade–both in the short- and long-run–is harmed in the immediate aftermath of disasters will be proportional to the initial magnitude of the disaster, which is itself dependent on the economic and institutional development of the victim state. Even in the absence of disaster aid, lost trade could recover naturally as infrastructure is repaired and citizens acclimate to their damages; accordingly, we should normally see increases in trade in the years following disasters. However, as I show below, disaster assistance has a number of effects that encourage higher subsequent volumes of trade between recipient and donor than would be experienced in the absence of such aid.

There are a number of characteristics of disaster aid that facilitate trade growth between donor and recipient. First, short-term emergency aid can provide critical food and medicine to mitigate short- and long-term human suffering and death from disasters. Disaster aid can therefore preclude widespread loss of economic output resulting from loss or displacement of the recipient's workforce. Unlike other forms of aid (particularly development aid), disaster assistance is targeted directly to individuals, rather than to governments. As a result, there is a (relatively) reduced likelihood that this aid will be mismanaged or captured by political leaders.[5] To the extent that disaster aid promotes stability, and therefore fosters economic activity within the recipient state, it should also promote trade by facilitating the production of exportable commodities and increasing the income of citizens, strengthening demand for imports. Importantly, this may be a relative effect; disaster aid could function primarily to mitigate trade decline associated with the damage caused by the disaster. Yet, this fact nonetheless suggests that disaster aid serves as an investment guaranteeing *relatively* higher

[5]This is particularly true of emergency food and medical aid, which often bypasses the recipient's government, distributed by non-governmental organizations. However, longer-term reconstruction aid could fall victim to misuse by governments. In a study of aid-for-trade effectiveness, Bearce et al. (2013, 164; see also Collier 1997) note that such policies could still promote exports even if recipients spend aid on government consumption. This follows because desire for imports (to be paid for with aid) could encourage reduction of trade barriers, a policy that could then be reciprocated by trade partners. A similar effect could apply to the mismanagement of disaster aid.

trade volumes in the wake of disasters. Indeed, these relative increases could potentially outweigh the cost of disaster aid provision; in such a case, from the perspective of policy-makers considering whether to allocate aid, it would be irrelevant that trade might be higher still if no disaster had occurred

Additionally, longer-term reconstruction aid can be directed towards the repair or creation of infrastructure to foster trade flows, particularly between the donor and the recipient. By repairing existing infrastructure, disaster aid lessens the otherwise trade-dampening impact of the disaster itself. The repair of roads, bridges, and other means of transportation is particularly important for preventing rising transaction costs, which could inhibit trade in the aftermath of a destructive disaster. In fact, the recipient could also take advantage of the opportunity to upgrade its infrastructure and physical capital, leading to productivity gains and the increase of trade beyond that in a counter-factual situation in which no disaster occurred (Skidmore and Toya 2002). Given that aid must be delivered from the donor to the recipient, the donor is likely to invest in immediate repair of infrastructure linking itself to the recipient. While the short-term goal of this behavior is to provide channels for the effective distribution of the aid itself, the long-run consequences could include a reduction in transaction costs for trade between the donor and recipient. Indeed, this behavior could be especially beneficial to the donor's exports, given the practicality of increasing exports of reconstruction material to the recipient, and the fact that the recipient's transaction costs for importing should be lowest with respect to the donor.

The factors above suggest means by which disaster aid can promote recipient trade over time, but do not necessarily imply that donor-recipient trade in particular will increase. However, disaster aid could also have beneficial cultural and affinity-related consequences specifically for the donor. Beyond its utility in the mitigation of long-term human suffering and the facilitation of reconstruction, disaster aid can also serve as a channel for soft power (Nye 2005). By demonstrating its economic capability as well as its generosity, the donor could motivate the recipient's population to desire increasing commerce with the donor

towards the goal of promoting economic growth. For example, disaster aid could promote improved attitudes towards the donor in the recipient's population. Although this possible causal mechanism has not been tested on a large scale, a case study by Rajapaksa and Dundes (2006) finds that US disaster aid following the December 2004 Tsunami that struck Sri Lanka fostered considerably reduced anti-Americanism among the Sri Lankan population. Another working paper finds similar results of disaster aid in the aftermath of the 2005 Pakistan Earthquake (Andrabi and Das 2010). Indeed, a recent study by Forster (ming) presents three specific mechanisms by which humanitarian aid could translate to increased attraction to the US. First, such aid can garner sympathy and gratitude via offering of care for those in need. Second, the aid recipient learns from the success of the donor state, seeking to emulate the capabilities and leadership displayed. Third, the recipient could pursue similar goals of health promotion, education, and commerce, which in turn leads to shared ideals and better relations. The studies above suggest that improved affinity associated with aid could lead to a higher willingness by recipient citizens to engage in economic transactions with the donor (e.g., Pollins 1989). Furthermore, the provision of aid itself comprises increased interaction between donor and recipient, possibly fostering the transmission of cultural information, building understanding and promoting increased commerce over time in accordance with the Kantian peace argument (e.g., Russett and Oneal 2001).

Finally, aid can serve to reduce political and economic risk associated with disasters (e.g., Oh and Reuveny 2010) by demonstrating the strength of the donor's commitment to assist the recipient.[6] This effect on investor perceptions could be direct; the provision of aid signals that the donor is providing safeguards to protect investments.[7] There could also be an indirect effect of disaster aid on risk through a reduction of the strain on the recipient's government. An influx of funds could bolster the recipient government's management of

[6]However, this effect would likely vary depending on pre-existing development and corruption levels within the recipient. More developed states are less likely to suffer in the absence of aid; however, they are also less likely to receive aid. More corrupt leaders might capture aid rather than use it in a way that improves investors' perceptions of risk. However, as noted above, prior research suggests that aid could promote trade even if it is used for government consumption (Bearce et al. 2013).

[7]Indeed, the provision of aid could even signal the opportunity for investment in reconstruction, leading firms to seek out this new market.

the recovery, thereby improving political stability by mitigating citizens' dissatisfaction with their leaders (e.g., Drury and Olson 1998). Aid could also have an indirect effect on investors' risk perception by promoting economic stability, preventing or reducing shocks to interest rates, prices, and terms of trade that could harm international (as well as domestic) commerce.[8] Accordingly, reduced risk premiums resulting from the stability provided by disaster aid will motivate investors to back commerce, particularly between donor and recipient.

It is important to note that extant studies suggest the potential for foreign aid at times to foster Dutch disease-like conditions that could actually harm the recipient's export sector (e.g., Rajan and Subramanian 2011).[9] If this phenomenon operates with respect to disaster aid, one might expect to find a negative relationship between aid commitment and subsequent recipient-donor trade growth. However, disaster aid should be less likely to have this detrimental effect because it is typically geared towards short-term emergency care (food and medicine) and one-time construction projects. As a result, disaster aid is unlikely to cause resource movement towards one specific sector of the recipient's economy. Additionally, disaster aid should not lead to long-term appreciation of the recipient's currency; rather, it should promote exchange rate stability.[10]

Accordingly, my argument leads to the hypothesis:

Hypothesis 1 *A higher commitment of emergency aid following a disaster is associated with a larger increase (or smaller decrease) in subsequent bilateral trade.*

[8] Again, this stabilizing role of aid implies that its trade-fostering effect could function for recipient trade with other states beyond the donor. However, my theory suggests this third-party effect would be weaker given the absence of cultural benefits with respect to non-donors, the potential prioritization of repairing infrastructure connecting recipient and target, and investor observation of the donor's role in stabilizing the recipient, as noted above. Nonetheless, the impact of disaster aid on the recipient's overall trade merits further study.

[9] There are two mechanisms through which aid generally could harm exports. First, it could increase wages in non-export sectors (construction, education, etc.), leading to resource movement away from export sectors. Second, it could cause appreciation in the recipient's exchange rate (e.g., Corden and Neary 1982).

[10] However, if disaster aid is mismanaged to the extent that it does lead to conditions associated with Dutch-disease, support for my hypothesis linking disaster aid and trade growth should be reduced. If I find empirical support for my hypothesis despite this potentially cross-cutting effect of aid, it would serve to increase confidence that this relationship is real.

3.1 The Potential for Reversed Causation

One could suspect that the granting of disaster aid correlates with increased subsequent bilateral trade because donors target aid specifically toward the ends of preserving trade, which might otherwise decline due to material damage. Theoretically, I expect not to find support for this alternative argument because, typically, need is the single biggest determinant of whether (and how much) disaster aid is issued (e.g., Kevlihan et al. ming; Kahn 2005; Fink and Redaelli 2011). However, given that, at least with respect to the United States, political factors have been shown to affect the provision of disaster aid (Drury et al. 2005), it follows that economic considerations may play a role as well. Policy-makers could be more likely to push for the provision of disaster aid when they perceive that inaction risks the loss of valuable trade gains. Accordingly, I test for the robustness of my theory by examining the association between preexisting trade levels and the provision of disaster assistance. Specifically, I test the following additional hypothesis:

Hypothesis 2 *A higher level of preexisting trade is associated with a higher grant of emergency aid following a disaster.*

4 Research Design

I test my hypothesis with data on disasters, US emergency aid, and trade spanning 1973 to 2008. Although the US is not the only donor of disaster aid, I restrict my analysis to US aid in order to avoid introducing omitted variable bias by donor.[11] Furthermore, this restriction on the scope of my analysis allows me to replicate the models of Drury et al. (2005) with the addition of variables for trade to examine the connection between preexisting trade ties and the decision to grant disaster aid. Beyond these practical considerations, the restriction of my analysis to US aid and bilateral trade is useful because the US is uniquely positioned to deliver humanitarian relief to any location on the globe, reducing problems wherein some

[11] Future analysis would benefit from an examination of multiple donors.

disaster victim states are too remote to receive timely assistance.[12]

My unit of analysis is the country year; however, I exclude all country-years prior to the onset of the first disaster that a given state experiences (since 1973).[13] This construction is useful to isolate comparable cases. Prior to the onset of a disaster, there is no opportunity for disaster aid to be allocated. Accordingly, models examining the influence of disaster aid would lump together observations where (1) the US chose not to grant disaster aid and (2) no disaster occurred and thus there was no opportunity for aid.[14] I define the occurrence of disasters using criteria from the Emergency Disasters Database (EM-DAT) (Center for Research on the Epidemiology of Disasters 2012). To be considered a disaster, an event must lead to 10 deaths, affect 100 people, or result in a declaration of emergency or plea for international assistance.

4.1 Statistical Models

My statistical models are designed to isolate the impact of disaster aid accounting for the facts that (1) aid could correlate with disaster severity, and (2) a natural process of trade reduction and recovery could exist irrespective of aid levels. To do so, I specify error correction model (ECM) variants of the standard gravity model of trade (e.g., Anderson 1979). These models allow for the estimation of the immediate impact of an aid shock as well as the long-run return to equilibrium, controlling for characteristics of the disaster as well as for typical correlates of trade. As discussed by De Boef and Keele (2008), error correction models are useful to examine the relationship between any pair of variables that maintain an equilibrium relationship. While one might expect not to find such an equilibrium relationship between

[12] For example, the United States Navy maintains the two largest hospital ships in the world, USNS *Comfort* and USNS *Mercy*, which provide humanitarian relief in the aftermath of disasters. *Mercy* is based in California, while *Comfort* is based in Virginia, thus providing ready access to both oceans surrounding the US.

[13] Given that disaster onset is essentially random (Kahn 2005), this restriction on observations should not cause a selection effect, which could bias my results. However, given that Kahn (2005) finds that disaster *tolls* are not random, I include explanatory variables for disaster severity in all models. Furthermore, I present models including all country years in the supplemental appendix.

[14] I contend that these problems outweigh the one benefit of including all country years: the ability to compare post-disaster trade levels with and without disaster aid to trade levels in states that never experience a disaster. As noted above, I present models including all country years (and thus, starting from 1973, including states not yet experiencing a disaster) in the supplemental appendix.

disaster aid and trade because there is no emergency aid in the absence of a disaster, the restriction of my analysis to years following disasters should isolate periods in which such relationships are likely. In all models, I cluster standard errors on the country in order to mitigate bias due to unequal residual variance by state.[15]

4.1.1 The Dependent Variables: Trade Growth

I code two dependent variables. the first is the change from year *t* to year *t+1* in total bilateral trade between the disaster victim and the United States. I measure this variable using the Correlates of War (COW) Trade data version 3.0 (Barbieri and Keshk 2012; Barbieri et al. 2009). Due to the presence of inflation, both disaster aid commitment and trade volumes have increased over time. Accordingly, to prevent spurious findings in which a positive association between aid and trade growth follows merely from the effect of inflation, I convert this variable to constant 2009 US dollars. I add the victim's imports originating from the US and exports from the victim to the US, taking the natural log of the raw trade volume (plus one),[16] before differencing. I also include an explanatory variable for trade in year *t* in accordance with the standard ECM.[17] This variable accounts for the fact that trade growth likely depends on preexisting trade levels–which, in turn, could have been influenced by the onset of a disaster. It is also useful to preclude auto-correlation.

My second dependent variable is the change from year *t* to year *t+1* in a state's imports from the US (i.e., US exports to that state). This second dependent variable is useful because US exports are particularly salient to US policy-makers seeking to promote a strong US economy. As with the total bilateral trade variable, this variable is coded in constant dollars to prevent bias from inflation. Again, I take the natural log of the raw value (plus

[15] While they account for heteroskedasticity, clustered standard errors do not eliminate possible omitted variable bias by recipient. However, I find that results are consistent if I include fixed effects by recipient. In these fixed effects models, time-invariant variables (specifically, distance) drop from the analysis. I do not present fixed effects models, however, because the inclusion of a lagged dependent variable could lead to a violation of the zero conditional mean assumption for the residuals. Notably, the inclusion of lags as well as the use of differenced dependent and explanatory variables also mitigate omitted variable bias.

[16] Adding one to the trade volume preserves zeros, which would otherwise be dropped.

[17] Given that my dependent variable is coded as a future change, this variable is equivalent to a lagged DV.

one), taking data from the COW data 3.0 (Barbieri and Keshk 2012; Barbieri et al. 2009). As with the total trade variable, I also include an explanatory variable for trade in year t in accordance with the ECM.

4.1.2 Primary Explanatory Variables: Disaster Aid Commitment

My primary explanatory variable is total US commitment of disaster aid, measured in constant 2009 US dollars (again, to account for inflation), taken from aiddata.org (Tierney et al. 2011).[18] Disaster aid incorporates all resources committed by the US for the purpose of emergency assistance (typically food, water, or medicine) and reconstruction following disasters.[19] I take the natural log of the raw value (plus one); as such, the coefficient for this variable is interpreted as an elasticity. In accordance with the ECM design, I include both the future change (year t to $t+1$) of this variable as well as the value of the variable in year t. A list of all states receiving commitments of US disaster aid between 1973 and 2008, along with the cumulative dollar total of the aid over that time span, is presented in the supplemental appendix.

4.1.3 Accounting for Timing and Disaster Severity

The most crucial control variables in my models capture the time since a disaster occurred, as well as the severity of the most recent disaster. These variables are included to account for the underlying process of trade reduction and recovery. Without these controls, I could find an apparent effect of aid simply because such aid tends to be given in years immediately following a disaster when trade is reduced, after which trade increases during the recovery process. First, I include a counter variable for the years since the most recent disaster. This

[18] Although disaster aid disbursement does not always follow in the same year that aid is committed, data on disbursement is considerably poorer than that for commitment, precluding its use in my analysis.

[19] Results look largely identical if I include separate variables for emergency assistance, typically a short-run goal, and reconstruction, which is typically a long-run goal. Also, the measure of total disaster aid includes disaster preparedness aid. However, results are consistent if I exclude preparedness aid, a potentially useful specification given that it could be viewed as more similar to official development assistance than emergency response assistance. However, preparedness aid tends to take very small values, suggesting that its influence on my results is minimal. Furthermore, the need for preparedness aid logically should be higher in the aftermath of a costly disaster.

variable is one of few that is included only for year *t*.[20] Notably, to account for disaster severity, I do *not* use the variables provided by EM-DAT (Center for Research on the Epidemiology of Disasters 2012). Although the variables for the disaster-inflicted deaths and the estimated dollar value of damage caused by the disaster are available from EM-DAT, neither of these variables is necessarily a good indicator of the disaster's immediate or long run impact on trade. Deaths might only weakly correlate with loss of human capital and wages. Furthermore, the link between deaths and trade damage could be dependent on the structure of the victim state's export economy. Although the overall economic cost of the disaster appears useful at first glance, two considerations reduce its practical value. First, there are difficulties inherent in estimating this variable in a standardized manner (over time and across countries), resulting in estimates that can follow from little more than guesswork. Second, the variable is aggregated over time, capturing the total estimated cost of the disaster for all years since the disaster occurred. Accordingly, the EM-DAT cost variable itself could be influenced by the presence or absence of disaster aid.[21]

Instead, I create a measure of the disaster's direct effect on trade. Specifically, I code the percentage reduction in trade from the year before a disaster to the year of the disaster.[22] I then use this variable for subsequent years until the next disaster occurs, after which I use that subsequent disaster's corresponding percentage reduction in trade. Accordingly, the variable coded for year t captures the severity of the most recent disaster, while the change variable (from year t to year $t+1$) equals zero except when a subsequent disaster occurs. One might question whether change in trade associated with the onset of a disaster is actually caused by the disaster. However, given that disasters occur randomly, I contend that my trade-based severity measure will, on average, capture the effect of the disaster. Even though disaster severity is in part a consequence of development and institutional quality, the event

[20] This design choice follows because a variable for change in years since disaster would always equal 1, except in years of a subsequent disaster.

[21] My results for aid commitment are unchanged when I use these two measures of severity. However, the measures themselves appear largely unrelated to future trade, possibly for the reasons discussed above.

[22] This variable is coded as new trade flow minus old trade flow, a quantity then divided by old trade flow. When examining only imports from the US as my DV, I also code the severity variable using only imports from the US.

that "stresses" these phenomena is nonetheless randomly assigned by nature. Accordingly, this variable is useful to capture the damage inflicted by a disaster, reducing the possibility of spurious correlation that could occur if, for example, a more severe disaster leads both to higher grants of disaster aid *and* a larger potential for trade recovery.[23]

Although controls for severity in terms of disaster trade costs could be sufficient to address this potential for spurious correlation, I take two additional steps to mitigate bias in my models. First, in alternate models, I interact the aid commitment variables with the disaster severity variables in order to address the potential for the influence of disaster aid to be conditional on disaster severity.[24] Aid might have the greatest opportunity for a positive impact where disasters are most severe; or, alternately, higher severity might blunt the effectiveness of a given level of aid. Second, in order to provide additional insurance against spurious correlation following from the overall level of investment the US has in the disaster victim, I also control for the value of disaster aid as a proportion of total US aid to a given recipient, using data from EM-DAT.

4.1.4 Other Explanatory Variables

Other explanatory variables are chosen in accordance with the standard gravity model of trade (e.g., Anderson 1979), in order to control for the fact that the US, acting rationally, might grant more disaster aid to states with which conditions facilitate trade. First, I include variables for the (natural log of the) disaster victim's and the United States's gross domestic products (GDP), taken from the Penn World Table (Heston et al. 2012), and converted to 2009 constant US dollars. I also include a variable for (the natural log of) distance between the US and the disaster victim, taken from the EUGene (Bennett and Stam 2000). The distance variable is included in my models as a current level indicator but *not* a future

[23] One caveat is that very fast administration of initial aid could affect the degree to which a disaster affects trade (measured as the difference between the year of the disaster and the year before the disaster). However, all measures of disaster severity face this same problem. In fact, the EM-DAT variables for deaths and total disaster cost are more susceptible to being influenced by aid because they are aggregated for the entire disaster, not measured yearly. Accordingly, I contend that my variable is the best available measure of the *initial* impact of a disaster that could have long-ranging consequences.

[24] Specifically, I interact the change in aid variable with the change in severity variable, and I interact the lagged aid variable with the lagged severity variable.

change indicator, a specification decision following from the fact that there is essentially no change in borders over the time span of my study.

I also include variables for the complementarity of factor endowments, which could facilitate higher trade volumes in accordance with the Heckscher-Ohlin model of international trade (Ohlin 1933). Specifically, I code (the natural log of one plus) the ratio of the victim's to the United States' land, labor, and capital endowments. A higher number suggests that the victim has a relative abundance of a specific factor, a condition that could promote trade with the US. To measure land endowment, I use data on arable land as a percentage of total land from the World Development Indicators (World Bank 2012). I code labor and capital endowment using data from the Penn World Table (Heston et al. 2012); specifically, indicators of population and GDP per capita, respectively.

Finally, I control for political factors that might affect both bilateral trade and the US decision to grant disaster assistance.[25] I take the natural log of population from the PENN World Table (Heston et al. 2012), given that more populous states could be more visible to US citizens, thereby installing a greater public demand for action. I account for the victim's level of institutional democracy using the 21-point combined Polity score (Marshall and Jaggers 2010), given evidence that the US is more likely to grant disaster aid to democratic states (Drury et al. 2005), while previous research suggests that democracies trade more with each other (Morrow et al. 1998). I include a variable for the victim's UN voting similarity with respect to the United States (Gartzke 1998; Strezhnev and Voten 2012), as US policy-makers may give preference in aid and trade to states holding similar foreign policy preferences. Summary statistics for all variables can be found in the supplemental appendix.

[25] These control variables exclude an indicator of US media coverage of disasters, an omission following from data limitations. However, given that previous research shows a strong link between media and foreign aid (Van Belle et al. 2004), I replicate all models including a measure of *New York Times* mentions of disasters in the recipient state, taken from Drury et al. (2005). Although the inclusion of the variable results in the reduction in the time frame of my analysis (to the 1973-1995 period), all results are consistent in these models.

4.2 Testing for Reverse Causation

The error correction models described above do not necessarily ameliorate all concerns for reversed causation that could arise if the US directs disaster aid to its trade partners. Accordingly, I also specify models examining the link between preexisting trade and the granting of disaster aid. To do so, I follow Drury et al. (2005), specifying Heckman selection models to estimate the decision to grant aid and the value of that aid simultaneously.[26] I alter the specification of these models slightly such that I can utilize the entire time period of my primary analysis: 1973-2008.[27]

In these models, the first equation dependent variable is a dichotomous indicator of whether the US commits aid to a given state in year *t*. The second equation dependent variable is a continuous indicator of aid commitment in constant 2009 US dollars in year *t*. I use the same logged indicator of aid described above. The primary explanatory variable is a measure of bilateral trade in year *t-1*; this variable is coded identically to the one described above in my discussion of the trade growth models. In both equations, I control for likely correlates of disaster aid: the severity of the disaster in terms of (logged) deaths as well as in trade cost, as described above,[28] the development of the victim state (using the GDP per capita indicator from the Penn World Table (Heston et al. 2012), the victim's UN voting similarity with the United States, and its Polity score (both as described above). In the issuance equation, I also include variables for the victim's population (as described above), which could correlate with heightened awareness in the US, as well as the US budget deficit as a percentage of US GDP, which could affect US willingness to grant foreign aid. I use deficit data from the US Department of Treasury (United States Department of the Trea-

[26] Following the authors, I do not present an ECM specification of (the second equation of) the Heckman model. However, I do include such a specification in the supplemental appendix.

[27] In robustness tests available by request, I replicate these models with the addition of an alliance variable from the Alliance and Treaty Obligation and Provision (ATOP) data (Leeds et al. 2002) in order to examine whether my results match the primary finding of Drury et al. (2005) that alliance is associated with a higher probability of aid issuance, but not with allocation. The time span of these models is reduced to the 1973-2003 period given the end date of ATOP alliance data. My results are consistent in these models; dyadic trade is not associated with the granting of aid. I also find, consistent with Drury et al. (2005), that alliance is associated with a higher probability that the US grants aid, but not with allocation.

[28] While deaths are not necessarily a good indicator of severity from the perspective of modeling future trade, deaths are likely to affect US response to a disaster, with a larger number of deaths corresponding to a greater demand by US citizens for action to mitigate the disaster's toll.

sury 2012). All explanatory variables except the disaster severity variables and distance are lagged one year to preclude simultaneity bias.[29]

5 Analysis

I find strong support for hypothesis 1 in error correction models examining trade growth in the aftermath of disasters. Furthermore, I find that the effect of an increase in aid continues to affect subsequent bilateral trade growth for a number of years following the initial aid commitment. Conversely, I find no evidence that preexisting trade levels increases the likelihood that the US decides to grant aid, nor does it increase the allocation of aid dollars. As such, hypothesis 2 is not supported.

5.1 Aid and Trade Growth

Table 1 presents coefficients and robust standard errors for ECMs examining the relationship between US disaster aid and subsequent total bilateral trade growth. Model 1 excludes the interaction between aid commitment and disaster severity (in terms of percentage reduction in trade), while Model 2 includes this interaction to assess potential conditionality in the impact of aid.

[Table 1 about here]

The single-equation error correction model that I use to examine the impact of disaster aid on subsequent trade provides two coefficients for each explanatory variable. The coefficient for the "change" (from year t to $t+1$) variable signifies the immediate impact of an increase in this variable on the change in bilateral trade (also from year t to $t+1$). The coefficient

[29] Furthermore, in additional robustness tests presented in the supplemental appendix, I use the Conditional Mixed Process (CMP) package in Stata (Roodman 2011) in order to estimate simultaneously the decision to grant aid, the value of aid, and the subsequent growth in trade. The CMP package estimates these three equations using seemingly unrelated regression, allowing for the Heckman selection process between the issuance and commitment equations, and furthermore tests for correlation of residuals among each pair of these three equations. The US budget deficit variable serves as an instrument for aid allocation, given that there is no correlation between US deficits and bilateral trade growth. These models return results consistent with those presented here.

for the "level" variable (at year t), when divided by the coefficient for the lagged dependent variable (i.e., bilateral trade at time t), provides the long-run multiplier: the additional effect of each explanatory variable over time (De Boef and Keele 2008).[30] I construct the error correction models such that the long-run multiplier can be calculated for all variables (with the exception of distance and years since disaster). However, for the purposes of this study, I present and interpret only the long-run impact of disaster aid commitment.

The coefficient for Δ *ln Disaster aid commitment* is positive and significant ($p \leq 0.01$) in both models. From Model 1, this coefficient suggests that a 1% increase in disaster aid is associated with a 0.008% increase in trade.[31] However, this disturbance to the equilibrium causes trade to be too low, such that it rises an additional 0.03 percent. While these changes in trade are quite low, they become more meaningful for larger increases in aid. If aid were to double from its mean value (i.e., increase by 100%), trade would increase by 0.8% immediately, then 3% over time. Figure 1 displays the timing of the return to equilibrium.

[Figure 1 about here]

The solid line in Figure 1 shows the cumulative effect of a doubling (i.e., increasing by 100% relative to a given baseline value) of disaster aid, from model 1. At period 0, reflecting the immediate impact of the aid shock, the percentage increase in trade is equal to 0.8 Over time, the effect of this disaster aid increase approaches a horizontal asymptote at 3.8, reflecting the total of 3.8% increase in trade (adding together the initial 0.8% increase and long-run 3.0% increase). Approximately 50% of this effect has occurred within 3 years after aid is committed; the vast majority of this increase occurs within 10 years after aid is committed, although change continues throughout the 15 years presented in the plot.

The beneficial impact of US disaster aid can be illustrated with an examination of the "average" case. The mean yearly commitment of US disaster aid over the 1973-2008 period

[30] I use the Bewley transformation of the ECM to calculate the long-run multiplier and its standard error (De Boef and Keele 2008). The Bewley transformation is particularly useful to estimate the conditional long-run multiplier in my interactive specifications.

[31] Because both the explanatory and dependent variables are logged, coefficients are elasticities, easily interpreted in terms of percentage changes.

is just over 1.7 million dollars. Conversely, average bilateral trade over this same period is 585 million dollars. The results reported above in Figure 1 suggest that a doubling of the average aid commitment from 1.7 to 3.4 million dollars would result in a 22.2 million dollar increase in the average trade volume (a 3.8% increase), 4.7 million dollars of which would occur immediately (a 0.8% increase). Accordingly, in this average case, a 100% increase in aid is outweighed more than 2–1 by trade growth in the immediate term, and more than 10–1 over time.

However, these projections incorporate data on (inflation adjusted) aid and trade volumes dating back to 1973. As US trade has grown over time, this potential to reap returns from investing in disaster aid has increased as well. In 2008, the last year for which I have data, the average value of US disaster aid committed was 2.4 million (averaged over 97 aid recipients). Simultaneously, average US trade with these aid recipients was 802.3 million. Consequently, a doubling of aid to the average recipient would cost the US an additional 2.4 million, yet would lead to an immediate increase in trade of 6.4 million. The model predicts that, over time, trade would increase by 30.5 million, all from this 2.4 million dollar investment.

The benefit to the United States is illustrated more clearly through an examination of aggregate disaster aid and trade values. The United States committed 2.3 billion (inflation adjusted) dollars of disaster aid in 2008, while US trade with disaster victims was estimated at 1.36 trillion (inflation adjusted) dollars. My model predicts that doubling of 2008 disaster aid (to 4.6 billion) would lead to an increase of 52 billion dollars in trade. This return on investment, although dispersed over time, represents more than a ten-fold return on aid commitment. Furthermore, my model predicts that half of this trade growth (26 billion) would occur within three years of commitment.

Model 2, in which I interact the variables for aid commitment and disaster trade cost, shows a pattern very similar to that in Model 1. The significance of the coefficient for the lagged indicator of aid could be evidence that disaster aid has a stronger long-run impact when the disaster causes no initial reduction in trade (that is, when disaster cost is equal to 0);

however, an examination of the conditional long-run multiplier show that the marginal effect of aid commitment is essentially flat over the range of 0-to mean plus one standard deviation of the disaster cost variable. Given this fact, along with the general lack of significance in the interaction terms for change in aid, I exclude the detailed presentation of conditional marginal effects here. However, conditional coefficients for the immediate impact of aid, as well as the long-run multiplier, are presented in the supplemental appendix. A detailed analysis therein demonstrates that disaster aid has a significant short- and long-run association with trade growth, but that this association is not conditional on disaster severity.

Table 2 presents Models 3 and 4, which replicate models 1 and 2 replacing bilateral trade variables with measures of the disaster victim's imports from the US. Results of these models look very similar to those reported in Table 1. However, the magnitude of aid coefficients is larger, while, simultaneously, the confidence is greater that their true value is different from 0. The dashed line in Figure 1 presents the change in imports from the US associated with an increase of 100% (relative to the mean) in US disaster aid commitment (from Model 3). Notably, the immediate impact of this aid is greater; it is associated with a 0.8% increase in imports from the US. Over time, imports from the US will continue to increase, up to a total of 4.7%. I find that doubling the mean level of US disaster aid in my data (that is, increasing from 1.7 million to 3.4 million dollars in aid), would lead to an increase of 20.8 million dollars in US exports, 3.55 million of which would accrue immediately. Again, these estimates suggest that US disaster aid is a profitable investment.

[Table 2 about here]

The interpretation of results thus far suggests that US disaster aid has a high return on investment. However, it is useful to put this association into perspective by examining it relative to the impact of disasters. Accordingly, I examine how the average (in terms of severity) disaster affects trade, all else equal. Model 1 suggests that in the first year after an average disaster occurs, trade will be 7% lower, while the disaster will result in an

additional 6.2% lower trade over time.[32] Estimates are similar in interactive models, and when looking at imports from the US specifically. Importantly, I find that a large increase in aid is necessary to offset the immediate impact of an average disaster. From Model 1, I estimate that, to replace the trade lost in the first year to a disaster of average severity, the US would have to increase aid by a factor of 14–in other words, an increase from 1.7 million dollars to 23.8 million dollars. However, in the long run smaller increases in aid have a relatively greater effect. Increasing aid by a factor of 3 (from 1.7 to 5.1 million) would more than offset the disaster's long-term damage. Importantly, even small allocations of disaster aid will lead to relatively less reduction in trade relative to a case where no disaster aid is committed, when the impact of the disaster and disaster aid are evaluated together. The relatively high cost associated with offsetting a disaster completely should not obscure the fact that disaster aid leads to higher levels of future trade than would otherwise be experienced, all else equal.

Remaining control variables in the ECMs typically look as expected. As expected, GDP growth is associated with higher trade growth, while distance is negatively associated with trade growth. I also find that democratization is associated with trade growth over time. Somewhat surprisingly, an increasing relative abundance of land for the recipient is associated with declining trade over time. With respect to total trade, the fact that US protectionism favors agriculture could explain this relationship; policy-makers could raise trade barriers in response to a new threat from foreign producers. When looking at imports from the US, this negative relationship follows logically from the theory of comparative advantage, as the disaster victim will have less need for US agricultural imports if land is its abundant factor of production.

[32] Given that the disaster severity variables are not logged, their influence on trade is calculated as e to the power of the coefficient, minus 1.

5.2 Preexisting Trade and the Grant of Disaster Aid

Table 3 presents two Heckman selection models that estimate simultaneously the US decision to grant aid and the dollar allocation of the aid. Model 5 includes explanatory variables for pre-existing bilateral trade, while Model 6 includes a variable specifically for pre-existing US exports to the disaster victim. The main finding of these models is that preexisting US-disaster-victim trade levels are not positively correlated with the decision to grant aid nor with the dollar allocation of disaster aid.[33] Accordingly, I find no support for hypothesis 2. Rather, the death count from the disaster is the consistently best predictor of the decision to grant aid. Similarly, development is negatively associated with the dollar value of aid committed, reinforcing extant findings that humanitarian need drives the provision of disaster aid. Interestingly, the disaster severity in terms of lost trade appears to be negatively associated with the decision to grant disaster aid, suggesting that the visible human cost of a disaster is more likely to drive this decision than is its material cost. Furthermore, this finding suggests reduced potential for spurious correlation; aid is not merely granted where trade is reduced more–and thus where trade has greater potential to recover.

Table 3 about here

Interestingly, UN voting similarity appears negatively associated with the decision to grant aid, possibly counter to expectations of Drury et al. (2005). However, Drury et al. examine *alliance* as the critical indicator of political affinity. My result is consistent with the recent findings of Fink and Redaelli (2011), who also examine UN voting similarity as a determinant of disaster aid provision. In robustness tests available by request, I find that alliance with the US is associated with a higher probability that disaster aid is granted, but not associated with dollar commitment, confirming the findings of Drury et al. (2005).[34] I find that US budget deficits are negatively associated with the decision to grant disaster aid, suggesting that US economic conditions influence the decisions of policy-makers. This

[33] Indeed, a higher value of pre-existing trade suggests a lower probability that the US will grant aid according to Model 5.
[34] I do not present these alternate results because alliance data are available only through 2003.

result also implies that policy-makers are unaware that disaster aid represents an investment that could return gains in subsequent trade volumes. Finally, I find that the (logged) total value of US development aid is positively associated with both the decision to grant disaster aid and the dollar value of granted aid, suggesting that policy-makers are eager to assist countries in which the US already invests to aid in development. This result is interesting in light of the fact that the impact of disaster aid on trade growth appears not to depend on its level relative to overall aid.

6 Conclusion

While a number of studies have examined the determinants of international disaster assistance, fewer have examined the consequences of this foreign aid. In this paper, I find strong evidence that US disaster assistance is associated with an increase in bilateral trade with the recipient, and specifically with an increase in exports to that state. Furthermore, this trade growth persists over a number of years following aid commitment, leading in many cases to increases in trade far exceeding the original aid commitment. Conversely, I find no evidence that preexisting US-disaster-victim trade levels are associated with the decision by US policy-makers to grant disaster aid, suggesting that humanitarian need is the primary driver of disaster aid commitments.

My findings hold a number of implications for policy-makers. First and foremost, I find evidence of a material incentive to complement humanitarian imperatives to grant disaster aid. The potential for job creation and an increased tax base stemming from growth in international trade suggests that disaster assistance can be viewed as an investment. Furthermore, disaster aid could serve as a channel for US soft power, promoting increased cooperation from, as well as growing commerce with, recipient states. Upon witnessing the generosity and economic power of the United States to assist in recovery from a disaster, citizens in recipient states may wish to increase commerce as part of a strategy to emulate

US prosperity.

My results also suggests a number of avenues for future research. In this study, I aggregate aid commitment and do not examine the means of administration. Future research could seek to uncover how aid can be targeted to build or repair infrastructure in order to restore economic activity, simultaneously improving prospects for trade growth. Future research could also benefit from examining disaster *preparedness* aid, which potential donors tend to under-provide (World Bank 2004). Given that relatively small investments in prevention and preparedness can potentially prevent deaths from disasters and save dollars, it could similarly protect existing trade and promote increased commerce over time.

Finally, future research could benefit from examining other consequences of US disaster aid. For example, given that disasters increase demands on political leaders, these leaders could face incentives to increase repression of discontented citizens if they lack the resources necessary to satisfy public outcry for relief. Yet, US disaster aid could help these leaders to meet the increased demands they face without retreating from democracy or increasing abuse of human rights. If true, then US disaster aid could hold the potential to ameliorate the political, as well as humanitarian, consequences of natural disasters.

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Table 1: ECM for US disaster aid and bilateral trade growth with the US.

	Model 1		Model 2	
	Coefficient	Robust SE	Coefficient	Robust SE
ln Dyadic trade$_t$	-0.265***	(0.063)	-0.264***	(0.063)
Δ ln Disaster aid commitment	0.005**	(0.002)	0.005**	(0.002)
ln Disaster aid commitment$_t$	0.008**	(0.004)	0.010**	(0.004)
Δ Disaster severity	-1.771***	(0.321)	-1.829***	(0.306)
Disaster severity$_t$	-1.328**	(0.569)	-1.256**	(0.590)
Δ Aid X Δ Severity			0.008	(0.009)
Aid$_t$ X Severity$_t$			-0.046**	(0.019)
Δ ln GDP	0.964*	(0.513)	0.941*	(0.507)
ln GDP$_t$	0.285***	(0.057)	0.276***	(0.057)
Δ ln US GDP	0.093	(0.633)	0.067	(0.632)
ln US GDP$_t$	-0.300**	(0.131)	-0.291**	(0.131)
Δ ln population	3.684*	(2.081)	3.459	(2.198)
ln population$_t$	-0.077*	(0.043)	-0.067	(0.042)
Δ Combined Polity score	0.004	(0.005)	0.004	(0.005)
Combined Polity score$_t$	0.010**	(0.005)	0.010**	(0.005)
Δ UN voting similarity	0.028	(0.096)	0.036	(0.097)
UN voting similarity$_t$	0.166*	(0.090)	0.173*	(0.090)
Δ Land ratio	-1.139*	(0.623)	-1.207*	(0.614)
Land ratio$_t$	-0.185**	(0.073)	-0.187**	(0.072)
Δ Labor ratio	15.411	(18.240)	16.201	(18.141)
Labor ratio$_t$	0.202	(0.132)	0.189	(0.133)
Δ Capital ratio	0.470	(1.740)	0.492	(1.729)
Capital ratio$_t$	0.065	(0.240)	0.104	(0.237)
Δ Disaster aid percentage	-0.056	(0.164)	-0.041	(0.161)
Disaster aid percentage$_t$	-0.101	(0.254)	-0.044	(0.242)
Years since disaster	0.006	(0.010)	0.006	(0.010)
ln Distance	-0.065***	(0.021)	-0.065***	(0.021)
Constant	8.923**	(4.309)	8.761**	(4.315)
Long-run multiplier				
ln Disaster aid commitment	0.030***	(0.003)	0.031***	(0.004)
Observations	4,007		4,007	
R^2	0.190		0.191	
F	20.5***		24.1***	

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$, two-tailed tests
standard errors clustered on the state
Dependent variable: Δ ln dyadic trade
Δ indicates change from year t to year t+1

Table 2: ECM for US disaster aid and growth in imports from the US.

	Model 3		Model 4	
	Coefficient	Robust SE	Coefficient	Robust SE
ln Imports from US$_t$	-0.346***	(0.057)	-0.345***	(0.058)
Δ ln Disaster aid commitment	0.008***	(0.003)	0.008***	(0.003)
ln Disaster aid commitment$_t$	0.014***	(0.005)	0.015***	(0.005)
Δ Disaster severity	0.004	(0.007)	0.004	(0.007)
Disaster severity$_t$	-1.929***	(0.290)	-1.956***	(0.277)
Δ Aid X Δ Severity			0.004	(0.010)
Aid$_t$ X Severity$_t$			-0.021	(0.019)
Δ ln GDP	0.688	(0.460)	0.683	(0.457)
ln GDP$_t$	0.388***	(0.072)	0.385***	(0.072)
Δ ln US GDP	-0.561	(0.548)	-0.564	(0.548)
ln US GDP$_t$	-0.154	(0.101)	-0.151	(0.100)
Δ ln population	5.212**	(2.417)	5.218**	(2.408)
ln population$_t$	-0.091*	(0.053)	-0.088*	(0.053)
Δ Combined Polity score	-0.010	(0.017)	-0.010	(0.017)
Combined Polity score$_t$	0.015***	(0.006)	0.015***	(0.006)
Δ UN voting similarity	-0.187	(0.217)	-0.185	(0.217)
UN voting similarity$_t$	0.151	(0.104)	0.153	(0.103)
Δ Land ratio	-1.229*	(0.640)	-1.234*	(0.637)
Land ratio$_t$	-0.257***	(0.091)	-0.257***	(0.091)
Δ Labor ratio	5.493	(17.654)	5.625	(17.567)
Labor ratio$_t$	0.089	(0.129)	0.083	(0.130)
Δ Capital ratio	0.674	(1.572)	0.668	(1.566)
Capital ratio$_t$	0.037	(0.270)	0.051	(0.269)
Δ Disaster aid percentage	-0.026	(0.169)	-0.021	(0.168)
Disaster aid percentage$_t$	-0.315	(0.230)	-0.298	(0.229)
Years since disaster	-1.592***	(0.502)	-1.556***	(0.527)
ln Distance	-0.088***	(0.026)	-0.088***	(0.026)
Constant	3.721	(3.090)	3.653	(3.088)
Long-run multiplier				
ln Disaster aid commitment	0.039***	(0.004)	0.038***	(0.004)
Observations	4,026		4,026	
R^2	0.235		0.236	
F	16.7***		16.0***	

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$, two-tailed tests
standard errors clustered on the state
Dependent variable: Δ ln imports from US
Δ indicates change from year t to year t+1

Table 3: Simultaneous equations models for preexisting bilateral trade and US disaster aid commitment (1973-2008)

	5: US imports + exports		6: Imports from US	
	Coefficient	Robust SE	Coefficient	Robust SE
	DV= Disaster aid issued (dichotomous)			
Trade_{t-1}	-0.057**	(0.023)	0.001	(0.029)
ln Deaths	0.044***	(0.016)	0.043***	(0.016)
Disaster severity	-0.453**	(0.204)	-0.509***	(0.175)
Combined Polity score_{t-1}	0.047***	(0.008)	0.047***	(0.008)
UN voting similarity_{t-1}	-2.033***	(0.283)	-2.085***	(0.282)
ln GDP per capita_{t-1}	-0.019	(0.067)	-0.097	(0.075)
ln Population_{t-1}	0.053	(0.047)	-0.000	(0.049)
US budget deficit/GDP_{t-1}	-0.185***	(0.018)	-0.190***	(0.018)
ln Total US bilateral aid_{t-1}	0.077***	(0.012)	0.073***	(0.012)
ln Distance	0.009	(0.065)	0.030	(0.063)
Constant	-1.486	(1.027)	-1.694*	(0.968)
	DV= ln Disaster aid commitment in dollars			
Trade_{t-1}	-0.000	(0.088)	0.044	(0.078)
ln Deaths	0.091	(0.058)	0.074	(0.057)
Disaster severity	-0.714	(0.461)	-0.960**	(0.416)
Combined Polity score_{t-1}	-0.009	(0.026)	-0.011	(0.026)
UN voting similarity_{t-1}	-0.274	(0.806)	-0.265	(0.817)
ln GDP per capita_{t-1}	-0.675***	(0.210)	-0.741***	(0.191)
ln Total US bilateral aid_{t-1}	0.175***	(0.045)	0.168***	(0.043)
ln Distance	0.220	(0.174)	0.237	(0.177)
Constant	13.821***	(2.667)	13.567***	(2.665)
Rho	0.270**	(0.119)	0.256**	(0.121)
Observations	4,224		4,231	
Log likelihood	-3655.72		-3657.98	
χ^2	69.83***		73.08***	

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$, two-tailed tests
standard errors clustered on the state
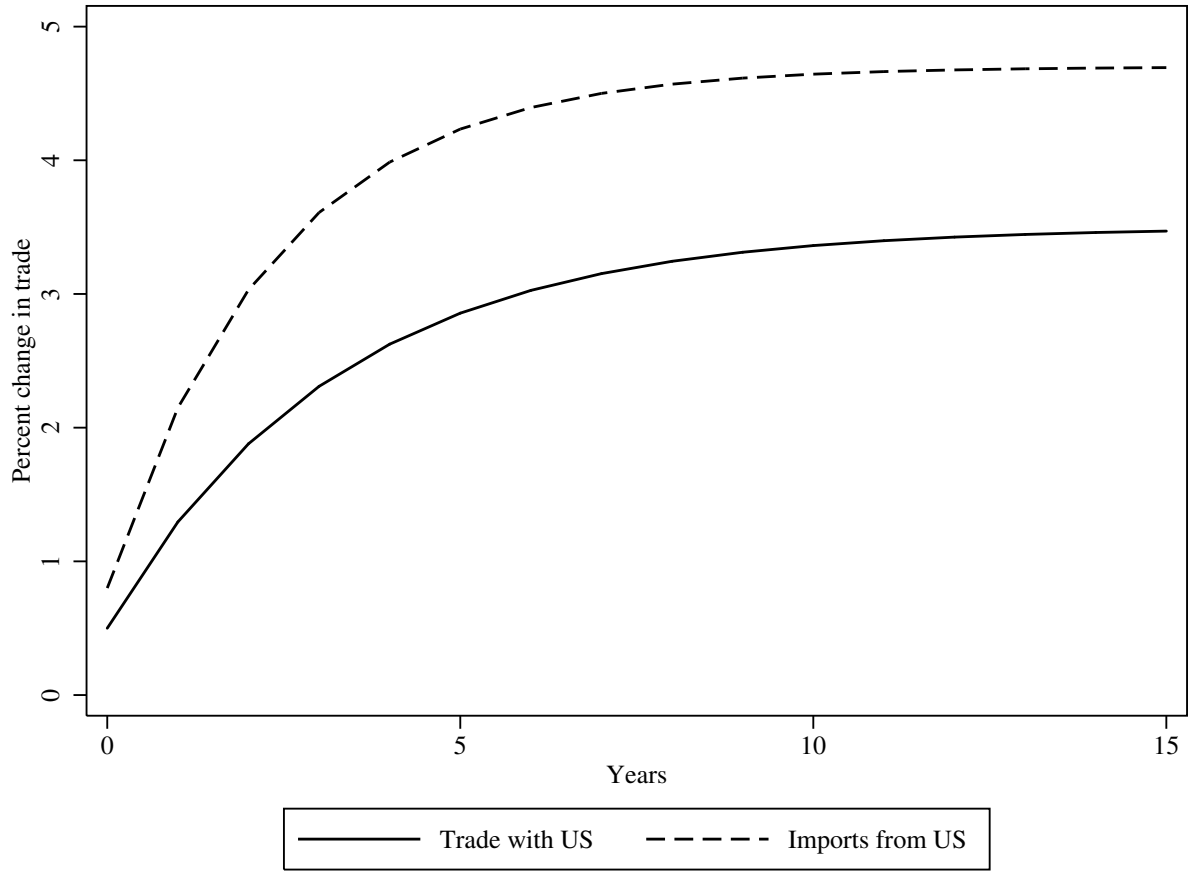
Figure 1: Long-run impact of doubling disaster aid (relative to the mean value), from Models 1 and 3