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Abstract

Foreign aid allocation by donor countries to developing economies is known to be motivated by the donor country's bilateral trade interests. Does this apply also to bilateral climate aid? In this paper, we combine theoretical and empirical analyses to investigate how bilateral trade affects donor countries' allocations of bilateral climate aid. Our theoretical analysis develops a simple model to support our hypothesis that bilateral trade has a positive impact on climate aid transfers. The model highlights the terms-of-trade and positive income effects of climate aid, and predicts a positive relationship between donor countries' exports to and imports from recipient countries and their climate aid transfers. The empirical analysis is based on bilateral climate aid data for 2002 to 2017. We employ fixed effects and instrumental variable-2 stage least square estimations (IV-2SLS) with a shift-share instrument to overcome the endogeneity of trade. Our empirical results show that donors' exports have a significant, robust, positive effect on climate aid transfers.

Keywords: Climate Aid, Trade, Transfers, Mitigation, Adaptation

JEL Codes: F35, F18, Q58

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1 Introduction

Despite the Paris Agreement (2015), there lacks an international climate treaty setting legally binding caps on greenhouse gas (GHG) emissions for individual countries (Bohringer, 2021). Existing climate agreements are undermined by free-riding behavior, lack of participation, unambitious targets, and carbon leakage due mainly to international trade. International aid for climate mitigation and adaptation from the developed countries could help to scale-up developing countries' climate mitigation efforts and help those countries to adapt to climate change. During the climate change negotiations in Cancun in 2010, the developed countries signed up to a joint mobilization target of $100 billion per year by 2020 to meet the needs of developing countries. This was reconfirmed by the Paris Agreement in 2015 which set an amount of aid of at least $100 billion per year up to 2025. However, the amount of climate aid from the developed countries has fallen well below this target (Roberts et al., 2021). In 2019, these transfers represented $79.6 billion dollars per year. The need for aid to enable adaptations to climate change is even more urgent than the need for climate mitigation assistance (United Nations Environment Programme, 2021).

This situation is highlighting the need to investigate the determinants of international climate aid. Empirical evidence in the foreign aid literature (Alesina and Dollar, 2000; Berthelemy, 2006; Dudley and Montmarquette, 1976; McKinlay and Little, 1977) indicates that donor interests are as important as recipient needs and merits in the allocation of foreign aid by donor countries. In this paper, we provide a systematic examination of whether bilateral trade motivates the allocation of bilateral climate aid[1] by donor countries by proposing a simple theoretical model and providing empirical evidence.

Before presenting the literature which examines the determinants of climate aid, we survey the literature that analyzes the effectiveness of climate aid which is rather limited. Most of the literature has assessed the impact of foreign aid, and not climate aid per se, on environmental issues including GHG emissions: see for instance, on foreign aid, Arvin et al. (2006), Arvin and Lew (2009), Kretschmer et al. (2013) and Lim et al. (2015), and for sectoral aid such as energy or renewable energy-related aid, see for instance Kretschmer et al. (2013), Bhattacharyya et al. (2016), Mahalik et al. (2021) and Kablan and Chouard (2022). These contributions provide mitigated results in terms of GHG emission reductions. For instance, Kretschmer et al. (2013) find foreign aid to be efficient in reducing the energy intensity of recipient countries but do not find any significant impact of foreign aid on emissions intensity. As concerns environmental aid, Kablan and Chouard (2022) find a small negative impact of aid for renewable energy on CO_2 emissions of recipient countries, but this effect is only transitory. Bhattacharyya et al. (2016) do not find any significant impact of environmental energy-related aid on CO_2 and SO_2 emissions of recipient countries. Finally, Lee et al. (2022) find a significant negative effect of multilateral

[1] We focus on bilateral public climate aid. While multilateral aid is larger in value than bilateral aid for international climate finance, for major donors such as Japan the main channel is bilateral aid (Yeo, 2019). Also, for international adaptation aid, the bilateral channel is the dominant one (Betzold and Weiler, 2017).

climate aid on CO2 emissions. This effect is greater for mitigation aid than for adaptation aid. The authors also find climate aid to be more efficient in reducing carbon emissions in Small Islands Developing States (SIDS) and higher income developing countries.

The effectiveness of climate aid is closely related to the allocation of this aid by donor countries and thus to the environmental, economic, and geopolitical factors that motivate this allocation. Several works examine the determinants of climate aid (Betzold and Weiler, 2017; Clist, 2011; Halimanjaya, 2015; Halimanjaya and Papyrakis, 2015; Persson and Remling, 2014; Robinson and Dornan, 2017; Stadelmann et al., 2014) by measuring the determinants of the payments and receipt of climate transfers based on aggregate transfers. Except Weiler et al. (2018), none of these studies investigates the bilateral relations between countries. These bilateral relations which consist of commercial, cultural, geographic, and geopolitical ties are important and can modify the architecture of climate transfers. An empirical study by Weiler et al. (2018) shows that bilateral adaptation aid is correlated with the donor country's exports to the aid recipient but the authors do not distinguish between trade flows. We try to identify the trade flows (both exports and imports) which determine bilateral climate aid, and provide an economic justification for climate aid and validate it empirically. We suggest that the provision of aid is based on pre-existing commercial relations founded on historical, geographic, and geopolitical factors which are threatened by the effects of climate change on the productive capacity of fragile countries. Specifically, the donor countries are keen to maintain these trade relations to conserve the benefit they provide for both parties. They may provide aid for adaptation to climate change or to reduce GHG emissions (which could also have local negative effects). We propose a simple theoretical model to show how climate aid is determined positively by the donor country's imports and exports vis-à-vis the recipient country.

The persistence of old trade relations is investigated in a stream of work that was initiated by Eichengreen (1998) who highlighted the continuity of trade relations based on old colonial or migratory relations which resist shocks. Eichengreen's work gave rise to a large empirical literature on this historical dependence of trade relations (see for instance De Sousa and Lochard (2012); Lavallée and Lochard (2019)). Our data show that the trade relations analyzed predate the signing of the Kyoto Protocol in 1997. However, the effects of climate change have increased with no accompanying threat to trade relations.

The links between foreign aid and international trade have been widely studied in other contexts than climate change (for empirical studies, see for instance Alesina and Dollar (2000); Berthelemy (2006); Barthel et al. (2014); Fuchs et al. (2015)). Barthel et al. (2014); Fuchs et al. (2015) depart from the fact that there are inefficiencies in current foreign aid systems with some recipient countries being favored disproportionately and a lack of coordination over aid flows among donor countries. It has been argued that donor countries compete to allocate foreign aid to certain recipient countries in order to increase their share of international trade. Fuchs et al. (2015) show that competition over exports to recipient countries results in donor allocations being inefficient and not based on recipient countries' needs or merit. Barthel et al. (2014) show that if a donor country increases its aid allocation to a certain recipient country, other donor countries in competition with the first donor in terms of exports also increase their allocation of aid to that recipient country. However, these studies consider overall foreign aid while we focus specifically on climate aid and propose a theoretical model to guide our empirical analysis.

Much of the theoretical literature on aid and trade focuses on the aid paradox[2] that aid can degrade the recipient country's welfare. The transfer of a good to a country which expresses strong demand for that good will raise the price of that good which has a negative effect on the welfare of the recipient country (Chichilnisky (1980); see also Geanakoplos and Heal (1983); Yano (1983); Basu (2003)). The literature focuses also on improvements to the terms of trade: foreign aid directed towards the export sector of the recipient country improves the recipient country's productivity and lowers the relative price of the exported good. This in turn benefits the donor country. The terms of trade effect of aid has been modeled in the context of climate adaptation aid (Schenker and Stephan, 2014). This highlights two problems. On the one hand, a mechanism similar to the one highlighted above may emerge. If the price of the good whose technology is being favored falls too much, the recipient country may experience a negative income shock and suffer a welfare loss. On the other hand, the other countries importing the good produced by the sector that is the recipient of the aid may also profit from a drop in the international price of the good. These international price externalities inevitably induce strategic and free-rider behaviors. However, although these strategic behaviors may slow the provision of aid, it still exists but becomes less important (Schenker and Stephan, 2017).

The objective of our analysis[3] is to identify the trade determinants of climate aid. Our theoretical model develops a simple trade model to provide an explanation for the existence of climate aid: the maintenance of former trade relations based on colonial ties, geopolitics, etc. which could be degraded by climate change. Indeed, climate change degrades the productivity of exporting industries in developing countries. In order to maintain the former trade relations (i.e. to keep constant the sum of the utilities of the pair of countries), the donor provides both mitigation and adaptation aid. Climate aid can alleviate the effects of climate change via two channels: the "price effect" and the "income effect". Thanks to climate aid, the price of the good produced by the recipient decreases (the price effect) and the income of the recipient increases (the income effect). The price effect increases the donor country's imports, and the income effect increases the donor country's exports. According to the mechanism highlighted by Schenker and Stephan (2014), climate aid makes it possible to reestablish the terms of trade of the developing country which could have been degraded by climate change. We are aware that this aid might reduce the recipient country's welfare due to the already mentioned negative income effect. We show that this does not occur if the climate aid has a sufficiently strong income effect (in terms of reducing the adverse impacts of climate change on the recipient country's productive process or in

[2] Another stream of theoretical literature focuses on climate funding: see e.g. Buob and Stephan (2013) for the tradeoff between mitigation and adaptation funding, Eyckmans et al. (2016) for the separate and combined effects of mitigation aid, adaptation aid and foreign aid, and Gersbach and Winkler (2012); Gersbach and Hummel (2016); Kornek and Edenhofer (2020) for multilateral climate funding. However, none of these papers consider trade relationships between countries.

[3] Our analysis contributes to work on foreign aid which emphasizes the effects of trade on aid – our topic of interest. However, there are other explanations for aid including the altruistic nature of aid as an element of the welfare of the donor country described by Dudley and Montmarquette (1976) which results in a "demand for the supply of aid". This body of work categorizes aid variously depending on the donor country's preferences related to infrastructure, education, health, etc.

terms of increasing the productivity). Rather, the recipient country benefits from aid in terms of welfare. For a given level of the stock of global GHG emissions, if the impact of aid is sufficiently strong, the recipient country's imports and exports improve. In other words, the welfare of both countries increases which is a necessary condition for the acceptability of aid by both countries. These mechanisms translate into a positive and reciprocal mathematical relationship between the donor country's imports and exports and climate aid. Thus, the empirical analysis aims to validate this relationship and eliminate possible endogeneity biases via an IV method.

In the empirical part of the paper, we provide an econometric evaluation of the predictions of our theoretical model by estimating the impact of trade on aid. We use the OECD Official Development Assistance (ODA) data relative to climate actions, and consider bilateral climate transfers from the members of OECD Development Assistance Committee (DAC) between 2002 and 2017. We use a panel data model with donor, recipient, and year fixed effects (FE). We control for the recipient's environmental vulnerability, economic development, and institutional quality, and the historical and political relationships between donor and recipient that we put forward in the model. The main empirical difficulty is the potential simultaneous determination of climate transfers and trade decisions, as emphasized by our theoretical model. To overcome endogeneity concerns, we use an instrumental variables strategy in a two-stage least squares estimation (IV- 2SLS) where we instrument the level of trade using a shift-share instrument. In particular, we use variations in world demand at the product level based on previous and lagged trade patterns to identify trade variations uncorrelated with country decisions and relationships. This strategy allows *causal* estimates of trade on climate aid transfers. In our methodology, our results are identified from variations in aid and trade across country pairs. Our estimation strategy is in line with state-of-the-art estimations of the determinants of foreign aid which we apply to this specific type of climate aid transfers.

Our estimations confirm the significant and quantitative role of trade as a determinant of climate aid which is in line with our theoretical predictions. For a given donor of climate aid, its exports to a specific recipient country increase climate transfers to that country. Our baseline estimates point to an elasticity of aid of around 0.3 for exports. Our estimates are robust to different specifications of the controls and potential omitted variables and to changes in the set of FE used. Our results are also not sensitive to minor violations of the exclusion restriction required for causal inferences. They are also in line with existing evidence regarding the standard determinants of foreign aid in general and of climate aid in particular. We however find no significant effect regarding donors' imports. Overall, our results show that the strategic export interests of donor countries to a large extent shape the allocation of climate aid.

Our paper contributes to the literature in several ways.

First, we propose an original approach that combines theoretical and empirical analysis of the role played by trade in climate aid allocation. Second, we investigate bilateral trade relationships by providing a complete picture of the trade effects related to the allocation of climate transfers. The existing evidence points to the quantitative role of trade on foreign aid (see among others Barthel et al. (2014) and Fuchs et al. (2015)), and on climate aid (Weiler et al., 2018). Our theoretical model highlights two economic mechanisms driving two distinct effects of trade on climate aid which we are able to estimate empirically. These are respectively the imports of donor countries related to terms-of-trade effect (in line with the theoretical prediction of Schenker and Stephan (2014)), and exports of the donor country related to positive income effect. Third, we provide a robust, causal estimate of the trade effect on climate aid, accounting for the bi-directional relationships between aid and trade. We employ an IV-2SLS strategy in which we leverage exogenous trade flow variations across countries to identify the causal effect of trade on climate transfers. This allows estimation of the causal elasticity of climate aid to trade which complements the estimates in the literature (such as Weiler et al. (2018)) which however may be subject to endogeneity problems. We contribute also to a stream of work in which trade shocks are used as shifters in empirical exercises. Following the seminal contribution of Bartik (1991), this type of strategy has been extensively used at both the aggregate (see for instance Autor et al. (2013)) and the microeconomic levels (see for instance Mayer et al. (2014) or Aghion et al. (2018)).

Our paper is organized as follows. Section 2 presents the proposed theoretical model. Section 3 presents the data and empirical analysis, and Section 4 presents the empirical results. Section 5 concludes the paper.

2 Theoretical model

2.1 Model framework

In our proposed theoretical model, climate aid improves the welfare of the recipient country directly through the reduction of negative local environmental externalities, and more importantly improves the welfare of the donor and recipient countries indirectly through trade.

We develop a simple trade model involving a developed and a developing country each of which produces a good (or a basket of goods) according to a linear technology in labor, the only factor of production. The goods produced by each country are substitutable in terms of welfare. Following Armington (1969) approach, countries exchange similar goods with different characteristics, and these trade relations increase the welfare of the countries involved. We assume that country preferences are represented by a constant elasticity of substitution (CES) utility function.

Welfare losses linked to climate change can be either direct through a negative externality (for instance local air pollution from CO2 emissions), or indirect through a drop in the consumption of both goods. In our model, local air pollution problems due to GHG emissions degrade the welfare of the recipient country, and more importantly climate change degrades the trade relations between the donor and recipient countries. We assume for simplicity that there is no negative externality from GHG emissions in the welfare of the donor country. To highlight the trade effects due to climate change, for simplicity, we also assume that climate change affects negatively the production process of only the developing country. It is well known and has been documented that climate change also affects developed countries' production of goods and services but that the magnitude of the effect is smaller than in the case of poor countries (Tol, 2018)[4]. For example, in the agriculture sector, developing countries have experienced more significant falls in the yields of most crops due to climate change (World Bank, 2010). A richer model would include lower production losses for the donor country. Our extreme hypothesis simplifies the calculus and represents the asymmetry in production losses due to climate change between countries.

We consider two countries: a donor country denoted 1 which produces the good (or basket of goods) denoted 1, and a recipient country denoted 2 which produces the good (or basket of goods) denoted 2. Country 1 is assumed to have more resources than country 2 to fight climate change: the exogenous revenue of country 1 is larger than that of country 2, $R_1 > R_2$. The stock of global GHG emissions is denoted P and is thus exogenous to the pair of countries.

We consider two types of climate aid from country 1 to country 2: mitigation aid denoted as T_M and, adaptation aid denoted as T_A. As concerns mitigation aid, we posit that it allows the recipient country to adopt more efficient and cleaner technology (energy saving technology). Adaptation aid is of different nature: it helps the recipient country to undertake adaptation actions reducing the adverse effect of GHG emissions on production. For example, drip irrigation, crop diversification, and cyclone shelters are adaptation devices which mitigate some of the effects of climate change. The donor funding to the recipient consists of the transfer of environmental goods manufactured using the domestically produced consumer good.[5]

We can found examples of these types of projects of climate aid in the database of the OECD for bilateral climate aid that will be used in the next section for the empirical analysis. Regarding mitigation aid, here are some examples:

- From Australia to China: aid over five years (1998-2003) for the purpose of energy generation from renewable resources.
- From France to Kenya in 2011: aid to support the development of geothermal energy.
- From France to Mali in 2016: aid to strengthen the photovoltaic and biogas sectors adapted to the Malian rural environment.

Regarding adaptation aid, some examples follow:

- From Korea to Cambodia in 2010: aid to stabilize the supply of the agricultural water in the Mongkol Borey River basin, and to reduce the frequent flood damage around the project area, and mitigate a critical power shortage.
- From France to Burkina Faso in 2013: aid to develop drainage and reduce flooding.

[4]Developing countries will suffer the most from the climate change because they are more dependent on climate-sensitive sectors such as agriculture, tend to have hotter climates, and have limited adaptive capacity.

[5]The model implicitly assumes the existence of a 1 to 1 technology which transforms the consumer good into the environmental good (e.g. air conditioners, dike protection against sea rises, etc.).

- From France to Tunisia in 2017: aid for securing and strengthening the northern water transfer infrastructures for the Sahel and Sfax regions.

These climate projects are likely to improve productivity in the recipient country and the mitigation projects reduce emissions from production processes. It should also be noted that some of these aid flows involve former trading partners within a same geographical block, such as Korea and Cambodia, or former colonies, such as France with Mali, Tunisia or Burkina Faso.

The preferences of the representative agents in the two countries are identical. The preferences of donor country 1 are given by:

$$U_1(C_1^1, C_2^1) = [(C_1^1)^\sigma + (C_2^1)^\sigma]^{\frac{1}{\sigma}} \tag{1}$$

where C_r^i is the consumption of good r in country i, and $0 < \sigma < 1$. The elasticity of substitution is $\rho = \frac{1}{1-\sigma} > 1$, meaning that the goods are substitutes.

The production of good 1 is linear with respect to labor:

$$Y_1 = a_1 L_1 \tag{2}$$

with $a_1 > 0$.

The budget constraint of country 1 is written as :

$$C_1^1 + pC_2^1 = R_1 = a_1 L_1 - T_A - T_M \tag{3}$$

where p is the relative price of good 2 assuming good 1 is the numeraire. The donor country provides two types of climate aid which are costly: adaptation aid T_A, and mitigation aid T_M.

The preferences of recipient country 2 are represented by the following utility function:

$$U_2(C_1^2, C_2^2) = [(C_1^2)^\sigma + (C_2^2)^\sigma]^{\frac{1}{\sigma}} - k\varepsilon \tag{4}$$

where $k > 0$ is the damage parameter, and ε denotes local air pollution from GHG emissions due to productive activities of the recipient country. Parameter k is a disutility parameter. It represents at what extent the local air pollution reduces welfare, through for instance human health problems.

This local pollution can be represented in the following way:

$$\varepsilon = z(T_M) Y_2(T_M) \tag{5}$$

where $z(T_M)$ denotes the emission function. We assume that the GHG emissions of the recipient ε are negligible with respect to the stock of global GHG emissions P, which is assumed to be constant.

The production of good 2 is linear with respect to labor:

$$Y_2(T_M) = a_2(T_M) L_2 \tag{6}$$

As mentioned before, mitigation aid allows the recipient country to adopt more efficient and cleaner technology. Consequently, the productivity $a_2(T_M)$ depends positively on mitigation aid T_M, and the emission coefficient $z(T_M)$ depends negatively on mitigation aid T_M. The emission externality can be re-written as:

$$\varepsilon = z(T_M)a_2(T_M)L_2 \tag{7}$$

For the sake of analytical simplicity, we assume the following functional forms: $a_2(T_M) = a_2T_M$ with a_2 a positive constant, and $z(T_M) = (1-\alpha T_M)$ with α a positive constant. The emission externality can thus be written as: $\varepsilon = (1-\alpha T_M)a_2T_ML_2$. In order to ensure that the emission externality is reduced with the receipt of climate aid, i.e. $\frac{d\varepsilon}{dT_M} < 0$, we assume that $T_M > \frac{1}{2\alpha}$.

The budget constraint of recipient country 2 is written as:

$$C_1^2 + pC_2^2 = pR_2 = p\left[a_2T_ML_2 - (bP - hT_A)\right] \tag{8}$$

As can be seen from this budget constraint, we assume that due to the stock of global GHG emissions P (assumed to be exogenous and constant), the production in the recipient country drops by an amount $-bP$, with $b > 0$. The adaptation aid helps to reduce this production loss due to climate change by $-hT_A$, with $h > 0$. Parameter h represents the productivity of the adaptation technology acquired with adaptation aid, i.e. at what extent the adaptation technology (for instance early warning or drip irrigation systems) is able to reduce the production losses from climate change. We naturally assume that $(bP - hT_A) > 0$.

In the first step, the representative agent in each country maximizes its utility with respect to the consumption of the two goods under its budget constraint. This leads to the following relationships for countries 1 and 2 respectively[6]:

$$C_1^1 = \frac{R_1 p^{\frac{1}{1-\sigma}}}{p + p^{\frac{1}{1-\sigma}}} \tag{9}$$

$$C_2^1 = \frac{R_1}{p + p^{\frac{1}{1-\sigma}}} \tag{10}$$

$$C_1^2 = \frac{R_2 p^{\frac{2-\sigma}{1-\sigma}}}{p + p^{\frac{1}{1-\sigma}}} \tag{11}$$

$$C_2^2 = \frac{R_2 p}{p + p^{\frac{1}{1-\sigma}}} \tag{12}$$

[6]Notice that the assumed CES preferences lead to linear demand for goods with respect to income. Therefore, the welfare function we consider can represent the heterogeneity of the incomes of agents within countries. Imports from the recipient country may affect only the wealthiest in the developing country population. Although their volume is small, these exports may play an important role in the relations between the two countries.

The trade balance is at equilibrium: country 1's imports are equal to country 2's exports, $pC_2^1 = C_1^2$. In a more sophisticated model which includes several countries producing a specific good or basket of goods, we would not have equality between the exports and imports of two countries taken separately.[7]

Using the condition on the trade balance, the relative price of good 2 produced by recipient country 2 can be expressed as:

$$p = (\frac{R_1}{R_2})^{1-\sigma} \tag{13}$$

We now proceed to prove the theoretical properties of the model which supports our empirical analysis. All of the properties are based on initial calculations provided in Appendix 1.

Proposition 1 shows the *positive* effect of both mitigation and adaptation aid on the recipient country's terms of trade.

Proposition 1: The price of good 2 produced by recipient country 2 is a decreasing function of adaptation and mitigation aid.

Proof: The result $\frac{dp}{dT_A} < 0$ and $\frac{dp}{dT_M} < 0$ is obtained from $\frac{dR_1}{dT_A} = -1 < 0$, $\frac{dR_2}{dT_A} = h > 0$, $\frac{dR_1}{dT_M} = -1 < 0$, and $\frac{dR_2}{dT_M} = a_2L_2 > 0$.

Propositions 2a and 2b show that the terms of trade effect allows the recipient country to export more to the donor country if the beneficial impact of the adaptation and mitigation aid on the recipient country's production is sufficiently large.[8]

Proposition 2a: If h is greater than σ, then imports of good 2 by donor country 1 are an increasing function of adaptation aid T_A.

Proof: If $h > \sigma$, then we obtain $\frac{dC_2^1}{dT_A} > 0$ because $\frac{R_1}{R_2} > 1$ and $\sigma < 1$ by assumption.

Proposition 2b: If a_2L_2 is greater than σ, then imports of good 2 by donor country 1 are an increasing function of mitigation aid T_M.

Proof: If $a_2L_2 > \sigma$, then we obtain $\frac{dC_2^1}{dT_M} > 0$ because $\frac{R_1}{R_2} > 1$ and $\sigma < 1$ by assumption.

Propositions 3a and 3b show that if the beneficial impact of adaptation and mitigation aid on production is sufficiently large, the increased production in the recipient country leads to positive income effects which in turn induce an increase in its imports from the donor country.

Proposition 3a: If h is greater than $\frac{2-\sigma}{\sigma}$, then exports of good 1 by donor country 1 are an increasing function of adaptation aid T_A.

Proof: If $h > \frac{2-\sigma}{\sigma}$, then we obtain $\frac{dC_1^2}{dT_A}$ >0 because $(\frac{R_1}{R_2})^{1+\sigma} > (\frac{R_1}{R_2})^{\sigma}$.

[7] It would be possible but mathematically difficult to enrich the model by introducing trade relations with other countries to avoid this equality in the value of imports and exports.

[8] Since we assume that trade relations are specific to country pair, we ignore the previously mentioned strategic aspects because no other country can benefit from this price drop.

Proposition 3b: If a_2L_2 is greater than $\frac{2-\sigma}{\sigma}$, then exports of good 1 by donor country 1 are an increasing function of mitigation aid T_M.

Proof: If $a_2L_2 > \frac{2-\sigma}{\sigma}$, then we obtain $\frac{dC_1^2}{dT_M} > 0$.

The findings in Propositions 1, 2 and 3 highlight the "price effect" and the "income effect " induced by climate aid. The greater the climate aid, the greater the production benefits in the recipient country. The price of the good produced in the recipient country decreases. According to the mechanism highlighted by Schenker and Stephan (2014), climate aid makes it possible to reestablish the terms of trade of the developing country which could have been degraded by climate change. This is what we call the price effect which increase the donor country's imports. This price effect induces also a negative income effect for the recipient country: the climate aid reduces the price of its produced good. At the same time, the climate aid leads to a positive income effect for the recipient: the climate aid increases the production of the recipient and hence its production value. If climate aid has a sufficiently strong impact (in terms of reducing the adverse impacts of climate change on the recipient country's productive process or in terms of increasing the productivity), the positive income effect dominates the negative one. In this case, the positive income effect allows for larger imports of the recipient country.

Consequently, the donor country's climate aid could increase both its imports and its exports which may improve the welfare of the consumers in both countries, a condition necessary for aid acceptability. In the second step, we investigate the conditions under which the transfers increase the welfare of both donor and recipient. To do so, we express the two welfare functions as a function of R_1 and R_2 (without environmental externality for the recipient in a first step):

$$U_1 = R_1^\sigma (R_2^\sigma + R_1^\sigma)^{\frac{1-\sigma}{\sigma}} \tag{14}$$

$$U_2 = R_2^\sigma (R_1^\sigma + R_2^\sigma)^{\frac{1-\sigma}{\sigma}} \tag{15}$$

Proposition 4a: If h is greater than $\frac{3-\sigma}{1-\sigma}$, then the welfare function U_1 of the *donor* increases with adaptation aid T_A.

Proof: If $h > \frac{3-\sigma}{1-\sigma}$, then we obtain $\frac{dU_1}{dT_A} > 0$ because $(\frac{R_1}{R_2})^{1-\sigma} > 1$ and $(\frac{R_2}{R_1})^{\sigma} < 1$.

Proposition 4b: If a_2L_2 is greater than $\frac{3-\sigma}{1-\sigma}$, then the welfare function U_1 of the *donor* increases with mitigation aid T_M.

Proof: If $a_2L_2 > \frac{3-\sigma}{1-\sigma}$, then we obtain $\frac{dU_1}{dT_M} > 0$.

Proposition 5a: If h is greater than $\frac{1-\sigma}{2\sigma}$, then the welfare function U_2 of the *recipient* increases with adaptation aid T_A.

Proof: If $h > \frac{1-\sigma}{2\sigma}$, then we obtain $\frac{d[U_2+(k(1-\alpha T_M)a_2.T_M.L_2]}{dT_A} > 0$ because $\frac{R_1}{R_2} + (\frac{R_1}{R_2})^{1-\sigma} > 2$. As $\frac{d[k(1-\alpha T_M)a_2.T_M.L_2]}{dT_A} = 0$, this implies $\frac{dU_2}{dT_A} > 0$ if $h > \frac{1-\sigma}{2\sigma}$. To complete the proof, note that the environmental externality $k\varepsilon$ is a decreasing function of T_A.

Proposition 5b: If a_2L_2 is greater $\frac{1-\sigma}{2\sigma}$, then the welfare function U_2 of the *recipient* increases with mitigation aid T_M.

Proof: If $a_2L_2 > \frac{1-\sigma}{2\sigma}$, then we obtain $\frac{d[U_2+(k(1-\alpha T_M)a_2.T_M.L_2]}{dT_M} > 0$. As $\frac{d[k(1-\alpha T_M)a_2.T_M.L_2]}{dT_M} < 0$, this implies $\frac{dU_2}{dT_M} > 0$ if $a_2L_2 > \frac{1-\sigma}{2\sigma}$. To complete the proof, the environmental externality $k\varepsilon$ is a decreasing function of T_M.

It is worthwhile to note that to obtain an increase in the donor and recipient countries' welfare, the beneficial impacts of adaptation and mitigation aid on the production of the recipient must be sufficiently large, so that the recipient increases its exports and imports. For the recipient country, the positive income effects of receiving the aid dominate the substitution effects of the increased price of imports.

Next we study the motivations for a transfer. For the historical and geopolitical reasons (colonial ties, migratory history, etc.) already mentioned in the introduction, we assume that the donor country wants to maintain its trade relations with the recipient country, that are damaged by climate change. It can be easily shown that the welfare of the donor and recipient countries $U_1 = R_1^\sigma(R_2^\sigma + R_1^\sigma)^{\frac{1-\sigma}{\sigma}}$ and $U_2 = \left[R_2^{\frac{\sigma^2}{1-\sigma}}(R_1^\sigma + R_2^\sigma)\right]^{\frac{1-\sigma}{\sigma}} - k\varepsilon$ depend negatively on the stock of global GHG emissions P, through R_1 and R_2.

As the objective of the donor country is to maintain its former trade relations with the recipient country, we assume that the donor country wants to keep the *sum* of their welfare $U_1 + U_2$ *constant*, independently of how its level was determined in the past:

$$U_1 + U_2 = \left[C_2^1(1 + p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}}\right] + \left[C_1^2(1 + p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}} - k\varepsilon\right] \tag{16}$$

Our theoretical model is in line with the trade agreements literature which is based on maximization of the sum of the welfare functions of the signatory countries. This approach was proposed originally by Bagwell and Staiger (1999) and developed by Limão (2005); Antràs and Staiger (2012); Grossman et al. (2021) among others. We would observe simply that the countries have signed similar trade agreements in the past and want to maintain the relations through climate aid following the effects on their trade relations due to climate change. This situation can be illustrated by the example of the relations between France and its former protectorate

Tunisia. The European Commission Tunisia Euro-Med Association Agreement (1995) trade agreement to which France is a signatory resulted in provision by France of climate aid to Tunisia in 2017: aid for securing and strengthening the northern water transfer infrastructures for the Sahel and Sfax regions. Another similar example is the long term relations based on geographical proximity such as the 2006 and 2007 trade agreements between South Korea and member countries of ASEAN (Association of Southeast Asian Nations) such as Cambodia which jointed ASEAN in 1999. The trade agreements between South Korea and Cambodia resulted in 2010 in the provision of climate aid from South Korea to Cambodia: aid to stabilize the supply of the agricultural water in the Mongkol Borey River basin, and to reduce the frequent flood damage around the project area, and mitigate a critical power shortage. We have shown theoretically that if climate change has a negative effect on the welfare of two countries, then climate transfers work to improve their welfare. We believe that this is the reason why two countries will agree to use climate transfers to counteract the effects of climate change and keep the sum of their welfare constant. Thus, following any increase in the stock of global GHG emissions leading to climate change, the developed country will increase the amount of its aid since it knows that this aid will have a positive impact on the welfare of the recipient country - directly and indirectly via consumption.

Thus, following any increase in the stock of global GHG emissions leading to climate change, the developed country will increase the amount of aid since it knows that aid will have a positive impact on the welfare of the recipient directly and indirectly via consumption.

We can show that in equilibrium, there is a positive relationship between the donor country's imports and exports and the level of its climate aid.

Prediction: At equilibrium, mitigation and adaptation aid (or their variation) depend positively on the donor country's imports (or their variations) and on the donor country's exports (or their variations).

Proof: If we consider the total differential of $U_1 + U_2 + k\varepsilon$ with respect to adaptation aid T_A, the stock of global GHG emissions P, imports of good 2 by donor country C_2^1, and exports of good 1 by donor country C_1^2, we obtain:

$$\begin{aligned} & dC_2^1(1+p^{\frac{\sigma}{1-\sigma}}) + dC_1^2(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}} + \\ & C_2^1\left[\frac{1}{\sigma}(1+p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}-1}\frac{\sigma}{1-\sigma}(p)^{\frac{\sigma}{1-\sigma}-1}[\frac{\partial p}{\partial P}dP + \frac{\partial p}{\partial T_A}dT_A]\right] + \\ & C_1^2\left[\frac{1}{\sigma}(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}-1}\frac{\sigma}{\sigma-1}(p)^{\frac{\sigma}{\sigma-1}-1}[\frac{\partial p}{\partial P}dP + \frac{\partial p}{\partial T_A}dT_A]\right] \\ = \; & 0 \end{aligned} \tag{17}$$

By replacing C_1^2 with pC_2^1 and rearranging the terms, we obtain:

$$\begin{aligned} & dT_A[C_2^1 \frac{1}{\sigma}\frac{\sigma}{1-\sigma}\frac{\partial p}{\partial T_A}((1+p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{1-\sigma}-1} - p(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{\sigma-1}-1})] \\ = \; & -dC_2^1(1+p^{\frac{\sigma}{1-\sigma}}) - dC_1^2(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}} + \\ & -dP[C_2^1 \frac{1}{\sigma}\frac{\sigma}{1-\sigma}\frac{\partial p}{\partial P}((1+p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{1-\sigma}-1} - p(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{\sigma-1}-1}] \end{aligned} \quad (18)$$

The term associated with dT_A is negative because $\frac{\partial p}{\partial T_A} < 0$, and $(1+p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{1-\sigma}-1} - p(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{\sigma-1}-1} > 0$ because $p > 1$ (as $R_1 > R_2$). This shows that if we regress dT_A with the imports and exports of the donor country, we would obtain positive coefficient estimates.

With mitigation aid, we obtain the same result but an additional term appears in the coefficient associated with T_M because we now take into account the negative externality of local pollution from GHG emissions in the utility function. The first line of Equation 18 becomes:

$$dT_M \left[C_2^1 \frac{1}{\sigma}\frac{\sigma}{1-\sigma}\frac{\partial p}{\partial T_M}(1+p^{\frac{\sigma}{1-\sigma}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{1-\sigma}-1} - p(1+p^{\frac{\sigma}{\sigma-1}})^{\frac{1}{\sigma}-1}(p)^{\frac{\sigma}{\sigma-1}-1} - ka_2L_2(1-2\alpha T_M) \right] \quad (19)$$

The bracketed term is negative if the damage parameter k is sufficiently low, because $ka_2L_2(1-2\alpha T_M) < 0$.

Why is the mathematical relationship between the trade variables and climate aid positive? If the trade variables (imports and exports) increase then *ceteris paribus*, the welfare of both donor and recipient increases. To keep the sum of the welfare constant requires the transfers to reduce the donor's revenue. As the donor's initial revenue is larger than the recipient's initial revenue, the sum of the welfare remains constant. Here, only the revenue effects are at work.

From an econometric point of view, we can conclude that there is a simultaneous and positive relationship between the donor country's transfers (variation in the transfers) and its imports (variation in imports) and exports (variation in exports). This simultaneity bias occurs because the variations in the imports and exports depend also on the variation in the transfers. For the econometric analysis, we need to use an instrumental variable to identify the true parameters.

What is the true relationship between climate aid and pollution? The "true" unbiased relationship is written for $T = T_M$ or $T = T_A$:

$$-dT(\frac{\partial U_1}{\partial T} + \frac{\partial U_2}{\partial T}) = dP(\frac{\partial U_1}{\partial P} + \frac{\partial U_2}{\partial P}) \quad (20)$$

The terms in parentheses are positive for the dT term and negative for the dP term, which means that when the stock of global GHG emissions P increases, the aid T also increases in line with the objective of transfers to compensate for the welfare losses through trade. If the stock of global GHG emissions increases then consumption decreases, and the donor will increase its aid to its trading partner which will increase the donor's imports and exports. This occurs because the price of the good produced by the recipient decreases and the income of the recipient increases. Trade and aid flows move in the same direction because the cumulative effects of the aid outweigh the effects of climate change. Two mechanisms are at work: price effects which improve the donor country's imports, and income effects which improve the recipient country's imports.

2.2 From theory to data

Our aim is to identify the trade determinants of climate aid and provide a simple explanation for their existence: the maintenance of historical trade relations based on colonial ties, geopolitics, etc. which could be degraded by climate change. Climate aid can alleviate the effects of climate change via two channels: price effects which increase the donor country's imports, and income effects which increase the recipient country's imports. These mechanisms translate into a positive mathematical relationship between the donor country's imports and exports and climate aid. However, this relationship is biased because these exports and imports also depend on the aid. Thus, the empirical analysis aims to validate this relationship and eliminate possible biases. This requires an IV method.

3 Empirics

In this section, we empirically test the theoretical model's alternative predictions using the OECD bilateral environmental aid database. In particular, we check whether trade (exports and imports) affects the allocation of climate aid.

3.1 Data

We gathered data on the universe of climate aid, trade flows, and some control variables, for the period 2002-2017.

Climate Aid. The OECD bilateral environmental aid database (OECD, 2020) includes bilateral environmental aid from the members of the OECD DAC. It distinguishes among four types of environmental actions corresponding to the four Rio markers: mitigation, adaptation, biodiversity, and desertification. The projects are screened and their relevance relative to the Rio markers is evaluated as "principal", "significant,"or "not targeted". We use the aggregate principal and significant mitigation and adaptation aids. Following the advice accompanying the database, we separate mitigation and adaptation transfers using project level data, and merge them to obtain total bilateral climate aid per year without duplicates. We also screen for identical bilateral transfers registered more than once by donor countries for different purposes. The data considered in our analysis refer to 154 recipient and 27 donor countries during the period 2002 to 2017. All the donor countries are DAC members. We excluded EU institution aid transfers; also, we merged Luxembourg's and Belgium's transfers to enable a matching with our trade data. We observed no environmental aid transfers from Hungary. We corrected the aid values for inflation using the US Consumer Price Index (CPI) (base 2010) (World Bank World Development Indicators - WDI[9]). We built a database which accounts for null transfers by rectangularizing the data at the donor, recipient, and year levels. If no transfer was made, this is recorded as a zero. The rectangularized dataset is used to check for potential selection bias (across donors and recipients) in the empirical estimation. This second set of data includes all possible climate aid transfers for each country pair in each year.

Trade. To measure trade flows, we use the CEPII BACI database (Gaulier and Zignago, 2010) which gathers bilateral trade data at the product-importer-exporter-year level. We matched these data to our period of analysis (2002-2017) and our countries. We aggregate all product-specific trade flows at the bilateral-year level and correct them for inflation using the US CPI (base 2010). This allows us to measure both exports and imports at the country-pair level.

Control Variables. We include in our analysis the following set of macroeconomic control variables.

In line with much of the foreign aid literature, we control for the following three categories of variables (Alesina and Dollar, 2000): recipient needs, recipient merit, and donor interests. To account for recipient needs, we include GDP and population (World Bank World Development Indicators - WDI), environmental vulnerability (Notre Dame Global Adaptation Initiative (ND-GAIN) indicators[10]), and per capita GHG emissions (Our World In Data[11]). To measure recipient merit, we include indicators of institutional quality (World Bank Worldwide Governance Indexes - WGI[12]). We created an indicator for average institutional quality by computing the mean of the five WGI.

To control for bilateral relationships, we include distance, a dummy representing past colonial ties between donor and recipient countries (taken from CEPII) (Head et al., 2010) as we underline in the theoretical model, and an index of voting similarity[13] at the UN General Assembly (Voeten and Merdzanovic, 2009). We control also for donor GDP (World Bank WDI[14]). In the regressions to control for omitted variables and selection bias, we use the share of green party seats in the donor country's parliament to proxy for the donor population's interest in environmental issues (Armingeon et al., 2020), foreign aid (OECD[15]), language similarity (taken from CEPII) (Head et al., 2010), and a dummy for whether donor and recipient countries are signatories to a regional

[9]Source: https://databank.worldbank.org/reports.aspx?source=world-development-indicators

[10]The ND-Gain Index is from 0 to 100 with the lowest scores representing the most vulnerable countries. Source: https://gain.nd.edu/our-work/country-index/download-data/

[11]https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

[12]The WGI score between -2.5 and 2.5, with the lower values corresponding to countries with the lowest outcomes. The 5 indexes measure: voice and accountability, political stability and absence of violence, government effectiveness, regulatory law, rule of law and control of corruption. Source: https://info.worldbank.org/governance/wgi/

[13]The voting similarity index is a bilateral-year variable (between 0 and 1) which indicates voting similarity practices between 2 countries in the UN General Assembly where 1 indicates perfect similarity. Abstention is counted as half-agreement with a yes or no vote.

[14]Source: https://databank.worldbank.org/reports.aspx?source=world-development-indicators

[15]Source: https://stats.oecd.org/qwids/

trade agreement (RTA) (de Sousa, 2012). Monetary variables are in USD millions corrected for inflation using the 2010 US CPI.

Descriptive statistics. Table 1 provides the descriptive statistics of the dataset limited to observed climate transfers. The full dataset including the null transfers includes $66,528$ observations. Separate mitigation and adaptation aid data are provided only from 2010, therefore the observations for these two variables cover only 2010 to 2017.

3.2 Empirical Strategy

Baseline Model To estimate the impact of trade relationships on the level of positive climate aid across years and pairs of countries, we estimate a multivariate linear regression with FE:

$$\text{Climate Aid}_{ijt} = \alpha_X \text{Exports}_{ijt} + \alpha_M \text{Imports}_{ijt} + \beta Z_{ij} + \theta Y_{ijt} + \gamma W_{it} + \eta X_{jt} + \mathbf{FE} + \epsilon_{ijt} \quad (21)$$

where $ClimateAid_{ijt}$ is our general measure of climate aid from country i to country j in year t. We consider total climate aid. In the additional results section, mitigation and adaptation aid are estimated separately.

To assess the impact of trade on climate aid, we focus on two measures of trade, consistent with the implications of our theoretical model. We estimate the impacts of both the exports from country i (aid donor) to destination j (aid recipient), and the imports of country i from country j in year t (trade flows go in the opposite direction to climate aid flows). Our objective is to estimate both α_M and α_X which *ceteris paribus* capture the impact of imports and exports on climate aid. Based on our theoretical model, we expect these parameters to be positive.

Our specification includes a set of bilateral time-invariant control variables (Z_{ij}) –such as distance, and a set of bilateral time-varying control variables (in Y_{ijt}) – such as voting similarity in the UN General Assembly. These variables are particularly important as they are direct confounding factors with respect to the trade variables. Also, as additional controls we include variables for donor-year (W_{it}) and recipient-year (X_{jt}) such as GDP, vulnerability, and quality of governance.

Finally, we include a set of FE to control for unobserved heterogeneity. As alternatives to donor, recipient, and year FE, we include two-dimensional FE. We consider donor-year and recipient-year FE to provide a quasi within-estimation. Given the size of our sample, this is a very demanding estimation. We first include donor-year FE which control for all changes in the donor country and hold constant the total amount of aid provided by this country to all recipients. The inclusion of these donor-year FE allow our main coefficient to be interpreted as the effect of trade on the share of aid to country j with respect to other recipients. The FE in this case allow us to study the allocation of aid across recipients for a given donor(-year). When included, all donor-year control variables are absorbed and cannot be identified. The FE also exclude donor-year groups with only one recipient. Next we introduce recipient-year

FE to control for all changes in the destination country. Similar to the donor-year FE, the recipient-year FE hold constant the total amount of aid received by a country, and study the relative origin of all aid received. If we include these FE we need to exclude recipients that receive climate aid from only one donor country (there is no variance for these observations), and we cannot identify the effect of changes in the (unilateral) recipient economic characteristics over time.

Endogeneity issues. We can estimate equation 21 with a standard ordinary least square (OLS) estimation. However, we cannot exclude endogeneity problems which could lead to biased estimation of both α_X and α_M. In particular, both the trade variables and aid could be determined simultaneously resulting in an aid to trade outcome, as we have underlined theoretically. On the one hand, climate aid might influence the aggregate revenue in the receiving country which would have an effect on the donor's exports by increasing demand. On the other hand, climate aid and especially adaptation aid might affect local production in the recipient country which could lead to shifts in the producing country's firms' production technology, specialization, or market power which in turn would affect the donor country's imports. Finally, since external factors such as political conflicts and resulting changes in both trade and aid flows might influence both variables we omit them from our main specification.

To overcome endogeneity issues, we use an instrumental variables (IV) strategy in a two-stage least squares (2SLS) estimation. In the first stage, we instrument the levels of both bilateral exports and imports using their expected level, and employ the predictions as the regressors in the second stage. Our IV strategy should identify the sources of variations in bilateral trade which are exogenous to climate aid and to the exporting and importing countries' decisions. This allows us to exclude simultaneous variations in aid and trade. Identifying the relationship requires instruments which (i) are related (and relevant) to trade, and (ii) are orthogonal to country pair decisions about trade or aid allocation.[16]

We use two shift-share instruments of exports and imports at the bilateral-year level. Our work is in line with a large literature which uses trade shocks as shifters in empirical exercises. Following the seminal contribution of Bartik (1991), this type of strategy has been used extensively at both the aggregate (see e.g. Autor et al. (2013)) and microeconomic (see e.g. Mayer et al. (2014) or Aghion et al. (2018)) levels.

Bilateral exports are instrumented by world demand (WD) for the products previously exported by country i to country j. Our baseline instrument is constructed using BACI product-level information at the HS4 level. Specifically, we start by computing WD by aggregating all trade flows for a given product p over all trade partners, except exporter i and importer j. We

[16]Following the advice of one of the referees, we have investigated the possibility to use weather shocks as an exogenous trade shifter. Even though we are interested in these trade variations from weather/climate issues, we believe that these variations lead to additional problems. We have identified that weather variations are only weakly correlated to trade flows, are thus potential weak instruments and are plausibly endogenous to climate aid. Finally, weather variations could be of particular importance for identfication of the relationship. Yet, weather shocks are implicitly included in the estimation via the country-year fixed effects and via vulnerability of the recipient country.

denote it WD_{ijpt} :

$$WD_{ijpt} = \sum_{\substack{i' \\ i' \neq i}} \sum_{\substack{j' \\ j' \neq j}} X_{i'j'pt} \tag{22}$$

Next, we aggregate all product-level (quasi) world demand in a bilateral-year variable to account for the importance of exports from country i to country j in the total world flows of product p five years earlier. We denote this share by s^X_{ijpt}:

$$s^X_{ijpt} = \frac{X_{ijpt-5}}{X_{pt-5}}. \tag{23}$$

This variable captures the importance of a specific export flow compared to world exports of a traded product. We obtain a shift-share variable where shifts in world demand are allocated to pairs of countries depending on their relative importance in total trade flows.

$$\text{Predicted Exports}_{ijt} = \sum_p s^X_{ijpt} \times WD_{ijpt} \tag{24}$$

For example, suppose that exports involving two countries account for 70% of the total exports of a given product. We argue that if world exports of that product double (but not based on increased supply from country i or increased demand from country j), it is likely that exports from country i to country j will also increase proportional to the overall shift in exports and to the initial share.

We perform a similar exercise to obtain the predicted imports of country i from country j. Our instrument measures total demand for the product that previously was imported by country i from country j. In practical terms, we use the same product-level WD shifts (again excluding country i and country j flows) but aggregate them using the share of the imports of country i from country j in the total world flows of product p:

$$s^M_{ijpt} = \frac{M_{ijpt-5}}{X_{pt-5}} \tag{25}$$

where M_{ijpt-5} is the level of imports of i from j in year $t-5$. Aggregating world flows at the product and the import-driven shares levels gives the predicted imports of country i from country j in year t:

$$\text{Predicted Imports}_{ijt} = \sum_p s^M_{ijpt} \times WD_{jipt}. \tag{26}$$

For example, suppose the same 70% increase in the total flows of a specific product. If the imports of country i from country j represent a minor fraction of the total flows, the predicted imports will likely be small. However, if the imports of country i from country j represent a major fraction of the total flows, the predicted imports will be quantitatively important.

Figure 1 depicts the first-stage relationship between exports and predicted exports (Figure 1-A) and between imports and predicted imports (Figure 1-B). Both plots show a strong correlation between the variable of interest and the instrument.

Equation 21 remains the key equation to estimate the impact of both trade effects on climate aid using the variables for the two predicted flows as instruments in the first-stage. We estimate all the equations using linear estimators; the variables are log transformed, and standard errors are clustered at the exporter-importer level. The robustness checks use alternative estimators and clustering levels.

4 Results

4.1 Baseline Results

IV Results. Table 2 provides the baseline IV results of equation 21 based on several alternative specifications. We can interpret them as causal since by construction, we ensure that variations in trade were uncorrelated to countries' decisions. In all the specifications which differ in terms of the FE included in the estimations, the observed import and export levels are instrumented, as described above. In terms of the quality of the instrumentation strategy, table 2 provides the Kleibergen-Paap Wald F-statistic. The validity of the IV strategy is described in detail in Appendix B

Table 2 columns 1 and 2 include only donor, recipient, and year FE. Column 1 includes the baseline set of controls which affect climate aid. Column 2 includes additional climate-related determinants of climate aid. Columns 3 and 4 respectively include donor-year and recipient-year FE. Column 5 accounts for both these FE. In all the columns, standard errors are clustered at the donor-recipient level.

First, we find that climate aid is not affected by the donor's imports from the recipient. Regardless of the control variables included, the coefficient of imports is never significant. Also, regardless of the standard errors, the point estimates are all close to zero suggesting no effect of the import channel.

Second, we find that exports have an effect on climate aid allocation. In all the columns, the coefficient of exports is close to 0.3. We estimate that a 10% increase in the exports from country i to country j increases climate aid by around 3%. The coefficient is stable across specifications, control variables, and the FE included. In particular, the pro-aid effect is not affected by controls for unobserved heterogeneities in donor-year and recipient-year. The counterpart is that the main variation used to identify this effect is across country pairs not within a country pair over time. For instance, the results in columns 4 and 5 can be interpreted as follows: for a given donor, increasing the exports to one destination country is correlated to an increase in bilateral climate aid to that country, controlling for aid and trade in the other potential destination countries, and controlling for the recipient country's average imports (i.e. the exports of other potential donors).We interpret these results as causal because we instrumented for the level of trade between countries: our results show that this effect accounts for the joint determination of aid and trade. Exogenous changes in export possibilities have a quantitative impact on climate aid.

How confident can we be in this result? First, our F-statistics are large and well above standard levels of confidence, confirming that our instruments are not weak. Second, most of the control variables have the expected signs, suggesting that the IV estimator is efficient. On average, the distance between the donor and recipient deters climate aid. More importantly, as we underlined in our theoretical analysis, former colonial ties increase climate aid. Common political concerns (measured by UN vote similarity) also increase climate aid. Higher donor GDP is associated with higher amounts of climate aid but the recipient country's GDP and the recipient country's GHG emissions seem to have no impact on the level of climate aid allocated. However, the size of the recipient country measured by number of inhabitants and its institutional quality do determine climate aid allocation.

We estimate also that climate aid is directed toward countries with higher levels of environmental vulnerability (the higher the environmental vulnerability index, the less vulnerable the country). This result is in line with most of the literature (Betzold and Weiler, 2017; Robinson and Dornan, 2017; Weiler et al., 2018; Peterson and Skovgaard, 2019; Mori et al., 2019) which estimates vulnerability as a potential determinant of climate aid using either the ND-GAIN index or the Climate Risk Index. However, case studies on the Adaptation Fund (Stadelmann et al., 2014; Persson and Remling, 2014) find less optimistic results. Stadelmann et al. (2014) evaluted 39 adaptation project proposals considered by the Adaptation Fund Board (AFB) using four vulnerability indices developed respectively by Barr et al. (2010), Buys et al. (2009), Wheeler (2011) and the Global Adaptation Initiative (2011). They find that the AFB has not approved the projects from the most vulnerable countries but rather selected projects in countries with low vulnerability and high income per capita. Analyzing 49 projects from the Adaptation Fund in 2012 with a similar methodology, Persson and Remling (2014) do not find any prioritization of projects in poorer and more vulnerable countries. These contrasting results may be due to the lack of a common definition of vulnerability and the diversity of vulnerability indicators.

Third, Appendix B, Table B.1 presents the first stage results for each of the endogenous regressors. They show that the observed exports are mainly explained by the variable for predicted exports (not predicted imports). The results are reversed for imports. Overall, the predicted exports and imports variables provide a good explanation of the variance in the observed trade flows. Appendix C provides a check of the properties of the IV estimations.

OLS Results Table 3 presents the OLS estimation results for the relationship between trade and climate aid. The results of the OLS are similar to the IV results: similar magnitudes (around 0.3 for the exports, 0 for imports) and significance (exports affect climate aid, imports do not). However, the OLS results are more precise. Across specifications, we estimate smaller standard errors (still clustered at the country pair level). Since the IV results seem to add some noise to the estimator, we assume that endogeneity is of minor importance in terms of the export channel for the effect of trade on climate aid. The quantitative conclusions regarding the effects of exports and imports are similar for both estimation types.

4.2 Robustness checks

We next check the robustness of our results and offer some additional results to support the baseline estimates.

4.2.1 Correcting for selection bias

First, we show that our results are robust to correcting for sample selection. Since our baseline results are estimated on a sample which includes only positive climate aid flows, we develop a two-stage model to account for this potential selection bias - known also as a Heckman correction.

In the first stage, we estimate the probability to receive climate aid using a set of models on rectangularized data which includes zero aid flows:

$$Pr(ClimateAid_{ijt} > 0) = \phi(\gamma W_{it} + \theta Y_{ijt} + \alpha Z_{ij}) \tag{27}$$

where $ClimateAid_{ijt}$ is a binary variable indicating whether or not climate aid was transferred from country i to country j in the year t.

In our model, provision of climate aid is determined by the existence of a foreign aid (ODA) relationship between the two countries and by the share of green party seats in the parliaments. We believe these two variables mainly determine the existence of a climate aid flow, and to a lesser extent determine the amount of climate aid. For robustness, we include additional covariates which quantitatively do not provide additional information – see the information criteria statistics (AIC) in Table D.1 in Appendix D. Conditional on this set of determinants, we run OLS estimations with country-pair and year FE, OLS with country-year FE, and probit estimations, and choose the specification with the highest information (AIC) statistics. The results are presented in Appendix D Table D.1. In the second stage, we estimate our baseline equation including the previously computed inverse Mills ratio (λ_{ijt}), using both IV and OLS estimations:

$$\text{Climate Aid}_{ijt} = \alpha_X \text{Exports}_{ijt} + \alpha_M \text{Imports}_{ijt} + \beta Z_{ij} + \theta Y_{ijt} + \gamma W_{it} + \eta X_{jt} + \lambda_{ijt} + \mathbf{FE} + \epsilon_{ijt} \tag{28}$$

The results of the modified second stage with an IV-2SLS strategy are presented in Table 4, and the modified OLS results in Table D.2. Overall, the coefficients are close to the baseline results which removes concern over sample selection issues. The inverse Mills ratio is large and significant in both estimations but does not affect the size or precision of the results.

4.2.2 Alternative IVs

Appendix B, Tables B.2, B.3 and B.4 present the second-stage results using alternative IVs. The results in Table B.2 are for the predicted flows computed using a 1-year instead of a 5-year lag. Table B.3 presents the results for the predicted flows computed using quantities rather than values. Table B.4 presents the results for exports and imports instrumented by 1-year lagged exports and imports. Overall, the coefficients are close to those in the baseline estimates, around 0.3, but the precision of the estimations is lower, especially in Table B.3.

4.2.3 Adaptation vs Mitigation

We have also replicated our estimations separately for mitigation aid – Table 5– and for adaptation aid – in Table 6.

In terms of trade, imports have no effect on either adaptation or mitigation aid but exports are a significant determinant of both with a higher coefficient of mitigation aid. We estimate that a 10% increase in the exports from country i to country j increases mitigation aid by around 3% and increases adaptation aid by around 1.5%. The quantitatively larger reaction of mitigation aid with respect to donor country's exports, compared to adaptation aid is puzzling. According to our theoretical model, the mitigation aid increases the productivity in a larger extent than adaptation aid. Thus, the income effects may be larger in the case of mitigation aid and thus may induce more exports of the recipient from the donor country. More generally, it is conceivable that the effects of mitigation aid are more persistent than adaptation aid because the technological change enabled by mitigation assistance may have longer-term impacts. These dynamic aspects are not taken into account in our model, which is static.

The control variables have the same signs as in the baseline estimations for both adaptation and mitigation aid, with recipient GDP still not a significant determinant of adaptation or mitigation aid. However, in the case of adaptation aid, we estimate a significant positive coefficient of recipient GHG emissions which contrasts with the baseline and mitigation aid estimations. We observe also that recipient environmental vulnerability seems to be a stronger determinant of mitigation aid while historical colonial relationships have a bigger impact on adaptation aid allocation.

4.2.4 Omitted Variables

The other threat to identification of the impact of trade on climate aid is omitted variables which jointly determine aid and trade. Table 7 checks for these possible biases. First, the correlation between climate aid and exports could be the result of a correlation among foreign aid (ODA), climate aid, and exports. We can expect a persistent effect on bilateral aid relations such that donor countries allocate climate aid to countries who are already recipients of their foreign aid. Then, since foreign aid is significantly larger than climate aid, the coefficient identified might be the result of the effect of foreign aid through climate aid. Table 7 column 1 excludes this bias but provides similar results.

Second, the main result abstracts from the potential trade agreements between donor and recipient countries. As a result, the observed correlation could be the outcome of a preferential trade agreement. Column 2 uses RTA data from de Sousa (2012). The results show that the effect of exports on aid is not driven by the existence of an (omitted) trade agreement between the donor and the recipient of the aid.

Third, language is a determinant of trade (Melitz, 2008) and might be a driver of (climate) aid. The results in columns 3 and 4 show that this additional control does not threaten the significance of the pro-aid effect of exports.

4.2.5 Heterogeneity across products

Our baseline results show a robust positive effect of the donor's exports on its allocation of climate aid but no significant effect of its imports. A potential explanation for this might be the different product composition of the donor's exports and imports to and from recipient countries.[17] While donor countries' exports consist mostly of specialized manufactured goods with high levels of differentiation, recipient countries tend to export more homogeneous raw products and commodities. On average in our sample, more than half of the recipients' exports (i.e. donors' imports) consist of homogeneous products while these represent around 33% of donors' exports.

Homogeneous products might be more easily substitutable than differentiated manufactured goods. Therefore, a donor country might have fewer incentives to maintain its import flows from a specific recipient country than to maintain its export flows to the same country through climate aid allocation. For instance, a donor country might be more able to substitute its commodity imports using another recipient country. However, if the donor country exports specialized products designed for the recipient country j's market, it might be more difficult to redirect this production to another recipient country j'.

We tested this hypothesis first based on the variation in product types. Specifically, we use product-level characteristics following Rauch (1999) highlighting the difference between homogeneous and differentiated products. We replicate our IV-2SLS strategy on subsamples of product types. We run the estimations, instrumenting both exports and imports using shift-share instruments for each product type. Table 8 presents the results. Column 1 focuses on differentiated products. Similar to our baseline results, we find no effect of imports on climate aid allocation. The point estimates are close to zero and are not significant for imports. For donor export flows of differentiated products, the results are similar to our baseline results, with a significant coefficient close to 0.3. Column 2 which includes only homogeneous products provides a different picture. A donor's exports of homogenous products have no impact on its climate aid allocation which supports the trade specialization hypothesis. Donor countries have a higher incentive to maintain their differentiated compared to their homogeneous trade flows since the former are less substitutable.

Second, we leveraged the variation in the intensity of differentiated products in donors' exports and imports. For exports, we identify – across donor-year observations– sellers that export relatively more differentiated products compared to other donors. We built a dummy variable ("High Share Diff.") for each donor country indicating whether their exports include higher shares of differentiated products compared to the sample average.[18]

Table 8 columns 3 and 4 show that the trade effect on climate aid is shaped by the importance of differentiated products. Column 3 introduces the interaction between exports and

[17] We thank one of the reviewers for this suggestion.

[18] In formal terms, we first computed the share of differentiated products in each donor exports: $\omega_{it}^{diff,X} = X_{it}^{diff}/X_{it}$, then compute the average share over all donor-years: $\bar{\omega}_{it}^{diff,X}$. We identified exporters that sell relatively more differentiated products by comparing the observed share to the average share: High Share Diff. = $\mathbb{1}\{\omega_{it}^{diff,X} > \bar{\omega}_{it}^{diff,X}\}$. We conducted a similar exercice for donors' imports.

this measure. The results suggest that differentiated exports are quantitatively more important for climate aid allocation than all exports taken together. All other things being equal and controlling for level of exports, "highly differentiated" exports from country i to country j are correlated with higher levels of climate aid allocation compared to more homogeneous-product exports. Column 4 includes the interaction between imports and this measure.[19] We find that climate aid is determined by imports in the case only of highly differentiated products. A large share of differentiated products is correlated with larger amounts of climate aid compared to other importers.

We interpret this result as follows: conditional on trade levels, product differentiation is a plausible mechanism determining how trade affects climate aid. Differentiated products –which are more difficult to substitute than homogeneous goods– seem to be a driver of the observed trade effect on aid.

4.2.6 Other checks

Plausibly exogenous IV The validity of our IV results relies on the validity of the excluded instrument we used. Appendix C checks the validity of world import demand as an instrument and provides insights into identification of the source of the shift-share instrument.

Alternative clustering level While the main results are derived from the standard errors clustered at the country-pair level, the results in Tables D.3, D.4 and D.5 are for standard errors clustered at the donor-year level and do not affect inferences.

4.3 Conclusion of the empirical analysis

Our estimations confirm the important role of exports from donor to recipient as a determinant of climate aid. The estimates point to an elasticity of 0.3 for exports which is robust to the specification, endogeneity issues, the FE included in the estimation, and the omitted variables. The separate estimations for mitigation and adaptation aid again show that imports have no impact on either but that exports are a significant determinant of both with respective elasticities of 0.15 and 0.3. The estimate of 0.15 for adaptation aid elasticity is larger than the elasticity of per capita adaptation aid of 0.03 for exports in Weiler et al. (2018) for the period 2010 and 2015.

Our estimations show that the import channel emphasized in the theoretical model, seems not to be having an effect. We did not find a significant impact of donor's imports on donor's allocation of climate aid to a specific recipient. Compared to the results in the literature, we estimate that the trade effect emphasized by Weiler et al. (2018) for instance, is only an export-driven channel: the more a donor exports to a specific country, the higher the relative amount of aid allocated to that recipient.

[19] For each donor country, this measure indicates whether the country's imports include a higher share of differentiated products compared to the sample average.

In addition, our results are in line with existing evidence regarding the standard determinants of foreign aid in general, and climate aid in particular. However, after accounting for trade interests, our results cast doubt on the role of recipient country GDP and recipient country GHG emissions on bilateral climate aid allocation.

5 Conclusion

Given the importance of climate aid for the developing countries, and the general objective of increasing funding for environmental objectives, understanding their determinants is important for both academics and policymakers. Our paper offers some information on the quantitative role of trade on climate aid. We conducted both theoretical and empirical analysis of the role played by trade on climate aid. We investigated the theoretical trade channels of climate aid, and provided an empirical assessment of them accounting also for endogeneity concerns.

We have provided a set of theoretical insights based on a simple trade model. Our model highlights the terms-of-trade and positive income effects of climate aid, and predicts a positive relationship between the donor's exports to and imports from the recipient country and its climate aid transfers. The empirical assessment provides a robust and causal estimate of the effects of trade on climate aid, accounting for the bi-directional relationships between aid and trade. For a given donor, climate aid is positively determined by its exports to a specific country but is unaffected by its imports from a potential aid recipient. Our baseline estimates suggest an elasticity of aid of around 0.3 for exports. We show that the impact of trade on climate aid is mainly export- rather than import-driven. We interpret this result as follows: climate aid may be used by donors to increase their exports through the establishment of stable and friendly relations with potential importers, for instance. While imports might be expected to have some influence triggered by a terms-of-trade effect, we found no evidence of this in the period of study 2002-2017. The low levels of climate aid which are the subject of complaint from recipient countries might explain their negligible influence on exchange rates. If climate aid increases in the future in line with donor pledges in the Paris agreement (2015), the import channel may begin to have some influence.

Overall, our paper reveals some empirical regularities which should be informative for policymakers about the determinants of climate aid. In particular, we show that trade interests are important quantitatively in the allocation of climate aid. As a result, any special trade interests may affect the allocation of aid with not just local but global environmental consequences.

Some limitations of our article must be underlined. First, our empirical results are based only on bilateral climate aid data, while at the aggregate level, multilateral aid is more important in value than bilateral aid. Our focus on bilateral aid is motivated by a greater presence of strategic behavior for this type of aid on the part of donor countries to maintain their bilateral trade relations with their historical partners. Secondly, the empirical distinction between adaptation and mitigation aid is only available since 2010. For future work, it would be interesting to analyze whether the behavior of donors in terms of allocation of climate aid has changed in the recent period following the ratification of the Paris Agreement (2015) and whether trade motives are less important than the needs of recipient countries in the allocation of climate aid by donor countries since then. Another avenue for future research could be to study the implications of trade-related measures such as carbon border adjustments in the European Union on the allocation of climate aid by EU countries as mitigation aid may help greening the exports of recipient countries.

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Tables

Table 1: Descriptive Statistics

variable	mean	sd	min	max	N
Climate Aid (million usd)	15.20	94.27	0.00	3,458.51	12,077.00
... for Mitigation (million usd)	11.61	81.80	0.00	2,804.69	12,077.00
... for Adaptation (million usd)	5.29	29.81	0.00	1,025.13	12,077.00
Donor Exports (usd)	1.68e+06	9.93e+06	1.66	2.11e+08	11,789.00
Donor Imports (usd)	2.29e+06	1.75e+07	1.09	5.36e+08	11,627.00
Distance (km)	7,534.39	3,665.79	394.75	19,447.35	11,860.00
Colony (dummy)	0.08	0.28	0.00	1.00	11,860.00
UN Vote Similarity	0.69	0.13	0.05	1.00	11,696.00
Donor GDP (usd)	2.83e+06	4.02e+06	15,503.20	2.19e+07	12,077.00
Recipient GDP (usd)	268961.24	1.09e+06	15.38	1.37e+07	11,839.00
Recipient Popu. (millions)	76.61	229.59	0.01	1,386.39	11,985.00
WGI	2.49	0.54	0.55	4.33	11,998.00
Vulnerability: Gain Index	41.98	7.57	15.93	62.18	11,476.00
Donor GHG (million tons CO2-eq)	725.09	1,325.53	0.00	6,601.13	12,077.00
Recipient GHG (million tons CO2-eq)	330.92	1,248.77	-85.62	11,592.12	12,064.00
ODA (million usd)	64.49	203.13	-16.65	5,194.44	11,956.00

Table 2: Baseline IV results

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.295***	0.284***	0.259***	0.300***	0.279***
	(0.081)	(0.086)	(0.081)	(0.082)	(0.084)
Imports	0.020	0.006	0.019	0.041	0.029
	(0.039)	(0.042)	(0.037)	(0.044)	(0.043)
Distance	-0.692***	-0.700***	-0.741***	-0.713***	-0.749***
	(0.151)	(0.162)	(0.153)	(0.160)	(0.165)
Colony	0.956***	0.850***	0.953***	0.970***	0.942***
	(0.201)	(0.211)	(0.198)	(0.215)	(0.216)
UN Vote Simi.	1.262***	1.255***	0.887***	1.531***	1.604**
	(0.241)	(0.247)	(0.336)	(0.297)	(0.629)
Donor GDP	2.157***	2.038***		2.298***	
	(0.253)	(0.265)		(0.265)	
Recip. GDP	0.017	-0.046			
	(0.186)	(0.199)			
Recip. Pop.	3.075***	3.263***			
	(0.669)	(0.745)			
WGI		2.084***			
		(0.673)			
Vulnera. GAIN		-3.924**			
		(1.614)			
Recip. GHG		0.151			
		(0.102)			
Observations	10542	9269	10601	10344	10327
R^2	0.073	0.068	0.067	0.080	0.076
K.P. Wald F-stat.	288.695	236.333	288.994	321.390	312.161
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table 3: Baseline OLS results

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.219***	0.207***	0.231***	0.230***	0.253***
	(0.036)	(0.039)	(0.035)	(0.040)	(0.041)
Imports	0.015	-0.001	0.017	0.018	0.013
	(0.020)	(0.022)	(0.020)	(0.023)	(0.023)
Distance	-0.772***	-0.789***	-0.760***	-0.809***	-0.773***
	(0.114)	(0.121)	(0.116)	(0.124)	(0.130)
Colony	0.974***	0.878***	0.914***	0.988***	0.916***
	(0.184)	(0.194)	(0.180)	(0.201)	(0.199)
UN Vote Simi.	1.240***	1.233***	0.931***	1.466***	1.535**
	(0.231)	(0.242)	(0.318)	(0.287)	(0.595)
Donor GDP	2.102***	1.925***		2.243***	
	(0.242)	(0.255)		(0.253)	
Recip. GDP	0.036	-0.019			
	(0.176)	(0.188)			
Recip. Pop.	2.652***	2.689***			
	(0.644)	(0.723)			
WGI		2.033***			
		(0.643)			
Vulnera. GAIN		-4.061***			
		(1.550)			
Recip. GHG		0.150			
		(0.101)			
Observations	11180	9724	11274	11057	11042
R^2	0.069	0.064	0.064	0.074	0.070
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table 4: Selection bias correction: second-stage IV results

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.315***	0.290***	0.274***	0.317***	0.287***
	(0.087)	(0.091)	(0.087)	(0.088)	(0.091)
Imports	0.021	0.012	0.016	0.037	0.023
	(0.042)	(0.044)	(0.040)	(0.048)	(0.047)
Inv. Mills Ratio	-0.544***	-0.352**	-0.631***	-0.386*	-0.471**
	(0.180)	(0.176)	(0.203)	(0.198)	(0.232)
Distance	-0.693***	-0.706***	-0.773***	-0.732***	-0.801***
	(0.169)	(0.179)	(0.170)	(0.182)	(0.186)
Colony	0.941***	0.848***	0.945***	0.964***	0.952***
	(0.205)	(0.213)	(0.202)	(0.219)	(0.220)
UN Vote Simi.	1.304***	1.280***	0.884**	1.622***	1.711***
	(0.246)	(0.251)	(0.346)	(0.305)	(0.646)
Donor GDP	2.292***	2.218***		2.441***	
	(0.267)	(0.278)		(0.281)	
Recip. GDP	-0.029	-0.059			
	(0.192)	(0.205)			
Recip. Pop.	3.145***	3.325***			
	(0.689)	(0.767)			
WGI		2.037***			
		(0.697)			
Vulnera. GAIN		-3.888**			
		(1.674)			
Recip. GHG		0.101			
		(0.102)			
Observations	9957	8782	10014	9734	9717
R^2	0.074	0.068	0.067	0.080	0.076
K.P. Wald F-stat.	261.802	217.486	262.652	288.165	280.569
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table 5: IV results on Mitigation aid

	Dep. Variable: log Aid - Mitigation				
	(1)	(2)	(3)	(4)	(5)
Exports	0.286***	0.301***	0.257***	0.342***	0.331***
	(0.093)	(0.097)	(0.092)	(0.096)	(0.097)
Imports	-0.001	0.001	0.006	0.007	0.010
	(0.041)	(0.043)	(0.040)	(0.049)	(0.049)
Distance	-0.672***	-0.621***	-0.690***	-0.657***	-0.648***
	(0.171)	(0.180)	(0.174)	(0.183)	(0.188)
Colony	0.683***	0.551***	0.699***	0.681***	0.652***
	(0.202)	(0.211)	(0.197)	(0.219)	(0.216)
UN Vote Simi.	1.304***	1.428***	0.807**	1.678***	1.609**
	(0.273)	(0.274)	(0.405)	(0.331)	(0.771)
Donor GDP	2.589***	2.485***		2.696***	
	(0.274)	(0.290)		(0.298)	
Recip. GDP	-0.038	-0.070			
	(0.198)	(0.210)			
Recip. Pop.	2.139***	2.004***			
	(0.697)	(0.760)			
WGI		2.264***			
		(0.726)			
Vulnera. GAIN		-5.039***			
		(1.710)			
Recip. GHG		0.079			
		(0.098)			
Observations	9086	8063	9119	8832	8811
R^2	0.058	0.059	0.050	0.066	0.059
K.P. Wald F-stat.	225.659	191.280	231.649	249.167	247.961
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table 6: IV results on Adaptation aid

	Dep. Variable: log Aid - Adaptation				
	(1)	(2)	(3)	(4)	(5)
Exports	0.190**	0.170*	0.153*	0.178**	0.153*
	(0.084)	(0.092)	(0.083)	(0.086)	(0.086)
Imports	0.026	0.016	0.023	0.048	0.047
	(0.047)	(0.053)	(0.045)	(0.051)	(0.050)
Distance	-0.804***	-0.755***	-0.840***	-0.830***	-0.841***
	(0.166)	(0.177)	(0.165)	(0.177)	(0.179)
Colony	1.483***	1.413***	1.457***	1.470***	1.421***
	(0.231)	(0.250)	(0.222)	(0.240)	(0.235)
UN Vote Simi.	0.562**	0.516*	0.984***	0.325	1.220*
	(0.281)	(0.286)	(0.367)	(0.410)	(0.717)
Donor GDP	3.064***	2.890***		3.149***	
	(0.363)	(0.387)		(0.381)	
Recip. GDP	-0.067	-0.320			
	(0.244)	(0.292)			
Recip. Pop.	2.509**	3.174**			
	(1.257)	(1.531)			
WGI		1.268			
		(0.969)			
Vulnera. GAIN		-2.282			
		(2.484)			
Recip. GHG		0.358***			
		(0.135)			
Observations	6502	5447	6554	6448	6443
R^2	0.086	0.076	0.077	0.090	0.082
K.P. Wald F-stat.	257.656	215.265	253.413	292.482	286.771
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table 7: Omitted Variables: IV results

	Dep. Variable: log Aid			
	(1)	(2)	(3)	(4)
Exports	0.337***	0.224**	0.254***	0.326***
	(0.113)	(0.090)	(0.084)	(0.112)
Imports	0.029	0.038	0.032	0.031
	(0.058)	(0.047)	(0.043)	(0.057)
Distance	-0.674***	-0.678***	-0.783***	-0.692***
	(0.207)	(0.169)	(0.165)	(0.205)
Colony	0.902***	0.829***	0.420*	0.359
	(0.250)	(0.228)	(0.232)	(0.272)
UN Vote Simi.	1.990**	1.660***	1.391**	1.870**
	(0.937)	(0.624)	(0.631)	(0.931)
L.ODA	-1.708			-1.720
	(1.165)			(1.199)
RTA		0.318*		
		(0.186)		
Language			0.834***	0.817***
			(0.161)	(0.193)
Observations	6838	8352	10327	6838
R^2	0.077	0.069	0.084	0.086
K.P. Wald F-stat.	211.853	247.049	301.066	205.730
Donor-Year FE	✓	✓	✓	✓
Recipient-Year FE	✓	✓	✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

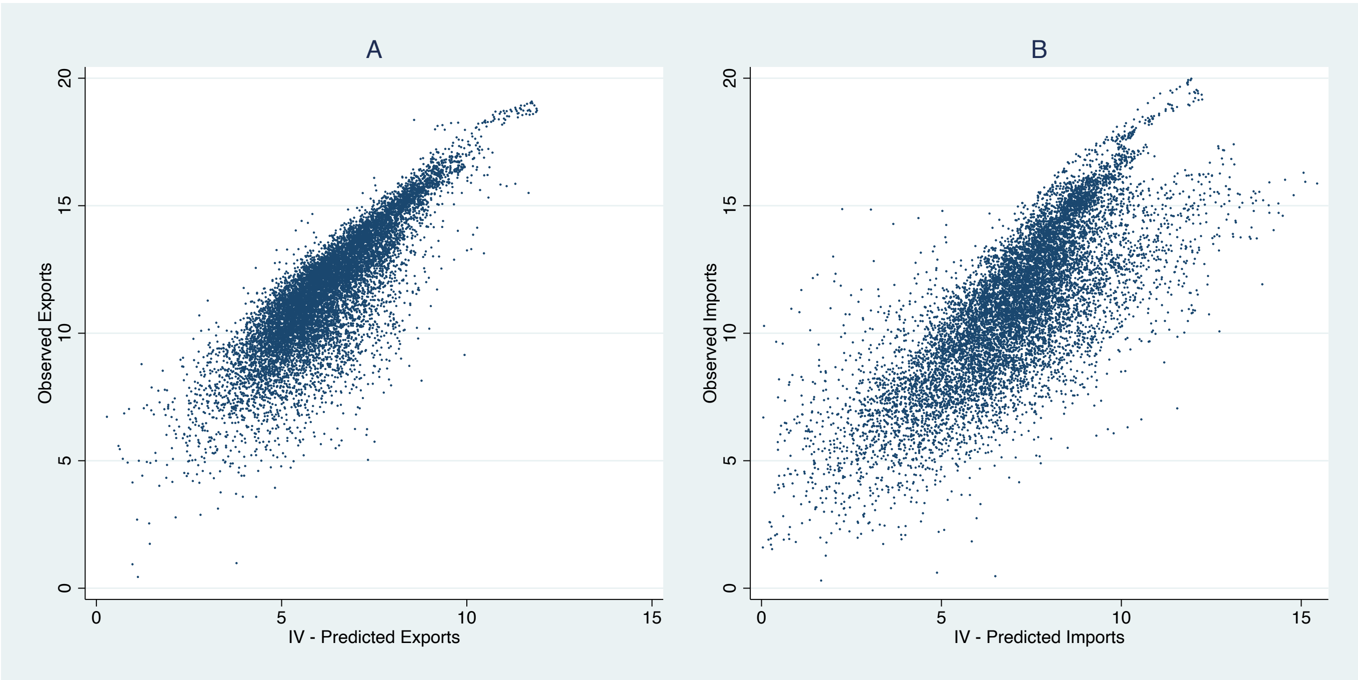
Table 8: Role of product specialization

	Dep. Variable: log Aid			
	(1)	(2)	(3)	(4)
Imports	0.010	0.041		-0.009
	(0.041)	(0.029)		(0.032)
Exports	0.271***	0.049	0.150**	
	(0.070)	(0.051)	(0.067)	
Distance	-0.804***	-1.014***	-0.833***	-1.066***
	(0.155)	(0.141)	(0.141)	(0.120)
Colony	0.970***	1.171***	0.982***	1.206***
	(0.210)	(0.211)	(0.205)	(0.200)
UN Vote Simi.	1.413**	1.497**	1.312**	1.491**
	(0.614)	(0.642)	(0.601)	(0.609)
Exports × 1 (High Share Diff.)			0.177***	
			(0.042)	
Imports × 1 (High Share Diff.)				0.132***
				(0.046)
Observations	10105	9853	10692	10692
R^2	0.075	0.069	0.079	0.066
Sample	Differentiated	Homogeneous	Full	Full

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. IV estimations. Column 1 focuses on differentiated products only (see Rauch (1999)). Column 2 focuses on homogeneous products only. Columns 3 and 4 use the full sample. All columns include donor-year and recipient-year fixed effects. Standard Errors are clustered at the country-pair level. All variables are in logs.

Figures

Figure 1: Relationship between endogenous trade flows and instruments



Appendix

A Theoretical model - the preliminaries

Once we have expressed the levels of the relative price of good 2 and the consumption as a function of R_1 and R_2, we can express their total differentials as a function of dR_1 and dR_2:

$$dp = (1-\sigma)(\frac{R_1}{R_2})^{-\sigma}\left(\frac{dR_1 R_2 - dR_2 R_1}{(R_2)^2}\right) \tag{A.1}$$

$$dC_2^1 = -\left[-\sigma(\frac{R_2}{R_1})^{1+\sigma} dR_1 + (\sigma-1)(\frac{R_2}{R_1})^{\sigma} dR_2 - dR_2\right](R_2)^{-2} \tag{A.2}$$

$$dC_1^2 = -\left[-\sigma(\frac{R_1}{R_2})^{1+\sigma} dR_2 + (\sigma-1)(\frac{R_1}{R_2})^{\sigma} dR_1 - dR_1\right](R_2)^{-2} \tag{A.3}$$

The utility of the donor country as a function of R_1 and R_2 is given by:

$$U_1 = C_2^1(1+(\frac{R_2}{R_1})^{-\sigma})^{\frac{1}{\sigma}} = R_1^{\sigma}(R_2^{\sigma}+R_1^{\sigma})^{\frac{1-\sigma}{\sigma}} \tag{A.4}$$

The utility of the recipient country (without the emissions externality) as a function of R_1 and R_2 is given by:

$$U_2 + k(1-\alpha T_M)a_{2.}L_2 T_{M.} = C_1^2(1+(\frac{R_1}{R_2})^{-\sigma})^{\frac{1}{\sigma}} = R_2^{\sigma}(R_2^{\sigma}+R_1^{\sigma})^{\frac{1-\sigma}{\sigma}} \tag{A.5}$$

The sign of the total differential of the donor country utility dU_1 is the sign of the following expression:

$$dR_1(1+(\frac{R_2}{R_1})^{\sigma}) + (1-\sigma)\left[(\frac{R_1}{R_2})^{1-\sigma} dR_2 + dR_1\right] \tag{A.6}$$

The sign of $d\left[U_2 + (k(1-\alpha T_M)a_{2.}T_{M.}L_2\right]$ is the the sign of the following expression:

$$\frac{\sigma^2}{1-\sigma} dR_2 + \frac{\sigma dR_1}{\frac{R_1}{R_2} + (\frac{R_1}{R_2})^{1-\sigma}} + \sigma\frac{dR_2}{1+\left(\frac{R_1}{R_2}\right)^{\sigma}} \tag{A.7}$$

We now investigate the positivity of the expressions $\frac{dC_2^1}{dT_A}$, $\frac{dC_2^1}{dT_M}$, $\frac{dC_1^2}{dT_A}$, $\frac{dC_1^2}{dT_M}$, $\frac{dU_1}{dT_A}$, $\frac{dU_1}{dT_M}$, $\frac{d[U_2+(k(1-\alpha T_M)a_{2.}T_{M.}L_2]}{dT_A}$, $\frac{d[U_2+(k(1-\alpha T_M)a_{2.}T_{M.}L_2]}{dT_M}$, and the negativity of the expressions $\frac{dp}{dT_A}$and $\frac{dp}{dT_M}$. Regarding the effects of adaptation aid, we have $\frac{dR_1}{dT_A} = -1$ and $\frac{dR_2}{dT_A} = h$. Regarding the effects of mitigation aid, we have $\frac{dR_1}{dT_M} = -1$ and $\frac{dR_2}{dT_M} = a_2 L_2$. These properties together with the assumptions of the model, that is $\frac{R_1}{R_2} > 1$ and $\sigma < 1$, allow us to obtain the results contained in Propositions 1-5.

Table B.1: IV: first-stage results

	Dep. Variable: log Exports				
	(1)	(2)	(3)	(4)	(5)
Predicted Exports	0.561***	0.550***	0.562***	0.622***	0.621***
	(0.023)	(0.025)	(0.023)	(0.025)	(0.025)
Predicted Imports	0.033***	0.034***	0.038***	0.038***	0.037***
	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
Observations	10542	9269	10601	10344	10327
R^2					

	Dep. Variable: log Imports				
	(1)	(2)	(3)	(4)	(5)
Predicted Exports	0.125***	0.124***	0.124***	0.122***	0.123***
	(0.024)	(0.025)	(0.024)	(0.026)	(0.026)
Predicted Imports	0.541***	0.535***	0.547***	0.559***	0.562***
	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)
Observations	10542	9269	10601	10344	10327
R^2					
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

B Additional IV results

Table B.2: Alternative IV: 1-year lag in shares

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.217***	0.208***	0.210***	0.222***	0.225***
	(0.059)	(0.062)	(0.058)	(0.065)	(0.067)
Imports	0.010	0.010	0.004	0.022	0.008
	(0.027)	(0.028)	(0.027)	(0.030)	(0.031)
Distance	-0.803***	-0.785***	-0.822***	-0.838***	-0.841***
	(0.132)	(0.139)	(0.134)	(0.145)	(0.151)
Colony	1.016***	0.894***	0.988***	1.055***	0.996***
	(0.192)	(0.201)	(0.188)	(0.210)	(0.209)
UN Vote Simi.	1.265***	1.262***	0.901***	1.491***	1.496**
	(0.235)	(0.243)	(0.327)	(0.289)	(0.600)
Donor GDP	2.100***	1.904***		2.256***	
	(0.248)	(0.259)		(0.258)	
Recip. GDP	0.061	-0.011			
	(0.181)	(0.191)			
Recip. Pop.	2.668***	2.745***			
	(0.657)	(0.736)			
WGI		2.077***			
		(0.656)			
Vulnera. GAIN		-3.975**			
		(1.579)			
Recip. GHG		0.150			
		(0.101)			
Observations	10880	9519	10946	10708	10692
R^2	0.070	0.065	0.064	0.078	0.073
K.P. Wald F-stat.	739.153	642.650	790.543	712.821	702.416
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the country-pair level. All variables are in logs. Second-stage IV results, where exports and imports are instrumented by predicted exports and predicted imports (see text for details). In this Table, predicted flows are computed using a 1-year lag, instead of a 5-year lag in the baseline results.

Table B.3: Alternative IV: using quantities in the IV

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.184*	0.128	0.147	0.204**	0.189*
	(0.099)	(0.106)	(0.101)	(0.104)	(0.107)
Imports	0.041	0.046	0.045	0.052	0.044
	(0.050)	(0.056)	(0.048)	(0.057)	(0.056)
Distance	-0.815***	-0.859***	-0.858***	-0.829***	-0.850***
	(0.164)	(0.174)	(0.168)	(0.174)	(0.180)
Colony	1.055***	0.975***	1.046***	1.059***	1.019***
	(0.207)	(0.217)	(0.206)	(0.223)	(0.224)
UN Vote Simi.	1.271***	1.261***	0.910***	1.525***	1.598**
	(0.240)	(0.246)	(0.338)	(0.295)	(0.628)
Donor GDP	2.125***	1.980***		2.267***	
	(0.252)	(0.263)		(0.264)	
Recip. GDP	0.094	0.054			
	(0.187)	(0.198)			
Recip. Pop.	2.905***	3.111***			
	(0.668)	(0.741)			
WGI		2.060***			
		(0.675)			
Vulnera. GAIN		-3.766**			
		(1.628)			
Recip. GHG		0.146			
		(0.103)			
Observations	10536	9264	10595	10338	10321
R^2	0.073	0.068	0.065	0.079	0.074
K.P. Wald F-stat.	195.187	159.460	185.363	203.897	193.063
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs. Second-stage IV results, where exports and imports are instrumented by predicted exports and predicted imports (see text for details). In this Table, predicted flows are computed using quantities instead of values in the baseline results.

Table B.4: Alternative IV: lagged exports and imports

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.342***	0.304***	0.351***	0.351***	0.362***
	(0.059)	(0.064)	(0.058)	(0.068)	(0.070)
Imports	-0.006	-0.028	-0.009	-0.012	-0.018
	(0.035)	(0.036)	(0.034)	(0.039)	(0.040)
Distance	-0.676***	-0.735***	-0.661***	-0.715***	-0.703***
	(0.148)	(0.156)	(0.150)	(0.164)	(0.169)
Colony	0.860***	0.819***	0.792***	0.920***	0.881***
	(0.216)	(0.232)	(0.212)	(0.232)	(0.230)
UN Vote Simi.	0.743***	0.674**	1.065**	0.872**	2.165**
	(0.288)	(0.299)	(0.439)	(0.408)	(0.870)
Donor GDP	2.316***	2.110***		2.655***	
	(0.318)	(0.334)		(0.350)	
Recip. GDP	-0.155	-0.269			
	(0.225)	(0.241)			
Recip. Pop.	2.687***	2.580***			
	(0.855)	(0.985)			
WGI		2.843***			
		(0.875)			
Vulnera. GAIN		-5.195***			
		(1.988)			
Recip. GHG		0.153			
		(0.111)			
Observations	7481	6417	7513	7185	7168
R^2	0.070	0.066	0.065	0.079	0.077
K.P. Wald F-stat.	1256.896	1186.308	1278.121	1378.212	1410.387
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs. Second-stage IV results, where exports and imports are instrumented by 1-year lagged exports and imports.

Table C.1: Quasi Random Instrument

	GDP(i)	GDP(j)	Pop.(j)	WGI(j)	Vuln.(j)	GHG(j)	Dist.	Colony	UN Simi.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Predicted Exports	0.005	0.008	-0.000	0.002	0.002***	0.014	-0.206***	0.035***	0.000
	(0.003)	(0.006)	(0.001)	(0.002)	(0.001)	(0.010)	(0.018)	(0.007)	(0.002)
Observations	10692	10829	10906	10913	10609	9610	11010	11010	10900
R^2	0.996	0.995	1.000	0.949	0.988	0.987	0.705	0.415	0.962
F-stat	2.604	1.918	0.048	1.207	6.962	1.934	124.394	26.495	0.044
Cluster Level	ij	ij	ij	ij	ij	ij	ij	ij	ij
Fixed Effects	ij jt	ij it	ij it	ij it	ij it	ij it	jt it	jt it	jt it

	GDP(i)	GDP(j)	Pop.(j)	WGI(j)	Vuln.(j)	GHG(j)	Dist.	Colony	UN Simi.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Predicted Imports	0.002	0.006*	-0.001	0.000	0.001	0.003	-0.069***	0.011***	-0.001
	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)	(0.004)	(0.008)	(0.003)	(0.001)
Observations	10160	10357	10420	10422	10211	9205	10462	10462	10367
R^2	0.996	0.995	1.000	0.947	0.988	0.985	0.676	0.414	0.964
F-stat	0.821	3.036	1.114	0.036	1.225	0.683	72.040	9.414	0.681
Cluster Level	ij	ij	ij	ij	ij	ij	ij	ij	ij
Fixed Effects	ij jt	ij it	ij it	ij it	ij it	ij it	jt it	jt it	jt it

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the country-pair level. All variables are in logs.

C Plausibly exogenous IV

The validity of our IV results relies on the validity of our excluded instrument we used. We now check the validity of the world import demand as an instrument and assess the sensitivity of the second-stage results. We proceed in 3 steps.

Quasi Random Instrument (Country Observables and Instrument) The IV strategy uses sources of variations in trade that should be uncorrelated to the trade partners and thus allow for causal inference. Our excluded instrument should in particular be uncorrelated to trade partners' observables. Table C.1 shows that there is no strong and quantitatively important correlation between our baseline instruments and the set of observables. We regressed the excluded instrument on the set of observables used in the exercise. In particular, we hardly estimate a significant and robust correlation independently of the fixed effects we use. Despite being sometimes significant, we argue that the instrument is plausibly exogenous given the small F-stats obtained regarding the correlation between the predicted exports and vulnerability, or expected imports and recipient population. We thus estimate that the instruments are quasi randomly distributed across observations in our sample, to the exclusion of distance which appears to be a major determinant of the value of the instruments.

Quasi-Random Product-level Demand Shocks The instrument we use in the present paper leverages foreign demand shocks, at the HS6 product level (denoted WD_{ijpt} in the paper). Key to identification is that these demand shocks are uncorrelated to observables at the country pair-year level:

Table C.2: Quasi Random Product-level Demand Shocks

	GDP(i)	GDP(j)	Pop.(j)	WGI(j)	Vuln.(j)	GHG(j)	Dist.	Colony	UN Simi
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Product-level Shock	0.001**	-0.000	0.003***	-0.000	-0.001***	-0.001	-0.016***	0.003***	0.000**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)	(0.000)
Observations	11625692	11462914	11556589	11562673	11447479	10718176	11625709	11625709	1155124
R^2	0.995	0.992	0.999	0.929	0.981	0.977	0.647	0.297	0.962
F-stat	4.352	0.041	117.063	0.375	59.140	0.367	104.206	29.806	5.811
Cluster Level	ij	ij	ij	ij	ij	ij	ij	ij	ij
Fixed Effects	ij jt p	ij it p	ij it p	ij it p	ij it p	ij it p	jt it p	jt it p	jt it p

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

identification would hence arise from random shocks to demand. Table C.2 shows that foreign demand shocks *at the product level* are mostly uncorrelated to country-level observables (as dependent variables in the table). On top of that, the table displays low F-stats.

Non-random exposure of country pairs to foreign shocks. By construction, our shift-share instrument combines foreign exogenous demand shocks with exporter-specific exposure to these shocks. Previous results showed that foreign shocks can hardly be correlated to partners observables. Yet, a remaining concern is that trade partners are non-randomly exposed to those quasi-random export shocks. For instance, we could imagine that some countries have an export structure which is oriented towards specific foreign markets, in former colonies, countries sharing the same language or close countries for instance. In other words, the non-random exposure to the random shock may lead to a bias in our estimations. Our results should thus be insulated from this non-random exposure of trade partners to foreign demand shocks.

Borusyak and Hull (2020) develop a general econometric framework for shift-share settings that allows for the possibility that shock exposure is non-random. They also provide a set of guidelines to implement this strategy in empirical applications. We follow these guidelines and use a re-centering process, i.e. we control for the random average exposure of trade partners, based on unobservables. In formal terms, we have computed a set of 20 random counterfactual country-product-year level demand shocks, replicating the average distribution of the observed demand shocks. Armed with these 20 random shifts, we combined them with the observed weights, creating a set of 20 counterfactual instruments (i.e. country-specific trade shifts). We thus computed an average exposure of exporters to foreign shocks, out of random shocks. Following the idea in Borusyak and Hull (2020), this average instrument should capture the differential (and potential non-random) exposure of the country to random shocks.

We include this average instrument (only for exports) in the second-stage estimation. Results are presented in Table C.3. Overall, controlling for the average, random exposure of firms to foreign shocks, we obtain close estimates compared to baseline results. Then, we also do not estimate a significant impact of the correction we implement here regarding the import channel. Our instruments thus do a good job at capturing the demand shifts abroad, without being contaminated by non-random exposure to these demand shifts.

Table C.3: Controlling for the average instrument

	Dep. Variable: log Climate Aid, (ln Aid_{ijt})				
	(1)	(2)	(3)	(4)	(5)
Exports	0.102**	0.175**	0.122***	0.209***	0.167***
	(0.048)	(0.078)	(0.052)	(0.065)	(0.069)
Imports	0.026	0.012	0.024	0.045	0.038
	(0.041)	(0.044)	(0.043)	(0.047)	(0.047)
Distance	-0.811***	-0.841***	-0.873***	-0.818***	-0.867***
	(0.196)	(0.207)	(0.212)	(0.196)	(0.201)
Colony	1.035***	0.947***	0.945***	1.016***	1.003***
	(0.232)	(0.243)	(0.245)	(0.243)	(0.244)
UN Vote Simi.	1.355***	1.345***	1.002**	1.504***	1.556**
	(0.257)	(0.265)	(0.416)	(0.304)	(0.667)
Donor GDP	2.095***	1.928***		2.250***	
	(0.257)	(0.268)		(0.272)	
Recip. GDP	0.122	0.069	0.082		
	(0.215)	(0.223)	(0.216)		
Recip. Pop.	2.640***	2.834***	2.840***		
	(0.704)	(0.776)	(0.745)		
Mean Shock	0.124	0.125	0.154*	0.137	0.172*
	(0.082)	(0.086)	(0.087)	(0.089)	(0.092)
WGI		2.369***	2.188***		
		(0.707)	(0.699)		
Vulnera. GAIN		-3.988**	-3.191*		
		(1.743)	(1.646)		
Recip. GHG		0.121	0.123		
		(0.109)	(0.106)		
Observations	9764	8608	8594	9560	9544
R^2	0.068	0.064	0.059	0.074	0.067
K.P. Wald F-stat.	85.211	75.160	75.442	103.749	101.816
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table D.1: Selection bias correction: initial stage

	Dep. Variable: Pr(Aid > 0)					
	(1)	(2)	(3)	(4)	(5)	(6)
ODA	0.123***	0.113***	0.087***	0.080***	2.932***	2.856***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.103)	(0.104)
Share Green	0.009***	0.009***			0.033***	0.035***
	(0.001)	(0.001)			(0.005)	(0.005)
UN. Vote Simi.		-0.000		-0.031**		-0.094
		(0.018)		(0.015)		(0.067)
Distance						0.044
						(0.039)
Colony						0.898***
						(0.088)
Constant	0.078***	0.088***	0.128***	0.126***	-3.978***	-4.371***
	(0.004)	(0.008)	(0.003)	(0.007)	(0.107)	(0.363)
Observations	64064	59216	64064	59216	64064	59216
R^2	0.016	0.014	0.558	0.562		
AIC	19023.656	19356.902	6483.236	7216.401	37557.109	35848.979
Estimator	OLS	OLS	OLS	OLS	Probit	Probit
Fixed Effects	✓	✓	✓	✓		

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the country-pair level. All variables are in logs.

D Additional Results

Table D.2: Selection bias correction: second stage, IV results

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.212***	0.195***	0.223***	0.217***	0.235***
	(0.037)	(0.041)	(0.036)	(0.042)	(0.043)
Imports	0.013	0.001	0.012	0.011	0.004
	(0.021)	(0.023)	(0.021)	(0.025)	(0.025)
Distance	-0.821***	-0.827***	-0.830***	-0.882***	-0.867***
	(0.124)	(0.132)	(0.127)	(0.137)	(0.144)
Colony	0.987***	0.893***	0.930***	1.014***	0.950***
	(0.185)	(0.195)	(0.181)	(0.203)	(0.201)
UN Vote Simi.	1.273***	1.251***	0.920***	1.544***	1.600**
	(0.238)	(0.246)	(0.329)	(0.298)	(0.631)
Donor GDP	2.198***	2.084***		2.326***	
	(0.254)	(0.265)		(0.267)	
Recip. GDP	0.002	-0.027			
	(0.181)	(0.193)			
Recip. Pop.	2.715***	2.779***			
	(0.661)	(0.743)			
Inv. Mills Ratio	-0.763***	-0.565***	-0.882***	-0.654***	-0.821***
	(0.177)	(0.181)	(0.204)	(0.210)	(0.261)
WGI		1.976***			
		(0.667)			
Vulnera. GAIN		-3.969**			
		(1.604)			
Recip. GHG		0.102			
		(0.100)			
Observations	10559	9215	10650	10412	10397
R^2	0.071	0.065	0.066	0.076	0.072
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Rec. Cluster	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the country-pair level. All variables are in logs.

Table D.3: IV: main results, second stage – Alternative clustering level

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Exports	0.295***	0.284***	0.259***	0.300***	0.279***
	(0.063)	(0.066)	(0.059)	(0.065)	(0.064)
Imports	0.020	0.006	0.019	0.041	0.029
	(0.030)	(0.033)	(0.029)	(0.033)	(0.032)
Distance	-0.692***	-0.700***	-0.741***	-0.713***	-0.749***
	(0.118)	(0.127)	(0.112)	(0.123)	(0.121)
Colony	0.956***	0.850***	0.953***	0.970***	0.942***
	(0.190)	(0.197)	(0.183)	(0.200)	(0.196)
UN Vote Simi.	1.262***	1.255***	0.887***	1.531***	1.604***
	(0.301)	(0.313)	(0.281)	(0.373)	(0.501)
Donor GDP	2.157***	2.038***		2.298***	
	(0.499)	(0.529)		(0.509)	
Recip. GDP	0.017	-0.046			
	(0.152)	(0.160)			
Recip. Pop.	3.075***	3.263***			
	(0.554)	(0.649)			
WGI		2.084***			
		(0.649)			
Vulnera. GAIN		-3.924***			
		(1.350)			
Recip. GHG		0.151*			
		(0.083)			
Observations	10542	9269	10601	10344	10327
R^2	0.073	0.068	0.067	0.080	0.076
K.P. Wald F-stat.	593.101	504.709	562.926	699.358	678.155
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Yr. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the donor-year level. All variables are in logs.

Table D.4: IV: first-stage results – Alternative clustering level

	Dep. Variable: log Exports				
	(1)	(2)	(3)	(4)	(5)
Predicted Exports	0.561***	0.550***	0.562***	0.622***	0.621***
	(0.016)	(0.018)	(0.017)	(0.017)	(0.018)
Predicted Imports	0.033***	0.034***	0.038***	0.038***	0.037***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Observations	10542	9269	10601	10344	10327
R^2					
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Yr. Cluster	✓	✓	✓	✓	✓

	Dep. Variable: log Imports				
	(1)	(2)	(3)	(4)	(5)
Predicted Exports	0.125***	0.124***	0.124***	0.122***	0.123***
	(0.020)	(0.019)	(0.020)	(0.021)	(0.021)
Predicted Imports	0.541***	0.535***	0.547***	0.559***	0.562***
	(0.012)	(0.013)	(0.012)	(0.013)	(0.014)
Observations	10542	9269	10601	10344	10327
R^2					
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Yr. Cluster	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard Errors are clustered at the donor-year level. All variables are in logs.

Table D.5: OLS: main results – Alternative clustering level

	Dep. Variable: log Aid				
	(1)	(2)	(3)	(4)	(5)
Distance	-0.772***	-0.789***	-0.760***	-0.809***	-0.773***
	(0.084)	(0.092)	(0.083)	(0.089)	(0.090)
Colony	0.974***	0.878***	0.914***	0.988***	0.916***
	(0.177)	(0.180)	(0.170)	(0.190)	(0.183)
UN Vote Simi.	1.240***	1.233***	0.931***	1.466***	1.535***
	(0.289)	(0.303)	(0.276)	(0.376)	(0.491)
Donor GDP	2.102***	1.925***		2.243***	
	(0.519)	(0.545)		(0.513)	
Recip. GDP	0.036	-0.019			
	(0.144)	(0.148)			
Recip. Pop.	2.652***	2.689***			
	(0.521)	(0.606)			
Exports	0.219***	0.207***	0.231***	0.230***	0.253***
	(0.029)	(0.033)	(0.027)	(0.033)	(0.032)
Imports	0.015	-0.001	0.017	0.018	0.013
	(0.016)	(0.017)	(0.015)	(0.018)	(0.017)
WGI		2.033***			
		(0.635)			
Vulnera. GAIN		-4.061***			
		(1.456)			
Recip. GHG		0.150*			
		(0.082)			
Observations	11180	9724	11274	11057	11042
R^2	0.069	0.064	0.064	0.074	0.070
Donor FE	✓	✓		✓	
Recipient FE	✓	✓	✓		
Year FE	✓	✓			
Donor-Year FE			✓		✓
Recipient-Year FE				✓	✓
Donor-Yr. Cluster	✓	✓	✓	✓	✓

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard Errors are clustered at the donor-year level. All variables are in logs.