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DOES GERMAN DEVELOPMENT AID PROMOTE GERMAN EXPORTS AND GERMAN EMPLOYMENT? A SECTORAL-LEVEL ANALYSIS

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Abstract

This paper uses an augmented gravity model of trade to investigate the link between German development aid and sectoral exports from Germany to the aid recipient countries. The findings indicate that in the long run each dollar of German aid is associated with an average increase of 0.83 US dollars of German exports of goods. The effect varies by sector and the sectors that gain the most are machinery, electrical equipment and transport equipment. By using German input-output tables and according to our estimates, the aid-induced gains in exports generate a total employment effect of about 216,000 jobs of which 52,000 jobs are created in machinery, 20,000 in transport equipment, 24,000 in electrical equipment, 23,000 in basic metals, 10,000 in food, beverages and tobacco and 78,000 in business-related services.

Key Words: F10; F35

JEL Classification: International Trade; Foreign Aid; Germany

1. Introduction

Foreign aid is given to developing countries for a number of reasons. Poverty reduction, economic growth and the promotion of human development in the recipient countries are the main aims of development aid, as exemplified for example by the United Nations Millennium Development Goals (MDG). Meanwhile, the aid allocation literature suggests that aid is instead given for a broad set of reasons, including the promotion of historical ties and political, economic, and commercial interests (Alesina and Dollar, 2001). The developed countries and in particular, the members of the OECD-Development Assistance Committee (DAC) made a commitment in 1970 to provide higher levels of aid in order to reach the cooperatively agreed 0.7 percent target of ODA/GNI. Sixteen out of the twenty-two DAC

donors have met or agreed to meet this target by 2015. The German government is among the sixteen countries committed to increasing its official development aid to 0.7 percent by 2015. However, German ODA was below 0.4 percent of GDP until 2012 and the Development Ministry will operate a smaller budget for 2013, with 87 million Euros less than in 2012. With this budget cut, Germany will further deviate from its self-imposed target, first set more than forty years ago.

Given the mix of motivations, donors are also interested in the effects of aid on the commercial and economic relationships with receiving countries (McKinley, 1978; McKinley and Little, 1979; Berthélemy and Tichit, 2004 and Berthélemy, 2006). In this paper, we specifically investigate whether aid leads to higher exports to recipient countries. The export channel has been investigated by a number of authors from a multi-donor perspective (Wagner, 2003; Osei, Morrissey, and Lloyd, 2004), and the main results point to a non-negligible positive effect. Martinez-Zarzoso et al (2009) and Nowak-Lehmann D. et al (2009) focused on the German case and found that German foreign aid has a positive and significant effect on German exports that is more than proportional in the long run. However, this effect seems to have decreased over time. Both studies used aggregated export flows and slightly different modelling approaches, with the first using panel-data methods and the second using a time-series and cointegration approach. Based on the aid-induced export effects estimated in these papers, Albrecht et al. (2007) estimated that around 140,000 new jobs were created in Germany due to the aid-induced increase in exports. Therefore, the political move to reduce development aid during the economic crisis after 2008 could also have a detrimental effect on the economic effects of aid on German exports and subsequently on German economic activity.

In this paper, we depart from the previous literature in two main respects. First, we focus on the effect of aid on sectoral exports instead of total exports and second, we compute the sectoral employment effects due to the aid-induced increase in German exports using

input-output tables. In particular, we estimate a sectoral gravity model of German exports to 75 German partner countries (so-called BMZ) and to 132 recipients augmented with development aid for the period 1978 to 2011. Our challenge and contribution is to re-visit the export and employment effects of aid, taking a close look at the sectoral level and using up-to-date econometric techniques. Sector-specific aid elasticities will be used to compute the increase of exports by sector generated by German bilateral aid and the sectoral employment effect of German bilateral aid.

To summarize our main results, we find that in the long run each Euro of German aid is associated with an average increase of 0.83 US dollars of German exports of goods. The effect varies by sector and the sectors that gain the most are machinery, electrical equipment and transport equipment. By using German input-output tables, the gain in exports is then used to estimate the corresponding employment effects, which are also most pronounced in the three abovementioned sectors. In total about 216,000 jobs are generated through German bilateral aid.

Section 2 presents the theoretical background and reviews the recent literature on trade and aid. Section 3 presents the model specification, data sources and variables. Section 4 present and discuss the main results and outlines the computation of the derived employment effects. Finally, Section 5 presents the conclusions.

2. From Aid to Donor's Exports: Theory and Empirical Evidence

2.1. The theoretical link between aid and donor's exports

Recipient countries perceive aid as additional income that will eventually lead to an increase in demand in general and of imports in particular. This is known as the income effect of aid. More specifically, aid can be used to close the savings-investment and the foreign exchange gap thus overcoming financing constraints (Chenery and Strout, 1965). However, it has to be kept in mind that only a fraction of the aid transfer will actually be spent on domestic and

foreign goods. In fact, a certain percentage of the aid received will never reach its destination due to corruption and capital flight (Graf Lambsdorff, 2002; Kasper, 2006) or due to bad governance (Kaufmann, 2009). Another part of aid received is used to administer and allocate the aid (Easterly and Williamson, 2010) and a certain part of aid will never become effective in the recipient country but will be spent in the donor country instead. E.g. According to the definition of official development aid (ODA) many activities are considered as aid, from money spent by the donor on refugees from developing countries, political asylum seekers or students from developing countries studying in the donor country, to the salaries of donor country consultants and research on developing countries in the donor country. Finally, a certain percentage of the aid could also be saved and will therefore not be spent on imports.

Basically, the above-mentioned theoretical considerations indicate that development aid could lead to an increase in the donor's exports through the income channel (income in the recipient country rises). However, there are a few other channels through which aid could lead to increased imports from donor countries: First, there might be an export effect triggered by the fact that a considerable share of donor aid has been tied to imports from the donor country. Second, there may be habit-formation effects in the sense that donor-funded exports for aid-related projects might increase the proclivity of recipient countries to buy goods from the donor. Finally, the aid relationship promotes a trade relationship in the sense that it creates "goodwill" towards donor exporters and as donor countries might often combine aid missions and aid negotiations with trade missions, the aid relationship might "open the door" for donor exporters and lead to trade agreements.

In addition, aid might also have second-round effects that affect recipient countries' income in the medium to long run: Foreign aid might lead to a behaviour in recipient countries that favours substitution of private domestic savings with external savings that come in the form of aid (Griffin, 1970; Griffin and Enos, 1970; White, 1992; Doucouliagos and

Paldam, 2006) and to an inclination 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).

According to the international trade literature (Bergstrand, 1985, 1989) the gravity model of trade is a suitable theoretical basis to evaluate the determinants of trade in a bilateral donor-recipient framework, and more specifically to evaluate the trade-aid link. It will be used in our study to estimate the fraction of aid that will actually be spent by recipient countries on imports from the donor country. Given its structure it further allows us to control for all sorts of other possible influences, such as recipient GDP, donor GDP, bilateral aid received by other donors, exchange rate developments and the effect of free trade agreements. Moreover, it allows us to simulate recipient country imports (German exports) with and without bilateral aid received by Germany. The specification of the gravity model is discussed in Section 4.1.

2.2. Empirical literature on aid and trade

Whereas the effects of developmental assistance on the economic performance of the recipient countries have been extensively investigated in the last two decades (Morrissey, 2006), less attention has been devoted to quantifying the impact of aid on donors' exports, perhaps because it is not the main motivation for giving aid. Nevertheless, it is worthwhile examining the issue given that previous research indicates that foreign aid also promotes donor's exports. This outcome could be used as an additional political argument to devote more resources to development aid.

Early studies that investigate the impact of aid on a donor country's exports are summarized in Martinez-Zarzoso et al. (2009). We focus on the recent literature on the effect of aid on a donor's exports that takes the gravity model of trade as its main modelling framework, which is in turn augmented with development aid. Using this approach, Wagner (2003) investigated the effect of aid on trade for twenty donors to 109 recipient countries for the period 1970 to 1990. The estimated trade elasticities with respect to aid were in the range

of 0.062 for fixed-effects (FE) to 0.195 for pooled OLS specifications, respectively. These elasticities translate into average returns on donors' aid of around \$2.29 (OLS) and \$0.73 (FE) of exports per dollar of aid. Pettersson and Johansson (2013) find instead that aid increases bilateral trade flows in both directions. The authors analyse the effects from various foreign development assistance variables on the recipient as well as donor country exports and find a particularly strong relation between aid in the form of technical assistance and exports in both directions, supporting their interpretation that market knowledge through interpersonal relations is an important driver for exports. However, the authors failed to control for unobservable heterogeneity related to each bilateral relationship and this may bias the estimates, as pointed out by Nowak-Lehmann et al. (2013).

The most recent studies by Albrecht et al. (2007), Martínez-Zarzoso et al. (2009) and Nowak-Lehmann et al. (2009) on German aid also relied on a gravity model and found that German aid always had a positive and significant impact on German exports. In particular, an average return of between US\$ 1.04-\$1.50 for each US dollar of aid spent by Germany was computed based on data from 1960 to 2005 and using fixed effects panel data techniques.

In this study we also follow a gravity model framework and extend the literature by studying the effect of aid on a sectoral level, using sectoral export data and more advanced econometric techniques. In particular, we follow Shepherd (2008) in using a sectoral gravity-type model which is well suited to studying the sectoral impact of aid on trade and employment. This model allows controlling for the impact of other influences on trade such as income (which affects production capacity and preferences for variety) 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 donors (DAC members) excluding Germany.

We deviate from most previous studies not only by estimating sectoral gravity equations that are much more demanding in terms of data requirements but also by focusing

on the employments effects of aid. With this aim in mind, we use sector-specific labour coefficients to derive the multiplier and to compute the employment effect of aid for different sectors.

3. Model Specification and Estimation

3.1. The gravity model

The gravity model of trade is nowadays the most commonly accepted framework to model bilateral trade flows. Although empirical applications preceded theory (Tinbergen, 1962), a sound theoretical basis has been given to the model (e.g. Anderson, 1979; Bergstrand, 1985 and 1989; Anderson and Van Wincoop, 2003). In particular, it is nowadays widely recognized that controlling for relative trade costs is important for a theoretically-founded gravity model (Anderson and Van Wincoop, 2003; Feenstra, 2004). According to the underlying theory, trade between two countries is explained by nominal incomes, by the distance between the economic centres of the exporter and importer as a proxy for transport cost, and by a number of other factors aiding or preventing trade between them (e.g. trade agreements, common language, or a common border, are generally modelled as dummy variables to proxy for these factors).

The gravity model has been used broadly 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 German exports, we add bilateral aid from Germany as a “trade facilitator” factor and aid from other DAC countries as a “trade-deterrent” factor. We also add bilateral exchange rates⁵. In our specific empirical application we focus exclusively on exports from Germany over time to all of its trading partners. Therefore, we will specify a one-side gravity model, in which recipients are indexed by j , sectors by k and years by t . This model is estimated for each sector (15 sectors in total).

In this case the model reads as follows:

⁵ When the gravity model is estimated using panel data (with a time dimension), exchange rates are generally included as important determinants of bilateral trade flows over time.

$$LX_{jkt} = (\chi_{kt}) + \alpha_j + \beta_1 LYR_{jt} + \beta_2 LYGER_t + \beta_3 LBAID_{jt} + \beta_4 LBAIDREST_{jt} + \beta_5 LEXRN_{jt} + \beta_6 FTA_{jt} + \varepsilon_{jkt} \quad (1)$$

where L denotes variables in natural logs; X_{jkt} are the exports of sector k from Germany to country j in period t in current US\$; YR_{jt} indicates the recipient country's GDP in period t at current US\$; $YGER_t$ stands for Germany's GDP in period t in current US\$; $BAID_{jt}$ is bilateral net official development aid (net ODA disbursement) from Germany to country j in current US\$; $BAIDREST_{jt}$ represents other DAC donors' net official development aid disbursed (except Germany) to country j in current US\$; $EXRN_{jt}$ is the nominal bilateral exchange rate in monetary units of the recipient currency per Euro; FTA_{jt} takes the value of 1 when Germany has a free trade agreement in force with the destination country, j , in period t . χ_{kt} are time fixed effects that control for omitted variables common to all trade flows but which vary over time (they are sector-specific in the estimation for all sectors). Sector-specific time-fixed effects are used as a proxy for the so-called “multilateral resistance” factors modelled by Anderson and Van Wincoop (2003). They can only be included if autocorrelation is not controlled for. Therefore, they appear in brackets.

α_j are recipient specific fixed effects that proxy for time-invariant recipient country characteristics or a time-invariant bonding between Germany and the recipient country (colonial ties). When these effects are included, the influence of the dummies that vary only with the “ j ” dimension, such as distance, colonial ties or common language, cannot be directly estimated. Therefore, these variables are not included in the regression equation.

As bilateral aid (and other explanatory variables) might be endogenous (an increase in exports might increase the donor's willingness to give more aid) and feed-back on each other, the endogeneity problem has to be tackled. To control for endogeneity in a panel setting we will use the leads and lags approach that is also known as the Panel Dynamic Ordinary Least Squares procedure (PDOLS). PDOLS has been proposed by Kao and Chiang (2000) and

Mark and Sul (2003) as a means of estimating long run relationships between cointegrating variables.

3.2. 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 A.3 and A.4 in the Appendix). As indicated above, the findings of cointegration are 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 maximum of 34 years and a cross-section of 75 countries⁶, 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 the 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, p. 642). Thus, an important feature of the DOLS procedure is that it generates unbiased estimates for

⁶ Due to missing values the regressions are run with 67 countries (cross-sections).

variables that cointegrate even with endogenous regressors. The panel DOLS regression is given by (see, for example, Kao and Chiang, 2000; Mark and Sul, 2003):

$$\begin{aligned}
LX_{jkt} = & (\chi_{kt}) + \alpha_j + \beta_1 LYR_{jt} + \beta_2 LYGER_t + \beta_3 LBAID_{jt} + \beta_4 LBAIDREST_{jt} + \\
& + \beta_5 LEXNR_{jt} + \beta_6 FTA_{jt} + \\
& \sum_{p=-1}^{p=+1} \theta_{1p} \Delta LYR_{jt-p} + \dots + \sum_{p=-1}^{p=+1} \theta_{lp} \Delta LEXNR_{jt-p} + \eta_{jkt}
\end{aligned} \quad (2)$$

where $\theta_{1p} \dots \theta_{lp}$ are the coefficients of the lead and lag differences that account for endogeneity. j is recipient, k is sector, p stands for the number of lags or leads, and t is time. Δ stands for the change that happened between period t and $t-1$ (first difference of the variables analyzed). In fact, Table A.5 in the Appendix shows that there is evidence of reverse causality for at least 2 out of 7 variables in Germany's exports equation⁷ implying that it is important to deal with this endogeneity problem (using DOLS).

α_j stands for the autonomous rise or fall in exports from donor countries through time-invariant factors that characterise the recipient country involved.

We basically use two estimation techniques: First, a PDOLS two-ways fixed effects estimation with country-fixed and time-fixed effects (estimation technique 1) which, however, does not remove the autocorrelation of the disturbances. Therefore we control for autocorrelation in the errors (Table 2; estimation technique 2) by integrating a FGLS procedure into the PDOLS procedure, we estimate the model using a panel dynamic feasible generalised least squares (PDFGLS) procedure. This procedure involves the following steps: After the model has been estimated via PDOLS (first step), the residuals are saved and the autocorrelation coefficient ρ of the residuals is estimated using $\eta_{jt}^* = \eta_{jt} - \hat{\rho}\eta_{jt-1}$. The estimated $\hat{\rho}$ is then used to transform all right and left-hand side variables into soft or quasi

first differences (e.g. $LX_{jt}^* = LX_{jt} - \hat{\rho}LX_{jt-1}$; $LYR_{jt}^* = LYR_{jt} - \hat{\rho}LYR_{jt-1}$; ...

⁷Exports and donor income were found to stand in a *direct* bi-directional relationship. Bilateral aid (LODA) and recipient income (LYR) stand in an *indirect* bi-directional relationship with exports which operates through donor income.

$LBAID_{jt}^* = LBAID_{jt} - \hat{\rho}LBAID_{jt-1}; \dots$) . In the second step, equation (2) is re-estimated by replacing the original variables with the soft differences.

3.3. Data sources and variables

Official Development Aid data are from the OECD Development Database on Aid from DAC Members⁸. We consider net ODA disbursements in current US\$, 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. Bilateral exports are obtained from the UN COMTRADE database. Data on income variables are drawn from the World Bank (World Development Indicators Database, 2011). Bilateral exchange rates are from the IMF statistics. Distances between capitals have been computed as great-circle distances using data from CEPII. The FTA variable has been constructed using data from the World Trade Organization and programs provided by De Sousa (2012). Table A.1 (Appendix) shows summary statistics for the main variables included in the empirical model.

4. Main Results

4.1 Sectoral-gravity estimation results

The model is estimated for data on German sectoral exports and development aid (ODA) to 75 BMZ countries and a larger sample of 132 recipient countries during the period from 1978 to 2011. Sectoral regressions have been run for 15 sectors using both a specification with time fixed effects and a control for autocorrelation based on the Feasible Generalized Least Squares (FGLS) technique⁹. The results from estimating the model for all sectors (last row of Table 1) show that the elasticity of trade with respect to aid is 0.062, which implies that the average return on aid for German exports is approximately a 0.83 US dollar increase in

⁸www.oecd.org/dac/stats/idsonline.

⁹ The Durbin-Watson statistic reveals that the technique that controls for autocorrelation (DFGLS) is clearly superior to the DOLS technique with time fixed effects (results available upon request). The latter technique is not able to control for serial correlation of the disturbances thus violating the assumptions of the Ordinary Least Squares (OLS) technique.

exports for every dollar spent on aid. The effect is similar to that calculated by Martinez-Zarzoso et al. (2009) using total exports. Figure 1 shows the evolution over time of the aid coefficients in the gravity model by interacting them with specific time dummies. The point estimates (bold line) and the corresponding confidence intervals at the 95 percent confidence level are depicted.

Focusing on the results generated for each sector using the DFGLS technique, we find that German bilateral aid had a positive and significant impact on German exports to the recipient countries in seven (in bold) out of fifteen sectors (Table 1). The benefitting sectors comprise: food, beverages and tobacco, non-metallic minerals, basic metals, non-electrical machinery, electrical equipment, transport equipment and coke & refined petroleum.

Most of the sectors that do not profit from aid, i.e. the sectors with insignificant aid coefficients, come as no surprise: Agriculture, hunting, forestry and fishing; textiles; leather; wood and products of wood; pulp and paper; rubber and plastics; other non-classified manufacturing. Within these sectors Germany clearly does not enjoy a competitive advantage (in terms of price competitiveness) when exporting to developing countries. Perhaps, one might have expected a positive and significant increase of chemical exports due to an increase in bilateral aid but here emerging economies (such as Brazil) might be more (price) competitive in developing countries' markets and outperform suppliers such as Germany.

Table 1. The impact of aid on German exports. Sectoral results

4.2. Computing sectoral exports and employment effects

In the preceding section we obtained a robust positive and significant effect of bilateral German aid on German exports (total exports) for the 1973-2011 period. Thus, one might wonder how this positive effect is distributed among sectors, i.e. which sectors profit most and which sectors least or not at all, and finally how these sectoral export effects translate into employment effects.

To this purpose, we collect sectoral export data (at the 2-digit level) from the UN-COMTRADE database using the Standard International Trade Classification (SITC Rev. 2). The 99-SITC sectors are then merged into sixteen sectors according to the International Standard Industrial classification (ISIC)¹⁰ used in the German input-output tables. They contain export as well as employment data (see concordances in Appendix Table 3). The ISIC-specific employment (labour) coefficients are computed based on 2009 figures, which reflect the latest available input-output data.

Sectoral export effects due to German bilateral aid can be either simulated¹¹ based on DFGLS regression coefficients or computed by multiplying the sectoral aid coefficient (only significant coefficients are used) with either average exports of the 2000-2011 period to produce conservative estimates or with the exports of 2009 which is the last available year in the input-output tables. The latter results are more up-to-date but are subject to the financial crisis that shattered the German economy.

When the elasticities of exports with respect to aid (aid elasticities = beta coefficients) were insignificant, no export and employment effects were calculated and the corresponding values were set to zero. Additional exports due to aid amounted to 23.7 billion US dollars using 1973-2011 averages or 27.4 billion US dollars relying on 2009 data (see Table 2).

Table 2. Sectoral exports and employment effects generated by German bilateral aid

¹⁰ Since there are no exports in the mining and quarrying sector, only computations for 15 sectors are shown.

¹¹ The value of exports is simulated with and without German bilateral development aid.

The computation of the employment effects required the application of input-output analysis (I-O-A) techniques¹². Additional sectoral exports due to aid ($\Delta export$) had to be transformed into additional sectoral gross output ($\Delta output$) given that an increase in final demand requires production of intermediates whose production in turn also requires intermediates (and so forth). The required production of intermediates leads to the multiplier effect of production for final demand (i.e. to produce 1 unit of exports the economy in question has to produce more than 1 unit of gross output to accommodate the production of intermediates). The multiplier is of the form $(I-A)^{-1}$, I denotes the identity (unit) matrix and A contains the input coefficients that result from the input-output tables.

$$\Delta output = (I - A)^{-1} \Delta export \quad (3)$$

After having computed the change in sectoral gross output that has been triggered by a change in exports, the sectoral employment effects of aid can be calculated according to,

$$\Delta jobs = job_multi * \Delta output \quad (4)$$

The input-output-analysis rests on several assumptions:

- (i) Each sector in the economy produces only one product
- (ii) There is no substitution between intermediate inputs
- (iii) The production function is linear; we have constant returns to scale; if we double intermediate inputs we double intermediate output
- (iv) Final demand is exogenous
- (v) Primary inputs are abundant; i.e. labor is abundant and available with the adequate mix of skills
- (vi) No stocks; if final demand rises, there are no stocks that could be depleted

¹² We would like to thank Bart Los (University of Groningen Europe's leading institution in input-output-analysis) for his assistance.

In particular, there are pronounced employment effects in non-electrical machinery, transport equipment, electrical equipment, basic metals and food and business-related services (renting of machinery and equipment; retail trade & repair of household goods; wholesale trade). About 52,000 jobs are created in non-electrical machinery, 20,000 in transport equipment, 24,000 in electrical equipment and basic metals, and another 10,000 jobs are created in food, beverages and tobacco and about 78,000 in business-related services. In total in between 24 to 27 billion of US\$ are generated in additional exports which translates into a total job effect of about 216,000 jobs (conservative estimate based on 2009 figures).

5. Conclusions

This paper investigates the relationship between sectoral German exports and foreign German aid and computes the employment effects stemming from the growth in exports due to development aid. The main results indicate that German aid has a huge positive effect on German sectoral exports and that for a number of sectors the employment effects due to aid are economically important. Although the aid effect is not as large as predicted by previous studies, it is still relevant. Our findings indicate that the average return for exports of German aid is about a 0.83 US dollar increase in exports for every dollar spent for BMZ countries. Second, this effect differs by sector. Substantive export effects are generated in non-electrical machinery, transport equipment, electrical equipment, basic metals and food and business-related services. Third, by using input-output techniques, the gain in exports is translated into the corresponding employment effects, which are most pronounced in non-electrical machinery, transport equipment, electrical equipment, and basic metals. In total about 216,000 jobs are generated through German bilateral aid following conservative estimates.

This investigation and the related literature suggest that the impact of aid on trade depends on the type of products traded and the export strength in the respective sectors. It is

also discernible that the impact of aid can change over time but there is no evidence of a constant decline of aid elasticities after 2002 when most of the aid had been untied.

The relationship between sectoral trade and aid could be more closely analyzed by using more donor countries, or focusing on country case studies for other donors. This would give us some information on how far a gain in donors' exports is driven by the export structure of benefitting donors or determined by the specific choice of recipient countries.

TABLES

Table 1. The impact of aid on German exports. Sectoral results

| Sector | Aid coeff. | t-value | R sq. adj. | D.W. stat. |
|---|----------------|---------------|-------------|-------------|
| Food, beverages, tobacco | 0.24*** | (3.17) | 0.92 | 2.16 |
| Non-metallic minerals (glass, products of glass etc.) | 0.12*** | (3.06) | 0.96 | 2.22 |
| Basic metals | 0.11*** | (2.45) | 0.96 | 2.07 |
| Non-electrical machinery | 0.13*** | (3.72) | 0.96 | 2.05 |
| Electrical equipment | 0.10*** | (2.74) | 0.98 | 2.16 |
| Transport equipment | 0.14*** | (2.52) | 0.95 | 2.13 |
| Coke, refined petroleum | 0.18*** | (2.46) | 0.95 | 2.09 |
| Agriculture, hunting, forestry and fishing | 0.07 | (0.90) | 0.85 | 2.18 |
| Textiles | -0.05 | (-1.00) | 0.97 | 2.09 |
| Leather | -0.05 | (-0.89) | 0.93 | 2.02 |
| Wood, products of wood | 0.09 | (1.13) | 0.92 | 2.07 |
| Pulp, paper | -0.14*** | (-3.37) | 0.96 | 2.17 |
| Chemicals | 0.03 | (1.00) | 0.98 | 2.3 |
| Rubber, plastics | -0.02 | (-0.44) | 0.96 | 2.24 |
| Manufacturing, nec. | -0.02 | (-0.44) | 0.95 | 2.12 |
| All Sectors | 0.062** | (2.06) | 0.95 | 2.04 |

Note: T-values are in brackets.*** p<0.01, ** p<0.05, * p<0.1. All regressions contain controls for recipient GDP, donor GDP, bilateral aid given by non-German DAC countries, bilateral nominal exchange rates, and a trade agreement dummy. Data are annual and run from 1978 to 2011. Dynamic Feasible Generalized least Squares (DFGLS) estimation techniques were used. FE (recipient-country dummies) are always used as controls. The Durbin-Watson statistic (D.W. stat) indicates that this technique tackle the autocorrelation problem. Endogeneity of all regressors is always controlled for by means of the leads and lags approach, also known as DOLS estimation. By imposing FGLS on the DOLS estimation the latter is transformed into a DFGLS estimation which removes serial correlation of the disturbances. The DFGLS procedure controls for cross-section heteroskedasticity. Figures in bold indicate the selected aid-coefficients used to calculate employment effects.

Table 2. Sectoral exports and employment effects generated by German bilateral aid

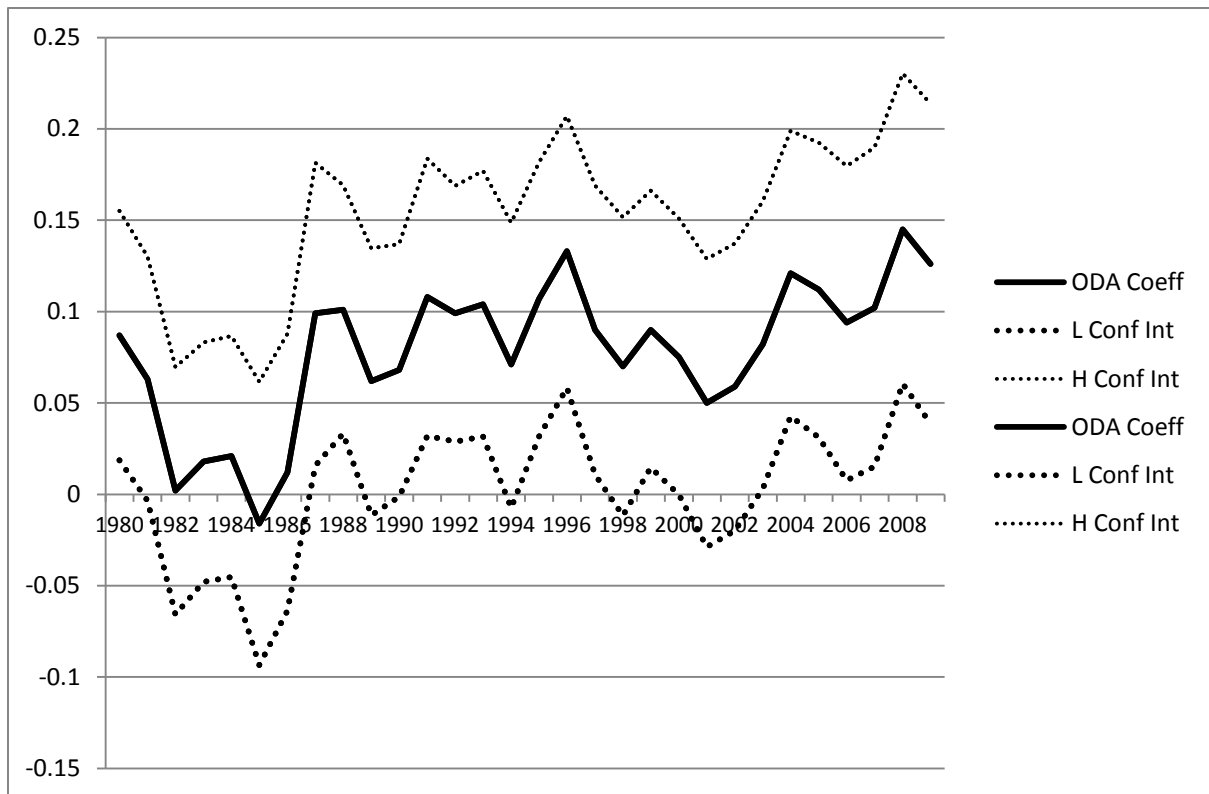
| Sector | Aid Coeff. (1) | Average Annual Exports* (2) | Exports 2009 (3) | Export effect * (4) | Export Effect 2009 ** (5) | Labor input coeff. 2009 (6) | Employment effect 2009** (7) |
|--|----------------------|--------------------------------------|------------------------|---------------------------|------------------------------------|---|---------------------------------------|
| Food, beverages, tobacco | 0.24 | 5.50E+09 | 8.00E+09 | 1.32E+09 | 1.92E+09 | 4.76 | 10,184 |
| Non-metallic minerals(glass, products thereof) | 0.12 | 3.00E+09 | 3.43E+09 | 3.60E+08 | 4.12E+08 | 5.00 | 2,887 |
| Basic metals | 0.11 | 2.26E+10 | 2.64E+10 | 2.49E+09 | 2.90E+09 | 4.15 | 23,331 |
| Non-electrical machinery | 0.13 | 7.25E+10 | 8.25E+10 | 9.43E+09 | 1.07E+10 | 4.26 | 52,180 |
| Electrical equipment | 0.1 | 3.62E+10 | 4.27E+10 | 3.62E+09 | 4.27E+09 | 4.59 | 23,821 |
| Transport equipment | 0.14 | 4.25E+10 | 4.61E+10 | 5.95E+09 | 6.45E+09 | 2.49 | 19,784 |
| Coke, refined petroleum | 0.18 | 2.76E+09 | 3.77E+09 | 4.90E+08 | 6.79E+08 | 0.25 | 0,226 |
| Agriculture, hunting, forestry, fishing | n.s. | 3.34E+09 | 4.98E+09 | --- | --- | 6.71 | 2,121 |
| Textiles | n.s. | 8.16E+09 | 8.91E+09 | --- | --- | 5.79 | 0,043 |
| Leather | n.s. | 1.25E+09 | 1.49E+09 | --- | --- | 6.92 | 0,004 |
| Wood, products of wood | n.s. | 1.09E+09 | 1.21E+09 | --- | --- | 5.07 | 0,354 |
| Pulp, paper | --- | 5.28E+09 | 6.37E+09 | --- | --- | 5.04 | 0,885 |
| Chemicals | n.s. | 2.27E+10 | 3.08E+10 | --- | --- | 2.52 | 0,288 |
| Rubber, plastics | n.s. | 8.96E+09 | 1.02E+10 | --- | --- | 5.41 | 2,050 |
| Manufacturing, nec | n.s. | 2.26E+10 | 3.53E+10 | --- | --- | 5.02 | 0,413 |
| Mining (no exports) | --- | --- | --- | --- | --- | | 0,220 |
| Total_goods | | | | | | | 138,789 |
| Total service (not reported)s | | | | | | | 77,662 |
| Total | --- | 258E+09 | 312E+09 | 23.7E+09 | 27.4E+09 | --- | 216,451 |

Note: Sectors are classified according to the International Standard Industrial Classification (ISIC) revision 3.1. Figures are computed based on the input-output table for Germany in 2009 (WIOD, available at: www.wiod.org). * based on the 200-2011 average. ** based on the year 2009. Δ exports denotes exports in US\$ generated by German bilateral aid. Δ employment denotes number of jobs generated by German bilateral aid. Δ exports** and Δ employment** have been computed based on 2009 data. The labour input coefficient indicates the number of employees (in thousands) that are necessary to produce an output value of one billion of US\$. Total output and total employment (in 2009) needed to compute the labor input coefficients are from the German input-output Tables (WIOD). Total exports are in current US\$ and total employment in number of employees.

Table 3. Concordance between SITC and ISIC classification

| SITC Rev. 2 (2-digit) | Input-Output Table for 2009, ISIC Rev. 3.1 | | |
|--------------------------------------|---|--|--------|
| 00+03+04+05+08+22+29 | AtB | Agriculture, Hunting, Forestry and Fishing | 1 |
| extraction is not exported | C | Mining and Quarrying | 2 |
| 01+02+06+07+09+11+12+41+42+43 | 15t1 6 | Food, Beverages and Tobacco | 3 |
| 26+65+84 | 17t1 8 | Textiles and Textile Products | 4 |
| 21+61+85 | 19 | Leather, Leather and Footwear | 5 |
| 24+63 | 20 | Wood and Products of Wood and Cork | 6 |
| 25+64 | 21t2 2 | Pulp, Paper, Paper , Printing and Publishing | 7 |
| 32+33+34+35 | 23 | Coke, Refined Petroleum and Nuclear Fuel | 8 |
| 27+51+52+53+54+55+56+59 | 24 | Chemicals and Chemical Products | 9 |
| 23+57+58 | 25 | Rubber and Plastics | 1 0 |
| 66 | 26 | Other Non-Metallic Mineral | 1 1 |
| 28+67+68+69 | 27t2 8 | Basic Metals and Fabricated Metal | 1 2 |
| 71+72+73+74+75+76 | 29 | Machinery, Nec | 1 3 |
| 77+87+88 | 30t3 3 | Electrical and Optical Equipment | 1 4 |
| 78+79 | 34t3 5 | Transport Equipment | 1 5 |
| 81+82+89+93 | 36t3 7 | Manufacturing, Nec; Recycling | 1 6 |

FIGURES**Figure 1. Time-specific aid coefficients and confidence bands**



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