DOES FOREIGN AID PROMOTE RECIPIENT EXPORTS?

by

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Abstract

This paper uses the gravity model of trade to investigate the effect of foreign aid on exports of aid recipients to donor countries. Most of the theoretical work emphasises the possible negative impact of aid on recipient countries' exports, primarily due to exchange rate appreciation, disregarding possible positive effects of aid in overcoming supply bottlenecks and promoting bilateral trade relations. Using non-stationary panel (cointegration) estimators to control for omitted variable and endogeneity bias, we find that the net effect of aid on recipient countries' exports is insignificant, both for our sample (of 123 countries) as a whole and for important regional sub-samples. This finding is in line with the small or insignificant macroeconomic impact of aid found in earlier studies and also suggests that exporters in recipient countries are not benefiting from improved trade relations with donors.

Key Words: International trade; Foreign aid; Recipient exports; Non-stationary panel data

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1. Introduction

Recent literature has shown that foreign aid is promoting exports from donor to recipient countries, with effects varying by donor and over time (for example, Martínez-Zarzoso et al. 2009, 2010; Nowak-Lehmann et al. 2009; Pettersson and Johansson 2012; Nelson and Juhasz Silva 2012; Zarin-Nejadan et al. 2008). While there are many reasons that could account for such an effect, one is that aid promotes overall bilateral trade between donor and recipient. In that case, the logical next question to ask is whether aid is indeed promoting the other side of that bilateral trade, i.e. exports from recipients to donors. That is the subject of this paper.

This is all the more important as promoting developing country exports is seen as one of the main ways for poor countries to grow and develop faster. Both the Doha Development Round and the UN declaration on the Millennium Development Goals (MDGs) emphasise the importance of improving trade in developing countries (DCs), especially in the least developed countries (LDCs). More specifically, Millennium Development Goal 8 (MDG8: "Develop a global partnership for development") is concerned with promoting a better participation of developing countries in international trade through improved access to developed countries' markets and an active improvement in production and export capabilities in developing countries by means of official development assistance (ODA), especially Aid for Trade (AfT) measures.[2] In this context, foreign aid is also seen as a means to alleviate the lack of net capital inflows to the least developed countries (LCDs) and to overcome severe supply-side constraints (physical and social infrastructure, insufficient capabilities in agriculture, manufacturing and services). It is therefore important to analyse

[2] AfT is part of ODA (about 20 percent by some estimates) and includes technical trade assistance, trade-related infrastructure and capacity-building to improve production and export capacities. The idea of giving AfT dates back to the Uruguay Round (1986-1994) and has become an important feature of world trade rounds, especially since the Sixth Ministerial Conference in Hong Kong in 2005. The original motivation was to grant AfT in return for the trade concessions made in trade liberalisation agreements (Cali and Te Velde, 2011).

whether aid is an appropriate means to promote the production of export goods and thus enhance export-led development, which in turn could decrease the aid-dependency of developing countries. As we will argue in Section 2, development aid may have both positive and negative effects on recipient countries' exports and it is up to empirical research to determine which prevail.

Last but not least, this issue is important because donors are becoming increasingly interested in aid effectiveness, having agreed on an increase in their aid-to-GDP ratio to 0.7 percent by 2015; if it served to actually promote the exports of recipient countries, aid would appear to be effective in this respect and the increase would be warranted.

All the more, it is surprising that empirical evidence on this issue is rather limited and has produced conflicting results. Most of the literature is actually focused on examining whether aid can promote overall exports. For example, Munemo et al. (2007) apply fixed-effect instrumental variable (FE-IV) estimators to a sample of 84 developing countries (unbalanced panel) and find a positive and significant relationship between aid and exports. However, in a sample of 72 recipient countries (balanced panel), this relationship becomes statistically insignificant. Kang et al. (2010) present results for 30 recipient countries utilising data for the period 1966-2002. Using a heterogeneous panel vector autoregression model, they find a positive relationship between aid and exports for 13 countries and a negative relationship for 17 countries. Brenton and von Uexkull (2009) study the effectiveness of export development programs by applying a difference-in-difference approach. They find evidence of a positive relationship between technical assistance for trade and developing countries' exports in the sense that trade assistance performs better if export activity is already strong, or that aid precedes or is correlated with a better export performance. Ferro, Portugal-Perez and Wilson (2011) find aid has a positive effect on services, in general, on downstream manufacturing exports of developing countries across regions and income-level groups.

More related to our work, Helble, Mann and Wilson (2012) examine the link between specific types of aid and bilateral trade flows, focusing on the link between aid spent on trade facilitation and recipients' exports to and imports from their trading partners using a gravity model. They find mixed evidence for aid effectiveness indicating that in general aid-for-trade facilitation is generally more related to higher exports and only weakly related to higher imports. With regard to other aid flows (different from aid-for-trade), Helble et al. (2012) find that this variable is negatively associated with recipients' exports and positively associated to their imports. Johansson and Pettersson (2009) and Pettersson and Johansson (2012) also use a gravity model and find a positive relationship between aid and recipient countries' exports. These authors use country fixed effects (importer-specific and exporter-specific effects) to control for unobserved heterogeneity and time fixed effects. Nonstationarity and autocorrelation are not taken into account, and endogeneity of aid is controlled for with instruments.

Our econometric analysis is also based on the gravity model. We use the usual control variables (Bergstrand 1985, 1989, 1990; Anderson and van Wincoop 2003; Nelson and Juhasz Silva 2012; Pettersson and Johansson 2012), but augment the model by bilateral exchange rates and three different types of foreign aid that are all measured on a bilateral level. The bilateral exchange rate is added to take changes in competitiveness between trading partners into account and the different types of aid are included to control for crowding-out effects between donors.

The most important difference in regard to previous studies is our endeavour to study the link between bilateral aid and bilateral trade more rigorously by accounting for unobserved heterogeneity more carefully. Our first and main contribution is thus to assure that changes in recipients' bilateral trade can in fact be traced back to changes in bilateral aid. This is achieved by accounting for the role played by unobservable or unquantifiable characteristics that affect donor-recipient relations (bilateral relations). These bilateral

relations can be more or less visible and form the foundation of or become the catalyser for trade: bilateral aid can enhance bilateral trade not only through reputation, mutual trust and support, goodwill and familiarity between trading partners of the North and the South (Arvin and Baum 1997; Arvin and Choudry 1997; Pettersson and Johansson 2011, Nowak-Lehmann et al. 2009; Martínez-Zarzoso et al. 2009), but also through more visible outcomes, such as the creation of customer relations, distribution channels and a better adaptation to the formal and informal market environment. We account for the time-invariant component of these unobservable or unquantifiable characteristics (i) by utilising country-pair specific effects (dyadic effects) and (ii) by using panel cointegration techniques that control for omitted variable and endogeneity biases (see Section 2.2 and Section 4.1).[3] The dyadic effects contain not only the information inherent in the country-specific characteristics, but also information with respect to the importance of bilateral ties between donors and recipients that do not change over time. As bilateral aid varies over time, what we are able to identify with our estimation strategy is the effect of the within variation of aid on trade over time for each pair of countries.

The second contribution is to use panel time series estimation techniques that are based on the concept of cointegration. The cointegration technique addresses the spurious regression problem associated with the non-stationarity of many economic variables.[4] In addition, and equally important, cointegration estimators are robust to potential endogeneity or reverse causality problems and can account for autocorrelation. In fact, Granger causality tests indicate that, in the long run, aid stands in a bi-directional relationship with donors' exports, while it has a unidirectional relationship with recipient countries' exports. However, recipient countries' exports generate feed-back on other right-hand side variables other than

[3] We should point out that we are not examining the effect of aid on countries' total exports, but only to a particular donor. This is in line with the issue we wish to address (whether recipients benefit as much as donors from increased exports to each other), but we assume that it is able to shed light on the impact of aid on total exports (although we are unable to test this assumption using our approach here).

[4] The spurious regression problem can also arise in panels when dealing with non-stationary variables. Entorf (1997) and Kao (1999) demonstrate that the tendency for spuriously indicating a relationship may even be stronger in panel data regressions than in pure time series regressions.

aid (such as donors' income, recipients' income, recipients' per capita income) thus creating an endogeneity problem. By taking the time series properties into account and by applying the Dynamic Ordinary Least Squares (DOLS) technique to our cointegrated series, we are able to "exogenise" all right-hand side variables. Control for omitted variable and endogeneity bias plus autocorrelation is achieved through the Dynamic Feasible Generalised Least Squares (DFGLS) procedure (see Section 4.1).

Our third contribution is to examine crowding-out effects between different types of aid. More specifically, we investigate whether aid only promotes imports from a given donor at the expense of other donors, or whether it promotes overall trade. This is done by considering three different types of aid: first, the bilateral aid of a single donor-recipient pair with a supposedly very high positive impact on bilateral trade relations; second, bilateral aid from the rest of the donors to a single recipient with a possibly trade-diverting (negative) impact on an existing bilateral trade relation, and third, multilateral aid to a single recipient with presumably no impact on existing bilateral trade relations.

Using panel cointegration techniques that account for unobserved heterogeneity and control for endogeneity as well as for autocorrelation, we find that the effect of aid on recipient countries' exports is insignificant. We therefore conclude that after controlling for country-pair unobserved heterogeneity aid has no observable (net) effect on recipients' exports, at least during the sample period (1988-2007). Any positive effect of increased aid is apparently countered by negative effects related to the macro impact of aid on the recipient country. Further results are that aid impacts weakly, but positively on investment, negatively on domestic savings (crowding-out effect) and negatively on the real exchange rate (appreciation of the real exchange rate).

The remainder of this paper is organised into five sections. Section 2 discusses the model specification and the transmission channels related to the aid-export link. Section 3 presents a description of the data. Section 4 explains the estimation technique and discusses

the results. Section 5 presents a number of robustness checks. Finally, Section 6 outlines some conclusions.

2. Aid-export link: conceptual framework

2.1 Augmented gravity model of trade and model specification issues

In order to study the impact of foreign aid on exports, we will concentrate on net Official Development Assistance (ODA) and within this category on three types of aid (see equation 1 below): First, bilateral net ODA (aid) from a donor *i* to a recipient country *j (BAID)*, second, the sum of bilateral aid given by all donors (except *i*) to *j* (BAIDI) and third, multilateral aid *(MAID)* given by donor *i* to developing country *j* (which is the share country *j* receives approximately through a multilateral institution that is fuelled by donor country *i*; the donor remains unknown to the recipient and vice-versa). The idea of utilising *BAID*, *BAIDI* and *MAID* is the following: to the extent that aid improves the capacity of recipient countries to export (through relieving supply bottlenecks, providing key imported inputs and targeted aid-for-trade initiatives), we would expect all three indicators of aid to promote overall exports, and also a fortiori to the donor country. In addition, *BAID* is also intended to measure the importance of time-varying bilateral relations between country pairs *ij*. Therefore, the question is whether bilateral aid specifically promotes exports from recipient j to donor *i* (and not just overall exports) and the basis of the improved trade relationship between the two countries, which should strengthen the general effect of aid on exports to the donor country. *BAIDI* is intended to check whether other donors disturb an existing bilateral trade relationship between *ij*. Thus, while aid from other donors may promote overall exports (including exports to the specific donor *i*), it might particularly promote exports to the other donors, rather than to donor *i*, due to *their* bilateral trade and aid relationship (see Martínez-Zarzoso et al. 2010). *MAID* is intended to proxy the efficiency of aid in promoting overall exports in the absence of specific donor-recipient bilateral trade relations. As the volumes of

bilateral aid from other donors and multilateral aid are generally much larger (see Appendix Table A.1), BAIDI and MAID may also provide proxies for the possibly negative macro effects of large volumes of aid (see below).

It should be noted that, in contrast to the studies by Clemens et al. (2004), Helble, Man, and Wilson (2012), Pettersson and Johansson (2012) and Minoiu and Reddy (2010), who look at disaggregated forms of aid (development aid versus non-development aid, technical assistance, aid for trade etc.), we focus on aggregate aid. The main reason for doing so is that the literature on the impact of aid on donor exports also considers total aid, whereas we aim to investigate whether improved bilateral trade relations also promote recipient exports. In addition, we believe this will also shed some light on the export-promoting effects of different types of aid for several reasons. First, when comparing the coefficients of aggregate aid and disaggregated aid in Pettersson and Johansson (2012), it turns out that aggregate aid had an even greater impact on recipients' exports than disaggregated aid. Moreover, Rajan and Subramanian (2008) show in their aid effectiveness study that there are no significant differences between different types of aid (social, economic and food aid). Both social and economic aid had an insignificant impact on growth in all periods (1970-2000; 1980-2000; 1990-2000), while food aid had a significant impact in only one period (the 1990-2000 period). Aside from these empirical findings, one would expect all types of aid to have a similar effect in the long term, especially as aid is fungible (Morrissey 2006).

We study the aid-export relationship within the framework of the gravity model, which has been developed in the past three decades by Anderson (1979), Bergstrand (1985, 1989 and 1990), Helpman (1987), Deardorff (1998), Feenstra et al. (2001), Anderson and van Wincoop 2003, Feenstra (2004), Haveman and Hummels (2004) and Redding and Venables (2004). Using the gravity model of trade we are able to evaluate and quantify the impact of aid on exports controlling for a variety of factors related to trade frictions, the business cycle, level of development etc. Anderson and van Wincoop (AvW) (2003) contributed to this

literature by modelling trade costs. The AvW model has been recently extended to applications explicitly involving developed and less developed countries by Nelson and Juhasz Silva (2012). They present an extension of AvW to the asymmetric north-south case and derive some implications related to the effect of aid on trade.

According to the underlying theory of the gravity model, trade between two countries is explained by nominal incomes and the populations of the trading countries by the distance between the economic centres of the exporter and importer and by a number of trade impediment and facilitation variables. Dummy variables such as former colony, common language and common border are generally used as proxies for these factors. The gravity model has been widely used to investigate the role played by specific policy or geographical variables in explaining bilateral trade flows. Consistent with this approach, and in order to investigate the effect of development aid on recipient countries' exports, we augment the traditional model with bilateral exchange rates, bilateral aid (ODA), from a specific donor and the rest of the donors to a recipient country and with imputed multilateral aid. The augmented gravity model is thus specified as follows:

$$X_{ijt} = \alpha_0 \; YD_{it}^{\alpha_1} YR_{jt}^{\alpha_2} YHD_{it}^{\alpha_3} YHR_{jt}^{\alpha_4} DIST_{ij}^{\alpha_5} \\ BAID_{ijt}^{\alpha_6} BAIDI_{jt}^{\alpha_7} MAID_{ijt}^{\alpha_8} \; XCHR_{ijt}^{\alpha_9} \exp F_{ij}^{a} \; u_{ijt} \qquad (1)$$

where t stands for year, X_{ijt} are the exports to donor i from recipient j in period t in current US$; YD_{it} (YR_{jt}) indicates the GDP[5] of the donor (recipient), YHD_{it} (YHR_{jt}) are donor (recipient) GDP per capita and $DIST_{ij}$ is the geographical distance between countries i and j. $BAID_{ijt}$ is bilateral net official development aid from donor i to country j in current US$. The variable $BAIDI_{jt}$ is bilateral net ODA from all the other donors (excluding i) to recipient j and $MAID_{ijt}$ is imputed multilateral development aid from donor i to country j in current US$. The

[5] We utilise GDP rather than GNP in order to avoid counting income received by third countries (international transfer payments, such as aid) twice.

variable $XCHR_{ijt}$ denotes nominal bilateral exchange rates[6] in units of local currency of country *i* (donor) per unit of currency in country *j* (recipient) in year *t* (indexed so that XCHR = 100 in base year 2000). Finally, F_{ij} denotes other factors impeding or facilitating trade (for example, former colony (*FORMCOL*), common language (*COMLANG*), or a common border (*COMBORD*)), which are 0-1 variables. The term "Exp" stands for exponential. Taking the natural logarithm of exp F_{ij}^{a} thus results in aF_{ij}. The model will be estimated for data on 21 donor and 123 recipient countries[7] over the period from 1988 to 2007.

In Equation 2, time fixed and country-pair fixed effects (dyadic effects) are incorporated. Taking logarithms, the basic specification of the gravity model is:

$$\begin{aligned} LX_{ijt} &= \gamma_0 + (\phi_t) + \delta_{ij} + \alpha_1 LYD_{it} + \alpha_2 LYR_{jt} + \alpha_3 LYHD_{it} + \alpha_4 LYHR_{jt} + \\ &\alpha_5 LDIST_{ij} + \alpha_6 LBAID_{ijt} + \alpha_7 LBAIDI_{jt} + \alpha_8 LMAID_{ijt} + \alpha_9 LXCHR_{ijt} + \\ &\alpha_{10} FORMCOL_{ij} + \alpha_{11} COMLANG_{ij} + \alpha_{12} COMBORD_{ij} + u_{ijt} \end{aligned} \tag{2}$$

where *L* denotes variables in natural logs and ϕ_t are time dummies to control for common time effects (later on in our estimations we will drop the time dummies, as time fixed effects and Feasible Generalised Least Squares (FGLS) routines are not compatible. If trading-partner (dyadic) fixed effects, δ_{ij}, which proxy for time-invariant characteristics in the relationship between *i* and *j* are included, the variables *LDIST*, *FORMCOL*, *COMLANG* and *COMBORD* and *LDIST* are dropped from the equation. It is well known that when these effects are included, the influence of variables that are time invariant cannot be directly estimated (due to perfect collinearity). This would be the case for distance, colony, common language and contiguity in a dyadic effects model of bilateral trade.

[6] When the gravity model is estimated using panel data, it is recommended to also add bilateral exchange rates as a control variable (Carrère, 2006).

[7] We started with 130 recipient countries, but 7 countries were dropped from the analysis by the statistical application due to missing data.

As regards the best specification of the gravity model, there is a discourse on whether it is more appropriate to use country-pair/dyadic effects (δ_{ij}) or exporter-specific (δ_i) and importer-specific effects (δ_j). According to Cheng and Wall (2005), the specification with trading partner fixed effects (dyadic effects) is superior (in terms of bias and efficiency of the estimates) compared to the specification with importer and exporter-specific effects (recommended by Mátyás (1997)). This is due to the higher information content of the data matrix containing the country pair-dummies.[8] Combining both dyadic and importer and exporter-specific fixed effects would lead to perfect collinearity and the elimination of country-specific dummies.

With respect to the utilisation of time fixed effects, it must be emphasised that including time fixed effects does not solve the potential problem of autocorrelation (see Table 1, column 3) and that other procedures, which will be described in section 4.1, are better able to pick up those effects (see Table 1, column 4).

2.2 The issue of omitted variables

While it is possible to study the "prima facie" impact of foreign aid on exports by means of export equations based on an augmented gravity model (treating aid as an income transfer or as a temporary increase in income), it is not possible to identify the transmission channels from development aid to bilateral exports within this framework or to incorporate all the possible variables into a regression equation.

Therefore, we must check whether ignoring these omitted variables (which might include transmission channels) will bias our estimates. An interesting question in this sense is whether we will still be able to measure the impact of bilateral aid (and its covariates) correctly if we leave out unquantifiable or unobservable variables, such as bilateral trade

[8] In our case it is a 51660 x 2583 matrix (a new dummy-vector is created for each country pair thus 2583 dummy vectors are created). In contrast, the importer-dummy matrix is a 51660 x 21 matrix (each pair with the same donor obtains the value 1; thus 21 dummy vectors are created) and the exporter-dummy matrix is a 51660 x 123 matrix (each pair with the same recipient obtains the value 1; thus 123 dummy vectors are created).

relations, trade costs, corruption pertaining to a trade link etc - the classic problem of omitted variables. Omitted variables can take two forms: (1) they can be time-invariant or; (2) they can vary over time.

If the omitted variables (for example bilateral trade relations) are time-invariant, their effect will be incorporated into δ_{ij}, the bilateral (country-pair) fixed effect. In this case, the regression coefficient on *LBAID* (α_6) is an unbiased estimate of the direct effect of bilateral aid on recipients' exports.

If the omitted variables vary over time (for example changing bilateral trade relations over time), the estimated coefficient on *LBAID* will correctly measure the effect of bilateral aid, if aid (and its covariates) and exports form a long-term or cointegrating relationship (see also Section 4.1). The intuition is that a regression containing all the variables of a cointegrating vector has a stationary error term, implying that no relevant non-stationary variables are omitted. Any omitted non-stationary variable that is part of the cointegrating relationship would become part of the error term, thereby producing non-stationary residuals and thus leading to a failure to detect cointegration. If there is cointegration between a set of variables, this stationary relationship also exists in an extended variable space. Adding further variables to the model may therefore result in further cointegrating relationships, which could be identified and estimated. The estimates of the original cointegrating equation, however, would not be significantly affected by the presence or absence of additional variables (Juselius, 2006).

The results of the pre-tests for unit roots and cointegration are reported in the Appendix (see Tables A2 and A3). They suggest that the variables are non-stationary and cointegrated, as implicitly assumed in Equation 2.

Of course, the above argument also applies to other possible transmission channels such as trade costs. As long as we a have a cointegrating relationship between aid (and its

covariates) and exports, the estimated coefficients do not change if this channel is omitted (even though the related literature emphasises the role of trade costs).[9] The contradicting views on whether trade costs have a significant negative impact on trade depend on whether or not a long-term perspective is taken.

2.3 Observable transmission channels from aid to total exports

In addition to the direct effects of bilateral aid on exports, there are macroeconomic transmission channels that can affect the relationship between aid and exports (Section 4.2.4). Even though these macroeconomic channels can be observed and quantified, their impact cannot be determined within the gravity model.

The gravity framework captures the effect of aid resulting in an income effect (which shows up in *LYR*, recipient country's income) and later in a production and export effect. Because part of the aid transfer will be consumed and part will be saved (savings effect) and invested (investment effect), one can expect a supply-side impact of aid-financed public expenditure (Adam and Bevan 2006). But at the same time, we must be aware of the possibility that aid crowds out domestic savings (Griffin, 1970; Griffin and Enos, 1970; White, 1992; Doucouliagos and Paldam, 2006). The opportunity to substitute private domestic savings with external savings is quite attractive for developing countries, as is the opportunity to substitute public revenue with external savings to get through the next elections (Heller 1975; Gang and Khan 1986; Mosley et al. 1987; Gang and Khan 1991; White, 1992).

[9] Trade costs were estimated to have an ad valorem tax equivalent of about 170% (with marked variation between countries and products), thus potentially having a strong trade impeding effect (Anderson and van Wincoop, 2004). More recently, the channel from aid (more specifically AfT) to trading costs has been studied by Calí and Te Velde (2011). They found a significant trade cost reducing effect of aid for trade facilitation. Ivanic, Mann and Wilson (2006) and Portugal-Perez and Wilson (2009) established a negative and significant relationship between bilateral trade costs and bilateral trade, which points to a functioning indirect channel between bilateral aid and bilateral trade supposedly driven by the impact of aid on trade costs. The contradicting views on trade costs might have to do with the long-term perspective that we take, but other papers do not. If aid (and its covariates) and exports are in a long-run relationship (as in our case), including trade costs will not change our long-term estimates. This is compatible with trade costs having a significant impact on trade in the short to medium term.

The demand-side effect of aid (Dutch disease effect) is partly[10] reflected in the bilateral nominal exchange rate, which enters the gravity model as a control variable. The Dutch disease effect, i.e. the appreciation of the real exchange rate, is caused by net capital inflows in general and development aid in particular (Rajan and Subramanian, 2005 & 2011) and results in an anti-export bias that arises in the short term (Adam and Bevan 2006). The real appreciation of the exchange rate hurts the producers of export and import substitution goods, but makes the production of non-tradables relatively more profitable. Therefore, in the medium to long term, resources will flow into the non-tradable sector and this sector will expand. As imports become cheaper, imports will rise, which will lead to trade deficits and cause a pro-import bias. Spending development aid on imports (preferably on capital and intermediate goods) will partly reverse this appreciation effect. The effect of development aid on the real economy therefore depends on the amount of development aid (capital inflow) and the share that is spent on tradables (imports) and non-tradables (transport, construction, telecommunication, energy). However, we must bear in mind that prudent exchange rate management in the recipient country can crucially influence the real exchange rate and neutralise any effect aid might have on appreciation.

These transmission channels all relate, directly or indirectly, to the impact of aid on incomes. Even the more recent empirical evidence on the impact of aid on growth is still mixed, such that the aid research community remains polarised (McGillivray et al. 2006). Arndt et al. (2010), applying a causal effects model to cross-section data, find a clearly positive and significant impact of aid on growth. They carefully instrument for aid and distinguish between treatment and control groups. However, omitted variables cannot be fully controlled for in cross-country regressions (especially if they are effectively unobservable). Other recent studies on the growth effect of aid suggest that the impact of aid on economic development turns out to be insignificant if the time series properties of the variables are

[10] This effect only shows up in a flexible exchange rate system.

taken into account and if adequate panel techniques are used (see Nowak-Lehmann D. et al. 2012). The non-existence of a statistically significant relationship is corroborated by Doucouliagos and Paldam (2005, 2008, and 2010) who conducted several meta analyses of a large number of aid effectiveness studies, and through a multitude of regressions which were run with great care over different samples, different time horizons, different time periods and utilising different types of aid (Rajan and Subramanian, 2008). In view of this literature, we do not expect these transmission channels to have a strong overall effect, as they would presumably also show up in a significant effect of aid on income. However, studying the details of the transmission channels is still very useful to understand how they operate and affect the aid-export linkage.

3. Description of data sources and data on aid

3.1 Data sources

Official Development Aid data are from the OECD Development Database on Aid from DAC Members. We consider net ODA disbursements in current US$[11], instead of aid commitments, because we are interested in the funds actually released to the recipient countries in a given year. Disbursements record the actual international transfer of financial resources, or the transfer of goods or services valued at the cost to the donor.

The original member countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Bilateral exports are obtained from the OECD online database (International Trade and Balance of Payments Statistics). Data on income and population variables are drawn from the World Bank (World Development Indicators Database, 2009). Bilateral exchange rates are from the IMF statistics, which have been corrected for the introduction of the euro and

[11] The gross amount comprises total grants and concessional loans granted (according to DAC criteria for concessional loans).

currency reforms in the recipient countries[12]. Distances between capitals have been computed as great-circle distances using data on straight-line distances in kilometres, latitudes and longitudes. They are from the CIA World Fact Book. Trade impeding or promoting factors such as being a former colony and sharing a common language or a common border are taken from the CEPII data base[13]. Data on the transmission channels are from the World Bank (World Development Indicators Database, 2009).

3.2 Net ODA, our measure of aid

Aid given by Development Assistance Committee (DAC) members is reported as official development aid (ODA) and other official flows (OOF). OOF are other official transactions that do not meet ODA criteria[14] and are therefore disregarded in our analysis.

The aid data contains bilateral transactions as well multilateral contributions. The former are undertaken by a donor country directly with an aid recipient and the latter are contributions made by international agencies and organisations that are allocated pro rata to recipient countries (see below).

Total net ODA disbursements, the aid data we will work with, are the sum of grants, capital subscriptions, total net loans and other long-term capital. Grants include debt forgiveness and interest subsidies in associated financing packages. Capital subscriptions to multilateral organisations are made in the form of notes and similar instruments unconditionally convertible at sight by recipient institutions. Loans and other long-term capital include the total disbursements of ODA loans and equity investment. Total net loans

[12] The IFS and WDI statistics are not adjusted for currency reforms and therefore very problematic. We corrected the data accordingly.

[13] http://www.cepii.fr/anglaisgraph/bdd/fdi.html.

[14] For example, grants to aid recipients for representational or essentially commercial purposes, official bilateral transactions intended to promote development but with a grant element of less than 25 per cent or official bilateral transactions, whatever their grant element, that are primarily export-facilitating in purpose ("official direct export credits"). Net acquisitions by governments and central monetary institutions of securities issued by multilateral development banks at market terms, subsidies (grants) to the private sector to soften its credits to aid recipients and funds in support of private investment are also classified as OOF.

and other long-term capital represent the loans extended minus repayment received and offsetting entries for debt relief. Technical cooperation, development food aid and emergency aid are included in grants and gross loans.

Figure 1 shows the ratios of net ODA as a percentage of GDP ranked according to the relative amount received. It illustrates that countries involved in conflicts or civil wars (Congo, Rwanda, Mozambique, Bosnia-Herzegovina, Sierra Leone, and Afghanistan) or countries plagued by natural disasters (Nicaragua) received huge amounts of ODA in the 1988-2007 period. The majority of countries (not in the figure), however, show net ODA ratios of 5 percent or less.

[Figure 1 about here]

As indicated in Section 2, we work with bilateral ODA and multilateral aid (ODA) computed at bilateral level. Multilateral aid, in the sense of multilateral contributions of international agencies and organisations (also part of ODA), can be imputed back to the funders of those bodies. The OECD uses a specific methodology that we briefly explain (OECD, 2008). The approach will vary depending on whether the intention is to show the share of the receipts of a given recipient attributable to a particular donor, or the share of a given donor's outflows that can be assigned to an individual recipient. As DAC statistics are primarily designed to measure donor effort, the second approach is taken in DAC statistical presentations. First, we calculate the percentage of total annual gross disbursements of each multilateral agency that each recipient country receives. This calculation is carried out only in regard to agency disbursements of grants or concessional (ODA) loans from core resources. Then, the recipient percentages derived in the first step are multiplied by a donor's contribution in the same year to the core resources of the agency concerned to arrive at the imputed flow from that donor to each recipient.[15] This calculation is repeated for each

[15] For example: In a given year, WFP provides 10% of its disbursements from core resources to Sudan. Donor A contributes USD 50 million to WFP core resources in the same year. Donor A's imputed multilateral ODA to Sudan through WFP is 0.1*50million = USD 5 million.

multilateral agency. The results from the second step for all agencies are summed to obtain the total imputed multilateral aid from each donor to each recipient country.

4. Estimation issues and main results

4.1 Estimation issues

The estimation techniques used in this study are based on the concept of cointegration. In order to work within a cointegration framework, it is necessary to check the time series and cointegration properties of the variables. In our case, we find that all variables in the regression are non-stationary [I(1)], while the error term, which contains all (redundant) omitted variables, is stationary [I(0)], implying that our variables are cointegrated (see Tables A2 and A3 in the appendix). As discussed above, the finding of cointegration is important for two reasons: First, the existence of a stationary error term implies that the relationship is not spurious. Second, as the cointegration property is invariant to extensions of the information set, estimates will not be significantly affected by the presence of additional variables.

As our data consists of a time span of a maximum of 20 years and a cross-section of 123 countries, we also test for the presence of autocorrelation and heteroskedasticity. The results of the Wooldridge test for autocorrelation in panel data and the LR test for heteroskedasticity indicate that the data suffer from both problems. Given the strong rejection of the null in both tests, the model is estimated by FGLS controlling for autocorrelation and by applying heteroskedasticity corrected standard errors.

In a first step, the long-term model is estimated using Dynamic Ordinary Least Squares (DOLS). The DOLS procedure (used throughout the paper) dates back to Saikkonen (1991) and Stock and Watson (1993) and involves augmenting the cointegrating regression with leads, lags and contemporaneous values of the first differences of the regressors to control for the endogenous feedback effects of all regressors (Wooldridge, 2009). Thus, an important feature of the DOLS procedure is that it generates unbiased estimates for variables

that cointegrate even with endogenous regressors. The panel DOLS regression is given by (see, for example, Kao and Chiang 2000):

$$LX_{ijt} = \gamma_0 + (\phi_t) + \delta_{ij} + \alpha_1 LYD_{it} + \alpha_2 LYR_{jt} + \alpha_3 LYHD_{it} + \alpha_4 LYHR_{jt} + \alpha_5 LDIST_{ij} + \alpha_6 LBAID_{ijt} + \alpha_7 LBAIDI_{jt} + \alpha_8 LMAID_{ijt} + \alpha_9 LXCHR_{ijt} + \sum_{p=-2}^{p=+2} \theta_{1p} \Delta LYD_{ijt-p} + ... + \sum_{p=-2}^{p=+2} \theta_{kp} \Delta LXCHR_{ijt-p} + \eta_{ijt} \quad (3)$$

where $\theta_{1p} \ldots \theta_{kp}$ are the coefficients of the lead and lag differences that account for endogeneity. In fact, Table A4 in the appendix shows that there is evidence of reverse causality for 3 out of 9 variables in the recipients' exports equation and for 5 out of 9 variables in the donors' exports equation,[16] implying that it is important to deal with this endogeneity problem (using DOLS).

Individual country-pair effects (dyadic effects, δ_{ij}) are assumed to be fixed and are considered as unobserved heterogeneous effects across trading partners. They are assumed to be constant over time and also act as proxies for the so-called "multilateral resistance" factors modelled by Anderson and van Wincoop (2003). δ_{ij} stands for the autonomous rise or fall in exports to donor countries through time-invariant factors that characterise the bilateral donor-recipient relationship.

As we also control for autocorrelation in the errors (Table 1, column 4) by integrating a FGLS procedure into the DOLS procedure, we estimate the model using a panel dynamic feasible generalised least squares (DFGLS) procedure. This procedure involves the following steps: After the model has been estimated via DOLS (first step), the residuals are saved and the autocorrelation coefficient ρ of the residuals is estimated using $u^*_{ijt} = u_{ijt} - \rho u_{ijt-1}$. The

[16] Bilateral aid (LBAID) was found to be exogenous in the recipients' export equation, but endogenous in the donors' export equation.

estimated $\hat{\rho}$ is then used to transform all right and left-hand side variables into soft or quasi first differences (e.g. $LX_t^* = LX_t - \hat{\rho}LX_{t-1}$; $LYD_t^* = LYD_t - \hat{\rho}LYD_{t-1}$; … $LBAID_t^* = LBAID_t - \hat{\rho}LBAID_{t-1}$; ….) . In a second step, equation (3) is re-estimated by replacing the original variables with the soft differences.

4.2. Main results

4.2.1 Findings for recipient countries' exports

Table 1 presents the estimation results for different model specifications and reports the estimates that are relevant in the long term for the full sample of 123 recipient countries. Prior to discussing the results, it is worth noting that different model specifications (common intercept, exporter and importer fixed effects, time fixed effects, dyadic effects) lead to very different results even when endogeneity is controlled for.

The impact of bilateral aid is positive and significant both in the pooled model with a common intercept (column 1) and the model with importer and exporter specific effects (column 2). However, the common intercept model does not account at all for time-invariant unobserved heterogeneity, while the model with exporter and importer fixed effects accounts for importer and exporter-specific omitted variables, but is unable to capture bilateral relations, as discussed above.

Using country pair fixed effects estimation (also to control for time-invariant unobserved bilateral effects), the effect of bilateral aid becomes insignificant, as can be seen in columns 3 and 4. If time fixed effects are used (column 3) instead of a Feasible Generalised Least Squares procedure (column 4), autocorrelation persists, the Durbin-Watson statistic being 1.21. The DFGLS estimation presented in column 4, in contrast, is able to eliminate autocorrelation. The Durbin-Watson statistic increases to 2.01.

As far as the model specification is concerned, the country-pair (dyadic) effects model is a more general formulation of the gravity equation than the model with exporter and importer fixed effects (Cheng and Wall 2005) and therefore superior in terms of bias and efficiency. The comparison of the estimates produced under different model specifications demonstrates how small changes in model specification can affect the results, especially with respect to our variable of interest (bilateral aid). This is not a minor issue as empirical studies based on importer and exporter-specific and time fixed effects have obtained opposing results, namely that bilateral aid seems to have a positive and significant impact on recipient country exports (Pettersson and Johansson, 2012).

In summary, the estimations presented in column 4 are the "first best" results produced with an estimation technique that uses the most informative matrix concerning the dummy variables and controls for endogeneity, omitted variable bias and autocorrelation. We therefore discuss the results in column 4 in more detail.

[Table 1 about here]

Bilateral aid given by other donors (*LBAIDI*) has a negative and significant effect on the exports of a specific donor-recipient pair and therefore reduces the effect of bilateral aid on a specific recipient country. These findings are to a certain extent puzzling. If an increase in aid does not lead to more exports to donor *i*, how can aid given by other donors reduce exports to donor *i*? Clearly this cannot logically be due to the fact that other countries' bilateral aid promotes exports to these other countries, i.e. crowding-out effects could only really apply if aid had an impact on recipient exports, which we do not find. Instead, bilateral aid from others might have a negative effect due to trade diversion. A larger inflow of aid from other donors (measured by *LBAIDI*) could result in a negative coefficient if trade increased with third-party trade partners (e.g. China and India) that are not donors themselves, reducing existing bilateral trade to donor *i*.

Multilateral aid given by international organisations (*LMAID*) has an insignificant impact on recipient countries' exports. Trying different types of multilateral aid, including considering the total amount of multilateral aid received[17], or leaving out this variable, does not change the results. We therefore conclude that it is important to control for the trade diverting effect of *LBAIDI*, but not for the role played by multilateral aid.

Most of the other variables have the expected sign and are statistically significant. The coefficients of donors' and recipients' income are positive and significant and around the theoretical value of unity. The coefficient of donors' income per capita is negative and statistically significant at the 1 percent level (signalling the Engel curve effect), whereas the coefficient of recipients' income per capita is positive and statistically significant at the 1 percent level. The impact of the bilateral nominal exchange rate is positive and significant. One would have expected a negative sign, implying that an increase or appreciation of the recipient country's currency reduces recipient countries' exports to the respective donor country. However, appreciation of a recipient country's currency might have also led to an expansion of the production of non-tradables (telecommunications, gas, water, transport, construction) in the long term, thus supporting exports.

4.2.2 Findings for donors and recipients and for more recent periods: a comparison

Having found that bilateral aid has an insignificant impact on recipient countries' exports, it is worth verifying whether donors profit from giving aid, as reiterated in related studies. Indeed, the results produced by Pettersson and Johansson (2012) and Martínez-Zarzoso et al. (2010) point clearly in this direction: bilateral aid has a significant and positive impact on donors' exports, leading us to the conclusion that donors do profit from giving aid in terms of increased exports. Checking whether this previous result for donors' exports survives our

[17] We re-estimated the model using total multilateral aid (*LMAIDTOT*) received by each specific recipient (as suggested by an anonymous referee) and by dropping *LMAID*, the coefficient of *LMAIDTOT* being positive but not statistically significant at conventional levels. Results are available upon request.

estimation strategy based on leads and lags (DFGLS) and dyadic effects in the 1988-2007 period, we see that bilateral aid undoubtedly has a positive and significant impact on donors' exports. This is even the case when more recent periods are examined, despite the drastic reduction in tying of aid after 2002[18] (see Table 2, column 2). However, after 2005 the results turn insignificant, although they are based on a rather small number of observations and a poor Durbin-Watson statistic of about 4.

[Table 2 about here]

As it is sometimes argued that aid for trade facilitation (a component of ODA) has become more important in recipient countries and also more pronounced in later periods, we ask the converse question of how recipient countries' exports have responded in more recent years to aid flows. We re-run the regression for more recent periods (such as the 2002-2007 period) and observe that the coefficient of bilateral aid (*LBAID*) remains insignificant (Table 2, column 4). Bilateral aid has no influence on recipient countries' exports in later periods (after 2002) either.

4.2.3. Findings for Sub-Saharan Africa (SSA) & MENA, SSA, Asia and Latin America & the Caribbean

We further tested whether the results concerning recipients' exports were similar across different regions of the world. Our hypothesis that Africa including MENA and Sub-Saharan Africa would fare worse than Latin America or Asia found support in the data only if we did not control for bilateral fixed effects and autocorrelation of disturbances (results available upon request).[19] However, if we use our preferred dyadic-effects-DFGLS estimation method (Table 2, columns 1-4), bilateral aid has an insignificant impact on recipients' exports; thus our hypothesis above must be rejected. Our estimations (all controlling for endogeneity and

[18] Aid effectiveness became a major issue in 2002 at the International Conference on Financing for Development in Monterrey and paved the way for gradually giving up on the tying of aid.

[19] Nissanke and Thorbecke (2010) find evidence that the poor in Africa profited the least from globalisation. Latin America is somewhere in between and Asia showed the largest poverty reduction effect.

omitted variables via FGLS) contrast the findings of Pettersson and Johansson (2012), who observe a positive impact of aid on recipients' exports.[20] This divergence in findings seems to be mainly due to the use of dyadic effects (bilateral fixed effects) in our estimation, instead of donor fixed and recipient-fixed effects.[21] The leads and lags-approach controls for endogeneity in the right-hand side variables, avoiding omitted variable bias, and the FGLS-technique ensures that the estimates are unbiased and efficient. It is worth mentioning that the negative effect of other donors' giving aid is only significant and sizeable in Asia.

[Table 3 about here]

4.2.4. Is the macroeconomic impact of aid in line with our findings?

As for the transmission channels of aid on the macro-economy, economic theory indicated that development aid is associated with two different effects on exports. Firstly, an income effect, which will lead to an expansion of consumption and investment in the recipient country. Eventually, productive capacity will also increase in the sector of exportables and the additional supply of exportables will be absorbed by export markets (supply-side effect).[22] Secondly, the income effect will also increase the demand for non-tradables, thus leading to an appreciation of the exchange rate if this is not impeded by strategic exchange rate management on behalf of the recipient country's central bank (demand-side effect). In order to scrutinise the importance of macroeconomic transmission channels, we checked them separately (see Technical note in the Appendix).

The results (based on DFGLS) are summarised in Table 4. Using these estimates, it can be calculated that an increase in the aid-to-GDP ratio from 5% to 10% would lead to a 7%

[20] Johansson and Pettersson (2009) do not control for factors that have a bilateral component, such as the bilateral exchange rate and bilateral time-invariant relations. They do not mention the value of the Durbin-Watson statistic or discuss the results in the Appendix when aid was instrumented either.
[21] As outlined in Section 4.2.1.
[22] A developing country is considered a small country that is unable to influence prices in the world market and foreign demand is considered to be perfectly elastic.

increase in the investment-to-GDP ratio (for example from 15% to about to 16.05%) and a 15% decrease in the domestic savings-to-GDP ratio (for example from 10% to 8.5%). The total savings-to-GDP ratio, however, would increase from 10% to 13.5% (8.5%+5%), assuming other external savings to be zero. The real exchange rate would appreciate by 3.5% if the aid-to-GDP ratio increased by 10%.

[Table 4 about here]

Taken together, we find a small but significant and positive impact on investment and a small but significant negative impact on domestic savings and the real exchange rate. This leads us to conclude that the effect of bilateral aid on bilateral exports (in Table 1, column 4) is in line with the rather weak income effect of aid, i.e. a macroeconomic improvement in the recipient country's economy, which results in aid having an insignificant impact on recipients' exports. Note that these results can also partly account for the negative and significant effect of other donors' aid on exports to donor *i*. If other donors' large aid volumes contribute to an appreciation of the real exchange rate and lower domestic savings, this might depress overall exports as surmised above.

5. Robustness checks

We checked the robustness of the results by employing imports from donor countries (reported by importers as c.i.f. values) as the dependent variable (the mirror statistics to exports reported by exporters as f.o.b. values). The regression results basically did not change and remained robust when using dyadic fixed effects and controlling for endogeneity in the explanatory variables and for autocorrelation via Dynamic Feasible Generalised Least Squares (DFGLS).

We also used the two-stage Heckman procedure to tackle the zero trade flow problem and therefore to check for sample selection bias; zero trade flows affect about 20% of our bilateral data. Corruption in the recipient countries was considered to be an adequate selection

variable. The coefficient was negative (as a more corrupt environment is expected to reduce the probability of becoming an exporter) and significant in the selection equation (probit estimation (1^{st} stage)). The inverse mill ratio from the first-stage equation turned out to be insignificant in the second-stage estimation equation applying cointegration techniques and controlling for endogeneity and autocorrelation (see Table A5 in the appendix). Having established cointegration, it is justified to only estimate the main equation on the volume of recipients' exports with appropriate techniques. Non-significance of the variable that controls for selection bias (inverse mill ratio) is another motive that justifies skipping the first-stage probit estimation. One reason why the inverse mill ratio turns out to be insignificant could have to do with our improved control for omitted variable bias. As explained in earlier sections, the dyadic effect-DFGLS estimation contains two safeguard mechanisms against the omitted variable problem: First, a safeguard against time-invariant omitted variables (country-pair dummies) that generate dyadic effects; second, a safeguard in the form of cointegration and control for autocorrelation (DFGLS) against time-variant omitted variables. The latter absorbs time-variant omitted variables, such as corruption, trade costs etc. Interestingly, even studies where the sample selection bias was found to be statistically significant, e.g. Helpman et al. (2008), show that selection bias is economically negligible. This finding is corroborated by Pettersson and Johansson (2012).

6. Conclusions

Our empirical estimates measure the influence of bilateral aid on recipients' exports (donors' exports) in the 1998-2007 period, controlling for changes in GDP, per capita income, the exchange rate and crowding-out effects of other types of aid. As aid effectiveness and the tying of aid became major issues and even changed the culture of giving aid in more recent periods, the impact of aid has also been evaluated for the period 2002-2007.

In particular, the empirical analysis showed that the direct impact of bilateral development aid on recipient countries' bilateral exports is insignificant on average both in the 1988-2007 period and more recent periods, e.g. the 2002-2007 period. This finding is in line with the very small macroeconomic impact of development aid that we observed when investigating the impact of development aid on investment, domestic savings and the real exchange rate in recipient countries. Besides, we could not determine - using adequate estimation methods - whether development aid was more effective (in terms of recipients' exports) in Asia and Latin America & the Caribbean than in Sub-Saharan Africa & MENA. Donors' bilateral exports, in contrast, were positively and significantly affected by giving bilateral aid in the period 1988-2007. It appears that the impact of bilateral aid on donors' bilateral exports became insignificant from 2005 onwards, this finding being based on a poor Durbin-Watson statistic.

As regards the role played by omitted variables, such as bilateral trade agreements, trade costs or corruption (and possibly some others), our results indicate that these factors do not seem to influence the existing long-term aid-recipient countries' export relationship and that our estimates are therefore unbiased and consistent. Proper estimation is guaranteed through cointegration and our control for unobserved heterogeneity, endogeneity and autocorrelation. The fact that bilateral aid does not influence recipients' bilateral exports contrasts our initial belief that bilateral aid would enhance bilateral trade relations and thus bilateral trade over time, assuming a correlation between aid and trade relations. This assumption turned out not to be true for recipient exports. Therefore, all our findings taken together suggest that bilateral aid seems to have been effective in enhancing donors' bilateral exports, but ineffective as a direct promoter of recipient countries' bilateral exports. As we have shown in this paper, this might be due to the fact that any positive impacts that might operate via an increase in investment appear to be offset by the negative macro effects of aid on savings and the real exchange rate. Further analysing the precise transmission channels of

aid on recipient exports remains an urgent issue for further research that can then guide policy on how aid can be given in ways that promote recipient country exports.

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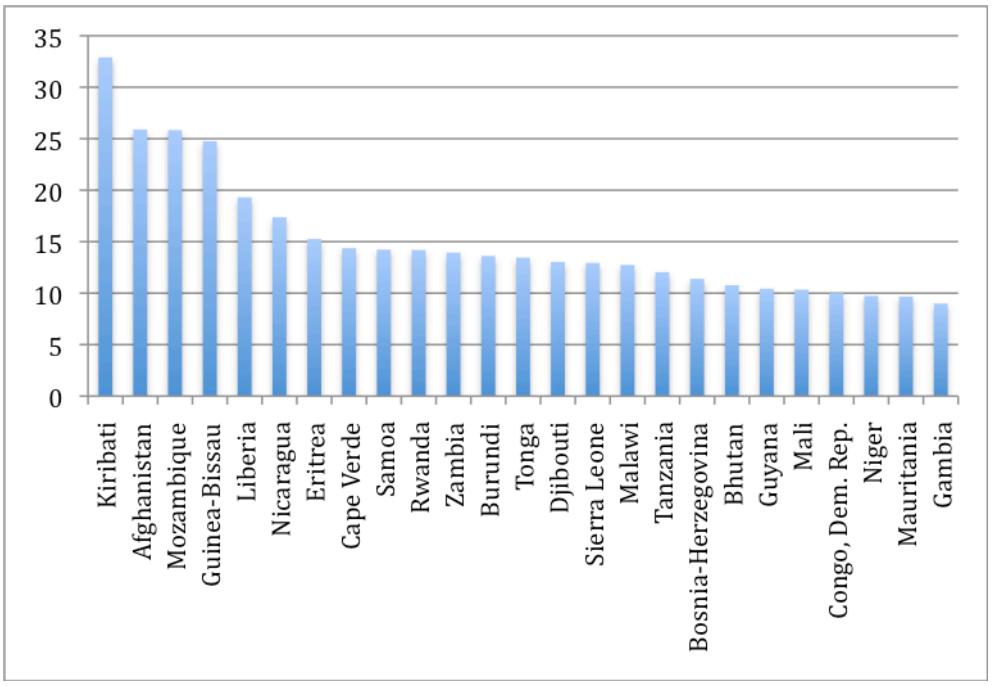
Figure 1. Net ODA as percentage of recipient countries GDP between 1988 and 2007 on average



Source: OECD; own calculations.

Table 1. Development aid and recipients' exports (all recipient countries)

Estimation technique	CI_TE_ DOLS (1)	X_M_TE_ DOLS (2)	Dyadic_FE_TE_ DOLS (3)	Dyadic_FE_ DFGLS (4)
LYD	0.96***	9.36***	0.07	0.70***
	(45.78)	(2.93)	(0.49)	(5.55)
LYR	1.15***	-1.53	0.27***	0.29***
	(72.23)	(-0.95)	(3.37)	(2.93)
LYHD	-1.62***	-10.51***	0.40	-0.56***
	(-12.07)	(-2.70)	(1.24)	(-2.85)
LYHR	0.32***	2.44	1.32***	1.10***
	(10.36)	(1.63)	(10.90)	(6.58)
LBAID	0.16***	0.09***	-0.002	0.003
	(14.63)	(5.00)	(-0.12)	(0.13)
LBAIDI	0.07***	-0.31***	-0.11***	-0.09**
	(3.14)	(-3.28)	(-3.18)	(-2.10)
LMAID	-0.001	-0.001***	0.001	0.0002
	(-1.01)	(-6.03)	(0.63)	(0.11)
LXCHR	0.07***	0.001	0.05***	0.05*
	(2.63)	(0.02)	(2.90)	(1.82)
Importer/exporter specific effects	no (common intercept)	yes	no	no
Dyadic effects	no	no	yes	yes
Leads and lags	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	no
Control for autocorrelation	no	no	no	yes
R-squared	0.61	0.77	0.91	0.93
N	14665	6615	14665	12558
Log-likelihood	-31481.64	-12313.3	-20796.35	-15913.56
Durbin- Watson stat.	0.29	0.40	1.21	2.01

Note: t-values in brackets. CI=common intercept; X=exporter-specific effect; M=importer-specific effect; TE=time fixed effect; Dyadic_FE=dyadic=country-pair fixed effect. Leads and lags are not reported in DOLS and DFGLS.

The variables LDIST, CONTIG, COMLANG and COLONY were estimated but not reported in columns 1 and 2.

The variables LDIST, CONTIG, COMLANG and COLONY were dropped from the analysis in the dyadic effects model. Importer-specific (21 donor countries) and exporter-specific (123 recipient countries) dummies are used in the model with country-specific effects; pair-specific dummies (2582 pairs) are used in the model with dyadic effects; time fixed effects and control for autocorrelation cannot be combined.

Columns 1, 3 and 4 were computed with EViews; Column 2 was computed by STATA.

Table 2. Development aid: Donor and recipient exports compared

Estimation technique	Dyadic_FE_ DFGLS Donor exports	Dyadic_FE_ DFGLS Donor exports	Dyadic_FE_ DFGLS Recipient exports	Dyadic_FE_ DFGLS Recipient exports
period	1988-2007	2002-2007	1988-2007	2002-2007
	(1)	(2)	(3)	(4)
LYD	0.21***	0.61***	0.70***	0.42
	(3.65)	(3.83)	(4.63)	(1.19)
LYR	0.67***	0.03	0.29**	0.96***
	(15.40)	(0.26)	(2.23)	(3.54)
LYHD	-0.24***	-0.47	-0.56**	-0.45
	(-2.73)	(-1.25)	(-2.24)	(-0.54)
LYHR	0.17**	1.22	1.10***	0.54
	(2.33)	(6.47)	(6.64)	(1.11)
LBAID	0.05***	0.06***	0.003	-0.04
	(5.81)	(3.36)	(0.13)	(-1.09)
LBAIDI	0.10***	0.18***	-0.09**	-0.10
	(4.98)	(5.22)	(-2.10)	(-1.06)
LMAID	-0.001	-0.003	0.0002	-0.002
	(-1.27)	(-1.95)	(0.11)	
LXCHR	0.01	0.31	0.05*	-0.13
	(0.61	(3.25)	(1.82)	(-0.56)
Dyadic effects	yes	yes	yes	yes
Leads and lags	yes	yes	yes	yes
Control for Autocorrelation	yes	yes	yes	yes
R-squared	0.96	0.97	0.93	0.94
N	21211	7648	12558	5174
Log likelihood	-16386.36	-4182.60	-15913.56	-6043.75
Durbin-Watson-Stat.	2.04	2.17	2.01	2.13

Note: t-values in brackets. Leads and lags are not reported.
The variables LDIST, CONTIG, COMLANG and COLONY were dropped from the analysis.

Table 3. Development aid and recipients' exports in different regions of the developing world

	Africa & MENA	Sub-Saharan Africa	Asia	Latin America & Caribbean
Estimation technique	Dyadic_FE-DFGLS	Dyadic_FE-DFGLS	Dyadic_FE-DFGLS	Dyadic_FE-DFGLS
	(1)	(2)	(3)	(4)
LYD	0.21	-0.08	0.77***	0.55*
	(0.74)	(-0.25)	(4.94	(1.86)
LYR	0.82***	1.06***	-0.37	0.20
	(3.46)	(3.89)	(-1.43)	(1.08)
LYHD	-1.13**	-1.50***	0.15	-0.53
	(-2.01)	(-2.78)	(0.54)	(-1.27)
LYHR	0.71*	1.35***	1.90***	1.50***
	(1.64)	(3.07)	(5.98)	(3.51)
LBAID	0.06	-0.03	-0.02	0.03
	(1.31)	(-0.70)	(-1.01)	(0.71)
LBAIDI	-0.12	-0.12	-0.25***	-0.04
	(-1.17)	(-1.06)	(-3.74)	(-0.50)
LMAID	0.01	0.00	0.00	-0.00
	(1.56)	(1.14)	(1.25)	(-0.59)
LXCHR	0.03	0.04	0.49***	0.03
	(0.52)	(0.71)	(5.66)	(0.60)
Dyadic effects	yes	yes	yes	yes
Leads and lags	yes	yes	yes	yes
Control for autocorrelation	yes	yes	yes	yes
R-squared	0.87	0.86	0.98	0.94
N	3734	3500	2605	3579
Log likelihood	-5527.76	-5425.30	-1401.35	-3835.54
Durbin-Watson-Stat.	2.05	2.05	1.87	1.96

Note: t-values in brackets. Leads and lags are not reported in DFGLS. The variables LDIST, CONTIG, COMLANG and COLONY were dropped from the analysis. Please note that time fixed effects and control for autocorrelation cannot be combined.

Table 4. Macroeconomic transmission channels (the long-term view)

	Investment channel (LINVY)	Savings channel (LDSY)	Real exchange rate channel (LXCHR)
Estimation technique	Panel DFGLS Eq. 5'	Panel DFGLS Eq. 6'	Panel DFGLS Eq. 7'
constant	1.97***	2.80***	6.01***
	(22.67)	(33.28)	(10.63)
LDSY	0.36***		
	(12.14)		
LEXTNSY	0.14***	-0.21***	-0.30**
	(9.21)	(-4.37)	(-2.04)
LAIDY	0.07***	-0.15***	-0.35**
	(3.39)	(-3.02)	(-2.08)
AR(1)	0.72***	0.47***	0.75***
	(22.15)	(13.84)	(22.48)
Leads and lags	yes	yes	yes
Fixed effects	yes	yes	yes
R^2	0.93	0.79	0.69
Durbin-Watson statistics	1.93	1.85	2.18

Note: t-values in brackets. DFGLS estimation is basically a DOLS estimation in which we correct for autocorrelation. All variables are in logarithms. INY=investment-to-GDP ratio; DSY=domestic savings-to-GDP ratio; XCHR=real exchange rate (increase stands for depreciation; XCHR=100 in the year 2000); EXTNSY=net external savings (minus ODA)-to-GDP ratio; AIDY=net ODA-to-GDP ratio. AR(1)=first-order autocorrelation of the disturbances.

APPENDIX

Table A1. Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
BAID	35003	2.21E+07	1.22E+08	-1.77E+07	1.12E+10
BAIDI	35003	3.85E+08	8.27E+08	-9520000	2.18E+10
MAID	46508	4.94E+09	1.43E+10	-5.53E+10	8.17E+11
X	26615	2.71E+08	1.83E+09	1	1.02E+11
M	36843	2.62E+08	1.98E+09	1	1.28E+11
XCHR	47250	118.9089	117.8249	0.0129694	2939.103
YD	51660	1.13E+12	2.05E+12	3.67E+10	1.38E+13
YR	49791	4.82E+10	1.66E+11	2.84E+07	3.38E+12
YHD	51660	24404.99	7330.851	9279.041	53432.5
YHR	47628	4738.044	7054.332	111.5047	64512.3
DIST	51660	7759.54	3791.68	270.6798	18953.23
LBAID	34921	14.49717	2.491744	9.21034	23.14166
LBAIDI	34983	5.083094	1.444329	-4.605338	9.991882
LMAID	46508	4.941066	14.30616	-55.34	816.63
LX	26615	15.54073	3.500141	0	25.34885
LM	36843	15.46038	3.423805	0	25.57454
LXCHR	49476	4.683498	1.122653	-4.345165	14.98787
LYD	51660	26.79275	1.315216	24.32498	30.25216
LYR	49791	22.65125	1.973622	17.16239	28.84957
LYHD	51660	10.05753	0.3025221	9.135513	10.88617
LYHR	47628	7.812596	1.125598	4.714067	11.07461
LDIST	51660	8.811403	0.5898773	5.600936	9.84973

Table A2. Results of the ADF-Fisher panel unit root test

Variable	Fisher statistic	*p*-value
LXDON	4656.36	1.00
LX(REC)	1348.87	1.00
LYD	1368.53	1.00
LYR	1061.61	1.00
LYHD	1008.35	1.00
LYHR	1109.81	1.00
LXCHR	4089.67	1.00
LBAID	2843.95	0.95
LBAIDI	2041.31	1.00
LMAID	2265.71	1.00

Note: The Fisher statistic proposed by Maddala and Wu (1999) is based on the *p*-values of the individual ADF tests. Under the null hypothesis of a unit root, it is distributed as chi-squared with $2 \times N$ degrees of freedom, where N is the number of cross-sections in the panel. LXDON=donors' exports; LX=LXREC=recipients' exports.

Table A3. Results of Kao's panel cointegration tests

Series in cointegration relationship: LX LYD LYR LYHD LYHR LXCHR LBAID LBAIDI LMAID		
DF rho-statistic	-37.57	(0.00)
DF t-statistic	-27.90	(0.00)
ADF *t*-statistic	-12.49	(0.00)
DF^* *rho*-statistic	-45.33	(0.00)
DF^* *t*-statistic	-10.68	(0.00)

Note: *p*-values in brackets. Kao (1999) presents four Dickey-Fuller (DF) test statistics and one augmented Dickey-Fuller (ADF) statistic. The first two DF statistics, DF *rho* and DF *t*, as well as the ADF statistic, assume strict exogeneity of the regressors, while the other two DF-type tests, DF^* *rho* and DF^* *t*, do not require this assumption. DF *rho* and DF^* *rho* are calculated on the basis of the estimated first-order autoregressive coefficient in the panel DF regression; the associated *t*-statistic is used in calculating the DF *t*- and DF^* *t*-statistics.

LXDON, LYD, LYR, LYHD, LYHR, LXCHR, LBAID, LBAIDI and LMAID were also cointegrated (p-value: 0.00).

Table A4. Testing for reverse causality: How do recipients' and donors' exports influence income, aid and the exchange rate?

	THE IMPACT OF RECIPIENTS' EXPORTS ON:							
	DLYD	DLYR	DLYHD	DLYHR	DLBAID	DLBAIDI	DLMAID	DLXCHR
DLXREC(-1)	-0.005	0.004	-0.0002	0.0008	-0.001	0.005	-0.12	0.005
	(-4.83)	(3.09)	(-0.58)	(1.74)	(-0.09)	(1.15)	(-0.75)	(1.44)
DLXREC(-2)	-0.004	0.001	0.0000	0.0000	-0.009	0.002	-0.02	0.004
	(-5.29)	(1.16)	(0.06)	(0.09)	(-0.96)	(0.59)	(-0.15)	(1.54)
ECT_{t-1}	0.006	-0.002	0.001	-0.001	-0.003	-0.01	0.29	-0.00
	(5.95)	(-1.35)	(1.74)	(-2.24)	(-0.22)	(-1.13)	(1.73)	(-0.19)
R^2	0.25	0.15	0.14	0.35	0.25	0.18	0.40	0.11
DW	1.96	2.02	2.10	2.13	2.10	2.14	2.04	2.20
	THE IMPACT OF DONORS' EXPORTS ON:							
	DLYD	DLYR	DLYHD	DLYHR	DLBAID	DLBAIDI	DLMAID	DLXCHR
DLXDON(-1)	-0.001	-0.001	0.0005	0.002	0.05	0.02	0.59	0.02
	(-1.13)	(-0.64)	(1.31)	(3.19)	(3.83)	(4.35)	(3.74)	(4.41)
DLXDON(-2)	0.003	0.003	0.0000	0.001	0.03	0.006	0.36	0.02
	(3.45)	(2.25)	(0.04)	(2.30)	(2.52)	(1.34)	(2.75)	(4.77)
ECT_{t-1}	0.004	0.01	-0.001	0.0001	-0.03	-0.01	-0.70	-0.01
	(4.16)	(5.35)	(-1.16)	(0.19)	(-2.10)	(-2.24)	(-4.21)	(-3.23)
R^2	0.18	0.11	0.12	0.22	0.20	0.13	0.36	0.10
DW	1.88	2.05	2.14	2.13	2.02	2.08	2.28	2.21

Note: Reverse causality of recipients' and donors' exports on the right-hand side variables of the original equations (LYD, LYR, LYHD, LYHR, LBAID, LBAIDI, LMAID and LXCHR) was tested. To this end, Granger causality equations were run in an error correction framework (panel vector error correction model (VECM) with variables in first differences and an ECT (error correction term). D stands for first difference. 2 lags were utilised. (-1) stands for a 1-year lag and (-2) stands for a 2-year lag. The Durbin-Watson statistic was always around 2. T-values are in brackets. The variables that are listed in columns are tested for endogeneity, i.e. DLYD = F (country-pair characteristics; DLYD(-1); DLYD(-2); DLXREC(-1); DLXREC(-2); other variables in first differences; ECT) ; DW=Durbin-Watson statistic. To save space, we only report coefficient values for DLXREC(-1), DLXREC(-2), DLXDON(-1) and DLXDON(-2).

Table A5. Development aid and recipients' exports (Heckman two-step procedure)

Estimation technique	1st step (Probit) Selection equation	2nd step (DFE_DFGLS) Main equation
	(1)	(2)
LYD	0.10***	0.94***
	(8.35)	(9.60)
LYR	0.16***	0.13*
	(14.81)	(1.78)
LYHD	-0.39***	-1.10***
	(-11.82)	(-7.54)
LYHR	-0.10***	1.40***
	(-5.40)	(10.99)
LBAID	-0.06***	-0.02
	(-8.55)	(-1.02)
LBAIDI	0.15***	-0.09***
	(10.58)	(-2.71)
LMAID	-0.009***	-0.001
	(-9.68)	(-0.40)
LXCHR	-0.09***	0.06***
	(-6.70)	(3.21)
Selection var.: Corruption	-0.12*** (-9.82)	---
IMILLS	----	-0.09 (-0.35)
Dyadic effects	---	yes
Leads and lags	yes	yes
Control for Autocorrelation	---	yes
R-squared	---	0.95
Pseudo R^2	0.07	
N	3527 (Dep=0) 15457 (Dep=1)	14074
Log likelihood	--8530.68	-14609.90
Durbin-Watson-Stat.	---	1.97

Note: t-values in brackets. Leads and lags are not reported in DFGLS. DFE=dyadic fixed effects; DFGLS=dynamic feasible generalised least squares
The variables LDIST, CONTIG, COMLANG and COLONY were dropped from the analysis.
Corruption in recipient country is taken from International Country Risk Guide (ICRG) published by "The PRS Group". It is a component of the Political Risk Dataset.

A6. Technical notes referring to Table 4

The investment channel is tested by the following equation:

$$LINVY_{jt} = \gamma_j + \chi_1 LDYS_{jt} + \chi_2 LEXTNSY_{jt} + \chi_3 LAIDY_{jt} + \upsilon^*_{jt} \qquad \text{(A6.1)}$$

where all variables are in logs. *j* stands for recipient country *j* and *t* stands for time. $INVY_{jt}$ is the investment-to-GDP ratio in recipient country *j* at time *t*. *DSY* is the domestic savings-to-GDP ratio, *EXTSNY* is net external savings (minus aid) -to-GDP and *AIDY* is the net aid-to-GDP ratio.

The impact of foreign aid on domestic savings can be tested using the following equation:

$$LDSY_{jt} = \varsigma_j + \delta_1 LEXTSNY_{jt} + \delta_2 LAIDY_{jt} + \nu^*_{jt} \qquad \text{(A6.2)}$$

Note that the impact on total savings-to-GDP is $\Delta TSY_{jt} = \Delta AIDY_{jt} + \Delta EXTSNY_{jt} + \Delta DSY_{jt}$.

The effect of net capital flows on the real exchange rate can be modelled as follows:

$$LXCHR_{jt} = \varphi_j + \varepsilon_1 LEXTNSY_{jt} + \varepsilon_2 LAIDY_{jt} + \omega^*_{jt} \qquad \text{(A6.3)}$$

We improve the basic long-term equations (A6.1-A6.3) by decomposing the error terms $(\upsilon^*_{jt}, \nu^*_{jt}, \omega^*_{jt})$ to control for endogeneity of the regressors. We estimate these equations by means of DOLS. The error terms now contains an endogenous part (the leads and lags of the regressors in first differences) and a white noise part $(\upsilon_{jt}, \nu_{jt}, \omega_{jt})$. In addition, we account for autocorrelation of the disturbances by applying the Feasible Generalised Least Squares (FGLS)-technique whenever necessary, ending up with a DFGLS estimation.

$$\begin{aligned} LINVY_{jt} = {} & \gamma_j + \chi_1 LDYS_{jt} + \chi_2 LEXTNSY_{jt} + \chi_3 LAIDY_{jt} + \sum_{p=-2}^{p=+2} \theta_{1p} \Delta LDYS_{jt-p} \\ & + \sum_{p=-2}^{p=+2} \theta_{2p} \Delta LEXTNSY_{jt-p} + \sum_{p=-2}^{p=+2} \theta_{3p} \Delta LAIDY_{jt} + \upsilon_{jt} \end{aligned} \qquad \text{(A6.4)}$$

$$LDSY_{jt} = \varsigma_j + \delta_1 LEXTSNY_{jt} + \delta_2 LAIDY_{jt} + \sum_{p=-2}^{p=+2} \theta_{1p} \Delta LEXTSNY_{jt-p} + \sum_{p=-2}^{p=+2} \theta_{2p} \Delta LAIDY_{jt-p} + \nu_{jt} \quad \text{(A6.5)}$$

$$LXCHR_{jt} = \varphi_j + \varepsilon_1 LEXTNSY_{jt} + \varepsilon_2 LAIDY_{jt} + \sum_{p=-2}^{p=+2} \theta_{1p} \Delta LEXTNSY_{jt-p} + \sum_{p=-2}^{p=+2} \theta_{2p} \Delta LAIDY_{jt-p} + \omega_{jt} \quad \text{(A6.6)}$$

Table A7. List of countries

List of recipients (j)	130			List of Donors (i)
Afghanistan	Congo, Dem. Rep.	Jamaica	Peru	Australia
Albania	Congo, Rep.	Jordan	Philippines	Austria
Algeria	Costa Rica	Kazakhstan	Qatar	Belgium
Angola	Cote d'Ivoire	Kenya	Rwanda	Canada
Argentina	Croatia	Kiribati	Samoa	Denmark
Armenia	Cuba	Korea	Saudi Arabia	Finland
Aruba	Djibouti	Kuwait	Senegal	France
Azerbaijan	Dominica	Laos Dem. Rep.	Seychelles	Germany
Bahamas	Dominican Republic	Lebanon	Sierra Leone	Greece
Bahrain	Ecuador	Lesotho	Somalia	Ireland
Bangladesh	Egypt	Liberia	South Africa	Italy
Barbados	El Salvador	Libya	Sri Lanka	Japan
Belarus	Eritrea	Madagascar	Sudan	Netherlands
Belize		Malawi	Suriname	New Zealand
Benin	Ethiopia	Malaysia	Swaziland	Norway
Bermuda	Fiji	Mali	Syria	Portugal
Bhutan	Gabon	Mauritania	Taiwan	Spain
Bolivia	Gambia	Mauritius	Tanzania	Sweden
Bosnia and Herzegovina	Georgia	Mexico	Thailand	Switzerland
Botswana	Ghana	Moldova	Timor-Leste	United States
Brazil	Grenada	Mongolia	Togo	United Kingdom
Brunei	Guatemala	Morocco	Tonga	
Burkina Faso	Guinea	Mozambique	Trinidad and Tobago	
Burundi	Guinea-Bissau	Myanmar	Tunisia	
Cambodia	Guyana	Namibia	Turkey	
Cameroon	Haiti	Nepal	Uganda	
Cape Verde	Honduras	Nicaragua	United Arab Emirates	
Central African Republic		Niger	Uruguay	
Chad	India	Nigeria	Venezuela	
Chile	Indonesia	Oman	Vietnam	
China	Iran	Pakistan	Yemen	
Colombia	Iraq	Panama	Zambia	
Comoros	Israel	Paraguay	Zimbabwe	

Note: Seven countries were dropped from the analysis due to an insufficient number of observations when running the regressions.