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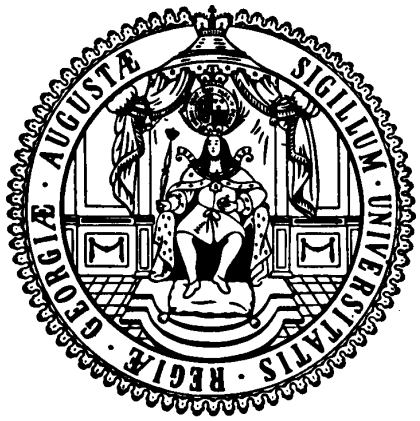

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Aid and Trade—A Donor's Perspective

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ABSTRACT *One reason donors provide foreign aid is to support their exports to aid-recipient countries. Time series data for Germany suggests an average return of between US$ 1.04 to US$ 1.50 for each US dollar of aid spent by Germany. Although this is well below previous estimates, the value is robust to different specifications and econometric approaches. Interestingly, we find strong evidence of crowding out between bilateral donors in the sense that bilateral aid from other EU members significantly reduces exports from Germany to the recipients. The evidence suggests that, in the long-run, aid causes exports and not vice versa. We discuss the implications these findings might have for aid volumes and allocation.*

Key words: trade; foreign aid; donors; time series based panel estimation techniques

JEL Classification: F10, F35; C23

I. Introduction

The primary objective of bilateral foreign aid[1] is to contribute to efforts to overcome worldwide poverty, underdevelopment, and distress. This objective is usually based on a humanitarian concern about alleviating absolute poverty and global economic inequality, as well as on appeals to enlightened self-interest where economic development in recipient

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countries is also believed to benefit donor countries in the long run through enhanced trade opportunities and greater global economic and social stability. However, the taxpayers and developmental agencies of donor countries are also interested in the shorter-term impact of aid on their own economies. The investigation of this issue is particularly important currently; EU governments committed themselves to substantially increasing their levels of official development aid in future years, although the current financial crisis may limit their ability to do so. The EU aims to meet the UN goal of 0.70% of a donor country's GDP allocated to aid by the year 2015, with an intermediate goal of 0.51% of GDP by 2010. Current trends in aid flows cast considerable doubt on the ability of EU countries to deliver on these promises. This is surely related to a lack of political and public support in donor countries, which, in turn, is related to doubts about the benefits of aid for the recipient, as well as for donors (Bourguignon et al., 2008).

The effectiveness of aid in promoting economic growth and human development in recipient countries has been the focus of many studies in recent years. Morrissey (2001), Hansen and Tarp (2001), Easterly (2003), Easterly et al. (2004), and Pattillo et al. (2007) address the effectiveness of aid in terms of promoting real GDP growth in recipient countries. While the now famous results of Burnside and Dollar (2000) suggested that aid promoted growth only in an environment of 'good policies', other authors pointed to a positive growth effect either independent of economic policies in recipient countries (Hansen and Tarp, 2001; Morrissey, 2001), or dependent on certain features particular to recipient countries, such as the share of a country's area that lies in the tropics (Daalgard et al., 2004), the level of democratisation (Svensson, 1999), institutional quality (Burnside and Dollar, 2004), political stability (Chauvet and Guillaumont, 2004), vulnerability to external shocks (Guillaumont and Chauvet, 2001), or absorptive capacity (Chauvet and Guillaumont, 2004).

Other empirical studies have even pointed to a questionable or even negative growth effect of aid in the long term (Svensson, 1999; Ovaska, 2003). The negative long-run effect is

said to be due to weak institutions, increased corruption, a dwindling willingness to raise taxes (Knack, 2004; Rajan and Subramanian, 2007), and real exchange-rate appreciation (Rajan and Subramanian, 2005) in the recipient economies.[2]

Even though donors clearly have an interest in aid effectively furthering economic growth and human development in recipient countries, apparent ineffectiveness of aid is not a sufficient reason for countries to refuse to give aid. Studies on aid allocation have shown that historical ties and the political and strategic interests of donor countries, as well as incentive structures within the donor community and its agencies, are also very important factors in determining aid flows and which can easily ensure continuing aid even in the absence of effectiveness (Alesina and Dollar, 2000; Mosley et al., 1990; Bourguignon and Sundberg, 2007); also, despite the prominence of the MDGs, aid allocation does not appear to have a strong MDG focus (Thiele et al. 2007).

Related literature discusses the possibility of short-term 'win-win' effects of bilateral aid for both donors and recipients, particularly if aid is spent by recipients on necessary imported investment goods. The recipient can expect a favourable impact of capital good imports on productivity and technological knowledge, leading to a positive effect on growth in the long run. Zhang and Zou (1995), for example, showed in an empirical study based on an intertemporal endogenous growth model and panel data for 53 less developed countries (LDCs) that the import of foreign capital goods has a positive and significant impact on developing countries' economic growth. They even found that the impact of foreign technology imports on GDP growth is about four to five times larger than the impact of domestic capital goods, due to differences in quality between foreign and domestic capital goods. Coe et al. (1997) have identified four channels through which imports to LDCs may promote growth, including forward linkages, embedded technologies, learning effects, and stimulation of imitation. Similarly, growth-promoting knowledge spillovers from developed to developing countries were noted by Coe et al. (1997) and Falvey et al. (2004). Falvey et al.

(2004) support the existence of spillovers through imports which may be of a public or private good character. To summarise, utilising aid money for imports, particularly capital goods, not only attenuates the currency-appreciation effect but may also spur recipient countries' technological advancement and productivity.

Despite this possibility of a 'win-win' situation, it is not necessarily the case that the particular bilateral donor will be the favoured exporter to the recipient country, and thus may not benefit directly from the aid in terms of increased exports. The traditional manner by which donors dealt with this issue was through the tying of aid, mandating that aid-related imports had to originate from the donor country. There is no doubt that such tied aid reduced the value of the transfer to recipients, by as much as 30% in some cases (World Bank, 1998). Mainly for this reason, donors progressively reduced the share of tied aid in the last three decades. But as we demonstrate below, bilateral aid appears to promote donor exports above and beyond any effect that may derive from tied aid. This effect could result from goodwill created by the donor, demonstration effects, the implicit and explicit promotion of donor products and processes by aid programmes, and the mixing of aid and trade relationships, as well as remnants of tied aid.

Germany's aid and exports can serve as an interesting case study for learning about the impact of aid on donors' exports for the following reasons. Germany, with a 2006 budget of US$ 10.4 Billion, is, in absolute terms, one of the world's largest aid donors, surpassed only by Japan and the USA. Less than 7% of German bilateral programme aid was tied in 2000 (DAC, 2008). Further, given that Germany lost its (few) colonies by the end of World War I, we would expect that historical ties and strategic interests in developing countries would be of lesser importance in Germany's aid decisions than for countries who have more and/or more recent colonies, and that the allocation of aid would therefore follow a priori developmental and humanitarian aspects more than political ones. In 2006 more than 75% of Germany's aid went to least developed countries, low income countries, and lower middle income countries,

while less than 25% went to the Middle East, and to North Africa, where political and strategic objectives are probably more relevant. The German government spent about 0.36% of its GNP on ODA in 2006, implying that German official development assistance (ODA) will have to increase substantially over the next few years to meet the terms of the EU aid compact (Bourguignon et al., 2008).[3]

A related issue to investigate is whether aid flows from *other* bilateral donors also affect exports from a particular donor. It could well be the case that, just as Germany's bilateral aid increases its export level, bilateral aid from other donor countries reduces Germany's exports, as recipient countries may favour the exports of those donors for the reasons discussed above. Thus, it may well be the case that the net effect of all bilateral aid on German exports is close to zero and bilateral aid thus simply serves to change the destination rather than total level of exports.

An important third related question to examine, within the larger context of the aid allocation literature, is whether or not bilateral aid flows are used largely to reward and cement pre-existing commercial ties. This would imply reverse causality, that is, an aid-related increase in donor export levels leading to subsequent aid donations, an issue that clearly deserves closer attention.

As we discuss in Section II, some previous studies explore the impact of bilateral aid on exports and consider the direction of causality. This study differs from those prior efforts by considering a longer time period, more covariates, and, most importantly, more advanced and, as we argue, more appropriate econometric estimation techniques. In particular, our method includes three important features. First, it takes the time series properties of the analysed data into account, thus avoiding the problem of spurious correlations in nonstationary data. Second, it examines the long-run impact of Germany's bilateral aid on German exports. To this end we apply panel cointegration and causality analysis to a panel of 77 developing countries over the period 1962 to 2005. Third, this study works in a

multivariate, rather than bivariate, framework.[4] To our knowledge, it is the first study to use these techniques to evaluate this issue and in an economically well-founded multivariate model which is embedded in the gravity model of international trade in terms of the variables employed.[5]

The organisation of the paper is as follows: Section II provides an overview of the aid and trade literature, Section III contains the econometric model and the estimation techniques, the empirical results are presented in Section IV, and Section V concludes.

II. Overview of the Literature on the Impact of Aid on Exports

In recent decades, extensive research effort has been devoted to investigating the effects of developmental assistance on the economic performance of the recipient countries and clarifying how aid can be used to promote exports from developing countries, the so-called 'aid for trade' principle (Morrissey, 2006). Much less attention has been devoted to the reverse issue of quantifying the impact of aid on donors' export revenues. While this is not (and should not be) the main motivation for giving aid, it is nevertheless worthwhile to examine the issue. A finding that aid flows promote exports from the donor countries would suggest that giving aid—if it also promotes development in the recipient country—can be a win-win situation for both parties and might also reduce taxpayer reluctance to devote resources to aid.

Interestingly, the literature on aid allocation has found that bilateral aid also strongly depends upon, among other things, economic circumstances in the *donor* country such as government performance and donors' relative individual income (Chong and Gradstein, 2008). In this political-economic model, a donor's willingness to provide foreign aid is positively related to the citizens' satisfaction with the donor government's performance and to per capita income. A political-economic equilibrium exists where the median voter is decisive in determining the political outcome in terms of a majority-supported tax rate. Therefore, the

aggregate amount of foreign aid depends positively on the aggregate income in the donor economy and negatively on the degree of its inequality. While a donor's exports are not explicitly considered in this model, increased exports are likely lead to an increase in GDP and thus increase a country's willingness to provide aid.

Other contributions to the aid allocation literature suggest that aid flows depend strongly on historical ties and strategic and economic interests, and are only weakly dependent on poverty levels or the existence of democratic governance in recipient countries (Alesina and Dollar, 2000). In this aid allocation context, an important question to examine is whether exports to a particular country promote subsequent aid flows to that country. If that reverse causality were present, this would be an important finding further questioning the motivation of donors when giving aid.

Turning directly to studies that investigate the impact of aid on a donor country's exports, Arvin and Baum (1997) and Arvin and Choudry (1997) evaluated the relationship between bilateral aid and bilateral exports with and without tying of the aid. They found that aid without tying was roughly as export-promoting as tied aid, and explained this as being due to the effects of the recipient countries' goodwill and/or parallel trade agreements and trade concessions. Accordingly, a formal tying of aid does not appear to provide additive benefits related to donor export levels (Jepma, 1991; Arvin and Baum, 1997; Arvin and Choudry, 1997). Benefits for donors through tying are therefore usually insubstantial, whereas tying noticeably reduces the benefit of aid for recipients (Jepma, 1991; Wagner, 2003; World Bank, 1998). Consequently, tying has been progressively reduced, partly due to pressure from the OECD-Development Assistance Committee (DAC).

The relationship between aid and exports was examined in various country studies which neglect, however, to consider the possible occurrence of spurious correlations.[6] Therefore, a word of caution is needed regarding the results since the figures have been derived from trending series.

Some studies have examined this link using a relatively simple macroeconometric model. For example, Vogler-Ludwig et al. (1999), using data for the period 1976 to 1995 for Germany's aid and trade relationship, found that every US$ 1.00 spent on ODA would increase exports by US$ 4.30. The authors included 43 recipient countries in the study but calculated the average impact of aid on trade for only 23 of those countries. Other studies analysed the aid-trade link relying on the gravity model of international trade. For example, a study done by Nilsson (1997) on the aid and trade relationship of EU countries and developing countries from 1975 to 1992 showed that US$ 1.00 worth of aid increased exports by an average of US$ 2.60 for EU countries, and by US$ 3.20 for Germany. Nilsson utilised a common intercept for all the EU countries, three-year averages, and a time trend. Studying the aid and trade relationship between OECD donors (especially Japan) and recipient countries, Wagner (2003), utilising pooled data for the years 1970, 1975, 1980, 1985, and 1990, computed the donor-country export-level impact of US$ 1.00 of aid to be approximately US$ 2.30.

A totally different approach was followed by Lloyd et al. (2000), Arvin et al. (2000), and Osei et al. (2004). These authors used Granger causality and cointegration techniques to examine the aid-trade relationship, getting mixed results. For some country pairs, the authors could not find an aid-trade link, but for some, the link was found to exist, and for still others, they identified a bi-directional relationship.

In our own study, we extend the literature by using more extended data, covariates, and more advanced econometric techniques. In particular, we follow Nilsson (1997) and Wagner (2003) in using a gravity-type model which is well suited to studying the impact of aid on trade. This model allows controlling for the impact of other influences on trade such as income (which affects production capacity and preferences for variety), population (absorption and economies of scale effects) and distance, in a world where trade agreements, colonial ties, common borders, and aid can also influence trade. We augment the model by

exchange rates and two types of aid—German bilateral aid and the bilateral aid from other EU members excluding Germany.

We deviate from most previous studies by exploiting the time series properties of the data. More specifically, we take trends and memory in the series into account, thus avoiding spurious regression results; utilising the study period from 1962 to 2005 allows us to do so. We also control for the endogeneity of aid by estimating the aid-export relationship with Dynamic Ordinary Least Squares (DOLS) and by running a Granger causality test. This assessment of causality will also enable us to add to the aid allocation literature by investigating whether or not aid is given as a reward for past exports. In addition, we distinguish between the short-term and the long-term impact of aid and trade by applying an error-correction model (ECM).

III. Model and Estimation Techniques

Modelling the Aid-Trade Link

Given that we focus exclusively on the effect of aid on the donor's exports in a gravity-type model, we also use control variables from this trade model to explain bilateral trade flows in the short and long run. We do not apply the full gravity model itself, which is a general equilibrium model, and which therefore includes all donors' trade with all recipient countries and where short-run and long-run dynamics are absent.

Since our data-generation process is linked to the gravity model, we will briefly summarise its main features. According to the underlying theory, trade between two countries is explained by the nominal incomes and population levels of the trading countries, the distance between the economic centers of the exporter and importer, and a number of other factors aiding or hindering trade between them (colonial history, common language, and so on). Under realistic assumptions, a price term must be added to avoid misspecification (Feenstra, 2004). This price term corrects for the imperfect substitutability of trade flows

and/or large and persistent deviations in national price levels from purchasing power parity (PPP). The bilateral exchange rate captures some of the price effect and should therefore not be omitted in a gravity model (Sologa and Winters, 2001). Anderson and Van Wincoop (2003), on the other hand, constructed a multilateral resistance term to control for all price effects and showed that the fixed-effects method produces consistent estimates of the average border effect across countries and proposed it as the preferred empirical method.

Thus, in order to estimate the effect of aid on the donor's exports we consider a multivariate long-run relationship of the following form:

$$LX_{gjt} = \mu_{gj} + \beta_1 LY_{gt} Y_{jt} + \beta_2 LPOP_{gt} + \beta_3 LPOP_{jt} + \beta_4 LEXRN_{gjt} + \beta_5 LBAIDG_{gjt} + \beta_6 LEBAIDG_{jt} + u_{gjt}, \quad (1)$$

where L denotes variables in natural logs. X_{gjt} are the exports from country g (Germany) to recipient country j in period t in current US dollars (hundreds of million US$). Y_{gt}, and Y_{jt} indicate the GDP of countries g and j, respectively, in period t at current PPP US$ (in billions). POP_{gt}, and POP_{jt} denote the population of countries g and j, respectively, in period t (in thousand inhabitants). $BAIDG_{gj}$ measures gross bilateral aid[7] flowing from Germany (g) to country j in millions of US$. $EBAIDG_j$ stands for other European donors' gross bilateral aid allocated to country j in millions of US$; it is the sum of all bilateral aid from EU countries minus Germany's bilateral aid. *EXRN* refers to the nominal bilateral exchange rate, and μ_{gj} represent the specific effects (fixed effects) associated with each bilateral trade flow. They serve as controls for all omitted variables that are specific for each trade flow and that are time invariant. In what follows, the subscript g will be dropped since we will be working with one donor (g) only.

As to the coefficients, we expect the following signs: A high level of income in the exporting country indicates a high level of production (which then increases the availability of

goods for export), and a high level of income in the importing country implies strong demand. Therefore, we expect β_1 to be positive. The coefficient estimate for the population level of the exporters, β_2, may be negatively or positively signed. On the one hand, a large population may indicate large resource endowment, self sufficiency, and less reliance on international trade. On the other hand, it is possible that a large domestic market (or population) promotes division of labour and thus creates opportunities for trade in a wide variety of goods (Oguledo and MacPhee, 1994). The coefficient of the importer population, β_3, also has an ambiguous sign, for similar reasons. Another factor that may influence the coefficient estimates for population is the composition effect that influences supply and demand. Each country produces and exports a different mix of commodities (supply), and the mix of goods demanded also differs for each country. The coefficient estimate of the bilateral exchange rate, β_4, is expected to have a negative impact on exports, as appreciation in the exchange rate decreases the export level. The coefficient of bilateral aid, β_5, is expected to be positive. We expect that bilateral development aid will lead to an increase in the donor's exports mainly due to the presence of habit formation or goodwill effects. In the presence of habit-formation effects, aid given today shifts preferences of the recipient in favour of the donor's export goods in the future. This effect is summarised in the coefficient, β_5.The coefficient of other donors' aid, β_6, is expected to be negative, implying that the same channel that promotes Germany's exports also works for other donors and thus crowds out exports from Germany.

Data Sources, Variables, and German Co-Operation Countries

ODA data are from the OECD Development Database on Aid from DAC members (www.oecd.org/dac/stats/idsonline). Bilateral exports data are obtained from the UN COMTRADE database. Data on income and population variables are drawn from the World

Bank (World Development Indicators Database 2007). Bilateral effective exchange rates are from IMF statistics. Distances between capitals have been computed as Great Circle distances using data on straight-line distances in kilometres; latitudes and longitudes are obtained from the CIA World Fact Book. The data are available on request.

A list of German development co-operation partner countries can be found at the web site of the German Ministry for Economic Co-Operation and Development (BMZ) http://www.bmz.de/en/countries/laenderkonzentration/tabelle.html. These countries will be the main focus of the analysis, as the BMZ has a bilateral aid relationship only with them.[8]

Estimation Issues and Estimation Procedure

Equation (1) assumes that long-run movements in trade are associated with long-run movements in GDP, population levels, exchange rates and aid levels. Empirically, this implies that the series must exhibit unit root behaviour and that trade must be cointegrated with aid and the other control variables (if the specification is the 'correct' one). Therefore, the time series properties must first be tested. We will do so by applying a panel unit root test. Second, to test whether aid (and some control variables) and exports are in a long-run equilibrium, that is, whether there is a long-run relationship between aid and exports, we use the panel cointegration tests of Pedroni (1999, 2004). Third, when we find the existence of a long-run relationship between aid and exports, we estimate the long-run coefficients (long-run impact) of Germany's bilateral aid and the control variables on exports by applying panel DOLS. Fourth, we test for causality between aid and exports—does aid money in the hands of recipients positively affect donor's exports? Specifically, which situation exists: 1) are aid funds actually spent on donors' exports, or 2) do recipient countries' imports/donors' exports increase donor willingness to provide aid, or 3) do we have a bi-directional relationship between aid and exports? We test for possible causality by applying a panel Granger causality test to our data. Fifth, having solved the causality problem, we check the robustness of our

results and examine the short-run and long-run impact of aid in the framework of a dynamic ECM.

Sample-Selection Bias

Clearly, by concentrating on Germany as a single donor country and on the developing countries with which Germany has an established aid relationship, sample selection bias through omission of other possible donor and recipient countries becomes an important issue (Lloyd et al., 2001). Our sample of 77 recipient countries (BMZ countries) contains all developing countries that actually receive aid from German government agencies on a regular basis.[9] Only estimations derived from this sample will allow us to draw conclusions for the future given that the BMZ has made it clear that aid will be concentrated on these countries. Some 60 additional countries are listed by DAC as receiving bilateral aid from Germany, but this aid primarily represents scholarships for students of these countries studying in Germany, disaster relief, and state support for the work of NGOs and foundations working in developing countries. As these recipient countries do not receive an official financial transfer, and since much of this aid is actually spent in Germany, we do not consider them in our analysis as we would not expect this 'incidental' aid to affect exports. This is confirmed by a pre-study where we estimated aid-export elasticities for all 138 countries where some aid flows were recorded in the OECD database by means of an error correction model to get a clearer understanding of the sample-selection issue (see also Martínez-Zarzoso et al., 2008). We found that the aid-export elasticity in the 138 country sample was 0.07 (smaller than in our sample below) and the return was US$ 0.88 in the long run. In the non-BMZ sample (138 countries minus the BMZ countries) the aid-trade elasticity was even slightly negative (-0.01) and the long-run return was US$ -0.19.

We have already given reasons for selecting Germany as a case study. Since we restrict the analysis to one donor country (Germany), we must control for the effects of

bilateral aid given by other important donor countries, such as other European countries which show a similar regional concentration of aid flows. We do this by plugging in an extra variable, called *LEBAIDG*. In a pre-study we also controlled for bilateral aid given by the USA and Japan. However, the coefficient of the control variable was insignificant. A possible explanation could be that the USA and Japan have a set geographical target for the bulk of their aid allocation (primarily the Middle East in the case of USA, and Asia in the case of Japan) that differs significantly from the German/European allocation (primarily Africa and Latin America).

IV. Empirical Findings on the Impact of Aid on Trade

Nonstationary Series

The statistical literature offers a wide range of unit-root tests to test for the nonstationarity of the series. However, when utilising unit root tests**,** caution is required. Unit root tests that assume individual unit roots for each cross-section are usually to be preferred over unit root tests that assume a common unit root process, given that the former are more flexible. Nonetheless, the available panel unit root tests can lead to implausible results, especially when the number of cross-sections is large. Maddala and Wu (1999) recommend the ADF-Fisher chi-square test in this context.

Table 1 shows the test results for all the variables entering our regression model. After inspecting the graphs, an intercept and trend were assumed. According to the ADF-Fisher chi-square test, which allows for individual unit roots, all variables that enter the regression model are nonstationary, integrated of order one, I(1). Thus, panel cointegration techniques are required in order to avoid spurious regressions.

[Table 1 about here]

Existence of a Long-Run Relationship Between Aid and Exports

There are several cointegration tests available to evaluate the long-run relationship between a set of variables. One can distinguish between single-equation-based and system-based cointegration tests. A simulation study of Wagner and Hlouskova (2007) showed that amongst the single-equation tests for the null hypothesis of no cointegration (Pedroni-type tests), the panel and mean-group tests of Pedroni perform best, whereas all other single-equation tests (Breitung, 2002; Westerlund, 2007), are, in part, significantly undersized and have very low power in many circumstances. For $T \leq 25$ there is practically no acceptable power. In contrast, system-based (or Johansen-type) cointegration tests (Larsson et al., 2001; Breitung, 2005) perform very poorly for small values of *T*, but are also inadequate when *N* is too large, as in our case (Wagner and Hlouskova, 2007).

Therefore, we choose Pedroni's panel cointegration tests (Pedroni, 1999, 2004) to test for a long-run relationship between aid and exports. We do so in a multivariate framework to control for the impact of exchange rates, the donor's and recipient countries' GDP, population, and most importantly, other donors' aid on Germany's exports. This involves estimating the hypothesised cointegrating relationship (Equation (1)) separately for each country and then testing the estimated residuals for stationarity using four test statistics. Two of these statistics (Panel PP and Panel ADF) pool the autoregressive coefficients across different countries while performing the unit root test and thus restrict the first-order autoregressive parameter to being the same for all countries. Pedroni (1999) refers to these statistics as *panel cointegration statistics*. The other two statistics (Group PP and Group ADF) are based on averaging the individually estimated autoregressive coefficients for each country. Accordingly, these statistics allow the autoregressive coefficient to vary across countries, and are referred to as *group mean panel cointegration statistics*. Both the panel cointegration statistics and the group mean panel cointegration statistics test the null hypothesis H_0: 'All of the individuals of the panel are not cointegrated.' For the panel statistics, the alternative hypothesis is H_1: 'All of the individuals of the panel are

cointegrated', while for the group mean panel statistics, the alternative is H_1: 'A significant portion of the panel members are cointegrated' (Pedroni, 2004).

The results are presented in Table 2. They show that the variables (*LX, LYY, LPOPG, LPOPJ, LEXRN, LBAIDG,* and *LEBAIDG*) are cointegrated and therefore exhibit a long-run relationship. The error when rejecting the null hypothesis of 'no cointegration' is zero for all test statistics. Thus, the next step is to estimate the long-run relationship between the variables.

[Table 2 about here]

Estimating the Long-Run Relationship by DOLS

One possibility for estimating the long-run relationship between bilateral aid and exports is the DOLS procedure. This procedure generates unbiased estimates for variables that cointegrate, even with endogenous regressors (Stock and Watson, 1993). It does so by employing leads and lags of the variables in differences that absorb changes in the variables caused by changes in the disturbances if both are correlated. Furthermore, Kao and Chiang (2000) showed that DOLS is more promising than OLS or fully modified (FM) estimators in estimating cointegrated panel regressions (Baltagi, 2002).

We use the fixed effects panel DOLS estimator suggested by Kao and Chiang (2000). The DOLS regression is given by:

$$
\begin{aligned}
LX_{jt} = {} & \alpha_j + \chi_1 LY_{gt} Y_{jt} + \chi_2 LPOP_{gt} + \chi_3 LPOP_{jt} + \chi_4 LEXRN_{jt} \\
& + \chi_5 LBAIDG_{jt} + \chi_6 LEBAID_{jt} \\
& + \sum_{m=-p}^{p} \delta_{jm} \Delta LY_{gt-m} Y_{jt-m} + \sum_{m=-p}^{p} \varepsilon_{jm} \Delta LPOP_{gt-m} + \sum_{m=-p}^{p} \phi_{jm} \Delta LPOP_{jt-m} \\
& + \sum_{m=-p}^{p} \varepsilon_{jm} \Delta LEXRN_{jt-m} + \sum_{m=-p}^{p} \gamma_{jm} \Delta LBAIDG_{jt-m} \\
& + \sum_{m=-p}^{p} \eta_{jm} \Delta LEBAIDG_{jt-m} + u_{jt}
\end{aligned}
\tag{2}
$$

When estimating the above equation, consistent regression coefficients can be obtained. Moreover, if (as in our case) the dependent variable and the regressors are cointegrated, then the DOLS estimator is efficient in large samples. In addition, statistical inferences about the cointegrating coefficients, χ_1, …, χ_6, in Equation (2), based on autocorrelation-heteroskedasticity-consistent (HAC) standard errors, are valid because the *t* statistic constructed using the DOLS estimator with HAC standard errors has a standard normal distribution in large samples.

Table 3 reports the DOLS point estimates. We find the elasticity of bilateral German aid on exports to be 0.13 and highly significant. The computed return of one US dollar spent on bilateral German aid is about US$1.50. Interestingly, we find that bilateral aid given by other EU donors negatively and significantly impacts Germany's export level, thus indicating a clear crowding-out effect of aid given by other European donors. The net effect remains positive, however, as can be seen in Table 3, where the average impact of US$ 1.00 of German and US $1.00 of non-German EU aid on exports from Germany is calculated. The bilateral exchange rate has the expected impact on German exports, that is, an appreciation of the Euro with respect to developing countries' currencies reduces the level of German exports, while an increase in exporter and importer GDP increases German exports. An increase in Germany's population decreases German exports due to its absorption effect, and

an increase in recipient-country population levels reinforces the import-substitution industry in the recipient country which requires a certain market size to be competitive.

[Table 3 about here]

Testing the Causality Between Aid and Exports

Even though estimation by DOLS in the previous section does not require the regressors to be exogenous, we are interested in detecting the direction of long-run causality. We intend to test only the direct, and not the indirect, channels between aid and trade. Therefore, the income, absorption, and growth effects of aid and exports are not considered in our model.[10] Note, however, that our model tests the aid and trade relationship in a multivariate framework, thus reducing the risk of finding causality due to omitted third variables.

Lloyd et al. (2000), who studied the relationship between aid and trade in a bivariate model by means of a Granger causality test, nicely summarise the channels through which aid may influence exports and exports may affect aid allocation. They set forth the following arguments for the 'aid-to-export' channel. Tied aid increases exports in a straightforward way according to the tying conditions. But non-tied aid, as well, can lead to a (semi-) direct increase in exports via 1) good experience in the recipient country with the donor's products, 2) the necessity of replacement parts from the donor country (aid-induced trade dependency), 3) showing goodwill in the recipient country for having received aid, or 4) a reinforcement of bilateral and political links between donor and recipient country that goes hand in hand with aid. The following points are put forward to explain the 'exports-to-aid' channel. Aid may follow exports via three routes: 1) the activity of export lobby groups in donor countries, 2) the donor's consideration of commercial links with developing countries as a factor influencing aid allocation, or 3) donors directly or indirectly rewarding the recipient for purchasing donor's exports.

Following common practice in panel cointegration studies, our causality test involves estimating a panel vector error-correction model given by

$$\begin{pmatrix} \Delta LX_{jt} \\ \Delta LYY_{jt} \\ \Delta LPOP_{gt} \\ \Delta LPOP_{jt} \\ \Delta LEXRN_{jt} \\ \Delta LBAIDG_{jt} \\ \Delta LEBAIDG_{jt} \end{pmatrix} = \begin{pmatrix} c_{1j} \\ c_{2j} \\ c_{3j} \\ c_{4j} \\ c_{5j} \\ c_{6j} \\ c_{7j} \end{pmatrix} + \sum_{p=1}^{P} \psi_p \begin{pmatrix} \Delta LX_{jt-p} \\ \Delta LYY_{jt-p} \\ \Delta LPOP_{gt-p} \\ \Delta LPOP_{jt-p} \\ \Delta LEXRN_{jt-p} \\ \Delta LBAIDG_{jt-p} \\ \Delta LEBAIDG_{jt-p} \end{pmatrix} + \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \end{pmatrix} ECT_{jt-1} + \begin{pmatrix} \varepsilon_{1jt} \\ \varepsilon_{2jt} \\ \varepsilon_{3jt} \\ \varepsilon_{4jt} \\ \varepsilon_{5jt} \\ \varepsilon_{6jt} \\ \varepsilon_{7jt} \end{pmatrix} \qquad (3)$$

where ECT_{jt} are the residuals of the panel DOLS long-run relation. That is, to compute the error-correction term, we use the long-run coefficients from Table 3. A significant error-correction term indicates long-run Granger causality from the independent to the dependent variables, where long-run Granger non-causality and weak exogeneity can be regarded as equivalent. Starting with three lags, we test for weak exogeneity of exports and aid—and thus for long-run Granger non-causality (between exports and aid)—by first eliminating the short-run dynamics in the model successively according to the lowest *t*-values. Then, we decide on the significance of the error-correction terms. In doing so, we reduce the number of parameters (according to Hendry´s general-to-specific methodology) and thereby we increase the precision of the weak exogeneity tests on the *a*-coefficients.

Table 4 reports the results. According to the *t*-statistics of the error-correction terms, *LBAIDG* can be regarded as weakly exogenous, whereas the null hypothesis of weak exogeneity of *LX* is decisively rejected. Consequently, exports are endogenous in the cointegrating relation and hence Granger-caused by aid in the long run. In other words, long-run causality is uni-directional from aid to exports.

[Table 4 about here]

Estimating the Aid and Trade Relationship in an ECM framework

Having found that there is a uni-directional causal long-run relationship from aid to exports, we now check the robustness of the DOLS results using the single-equation conditional error correction model introduced by Stock (1987). The conditional ECM, besides serving as a robustness check, has an advantage over DOLS since it provides information about the short-run and the long-run impact of aid and the other right-hand-side variables on exports. It is in our case given by

$$\begin{aligned}\Delta LX_{jt} = \mu_j &+ \sum_{p=0}^{p=k} \beta_{1p} \Delta LY_{gt-p} Y_{jt-p} + \sum_{p=0}^{p=k} \beta_{2p} \Delta LPOP_{gt-p} + \sum_{p=0}^{p=k} \beta_{3p} \Delta LPOP_{jt-p} \\ &+ \sum_{p=0}^{p=k} \beta_{4p} \Delta LEXRN_{jt-p} + \sum_{p=0}^{p=k} \beta_{5p} \Delta LBAIDG_{jt-p} \\ &+ \sum_{p=0}^{p=k} \beta_{6p} \Delta LEBAIDG_{jt-p} + \sum_{p=1}^{p=k} \beta_{7p} \Delta LX_{jt-p} \\ &+ \lambda (LX_{jt-1} - b_1 LY_{gt-1} Y_{jt-1} - b_2 LPOP_{gt-1} - b_3 LPOP_{jt-1} \\ &- b_4 LEXRN_{jt-1} - b_5 LBAIDG_{jt-1} - b_6 LEBAIDG_{jt-1}) + u_{jt}\end{aligned} \quad , \qquad (4)$$

where

$$\begin{aligned}ECT_{jt-1} = (&LX_{jt-1} - b_1 LY_{gt-1} Y_{jt-1} - b_2 LPOP_{gt-1} - b_3 LPOP_{jt-1} \\ &- b_4 LEXRN_{jt-1} - b_5 LBAIDG_{jt-1} - b_6 LEBAIDG_{jt-1})\end{aligned}$$

is the error-correction term which contains the long-term elasticities. The short-run relationship is described by the variables in first differences, where we condition on the current values of the explanatory variables and the lagged values of all variables.

We estimate the ECM with up to three lags. After applying the general-to-specific approach, we obtain the results in Table 5. As expected, the lagged error-correction term is

negative and highly significant, which implies cointegration, as well as long-run Granger causality from aid to trade. Thus, our previous findings are confirmed by the ECM.

In terms of individual coefficients, a 1% increase in bilateral aid increases exports by 0.09% in the long term, resulting in a long-run return on bilateral aid of US$ 1.04. The short-run impact of bilateral aid on export levels is much smaller (US$ 0.69), with an elasticity of aid of 0.06 in the short run.

In addition, the ECM specification points to the short-run relevance of bilateral exchange rates and their long-run irrelevance[11] and to the importance of exporter and importer incomes. In the short run, an increase in Germany's population (excess absorption) can lead to a decrease in exports, and the importer's population growth (import substitution and economies of scale) may eventually result in a long-term decrease in exports.

The estimated coefficient for the EU official gross bilateral development aid (minus Germany's bilateral aid) is negative and significant over the long run, i.e., bilateral aid given by other EU countries crowds out German exports. In the short run, however, this coefficient is positive and significant. As before, the net effect of increased aid from Germany and other EU countries on German export levels remains positive, as shown at the bottom of the table.

All in all, the estimated long-run coefficients in Table 5 are close to the results of the DOLS procedure (Table 3). From this it follows that the estimates are fairly robust to different estimation techniques.

V. Conclusions

This paper provides a multivariate econometric method based on a gravity-type model to assess the impact of a donor's aid on that donor's exports to the recipient country, with an application to Germany. The study shows that Germany's aid flows do not depend upon whether recipient countries had promoted German exports in the past, which is 'good news'

for developing countries. We have found that, in the long run**,** exports are caused by aid and not vice versa. Therefore, it seems quite safe to conclude that German aid agencies do not allocate aid as a reward for existing commercial ties, at least in the long run. Whilst other political, historical, and strategic interests also influence German aid allocation, a straight-forward promotion of existing export interests does not find empirical support here. It has also been observed that aid given by other EU countries to recipients of German aid crowds out German exports. A crowding-out effect due to aid donations from the USA and Japan could not be detected. While Germany and other EU countries have some overlap in their aid allocation, the USA and Japan have disparate favourites in terms of recipient countries. The results seem to imply that if European donors concentrated their aid allocation on fewer non-overlapping recipient countries, this crowding-out effect would be smaller. But this implication merits further detailed investigation and should be seen as tentative at this stage.

The evidence based upon the enhanced empirical framework presented in this paper suggests that the impact of bilateral aid is well below the previously computed impact of US$ 4.30 or US$ 3.20 for Germany. Our findings show that Germany's bilateral aid increases its own level of exports by approximately the amount of aid money given (US$ 1.04 to US$ 1.50). For those concerned about the impact of aid on donor countries, this is both good and bad news. It shows that bilateral aid appears to generate substantial benefits to the donor country, over and above any effects that might have been expected from tying aid; thus, tying aid is not only an inefficient way to deliver aid, but is also unnecessary to insure benefits to the donor country. Consequently, Germany (and presumably other donors which agreed to augment aid levels) need not worry that the promised increase in aid will generate little or no benefits to the donor country. Such an increase will not only make a contribution to promoting economic and social development in recipient countries, but should also result in higher export levels for the donor countries. The bad news, however, is that the effect is considerably smaller than previously estimated. These results for Germany do not necessarily

apply to other donors, especially those with longer and stronger historical or strategic ties with particular recipients, but the paper does provide a method that could easily be applied to other donors as well.

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Notes

1. In the following we will call it simply *aid*.
2. It is argued that real exchange-rate overvaluation, which eventually harms exports and the import-substitution sectors, is brought about by the aid inflow which affects the capital account under both flexible and fixed exchange rate systems. To the extent that aid is spent on imports, however, the impact on the exchange rate will be smaller. Moreover, aid should be seen in a larger context of all capital inflows (including FDI, private flows, and debt flows) and policies to deal with such inflows (for example, the extent of which such flows are monetised or sterilised).
3. Just to compare, the relative ODA/GNP shares were 0.18% for the USA, 0.25% for Japan, and 0.51% for the UK in the same year.
4. Bivariate frameworks are dangerous vehicles from which to draw conclusions regarding cointegration and causality or to estimate regression coefficients since they are prone to severe bias by omitting variables that might be correlated with the independent variable. If, for example, in a bivariate aid-trade model, aid is made conditional upon macroeconomic stabilisation (MS) in the recipient country, and such stabilisation is achieved via the exchange rate (currency appreciation), then aid is clearly correlated with

MS and an increase in donors exports might then be due to the exchange-rate appreciation in the recipient country, and not specifically to aid.

5. Martinez-Zarzoso et al. (2008) investigated a closely related question but used standard panel estimation techniques.
6. Spurious regression results occur when either autocorrelation of the disturbances is not taken into account, or regressions with nonstationary series are run. Autocorrelation and nonstationarity of the series are interlinked, as they result from memory of the series.
7. According to DAC, gross ODA comprises total grants (position 201) and loans extended (position 204).
8. In the list were 77 countries. Four countries (Bosnia-Herzegovina, Lesotho, Namibia, and South Africa) had to be dropped due to lacking export data.
9. The number of countries receiving financial transfers has been reduced in recent years based on the German BMZ strategy of 1998 to limit the aid-recipient-country portfolio to only 70 to 75 countries in order to increase aid effectiveness.
10. We do not (and cannot) test the indirect channel of aid to exports that works through an increase of GDP in the recipient country because it is impossible to determine how much of a GDP increase is due to aid and how much is due to other policy changes.
11. A *beggar-thy-neighbour* policy (through currency devaluation) can only work in the short run, not in the long run.

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Table 1. Results of the ADF-Fisher panel unit root test

Variable tested	Fisher statistic	Probability	Variable is integrated
LX	142.79	0.33	I(1)
LYY	72.10	1.00	I(1)
LPOPG	86.34	1.00	I(1)
LPOPJ	92.60	1.00	I(1)
LEXRN	96.19	0.97	I(1)
LBAIDG	89.04	0.99	I(1)
LEBAIDG	101.79	0.94	I(1)

Note: The first differences of the series are stationary (results not reported). The Fisher statistic is distributed as χ^2 with $2\times N$ degrees of freedom, where N is number of countries in the panel.

Table 2. Results of the Pedroni (1999, 2004) panel cointegration test

	Panel cointegration statistics	Group mean panel cointegration statistics
PP *t*-statistics	-6.90***	-12.18***
ADF *t*-statistics	-6.38***	-8.00***

Note: H_0: The variables of interest are not cointegrated for each member of the panel; H_1: For each member of the panel, there exists a single cointegrating vector, although this cointegrating vector does not have to be the same for each member (Pedroni, 1999). *** indicate a rejection of the null of no cointegration at the 1% level. All test statistics are asymptotically normally distributed. The number of lags was determined by the Schwartz criterion with a maximum number of 9 lags.

Table 3. DOLS results

Variable	Long-run coefficients	*t*-statistics
LYY	0.89***	39.28
LPOPG	-0.49***	-2.93
LPOPJ	-1.31***	-10.12
LEXRN	-0.03***	-4.42
LBAIDG	0.13***	6.18
LEBAIDG	-0.15***	-9.26
Long-run return on bilateral aid	US$ 1.50	
Crowding-out effect	US$ 0.69	
Net effect	US$ 0.81	
Fixed effects	Yes	
Adj. R^2	0.96	

Note: The DOLS regression was estimated with two leads and lags. *** indicate significance at the 1% level. In static terms, the average return on aid for German exports is an increase of approximately US$ 1.50 in exports for every aid dollar spent. This average is calculated as:

$$\beta_{LBAIDG} = \frac{\partial X}{\partial BAIDG} * \frac{BAIDG}{X} \Rightarrow \frac{\partial X}{\partial BAIDG} = \beta_{BAIDG} * \frac{X}{BAIDG} = 0.13 * \frac{41200000000}{3563000000} = +1.50$$

The crowding-out effect (the impact of aid given by other EU countries) is

$$\beta_{LEBAIDG} = \frac{\partial X}{\partial EBAIDG} * \frac{EBAIDG}{X} \Rightarrow \frac{\partial X}{\partial EBAIDG} = \beta_{EBAIDG} * \frac{X}{EBAIDG} = -0.15 * \frac{41200000000}{8924000000} = -0.69$$

.

Table 4. Results of the weak exogeneity test / Granger causality test

	H_0: *LX* is weakly exogenous / aid does not Granger-cause exports in the long run; dependent variable: Δ*LX*		H_0: *LBAIDG* is weakly exogenous / exports do not Granger-cause aid in the long run; dependent variable: Δ*LBAIDG*	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
ECT_{t-1}	-0.251***	-14.77	-0.01	-0.34

Note: *** (**) indicate significance at the 1% (5%) level.

Table 5. ECM results

Variable	Long-run coefficients	*t*-statistics
LYY	0.77***	10.47
LPOPG	-0.17	-0.53
LPOPJ	-1.07***	-3.71
LEXRN	-0.01	-0.37
LBAIDG	0.09**	2.22
LEBAIDG	-0.12***	-3.24
ECT_{t-1}	-0.28***	-16.32
Long-run return on bilateral aid	US$ 1.04	
Crowding out effect	US$ 0.55	
Net effect	US$ 0.49	
	Short-run coefficients	*t*-statistics
ΔLX_{t-1}	-0.07***	-2.98
ΔLX_{t-2}	-0.07***	-3.20
ΔLYY_t	0.61***	12.71
$\Delta LPOPG_t$	-0.46**	-2.57
$\Delta LEXRN_t$	-0.08***	-3.38
$\Delta LBAIDG_t$	0.06***	5.10
$\Delta LEBAIDG_{t-1}$	0.05***	3.37
$\Delta LEBAIDG_{t-2}$	0.03**	2.17
$\Delta LEBAIDG_{t-3}$	0.03**	2.33
Short-run return on aid	US$ 0.69	3.37
Fixed effects	Yes	
Adj. R^2	0.24	

Note: *** (**) indicate significance at the 1% (5%) level. We find that, in static terms, the average return on aid for German exports is an increase of approximately US$ 1.04 in exports for every aid dollar spent. This average is calculated as

$$\beta_{LBAIDG} = \frac{\partial X}{\partial BAIDG} * \frac{BAIDG}{X} \Rightarrow \frac{\partial X}{\partial BAIDG} = \beta_{BAIDG} * \frac{X}{BAIDG} = 0.09 * \frac{41200000000}{3563000000} = +1.04$$

The crowding-out effect (impact of other EU countries' aid) is

$$\beta_{LEBAIDG} = \frac{\partial X}{\partial EBAIDG} * \frac{EBAIDG}{X} \Rightarrow \frac{\partial X}{\partial EBAIDG} = \beta_{EBAIDG} * \frac{X}{EBAIDG} = -0.12 * \frac{41200000000}{8924000000} = -0.55$$