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More than Meets the Port:
Donor Export Effects of Foreign Aid Revisited

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Abstract

Despite growing fiscal pressures and public scrutiny of aid spending, the domestic returns from official development assistance (ODA) remain understudied, particularly for services trade. This paper examines how bilateral ODA from five different European donors –Denmark, Germany, the Netherlands, Norway and Sweden– affects their exports to recipient countries over the period 2005-2024. Using a gravity model specification estimated with panel dynamic feasible generalised least squares, we mostly find robust positive aid-trade elasticities that hold across goods and services sectors. ODA variables retain explanatory power after controlling for Aid-for-Trade shares, suggesting that indirect channels, such as economic development and goodwill, persist next to direct procurement. These findings provide evidence for the benefits of aid for donor countries. When recipient countries are analysed separately by political importance or income level, evidence suggests that the aid-trade-link is mainly driven by larger emerging economies as the effect of aid for poorer countries yields comparable point estimates yet translates into smaller economic returns. Further analysis also shows heterogeneity by donor in terms of domestic effects. The underlying causes for the differences remain to be explored.

Key words: foreign aid, international trade, services trade

JEL: F10, F35, F63

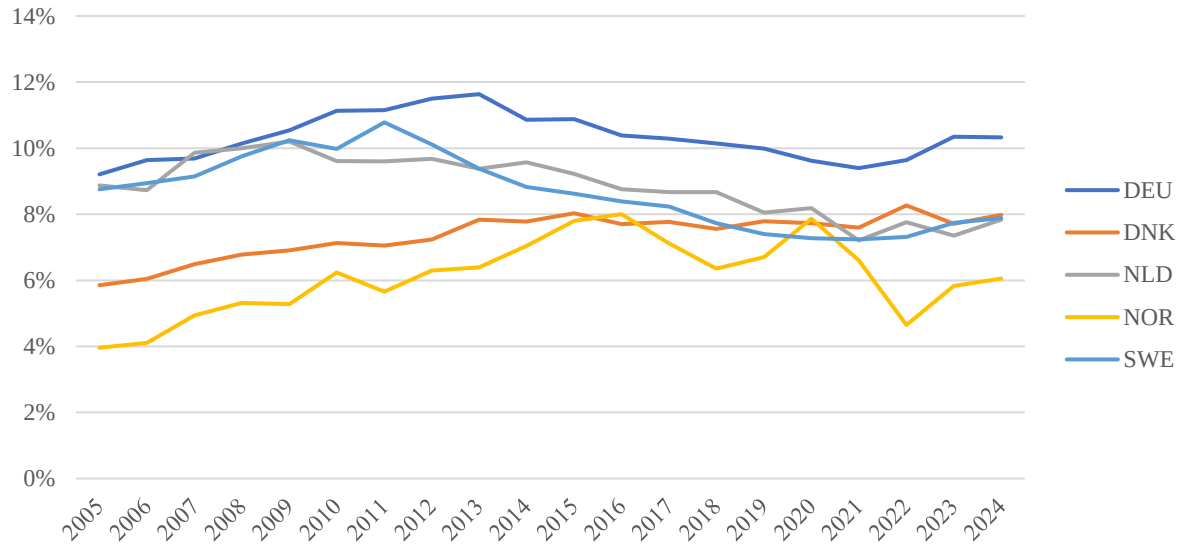
1 Introduction

The main objective of development aid is to contribute meaningfully to the progress of developing countries. Its focus extends beyond addressing immediate needs—such as hunger relief, malnutrition eradication, poverty reduction, and disease control—to supporting long-term development through investments in economic and social infrastructure to boost production and competitiveness (Werker et al., 2009). Yet foreign aid has also long been recognised as a tool that equally serves donors' strategic economic interests, particularly through its impact on bilateral trade flows (Martínez-Zarzoso et al., 2014; Wagner, 2003; among others). Empirical evidence also supports positive aid-trade elasticities for Aid-for-Trade (AfT), which promotes donor exports via tied arrangements, goodwill effects, and infrastructure improvements that lower trade costs (Cali and Te Velde, 2011; Hühne et al. 2014; Martínez-Zarzoso et al., 2017). Yet compared to the recipient-country effects of ODA (Nowak-Lehmann et al., 2013), the *domestic* effects of foreign aid remain poorly understood.

Given the growing scrutiny of aid expenses in major donor countries in 2025 and the increasing fiscal pressure on public budgets, the interest in donor country effects of aid has been growing rapidly. To properly inform a public debate on how to redesign aid in a more mutually beneficial way, there is a need for a better understanding of the potential domestic effects of ODA. While such mutual interest can have multiple dimensions—see Heidland et al. (2025) for a well-structured overview—this paper focuses on the effects of aid on donors' exports—and in turn on domestic employment and economic growth for five donor countries, namely: Denmark, Germany, the Netherlands, Norway and Sweden. These pool of donors is selected to have a diverse representation of north-European countries of different economic size and aid motives. For instance, Germany is a big donor, as well as an important exporter in the world economy, whereas the Netherlands is also an important exporter but with comparative advantage in different sectors as Germany. The three Nordic donors are well known for their high share of ODA as a percent of GNI and for their prevalent altruistic motives when giving aid.

As Figure 1 shows, exports from donor countries to ODA recipient countries can account for between 5-12 % of total exports, after excluding trade with China. Hence, a better understanding of the impact ODA can have on this relationship could unlock a significant trade potential.

Figure 1: Share of trade (goods and services) with ODA-recipients between 2005 and 2024 without China



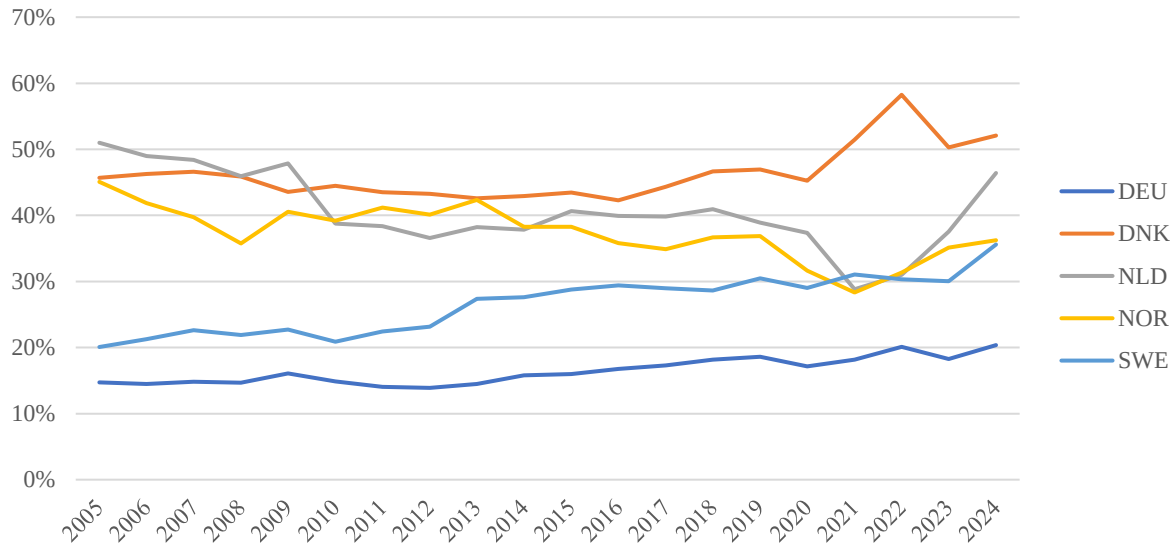
In this paper, we build on important prior work regarding the aid-trade nexus. Existing studies on the effect of foreign aid on trade for a pool of donors suggest positive but varying effects of bilateral ODA on donor exports, driven partly by tied-aid arrangements that channel procurement to donor-country firms (e.g. Martínez-Zarzoso et al. 2016; Silva and Nelson 2012). Untying mandates have attenuated this linkage (Martínez-Zarzoso et al. 2014), though with notable exceptions—Japan, known for reluctant compliance, saw long-run returns rise from USD 1.41–1.86 to USD 2.03–2.62 per aid dollar after 1992, without corresponding recipient export gains (Otor 2014). In Germany's case, for every euro of German development aid, there was an estimated return of EUR 0.83 in increased exports (period 1973-2011). Overall, bilateral aid from Germany was estimated to have generated between EUR 24 and EUR 27 billion in additional exports (Martínez-Zarzoso et al., 2016). This trade boost was also linked to job creation, contributing to at least 216,000 jobs (based on 2009 figures). In the Dutch case, each dollar of aid disbursed between 1964 and 1999 generated an estimated return of USD 0.26 to USD 0.40 (Martínez-Zarzoso et al., 2017). However, this effect weakened significantly for the 2000–2011 period, when fewer countries—only 33—maintained substantial bilateral aid ties with the Netherlands. For all donors on average, according to Martínez-Zarzoso et al. (2014), the increase in the amount of donors' exports flowing from donors' aid was around USD 0.50 for every aid dollar spent in the short run. For a focus on recipient country's exports, see Nowak-Lehmann et al. (2013).

The 2005 WTO Aid-for-Trade (AfT) initiative—targeting economic infrastructure, productive capacity, and trade facilitation—has produced further mutual benefits, robustly boosting recipient exports via supply-side improvements (Vijil and Wagner 2012; Hühne et al. 2014; Cali and te Velde 2011; Martínez-Zarzoso et al. 2017). Donor exports benefit similarly: Hühne

et al. (2014) estimate that doubling AfT raises donor-to-recipient imports by ca. 3% (and recipient-to-donor exports by ca. 5%), also Nishitateno and Umetani (2023) document strong average effects (elasticity 0.01 across 45 donors, 2002–2019). Crucially, substantial donor heterogeneity emerges: Japan's AfT elasticity reaches 0.021 (based on mean export and AfT variables during the period of interest, this yields USD 1.1 exports per USD 1 AfT), France's is 0.008 (USD 0.6 exports), and effects are insignificant for Germany, the US, and the UK.

Notwithstanding these advances, some gaps persist in the literature. First, empirical work has overwhelmingly centred on merchandise trade, overlooking services. This is despite services by now making up 15–50 % of export flows from donors to ODA recipients, as Figure 2 shows. For some donor countries, notably Germany, Denmark and Sweden, the share of services exported to ODA recipients has even seen a slow but sustained increase over time. This stands in contrast to the relative decline in importance of exports to ODA recipients after 2010, as apparent from Figure 1. Also, services trade may generally respond differently to aid due to distinct infrastructure needs. For instance, Hoekman and Shingal (2020) report negative AfT-services elasticities, suggesting that services do not necessarily follow the same trade-promoting patterns as goods. Focusing on goods exports hence risks biasing established elasticities downward or upward, depending on the services' sensitivity. Second, recent analyses disproportionately emphasise AfT, leaving the trade impacts of broader ODA (e.g., social sectors, governance aid) underexplored.

Figure 2: Share of trade in services with ODA-recipients within total services trade without China



To address these gaps, the present study includes both trade in goods and trade in services at the aggregated and disaggregated level. Also, by adding AfT as a control variable, the study opts to analyse the effects of ODA in general, thereby covering the more indirect effects that

lead to additional donor-country exports. Moreover, sectoral estimates are used together with input-output multipliers to compute employment and value-added effects of ODA for the five donor countries under study.

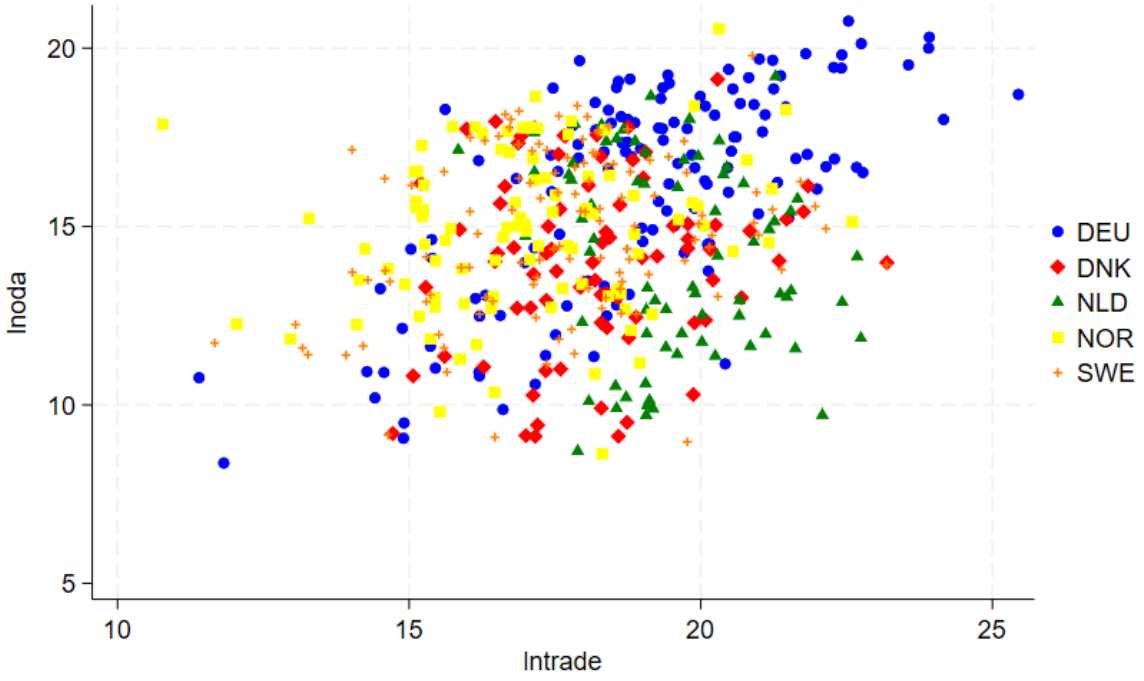
The main results show that ODA is associated for most donors with increases in their exports. These effects are robust to controlling for AfT and hold when including trade in services. Results further point to differences between industrial sectors when it comes to the export effect of aid, with some sectors showing relatively large effects, while for other sectors no concluding effects could be stablished.

The rest of the paper is structured as follows: we frame our conceptual model in Section 2. Section 3 introduces the dataset used and our model specifications. We generally start from a basic bilateral specification of an aid-trade model and step-by-step expand it to a multi-sector, multi-donor setup. In Section 4, we present our results for aggregated and sectoral trade flows. Finally, in Section 5, we discuss the main results to conclude and outline avenues for further research in Section 6.

2 Conceptual Framework

Bilateral aid and bilateral trade, in our case exports from donor to recipient, are positively linked. A visual inspection shows their correlation, as presented in Figure 3.

Figure 3: Scatter plot of bilateral aid and trade (both in logs) between donors and recipients in 2024



For a conceptual understanding of this link, we follow the definition of Wagner (2003) and differentiate between direct and indirect effects, expanding its original scope with more recent findings: while direct effects of aid on trade are observable and can be causally related to aid-financed projects, indirect effects are more difficult to measure—and equally more difficult to prove (with a causal interpretation) and communicate to a voter audience (in a political setting).

There are several potential types of *direct* effects:

a) *Tied aid.* ODA can be understood as a financial transfer to a recipient country. When capital flows in, the recipient country can afford to import more. If such a transfer is conditional on, or 'tied', to a procurement from the donor country, one can directly link the additional export to an underlying development project. Such tied aid was the norm in the early days of post-war international cooperation but has gradually been reduced to a minor role for most DAC donors. Still, governments (e.g., Germany's Federal Ministry for Economic Cooperation and Development 2026) are openly reconsidering the adoption of tying practices to secure domestic effects from international development cooperation.
b) *Informal tying.* Closely connected to direct effects, donors can decide to spend aid without strings attached but earmark it for projects or sectors in which they have a comparative advantage (Wagner, 2003). In such a case, the individual export contract is eventually not directly linked to an ODA project.
c) *Aid for trade (AfT).* When ODA projects do not directly translate into export contracts but arguably have an immediate and positive effect on overall bilateral trade flows, such aid is referred to as AfT. Examples include customs training or investments in trade infrastructure (Martínez-Zarzoso et al., 2017).

Focusing solely on direct links overlooks *indirect* effects. Here, possible transmission mechanisms are:

d) *Economic development.* If aid is spent well, it can lead to economic growth in the recipient countries. This growth can, in turn, increase a recipient country's import capacity, leading to further imports from donor countries. Please refer to the extensive body of aid-effectiveness literature (e.g., Dreher and Langlotz (2020), Galiani et al. (2017)) that studies the effect of aid on economic growth.
e) *Habit formation.* With a persistent presence of ODA projects in a recipient country, acceptance and familiarity with citizens and products from a donor country can lead to follow-up exports (Osei et al., 2004; Silva and Nelson, 2012).

f) *Reduced information asymmetry*. Just as with habit formation, once a trade link between donor and recipient has been established, this eases future transactions. This might partly be attributable to a reduction in information asymmetry between donor and recipient due to aid financed projects (Wagner, 2003).
g) *Goodwill.* With ODA from a certain donor, recipients might feel more inclined to consume products from the donor country—be it to secure future aid flows or because firms and consumers generally develop a positive attitude towards the donor economy (Wagner, 2003).

To gauge the combined effect that aid can have on exports, econometric methods are necessary to identify the effect of variations in ODA on exports over time and by donor country. Furthermore, both direct and indirect channels have in common that restricting their logic to trade in merchandise seems insufficient. Still, this is what most prior studies have been practising, often limited by the availability of reliable and consistent data on trade in services.

Given the political prominence of questions about the domestic effects of aid, we reexamine the evidence on the aid-trade nexus using more recent years, specifically for donor countries exports. In doing so, we consider both direct and indirect effects, relying on aid measures and controlling for AfT shares. Also, we aim to test to what extent prior findings on aid and trade can also be extended to trade in services.

3 Data & Methods

To study the impact of foreign aid on exports, we focus on net ODA and within this category on two types of aid, namely bilateral ODA disbursements (net of debt relief) from a set of European donors *i* to recipient countries *j* (*oda*) and the sum of bilateral aid (again net of debt relief) given by all *remaining* OECD DAC donors to *j* (*odadacr*). We take a yearly view over 2005-2024 (*t*). As focus countries, we chose a group of northern European donors: Denmark (DNK), Germany (DEU), the Netherlands (NLD), Norway (NOR), and Sweden (SWE). This choice allows for comparison of different donor behaviour, for example, the Netherlands follows a relatively trade-oriented ODA policy (IOB, 2014), while the Nordic countries have a reputation for especially altruistic ODA allocation (Mahamed, 2025). As Europe's largest donor and the largest exporter in absolute terms, we take a special interest in Germany. For a list of recipient countries, please refer to Appendix 3. We hence estimate aid-trade elasticities for five structurally diverse European donors and 106-138 recipients, yielding about 1,000-2,300 bilateral observations per donor. We cover a period from 2005 until 2024; this recent period addresses post-untying dynamics absent from earlier studies.

In determining exports from *i* to *j*, aid is only one factor among many. To account for established determinants of bilateral trade, we analyse the aid-export relationship within the framework of the gravity model of trade, the widely accepted workhorse model in international trade theory. The gravity model of trade was primarily established and refined by Anderson (1979), Bergstrand (1985 and 1989), Helpman (1987), Deardorff (1998), Feenstra et al. (2001), Anderson and van Wincoop (2003), and Haveman & Hummels (2004). Recent advances concerning the estimation of gravity models are reviewed in Yotov (2024). Using a gravity model of trade, we can evaluate and quantify the impact of aid on bilateral exports from donor *i* to country *j* at time *t*, controlling for a variety of factors related to trade frictions, the business cycle, level of development, bilateral exchange rates, etc. In our model set-up, we add bilateral aid from country *i* as a "trade facilitator" and aid from other DAC countries as a "trade-deterrent" factor. When the model is applied to a single donor, we refer to a one-sided gravity model.

The baseline specification is a log-log version of a one-sided gravity model that accounts for economic mass and trade costs (via income, exchange rate, and a bilateral free trade agreement (FTA- dummy), while absorbing time-invariant variables such as distance, shared language, or a colonial history via country fixed effects. The baseline specification is given by:

$$\ln Exports_{jt} = \alpha_j + \chi_t + \beta_1 LnODA_{jt} + \beta_2 LnODADACR_{jt} + \beta_3 lnIncome_{jt} + \beta_4 lnExchangeRate_{jt} + \beta_5 FTA_{jt} + \varepsilon_{jt} \quad (1)$$

where in a respective bilateral donor-recipient set-up α_j denotes recipient-fixed effects and χ_t time-fixed effects. ε_{jt} is an error term. The coefficient of interest, β_1 represents the elasticity of exports with respect to donor i's bilateral aid. See Appendix 2 for variable definitions.[1]

For a more comprehensive estimation framework that accounts for dynamics and endogeneity issues, we add leads and lags of the first-differenced explanatory variables to the log-log specification in (1). We rely on a Panel Dynamic Feasible Generalised Least Squares (PDFGLS) estimator, a method designed to account for potential endogeneity, for example, trade influencing aid allocation in the first place. PDFGLS is based on a linear gravity model, applying a Panel Dynamic Ordinary Least Squares procedure (PDOLS) as by Kao and Chiang (2000) and Mark and Sul (2003). It accounts for a cointegrating long-run relationship extending model (1) with leads (*t+p*) and lags (*t-p*) of the first differenced target and control variables in the model, as given by:

[1] The results from estimating equation (1) are presented in Appendix 4 for comparative purposes.

$$lnExports_{jt} = \alpha_j + (\chi_t) + \delta_1 lnODA_{jt} + \delta_2 lnODADACR_{jt} + \delta_3 lnIncome_{jt} + \delta_4 FTA\_Dummy_{jt} + \delta_5 lnExchangeRate_{jt} + \sum_{p=-1}^{p=+1} \theta_{1p} \Delta lnIncome_{jt-p} + \ldots + \sum_{p=-1}^{p=+1} \theta_{lp} \Delta lnExchangeRate_{jt-p} + \varepsilon_{jt} \quad (2)$$

where in a respective bilateral set-up, ODA denotes bilateral aid from donor *i* to recipient *j* at time *t*. The coefficient of interest, δ_1 represents the elasticity of exports with respect to donor *i*'s bilateral aid. θ_{1p} and θ_{1p} are the coefficients of the lead and lag differences, where *p* indicates the number of leads or lags. Δ stands for the first difference of the variables. α_j stands for characteristics of the recipient country through time-invariant factors. Note that time effects χ_t, can only be included if autocorrelation is not controlled for. ε_{jt} is an error term. See Appendix 2 for variable definitions.

As we detect autocorrelation in the disturbances, we control for it in the errors by integrating a Panel Dynamic Feasible Generalised Least Squares (FGLS) procedure into the PDOLS procedure. This involves the following steps: After the model has been estimated via PDOLS (the first step), the residuals are saved, and the autocorrelation coefficient ρ of the residuals is estimated using $\eta_{ijt} = \rho\eta_{ijt-1} + v_{ijt}$. A new error term is generated $\eta^*_{ijt} = \eta_{ijt} - \hat{\rho}\eta_{ijt-1}$ which has all desirable properties. The estimated $\hat{\rho}$ is then used to transform all right- and left-hand-side variables into soft or quasi-first differences. In the second step, equation (2) is re-estimated by replacing the original variables with the soft differences. This whole procedure is referred to as PDFGLS.

We first estimated model (2) using aggregated trade flows by donor, recipient, and year. To better understand how the effects of aid differ within a donor and across sectors, we also estimate model (2) using sectoral data. For this, we convert HS 2002 6-digit-level data on trade in goods and EBOPS 2-digit-level data on trade in services to the International Standard Industrial Classification (ISIC, 2-digit) to facilitate better comparison with previous studies. We estimate our model for 40 industrial sectors separately, following the PDFGLS procedure described above. Results on the effect of aid on trade also allow us to translate the aid-induced effects for exports into more tangible estimates for jobs and value-added creation using input-output analysis. We will detail the steps of input-output analysis in Section 4.

Applying the model as introduced above, we find a varying effect of aid on donor exports. To validate how far the effects between different donors are statistically different from one another,

we re-estimate model (2) in a multi-donors set-up including donor-specific coefficients for bilateral ODA:

$$LnExports_{ijt} = \alpha_{ij} + (\chi_t) + \delta_{1i} lnODA_{ijt} + \delta_2 lnODADACR_{ijt} + \delta_3 lnIncome_{it} + \delta_4 lnIncome_{jt} + \delta_5 FTA\_Dummy_{ijt} + \delta_6 lnExchangeRate_{ijt} + \sum_{p=-1}^{p=+1} \theta_{1p} \Delta lnODA_{ijt-p} + \ldots + \sum_{p=-1}^{p=+1} \theta_{lp} \Delta lnExchangeRate_{ijt-p} + \eta_{ijt} \quad (3)$$

where in a multi-donor set-up, ODA denotes bilateral aid from donor *i* to recipient *j* at time *t*. The coefficient of interest, $\delta_{1\mathrm{i}}$ represents the elasticity of exports with respect to donor *i*'s bilateral aid. θ_{1p} and θ_{1p} are the coefficients of the lead and lag differences, where *p* indicates the number of leads or lags. Δ stands for the first difference of the variables. α_j stands for characteristics of the recipient country through time-invariant factors. Note that time effects χ_t, can only be included if autocorrelation is not controlled for. ε_{jt} is an error term. See Appendix 2 for variable definitions.

Considering the recent developments in estimation techniques in the gravity model framework, we use a Pseudo-Poisson Maximum Likelihood (PPML) specification as a robustness check. It is specified with recipient and year fixed effects, following Santos Silva and Tenreyro (2006) and as recommended by Yotov (2024). PPML comes with three advantages: first, trade data often exhibit heteroskedasticity (the variance of the error term varies with the regressors). PPML provides consistent estimates under these conditions. Second, trade data often involves zero trade flows when two countries did not trade in a specific sector each year. PPML can generally handle zeros in the estimation, preserving the full information set (Santos Silva and Tenreyro 2022). Third, PPML also allows for the inclusion of several sets of fixed effects to control for unobserved heterogeneity, such as time-invariant recipient characteristics or the general business cycle (year fixed effects). In our case, we include recipient and year fixed effects in the bilateral analysis. A PPML model for an aid-trade gravity set-up can be specified as follows, with the logic following the more intuitive model (1) yet now as an exponential function:

$$Exports_{jt} = exp\left[\alpha_j + \chi_t + \beta_1 \ln\left(ODA_{jt}\right) + \beta_2 \ln\left(ODADACR_{jt}\right) + \lambda Z_{jt}\right] \times \epsilon_{jt} \quad (4)$$

where α_j denotes recipient-fixed effects and χ_t time-fixed effects and ε_{jt} being the error term. The coefficient of interest, β_1 represents the elasticity of exports with respect to donor i's bilateral aid. Z is a matrix of further control variables. See Appendix 2 for variable definitions.

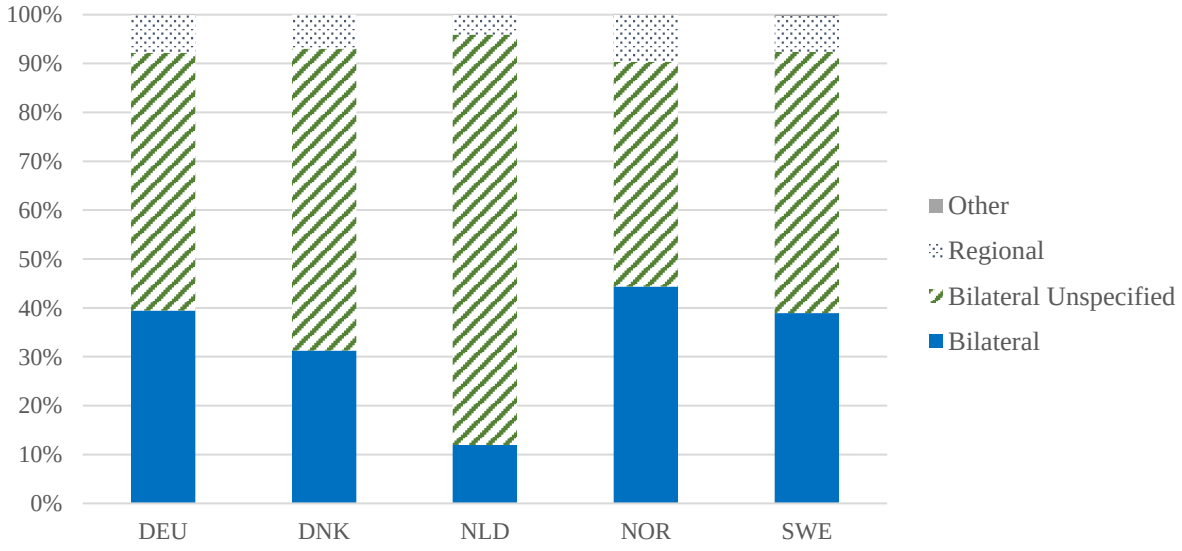
To validate how far the effects between different donors are statistically different from one another, we also re-estimate model (4) in a multilateral set-up including multiple donors and a donor-specific coefficient for bilateral ODA:

$$Exports_{ijt} = exp\left[\alpha_{ij} + \chi_t + \beta_{1i} \ln\left(ODA_{ijt}\right) + \beta_2 \ln\left(ODADACR_{ijt}\right) + \lambda Z_{ijt}\right] \times \epsilon_{ijt} \quad (5)$$

where in a multi-donor set-up, α_{ij} denotes donor-recipient pair-fixed effects and χ_t time-fixed effects. ϵ_{jt} is an error term. The coefficient of interest, $\beta_{1\mathrm{i}}$ represents the donor-specific elasticity of exports with respect to donors bilateral aid. Z is a matrix of further control variables. Appendix 2 has the variable definitions.

We obtain data on bilateral development aid from the OECD Development Database on Aid, using net ODA disbursements in current USD. We use data that excludes debt relief, as it has no direct impact on either trade (capacity) or indirect links between donor and recipient. Our dataset relies on directly attributable bilateral aid, meaning that funds spent in a multi-country region or funds spent without clear bilateral recipient are not included in the analysis. This is important to keep in mind when setting results into context, as our aid variable corresponds to only between 12 percent and 44 percent of headline disbursements of aid (see Figure 4). Furthermore, the ODA data used for the analysis does not include domestic expenditures (e.g., spending on refugees within a donor country), even though such expenses can, under some conditions, be counted toward a donor's aid position under OECD rules. For control variables and breakdowns of aid categories, we use the OECD creditor reporting system (CRS) dataset.

Figure 4: Share of strictly bilateral aid compared to overall disbursements in OECD CRS, 2024 data



Data on trade in goods is obtained from CEPII, which in turn relies on raw data from the UN COMTRADE database. We map HS 2002 data on a six-digit level to ISIC Rev. 4 using the

correspondence by Roy et al. (2022) as a starting point, which we adjust and expand manually. Data on trade in services are obtained from the OECD-WTO Balanced Trade in Services (BaTIS) database. BaTIS is only available from 2005 onwards, yet it provides a dataset on trade in services that is balanced between exporter and importer data. BaTIS further fills missing trade data empirically. Both steps account for common errors in trade-in-services data and hence allow us to include the full dataset in the analysis with more confidence. For details, please refer to OECD (2025). We combine data on trade in goods and services into one dataset. To align with the ISIC industry logic, most sectors from HS and EBOPS can be matched directly; for trade in manufacturing services, we redistribute services to the corresponding manufacturing exports based on goods' export shares.

Bilateral exchange rates are obtained from the IMF statistics, data on income and population from the World Development Indicators database provided by the World Bank. The FTA variable is based on de Sousa (2012) and has been updated to the last year in our sample using information from the WTO. For input-output analysis, we use the World Input-Output Database (WIOD), as presented by Timmer et al. (2015) and updated by Timmer et al. (2016). For descriptive statistics, please see Appendix 1. For a description of variables, sources, and units of measurement, see Appendix 2.[2]

4 Results

In this section we first present the aggregated results for total exports in goods and services (4.1) and then we present the disaggregated results obtained by industry for goods and services in (4.2).

4.1 Aggregated Results

We start by presenting the effects of aid on donors' exports obtained using the PDFGLS specification (2). Table 1 presents results for each donor for the whole period. Results for a control setup with a period of 2005 through 2019, intended to exclude the trade frictions of the Covid-19 pandemic years starting in 2020, are presented in Appendix 5. In column (A) of Table 1, the coefficient on the target variable, German bilateral aid, is positive and statistically significant at the one percent significance level. The coefficient indicates that a 10 percent increase in bilateral aid leads to a 1.1 percent increase in German exports; a value at the upper bound of the range of comparable results from earlier studies covering other OECD donors. Once the period after 2019 is excluded (Appendix 5, column A), the coefficient's significance

[2] All data was accessed between April 11, 2025 and October 31, 2025 (updated for 2024 in May 2026).

remains unchanged while the coefficient slightly increases. The German effect generally stands out compared to the other donors in the panel, e.g., the Netherlands, with an increase in Dutch exports of around 0.33 percent in return for a 10 percent increase in bilateral aid. Danish aid yields no significant results in either setup or period, while Norwegian aid shows a significant coefficient for the period of 2005 through 2019 only.

Table 1: PDFGLS estimation results for exports 2005-2024

	(A)	(B)	(C)	(D)	(E)
VARIABLES	DEU 05-24	DNK 05-24	NLD 05-24	NOR 05-24	SWE 05-24
loda	0.108***	0.00855	0.0330***	0.0112	0.0902***
	[0.0136]	[0.0146]	[0.00973]	[0.0198]	[0.0139]
ltodadacr	-0.107***	0.0599*	-0.0645***	-0.0364	-0.0583**
	[0.0176]	[0.0318]	[0.0203]	[0.0347]	[0.0252]
lyr	0.937***	0.805***	0.743***	0.969***	0.853***
	[0.0131]	[0.0189]	[0.0143]	[0.0202]	[0.0103]
lexrn	0.0539***	0.0566***	0.0570***	0.0522***	0.0660***
	[0.00788]	[0.0122]	[0.0100]	[0.0137]	[0.00945]
fta	0.354***	0.295***	0.311***	0.0961	0.226***
	[0.0409]	[0.0603]	[0.0486]	[0.0792]	[0.0436]
Observations	1,693	773	926	1,428	1,507
Number of recipients	132	89	94	115	120
Leads and lags in first differences	yes	yes	yes	yes	yes
Number of years	17	17	17	17	17

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (2), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Using the point estimate and the 95-percent confidence interval together with trade and aid averages[3] to compute an elasticity of the respective aid spending, we find that, in static terms, the average return on aid for German exports in the period from 2005 until 2024 falls in a range of USD 1.88 to USD 3.11 increase in the value of exports for each Dollar spent:

$$\beta_{AID} \times \frac{Avg.Exports}{Avg.Aid} \Rightarrow 0.108 * \frac{1{,}413.90}{61.29} = 2.5 \quad (6)$$

Elasticities for all donors in the sample are presented in Table 2. While the return for Germany is the highest among the donors analysed, the confidence interval for the Dutch return is even larger.

[3] Please note that the averages of ODA and bilateral trade used for the computation of elasticities are based on the observations used for each regression and hence differ from the averages presented in the Appendix.

Table 2: Monetary return to aid based on 2005 - 2024 averages, PDFGLS

	Coefficient lnODA	95% Conf. Interval	Average Exports	Average Aid	Average monetary return
DEU 05-24	0.108***	0.0814 ~ 0.1349	1,413.90	61.29	1.88 2.5 3.11
DNK 05-24	0.0086	n.a.	187.68	18.27	n.a.
NLD 05-24	0.033***	0.0139 ~ 0.0521	851.98	18.46	0.64 1.53 2.4
NOR 05-24	0.0112	n.a.	126.47	16.23	n.a.
SWE 05-24	0.0902***	0.0629 ~ 0.1175	241.25	15.57	0.97 1.4 1.82

Note: Coefficients are taken from Table 1; return expressed in USD of exports for each 1 USD of aid spent, using equation (6).

While average monetary returns help to gauge the export effect of ODA, they should be treated with caution: while the coefficient of ODA is robust to the exclusion of single recipients, the averages of aid or trade can be markedly altered by excluding important trading partners or recipients of larger amounts of aid. As an example, excluding China from the analysis, the coefficient on German aid remains relatively stable (0.110), yet due to changes in average exports and aid, the range of the static-average monetary return decreases to between USD 1.8 and USD 2.9.[4]

The literature on the domestic effects of aid has emphasised AfT as the share of aid that can be directly connected to trade facilitation. We control for Aft shares to assess whether the effect of ODA persists, providing evidence of indirect transmission mechanisms beyond direct trade effects. Table 3 shows that including AfT shares as a control variable reduces the size of the coefficient on bilateral aid but leaves its significance unchanged at a one percent level. The coefficient on the AfT variable is statistically significant for Denmark, the Netherlands and Sweden, not for Norway and the Germany.

[4] $\beta_{AID} \times \frac{Avg.Exports}{Avg.Aid} \Rightarrow 0.0829 * \frac{1{,}321.57}{60.78} = 1.80$ and $0.1365 * \frac{1{,}321.57}{60.78} = 2.96$; based on 2005 – 2024 averages in current USD corresponding to Table 2.

Table 3: PDFGLS estimation results for exports 2005-2024, controlling for AfT

VARIABLES	(A) DEU 05-19	(B) DNK 05-19	(C) NLD 05-19	(D) NOR 05-19	(E) SWE 05-19
loda	0.100***	0.00699	0.0310***	0.00642	0.0798***
	[0.0138]	[0.0147]	[0.00961]	[0.0197]	[0.0146]
ltodadacr	-0.0883***	0.0601*	-0.0728***	-0.0305	-0.0590**
	[0.0194]	[0.0324]	[0.0201]	[0.0348]	[0.0259]
aft_share	0.126	0.228***	0.267**	0.0739	0.406**
	[0.0823]	[0.0760]	[0.115]	[0.136]	[0.165]
lyr	0.930***	0.805***	0.745***	0.969***	0.857***
	[0.0139]	[0.0187]	[0.0145]	[0.0193]	[0.0103]
lexrn	0.0589***	0.0498***	0.0567***	0.0533***	0.0668***
	[0.00835]	[0.0122]	[0.0100]	[0.0131]	[0.00981]
fta	0.331***	0.329***	0.312***	0.0992	0.203***
	[0.0437]	[0.0603]	[0.0483]	[0.0776]	[0.0448]
Observations	1,508	773	926	1,428	1,507
Recipients	131	89	94	115	120
Leads and lags in first differences	yes	yes	yes	yes	yes
Number of years	17	17	17	17	17

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (2), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

When comparing coefficients between donors, the effects seem different at a first glance. But when considering the confidence intervals, the coefficients from the different donors overlap at the 95 per cent confidence level, requiring further estimations and testing before treating the effects as different. To assess whether the export effects of aid differ systematically across donors, we estimate a single model for all donors and interact bilateral ODA with donor dummy variables in a PDFGLS set-up as described in (3). Results are presented in Table 4. Now including all five donors in a single model, the effect of ODA is positive and statistically significant for all donors while differences in magnitude persist, as the partial effects presented in Table 5 indicate.

Table 4: Multi-donor model, PDFGLS estimations

VARIABLES	(A) PDFGLS 05-24	(B) PDFGLS 05-24	(C) PDFGLS 05-19	(D) PDFGLS 05-19
Baseline (DEU)	0.147***	0.140***	0.155***	0.147***
	[0.00672]	[0.00688]	[0.00805]	[0.00836]
DNK × loda	-0.138***	-0.135***	-0.128***	-0.125***
	[0.00830]	[0.00819]	[0.00996]	[0.0101]
NLD × loda	-0.0281***	-0.0252***	-0.0242***	-0.0211***
	[0.00500]	[0.00500]	[0.00597]	[0.00604]
NOR × loda	-0.190***	-0.187***	-0.181***	-0.178***
	[0.00744]	[0.00740]	[0.00905]	[0.00914]
SWE × loda	-0.112***	-0.108***	-0.0977***	-0.0933***
	[0.00672]	[0.00669]	[0.00812]	[0.00819]
ltodadacr	-0.0700***	-0.0605***	-0.0813***	-0.0722***
	[0.00927]	[0.00890]	[0.00950]	[0.0104]
aft_share		0.198***		0.218***
		[0.0406]		[0.0444]
Observations	6,327	6,327	4,932	4,932
Number of years	17	17	13	13

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (4) and (5), underlying data in current USD.

Table 5: Estimated marginal effects by donor based on Table 4

	(A) PDFGLS 05-24	(B) PDFGLS 05-24 (AfT)	(C) PDFGLS 05-19	(D) PDFGLS 05-19 (AfT)
DEU	0.147***	0.140***	0.155***	0.147***
DNK	0.009	0.005	0.027***	0.022***
NLD	0.119***	0.115***	0.131***	0.126***
NOR	-0.043***	-0.047***	-0.026***	-0.031***
SWE	0.035***	0.032***	0.057***	0.054***

Note: *** p<0.01, ** p<0.05, * p<0.1; columns corresponding to Table 4**Table 6**

Overall, when assessing the aid-trade relationship of all five donors together, the coefficients on single donors' ODA suggest a common positive aid–trade elasticity across five-donors. This picture does change only slightly when controlling for the donor-recipient-year specific share of AfT. When included in the regression, the share of AfT is significant at the one-percent level but does not change the significance of the main coefficient (which it reduces in size). More generally, we find evidence that the effects of bilateral ODA on trade significantly differs between donors. The surprising negative effect reported for Norway could be masking some heterogeneities among groups of recipients that are investigated in the robustness checks.

4.2 Robustness

Before moving from the aggregated to the sectoral results, we test the robustness of the estimates presented in chapter 4.1. Therefore, we use the PPML specification for our model and also use subsamples of recipient countries to test robustness to heterogeneous characteristics of recipient countries that go beyond country-specific traits.

To start, we estimate our model based on the PPML estimator as presented in equation (4). Results tables are relegated to Appendix 6. The coefficient on bilateral aid is only statistically significant and positive for Norway, while the coefficients for other donors is not statistically significant at conventional levels in any of the periods of interest. This picture remains unchanged when we include a control variable for AfT, as presented in Appendix 8. Also, when including all donors in a single model, as reported in Table 6 based on model (5), only Norwegian aid stands out as statistically significant.

Table 6: Multi-donor model, PPML estimations

	(A)	(B)	(C)	(D)
VARIABLES	PPML 05-24	PPML 05-24	PPML 05-19	PPML 05-19
Baseline (DEU)	0.00190	-0.00244	0.0327	0.0257
	[0.0159]	[0.0157]	[0.0236]	[0.0216]
DNK × loda	0.0237	0.0291	-0.0346	-0.0260
	[0.0265]	[0.0268]	[0.0299]	[0.0282]
NLD × loda	-0.00943	-0.00614	-0.0424	-0.0362
	[0.0211]	[0.0214]	[0.0273]	[0.0269]
NOR × loda	0.0726***	0.0763***	0.0486	0.0549*
	[0.0263]	[0.0259]	[0.0324]	[0.0309]
SWE × loda	0.00918	0.0126	-0.0305	-0.0242
	[0.0345]	[0.0343]	[0.0393]	[0.0380]
ltodadacr	-0.0179	-0.0188*	-0.0130	-0.0129
	[0.0110]	[0.0109]	[0.0145]	[0.0144]
aft_share		0.0575		0.0607
		[0.0530]		[0.0562]
Observations	9,011	9,011	6,872	6,872
Number of years	20	20	15	15

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (5), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Table 7: Estimated partial effects by donor based on Table 6

	(A) PPML 05-24	(B) PPML 05-24 (AfT)	(C) PPML 05-19	(D) PPML 05-19 (AfT)
DEU	0.002	-0.002	0.033	0.026
DNK	0.026	0.027	-0.002	0.000
NLD	-0.008	-0.009	-0.010	-0.011
NOR	0.075***	0.074***	0.081***	0.081***
SWE	0.011	0.01	0.002	0.002

Note: *** p<0.01, ** p<0.05, * p<0.1; columns corresponding to Table 6.

To see whether the results are heterogeneous across groups of recipients, we use model (2) and estimated it by income group following the OECD DAC country grouping[5]. As Table 8 reports, effects differ between recipient groups.

Table 8: PDFGLS results for 2005 – 2024 by income group

		(A) LDC	(B) LMIC	(C) MADCT	(D) UMIC
DEU	loda	0.154***	0.137***	0.363***	0.120***
	Recipients	42	34	7	48
	Avg. Exports	161.68	1,800.76	1,762.59	2,493.81
	Avg. Aid	49.70	85.72	22.04	47.81
DNK	loda	-0.120***	0.0574***	n.a.	-0.0206
	Recipients	35	26	n.a.	25
	Avg. Exports	43.70	253.01		371.51
	Avg. Aid	27.05	18.20		4.18
NLD	loda	0.0391	0.0426**	n.a.	0.0461***
	Recipients	33	28	2	30
	Avg. Exports	174.36	1,068.27		1,411.02
	Avg. Aid	34.07	13.05		7.22
NOR	loda	0.0268	0.0860**	n.a.	-0.0391
	Recipients	40	32	3	39
	Avg. Exports	29.44	157.52		223.63
	Avg. Aid	22.94	10.96		11.59
SWE	loda	0.0882**	0.0809***	0.0120***	0.0801***
	Recipients	42	33	3	41
	Avg. Exports	49.93	325.79	387.96	403.92
	Avg. Aid	24.51	10.20	0.73	9.03

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (2), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

[5] LDC = Least Developed Countries, LMIC = Lower-Middle Income Countries, MADCT = More Advanced Developing Countries and Territories, UMIC = Upper-Middle Income Countries

While for German and Swedish aid there are statistically and positive trade effects of aid in all income groups, Norwegian aid only yields significant effects in lower middle income recipient countries. Taking a more nuanced perspective on recipient countries also contextualises the static average monetary returns used to interpret the effect of aid on trade. Applying equation (6) to German aid allocated to least developed and upper-middle income countries yields returns as different as USD 0.5 and USD 6.26 per dollar of aid spent, respectively.[6]

4.3 Sectoral Decomposition

To add a last dimension to the aid-trade-nexus, we analyse the effect on a sectoral basis. We employ a similar empirical strategy as applied to aggregated trade data and focus on PDFGLS (long-run) estimates. We present sectoral results for Germany in Table 9 for production sectors and Table 10 for services sectors, while presenting the results for the remaining donors in the Appendix. We find that in the case of Germany the effect of aid on trade is statistically and economically significant in 32 out of 40 sectors. A further 18 ISIC 2-digit-sectors were not included in the analysis, given a lack of sufficient trade flows or difficulties in properly attributing trade flows to specific industries[7].

Using input-output tables, we can estimate the number of jobs needed to produce the additional exports. Given that an increase in final demand (additional exports; $\Delta exports$) in a certain sector requires the production of intermediates, which in turn requires intermediates (and so forth), we first calculate the additional gross output necessary to produce the additional exports ($\Delta output$). Based on the additional output, sectoral job multipliers (*job_mult*) translate the additional output into additional employment, accounting for the inputs required from all other sectors in a donor country. The same logic also applies to additional domestic sectoral value-added:

$$\Delta output = (I - A)^{-1}\, \Delta export \tag{7}$$

$$\Delta jobs = job\_mult * \Delta output \tag{8}$$

In (7) and (8), *I* denotes the identity (unit) matrix, and A contains the input coefficients obtained from the input-output tables, being $(I - A)^{-1}$ the output multiplier. For better presentability, please note that in the tables, we multiply the job multiplier by the output multiplier. to obtain

[6] $\beta_{AID} \times \frac{Avg.Exports}{Avg.Aid}$; **LDC**: $0.154 * \frac{161.68}{49.70} = 0.5$; **LMIC**: $0.137 * \frac{1{,}800.76}{85.72} = 2.88$; **UMIC**: $0.120 * \frac{2{,}493.81}{47.81} = 6.26$

[7] Due to a lack of sufficient trade flow or no clear mapping to our sectoral model, we excluded electricity and other energy supply, water collection/treatment, wholesale and retail trade, warehousing; real estate activities; legal/accounting/managerial services, administrative support, education as well as households and extraterrestrial organisations as employers. Manufacturing services were repartitioned relative to other manufacturing exports.

a single multiplier covering employment effects in the whole economy, not only the specific industry. Thus, substituting (7) into (8) we obtain:

$$\Delta jobs = job\_mult * (I - A)^{-1} \ \Delta exports \quad (9)$$

When the elasticities of exports with respect to aid were not statistically significant, no export and employment effects were calculated, since the statistical link could not be established with precision. Table 9 and Table 10 show that, in the period from 2005 to 2024, exports supported by aid translate into the security of ca. 378,933 jobs. To estimate how aid-induced additional exports can affect Germany's overall economic development (as measured by GDP), input-output analysis could provide an indication. It allows tracing how export demand flows through the economy and extracting the value-added content of exports—that is, the portion of export value created domestically, excluding imported inputs. This procedure again includes the knock-on effects within the supply chain. In the period from 2005-2024, aid can be linked to an average amount of USD 37.8 billion value-added contribution to the German GDP. We did not include “other services” and payments for intellectual property (IP) in the calculation as the heterogeneous nature of both positions makes it difficult to attribute job effects or value added.

Table 11 sets the core-results of all country-wise sectoral analyses into context, allowing for comparison of the respective sectoral coefficients on logged ODA in the first part of the table and their respective weight in economic terms in the second part, where the share of additional sectoral exports within total donor exports is reported for all sectors with a coefficient that is statistically significant at conventional levels. Combining both perspectives allows to identify sectors with a strong and robust ODA-link that are also accounting for a meaningful share of additional exports. It is where both criteria overlap that a meaningful economic effect for the donor country is materialising. Alternatively, some sectors do see a strong statistical link yet only trade a small volume. While this might be a lever for future trade, these sectors are not driving results in our ex-post analysis.

Beyond donor-specific sectoral links, four clusters of sectoral effects appear across the different donors: chemistry and pharma products; electrical equipment, machines and transport equipment; water and air transport services; and the hospitality sector.

Table 9: PDFGLS estimation results for German good exports. 2005-2024

	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(millions USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
Agriculture	0.177	***	2,097		371	15.17	5,630	270
Forestry	0.183	***	130		24	10.62	253	18
Fishing	-0.010		64		-1	n.a.	n.a.	n.a.
Mining	0.225	***	209		47	7.50	352	33
Food	0.125	***	9,025		1,128	10.70	12,076	783
Textiles	0.205	***	3,443		706	8.75	6,175	431
Wood	0.347	***	1,110		385	9.54	3,673	264
Paper	0.206	***	3,034		625	6.65	4,155	390
Printing	0.206	***	487		100	10.27	1,030	73
CokePetro	0.269	***	1,450		390	1.69	660	78
Chem	0.175	***	29,751		5,206	4.92	25,637	2,984
Pharma	0.153	***	19,745		3,021	4.97	15,012	2,339
RubberP	0.177	***	9,258		1,639	7.28	11,924	1,031
Nonmet	0.177	***	2,558		453	8.20	3,713	330
BasicM	0.288	***	6,865		1,977	5.12	10,122	999
MetalPro	0.136	***	10,319		1,403	8.92	12,519	1,026
Computer	0.184	***	32,115		5,909	6.55	38,716	4,206
Electrical	0.152	***	23,198		3,526	6.89	24,290	2,423
Machines	0.193	***	55,661		10,742	6.91	74,199	7,343
Transport	0.249	***	52,770		13,140	5.54	72,737	8,452
Other	0.154	***	12,935		1,992	6.10	12,155	1,272
Trans Furnit	0.174	***	1,789		311	9.59	2,986	231
Total			278,012	10,310	53,096		338,015	34,979

Note: Coefficients of leads and lags of explanatory vars in first differences and standard errors not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (9). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Table 10: PDFGLS estimation results for German services exports. 2005-2024

	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(millions USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
RepairInst	0.091	***	2,068		188	8.30	1,562	130
Waste	-0.19		94		n.a.	n.a.	n.a.	n.a.
Constr	0.233	***	836		195	10.56	2,056	152
Landtransp	0.371	***	2,373		880	11.04	9,718	740
Watertransp	-0.01		11,358		n.a.	n.a.	n.a.	n.a.
Airtransp	0.171	***	6,594		1,128	6.57	7,407	693
Post&Courier	0.026		4,004		n.a.	n.a.	n.a.	n.a.
HotelsRest	0.114	***	6,743		769	20.63	15,858	648
Publish	0.045		614		n.a.	n.a.	n.a.	n.a.
Audiovisual	0.159	***	162		26	6.53	168	23
Teleco	0.221	***	484		107	5.19	555	90
ITServ	0.013		6,360		n.a.	n.a.	n.a.	n.a.
Financ	0.018		1,674		n.a.	n.a.	n.a.	n.a.
Insurance	0.06	***	1,684		101	8.20	829	87
PublicAdmin	0.156	***	1,353		211	10.26	2,165	184
HealthSocial	0.133	***	275		37	16.40	599	32
Other	-0.01		15,258		n.a.		*no data*	
IP	0.048	*	8,997		432		*no data*	
Total			70,932	10,310	4,073		40,918	2,783

Note: Coefficients of leads and lags of explanatory vars in first differences and standard errors not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant.

Table 11: Overview of sectoral results by donor

	Coefficient on loda (PDFGLS, 2024)					*Share of add. exports / total exports*				
Sectors:	*DEU*	*DNK*	*NLD*	*NOR*	*SWE*	*DEU*	*DNK*	*NLD*	*NOR*	*SWE*
Agriculture	**0.18**	**-0.20**	0.02	-0.06	0.05	1.92%	0.00%			
Forestry	**0.18**	0.00	0.04	**0.36**	-0.19	3.07%			4.06%	
Fishing	-0.01	-0.10	0.03	**-0.10**	0.06				0.00%	
Mining	**0.23**	**-0.14**	0.01	0.24	**0.14**	1.40%	-0.20%		1.01%	2.02%
Food	**0.13**	-0.05	0.02	-0.06	**0.10**	1.34%				0.84%
Textiles	**0.21**	0.02	**0.07**	**0.19**	**0.16**	2.01%		0.52%	1.41%	0.81%
Wood	**0.35**	-0.01	**0.19**	**-0.22**	0.05	3.89%		0.77%	-0.82%	
Paper	**0.21**	0.05	**0.09**	0.09	**0.15**	2.74%		1.15%		3.30%
Printing	**0.21**	**0.09**	**0.13**	0.07	**0.14**	2.58%	0.57%	0.89%		1.40%
CokePetro	**0.27**	**0.14**	0.00	**-0.52**	**0.11**	1.52%	0.21%		0.00%	0.59%
Chem	**0.18**	0.02	**0.06**	0.00	**0.04**	3.61%		0.70%		0.71%
Pharma	**0.15**	0.03	0.01	0.04	**0.11**	2.54%				1.84%
RubberP	**0.18**	0.02	**0.06**	0.01	**0.05**	2.82%		0.51%		0.61%
Nonmet	**0.18**	0.04	**0.07**	0.06	**0.05**	2.57%		0.59%		0.49%
BasicM	**0.29**	**0.13**	**0.09**	-0.04	**0.14**	3.57%	2.85%	1.29%		2.71%
MetalPro	**0.14**	**0.08**	**0.05**	**0.10**	**0.08**	2.22%	1.03%	0.55%	2.23%	0.98%
Computer	**0.18**	**-0.03**	**0.06**	0.04	**0.11**	4.04%	-0.60%	0.58%		1.41%
Electrical	**0.15**	-0.01	**0.08**	**0.09**	**0.16**	3.34%		0.68%	2.38%	2.49%
Machines	**0.19**	**0.11**	**0.07**	0.00	**0.04**	4.91%	1.90%	1.84%		0.87%
Transport	**0.25**	**0.12**	**0.05**	-0.01	**0.16**	4.56%	0.57%	0.60%		2.20%
Other Trans	**0.15**	**0.11**	**0.17**	**-0.14**	**0.11**	3.63%	2.71%	2.46%	0.00%	1.09%
Furnit	**0.17**	0.04	**0.08**	**0.16**	-0.02	1.57%		0.39%	1.95%	
RepairInst	**0.09**	-0.01	**0.09**	**0.05**	**0.17**	0.76%		1.13%	0.36%	1.56%
Waste	-0.19	-0.18	0.09	0.18	0.14					
Construction	**0.23**	**0.09**	**0.16**	**-0.13**	**0.12**	2.08%	0.95%	2.42%	-1.65%	1.07%
Landtransp	**0.37**	-0.03	**0.15**	**0.09**	**0.13**	1.58%		0.44%	0.29%	0.27%
Watertransp	-0.01	-0.01	**0.07**	**0.04**	0.02			0.87%	0.49%	
Airtransp	**0.17**	-0.02	**0.11**	0.03	**0.11**	2.02%		0.95%		0.76%
Post&Courier	0.03	-0.05	0.08	**-0.07**	-0.01				-0.56%	
HotelsRest	**0.11**	0.02	**0.08**	0.01	**0.09**	0.79%		0.48%		0.57%
Publish	0.05	**-0.23**	**0.06**	-0.03	0.06		-0.50%	0.79%		
Audiovisual	**0.16**	-0.08	**0.14**	**-0.16**	**-0.08**	0.42%		0.41%	-0.64%	-0.79%
Teleco	**0.22**	0.02	**0.09**	0.00	0.02	1.37%		0.91%		
ITServ	0.01	-0.01	**0.15**	0.00	**0.07**			1.24%		0.73%
Financ	0.02	-0.01	**0.06**	-0.02	-0.04			0.17%		
Insurance	**0.06**	-0.04	**0.07**	**-0.05**	**0.07**	0.25%	-0.23%	0.39%	-0.30%	0.52%
PublicAdmin	**0.16**	**0.08**	**0.08**	-0.01	**0.15**	1.42%	0.81%	1.67%		2.57%
HealthSocial	**0.13**	**0.07**	0.08	-0.01	**0.10**	0.93%	0.29%			2.01%
Other	-0.01	0.02	**0.14**	**0.06**	**0.07**			1.04%	0.36%	0.31%
IP	**0.05**	0.02	**0.09**	-0.01	**0.12**	0.57%		0.72%		0.97%

Note: heatmap of *loda*-coefficients by sector; statistically significant effects in bold.

Note: share of additional exports in total donor exports; for statistically significant effects.

5 Discussion

Our empirical results provide evidence that foreign aid generates positive domestic returns through increased donor exports over the period 2005-2024. Long-run estimates based on PDFGLS models reveal consistent and economically important effects across donors, with German bilateral ODA showing a 0.11 elasticity. This translates into an export return between USD 1.88 to USD 3.11 per aid dollar spent. Although average elasticities remain relatively stable across periods, their economic magnitude varies with changes in average trade and aid volumes. Analysing different recipients clustered by income group suggests that higher average monetary returns are mainly driven by middle-income countries that receive aid rather than LDCs. At the same time, estimated effects appear somewhat weaker post-2019, potentially reflecting trade disruptions associated with the COVID-19 and changing aid allocation patterns following the Russian war against Ukraine.

Moreover, the explanatory power of net ODA remains after controlling for AfT shares, which enter the model with positive coefficients but do not absorb the overall effect of ODA. This finding suggests that indirect channels—economic development boosting recipient import capacity, informal tying via sectoral comparative advantage, goodwill/habit formation—drive most returns, rather than just direct procurement or AfT infrastructure investments.

An important contribution of the paper is to extend the analysis beyond merchandise trade and show that aid-related trade effects are also present in services exports. Significant positive effects are identified at both the aggregated level and across service sectors. This finding is increasingly relevant as advanced economies –like Germany– shift toward more service-intensive export structures and global value chains become less dependent on physical goods. Services comprise nowadays around 20 percent of bilateral flows and are less tied to physical infrastructure than goods. Aid-supported activities often require complementary services such as engineering, consulting, education, health-related expertise, and institutional support. As donor economies continue to expand their service sectors, these complementarities may strengthen the overall domestic effects of development cooperation.

Prior studies' merchandise-only focus understated overall returns. The significant effects on trade in services suggest aid creates demand for donor expertise beyond manufactured goods. Infrastructure projects require engineering consulting; health programs demand medical training services; institutional development needs legal and administrative expertise. This service-good complementarity amplifies total export effects and becomes increasingly important as donor economies become more tertiary. The use of balanced OECD-WTO BaTIS

services data is a first attempt to evaluate the relation of trade in services and aid. For a better understanding, a more granular analysis could be desirable.

The results also point to substantial heterogeneity across donor countries. Long-run export effects differ considerably, indicating that domestic returns from development cooperation are shaped by donor-specific characteristics, including trade structure, aid allocation, and economic scale. Larger donors, such as Germany, exhibit more precisely estimated effects because broader geographic engagement and larger aid volumes generate greater variation for empirical identification.

Alternative estimation approaches broadly support the existence of a positive relationship between aid and trade, although the magnitude and precision of estimates vary across specifications and samples. Taken together, the evidence suggests that aid–trade linkages are complex and likely operate through multiple channels that deserve further investigation.

The estimated coefficients of ODA in the sectoral gravity model–when significant–are used to compute employment and value-added effects that are sizable for most donors. For Germany, exports supported by aid translate into ca. 378,933 jobs and around USD 37.8 billion value-added contribution to the German GDP. These figures are smaller for other donors in term of jobs (1,487 for Denmark 28,782 for the Netherlands, 720 for Norway and 17,014 for Sweden) and in terms of value-added contributions (USD 183 million for Denmark, 2,994 for the Netherlands, 486 for Norway and 2,157 for Sweden), but still economically meaningful (see Appendix 17).

Concerning the employment and value-added effects, it is important to notice that input-output analysis relies on a set of assumptions required for the corresponding vector computations. These assumptions include, among others, ignoring substitution effects between different inputs, the homogeneity of output within a certain sector and constant returns to scale. Moreover, the last release of the WIOD input-output database available corresponds to 2016. Even though domestic value chain patterns tend to be persistent, more recent data should be used to capture recent developments in job effects or value added. Combining data on trade in goods and trade in services means to accept some degree of mismatch between sectoral data: while data on international trade in goods can be deducted from actually transported items that crosses a border, trade in services is derived from international payment statistics and hence draws more heavily on corresponding statistical declarations made by exporters and importers. Within these, it can be difficult to clearly disentangle services across different sectors. Since we opted by excluding from the analysis sectors for which a proper matching to input-output

data is not warranted, our estimate of the effects of aid on trade in services must be consider as conservative. Finaly, the fact that the aid variable used for the analysis makes up about a third of headline aid figures reported by donors, and earmarked multilateral aid effects are not accounted for, the overall effects of development aid on trade are presumably higher than reported.

6 Conclusions

This paper examines whether foreign aid generates domestic economic returns for donor countries through increased exports. Using bilateral data for 2005–2024 and focusing on long-run dynamics, the findings indicate that development cooperation is associated with economically meaningful increases in donor exports. These effects persist after accounting for AfT and extend beyond goods exports to include trade in services. Results further point to differences between industrial sectors when it comes to the export effect of aid: some sectors see relatively large effects, while other sectors appear entirely unaffected.

The results suggest that domestic returns from aid emerge primarily through indirect channels rather than explicit tying arrangements. Development assistance appears to strengthen economic relationships, support demand creation in recipient economies, and facilitate future trade opportunities. The evidence also highlights that the magnitude of returns varies across recipient groups and donor countries, implying that development cooperation outcomes depend on both recipient characteristics and donor economic structures.

From a policy perspective, the findings indicate that development cooperation and domestic economic interests need not be viewed as conflicting objectives. A broad aid strategy focused on supporting recipient development can also generate benefits for donor economies over time without relying on narrowly defined tied aid mechanisms. At the same time, policymakers should recognise that maximising short-term export returns and prioritising development objectives in lower-income countries may not always fully coincide.

As with most ex-post analyses, the results should be interpreted as evidence of robust empirical associations rather than definitive causal estimates. Future research could further improve measurement of services trade, incorporate more recent input-output structures, and explore additional channels through which development cooperation affects donor economies.

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Appendix

Appendix 1: Descriptive statistics

VARIABLES	(1) *N*	(2) *mean*	(3) *sd*	(4) *min*	(5) *max*
Year	13,060			2005	2024
Total Exports *(in millions of USD)*	13,060	682.1	4,308	0	138,815
Total Export DEU	2,900	1,952	8,782	0	138,815
Total Export DNK	2,300	202.0	733.7	0	11,799
Total Export NLD	2,520	696.3	1,800	0	24,435
Total Export NOR	2,620	137.5	551.7	0	11,645
Total Export SWE	2,720	245.4	864.4	0	11,880
Net ODA *(in millions of USD)*	10,406	24.40	65.33	-163.5	2,021
Net ODA DEU	2,654	54.73	114.2	-163.5	2,021
Net ODA DNK	1,626	11.70	21.66	-32.10	202.4
Net ODA NLD	1,711	13.93	25.87	-49.29	336.1
Net ODA NOR	2,143	15.55	38.68	-29.37	837.4
Net ODA SWE	2,272	14.31	24.75	-17.74	393.9
ODA remaining OECD donors *(in millions of USD)*	10,406	922.0	1,727	-1,394	38,753
AfT share	13,060	0.333	0.405	0	1
Trade agreement dummy	13,060	0.245	0.430	0	1
log donor GDP	13,060	27.42	0.889	26.30	29.18
log recipient GDP	12,752	23.84	2.036	16.94	30.56

Appendix 2: Definition and sources of variables used

Donor countries included: Denmark (DNK), Germany (DEU), the Netherlands (NLD), Norway (NOR), and Sweden (SWE).

Variable	*Abbreviation*	*Definition*	*Unit*	*Source*
AfT share	aft_share	share of Aid for Trade (AfT) within ODA given from donor to recipient in a given year	ratio	Authors calculation based on OECD CRS
Exchange Rate	exrn	Bilateral nominal exchange rate expressed as units of recipient currency per unit of donor currency	ratio	IMF statistics
Exports (goods)	Exports	bilateral exports from donor to recipient	total current USD	CEPII (HS 2002, mapped to ISIC Rev. 4)
Exports (services)	trade	bilateral exports from donor to recipient (balanced)	total current USD	OECD-WTO Balanced Trade in Services database (BaTIS)
Free Trade Agreement Dummy	fta	Dummy variable indicating if in a given year a free trade agreement was in place between donor and recipient country	dummy	WTO and de Sousa (2012)
Income (recipient)	yr	GDP of the recipient country in a given year	total current USD	World Bank Development Indicators
Income (donor)	yd	GDP of the donor country in a given year	total current USD	World Bank Development Indicators
ODA	oda	net ODA disbursements (excluding debt relief)	total current USD	OECD CRS
ODADACR	odadacr	net ODA disbursements (excluding debt relief) of the respective remaining DAC donors	total current USD	Authors calculation based on OECD CRS

Appendix 3: List of recipient countries in the dataset

Afghanistan	Eritrea	Morocco	Solomon Islands
Angola	Ethiopia	Moldova	Sierra Leone
Albania	Fiji	Madagascar	El Salvador
Argentina	Micronesia	Maldives	Somalia
Armenia	Gabon	Mexico	Serbia
Antigua and Barbuda	Georgia	Marshall Islands	South Sudan
Azerbaijan	Ghana	North Macedonia	Sao Tome and Principe
Burundi	Guinea	Mali	Suriname
Benin	Gambia	Myanmar	Eswatini
Burkina Faso	Guinea-Bissau	Montenegro	Seychelles
Bangladesh	Equatorial Guinea	Mongolia	Syria
Bosnia and Herzegovina	Grenada	Mozambique	Chad
Belarus	Guatemala	Mauritania	Togo
Belize	Guyana	Mauritius	Thailand
Bolivia	Honduras	Malawi	Tajikistan
Brazil	Croatia	Malaysia	Turkmenistan
Barbados	Haiti	Namibia	Timor-Leste
Bhutan	Indonesia	Niger	Tonga
Botswana	India	Nigeria	Trinidad and Tobago
Centr. African Republic	Iran	Nicaragua	Tunisia
Chile	Iraq	Nepal	Turkey
China	Jamaica	Nauru	Tuvalu
Côte d'Ivoire	Jordan	Oman	Tanzania
Cameroon	Kazakhstan	Pakistan	Uganda
Dem. Rep. of the Congo	Kenya	Panama	Ukraine
Republic of the Congo	Kyrgyzstan	Peru	Uruguay
Colombia	Cambodia	Philippines	Uzbekistan
Comoros	Kiribati	Palau	St Vincent & Grenadines
Cabo Verde	Saint Kitts and Nevis	Papua New Guinea	Venezuela
Costa Rica	Laos	North Korea	Vietnam
Cuba	Lebanon	Paraguay	Vanuatu
Djibouti	Latvia	Palestine	Samoa
Dominica	Libya	Rwanda	Yemen
Dominican Republic	Saint Lucia	Saudi Arabia	South Africa
Ecuador	Sri Lanka	Sudan	Zambia
Egypt	Lesotho	Senegal	Zimbabwe

Appendix 4: Estimation results of the log-log baseline model

A4.1 Results for the log-log baseline model for the period 2005-2019

VARIABLES	(A) DEU 05-19	(B) DNK 05-19	(C) NLD 05-19	(D) NOR 05-19	(D) SWE 05-19
loda	-0.0231	-0.00439	-0.00477	0.00414	0.0287
	[0.0152]	[0.0203]	[0.0116]	[0.0228]	[0.0244]
ltodadacr	-0.0104	0.00504	-0.0529	-0.0214	-0.0316
	[0.0327]	[0.0482]	[0.0441]	[0.0397]	[0.0452]
lyr	0.821***	0.630***	0.552***	0.315***	0.815***
	[0.105]	[0.140]	[0.115]	[0.112]	[0.168]
lexrn	-0.0162	-0.0538	0.0179	0.0257	-0.0549
	[0.0403]	[0.0557]	[0.0228]	[0.0310]	[0.0905]
fta	0.0374	0.0713	-0.0373	0.0796	-0.00284
	[0.0570]	[0.0622]	[0.0689]	[0.0920]	[0.0853]
Observations	1,737	992	1,142	1,487	1,519
Time FE	Yes	Yes	Yes	Yes	Yes
Recipient FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.361	0.317	0.262	0.147	0.172

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (1), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

A4.2 Results for the log-log baseline model for the period 2005-2024

VARIABLES	(F) DEU 05-24	(G) DNK 05-24	(H) NLD 05-24	(I) NOR 05-24	(J) SWE 05-24
loda	-0.0212	-0.00238	-0.0153	0.00438	0.0167
	[0.0131]	[0.0145]	[0.0126]	[0.0217]	[0.0195]
ltodadacr	-0.0172	0.0100	-0.0145	0.00634	-0.00799
	[0.0283]	[0.0421]	[0.0359]	[0.0347]	[0.0394]
lyr	0.746***	0.555***	0.571***	0.383***	0.636***
	[0.0944]	[0.142]	[0.0895]	[0.106]	[0.166]
lexrn	-0.0138	-0.0234	0.00927	0.00968	-0.0329
	[0.0410]	[0.0526]	[0.0365]	[0.0295]	[0.0744]
fta	0.0296	0.143*	0.0769	0.153*	0.0416
	[0.0590]	[0.0742]	[0.0689]	[0.0880]	[0.0938]
Observations	2,279	1,325	1,458	1,918	2,039
Time FE	Yes	Yes	Yes	Yes	Yes
Recipient FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.366	0.360	0.270	0.169	0.132

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (1), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Appendix 5: PDFGLS estimation results for exports for the period 2005 - 2019

VARIABLES	(A) DEU 05-19	(B) DNK 05-19	(C) NLD 05-19	(D) NOR 05-19	(E) SWE 05-19
loda	0.112***	0.0213	0.0537***	0.0399**	0.0699***
	[0.0161]	[0.0168]	[0.0123]	[0.0197]	[0.0151]
ltodadacr	-0.0923***	0.0484	-0.109***	-0.0489	-0.0249
	[0.0204]	[0.0380]	[0.0277]	[0.0365]	[0.0275]
lyr	0.930***	0.818***	0.765***	0.969***	0.834***
	[0.0141]	[0.0202]	[0.0154]	[0.0186]	[0.0110]
lexrn	0.0517***	0.0363***	0.0593***	0.0556***	0.0469***
	[0.00854]	[0.0140]	[0.0107]	[0.0130]	[0.00949]
fta	0.408***	0.355***	0.306***	0.0786	0.311***
	[0.0437]	[0.0734]	[0.0531]	[0.0823]	[0.0479]
Observations	1,317	614	731	1,125	1,145
Number of recipients	129	87	92	113	112
Leads and lags in first diff.	yes	yes	yes	yes	yes
Number of years	13	13	13	13	13

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (2), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Appendix 6: PPML estimation results for exports: Single donors

A6.1. Estimation results for the period 2005-2024. PPML

VARIABLES	(A) DEU 05-24	(B) DNK 05-24	(C) NLD 05-24	(D) NOR 05-24	(E) SWE 05-24
loda	-0.00393	0.0142	-0.0190	0.0583***	-0.000924
	[0.0130]	[0.0121]	[0.0136]	[0.0226]	[0.0239]
ltodadacr	-0.0254*	-0.0365**	0.0237	-0.0102	-0.00712
	[0.0146]	[0.0164]	[0.0314]	[0.0315]	[0.0217]
lyr	0.581***	0.262***	0.562***	0.417**	0.377***
	[0.0874]	[0.0926]	[0.0694]	[0.167]	[0.127]
lexrn	0.0700	0.0578	0.00527	-0.0526	0.00455
	[0.0490]	[0.0416]	[0.0550]	[0.0499]	[0.0476]
fta	0.0546	-0.000877	-0.00649	0.111	0.0119
	[0.0673]	[0.0898]	[0.0757]	[0.102]	[0.0956]
Pseudo R^2	0.991	0.975	0.970	0.952	0.969
Observations	2,281	1,324	1,455	1,914	2,037

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (4), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

A6.2. Estimation results for the period 2005-2019. PPML

VARIABLES	(F) DEU 05-19	(G) DNK 05-19	(H) NLD 05-19	(I) NOR 05-19	(J) SWE 05-19
loda	0.0328	-0.00142	-0.0176	0.0633**	-0.0121
	[0.0201]	[0.0132]	[0.0172]	[0.0252]	[0.0238]
ltodadacr	-0.0227	-0.0275	0.0348	-0.0156	-0.0238
	[0.0159]	[0.0216]	[0.0440]	[0.0387]	[0.0276]
lyr	0.577***	0.314***	0.300**	0.228	0.479***
	[0.122]	[0.109]	[0.147]	[0.223]	[0.0993]
lexrn	0.157*	0.0353	0.118	0.0421	0.0300
	[0.0946]	[0.0619]	[0.0811]	[0.125]	[0.0687]
fta	0.104*	0.0466	-0.234**	0.138	-0.00736
	[0.0581]	[0.0928]	[0.106]	[0.0968]	[0.0867]
Pseudo R^2	0.992	0.979	0.974	0.959	0.973
Observations	1,739	991	1,138	1,485	1,519

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (4), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Appendix 7: PDFGLS estimation results for exports 2005-2019, controlling for AfT

VARIABLES	(A) DEU 05-19	(B) DNK 05-19	(C) NLD 05-19	(D) NOR 05-19	(E) SWE 05-19
loda	0.103***	0.0199	0.0543***	0.0299	0.0439***
	[0.0166]	[0.0163]	[0.0124]	[0.0199]	[0.0163]
ltodadacr	-0.0884***	0.0659*	-0.114***	-0.0326	-0.0112
	[0.0204]	[0.0349]	[0.0275]	[0.0373]	[0.0284]
aft_share	0.170*	0.266***	0.139	0.126	0.781***
	[0.0897]	[0.0825]	[0.129]	[0.135]	[0.184]
lyr	0.931***	0.812***	0.766***	0.969***	0.839***
	[0.0143]	[0.0184]	[0.0154]	[0.0185]	[0.0122]
lexrn	0.0497***	0.0330***	0.0596***	0.0602***	0.0462***
	[0.00858]	[0.0126]	[0.0107]	[0.0129]	[0.0100]
fta	0.401***	0.376***	0.319***	0.0852	0.298***
	[0.0439]	[0.0680]	[0.0528]	[0.0842]	[0.0504]
Observations	1,317	614	731	1,125	1,145
Recipients	129	87	92	113	112
Leads and lags in first diff.	Yes	Yes	Yes	Yes	Yes
Years	13	13	13	13	13

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (3), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Appendix 8: PPML estimation results for exports, controlling for AfT

A8.1. Estimation results for the period 2005-2024. PPML controlling for AfT

VARIABLES	(A) DEU 05-24	(B) DNK 05-24	(C) NLD 05-24	(D) NOR 05-24	(E) SWE 05-24
loda	-0.0103	0.0145	-0.0187	0.0546**	-0.00414
	[0.0146]	[0.0123]	[0.0137]	[0.0234]	[0.0246]
ltodadacr	-0.0281**	-0.0357**	0.0253	-0.00942	-0.00409
	[0.0142]	[0.0164]	[0.0316]	[0.0305]	[0.0216]
aft_share	0.105	0.0261	-0.0701	0.174	0.247**
	[0.0771]	[0.0626]	[0.0803]	[0.143]	[0.120]
lyr	0.592***	0.260***	0.569***	0.399**	0.371***
	[0.0807]	[0.0934]	[0.0701]	[0.162]	[0.124]
lexrn	0.0596	0.0570	0.00375	-0.0487	0.00336
	[0.0454]	[0.0414]	[0.0536]	[0.0492]	[0.0467]
fta	0.0536	-0.000797	-0.00110	0.0975	0.0225
	[0.0665]	[0.0891]	[0.0782]	[0.102]	[0.0963]
Pseudo R2	0.991	0.975	0.970	0.952	0.969
Observations	2,281	1,324	1,455	1,914	2,037

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Estimation result obtained from model (4), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

A8.2. Estimation results for the period 2005-2019. PPML controlling for AfT

VARIABLES	(F) DEU 05-19	(G) DNK 05-19	(H) NLD 05-19	(I) NOR 05-19	(J) SWE 05-19
loda	0.0193	-0.00178	-0.0176	0.0609**	-0.0125
	[0.0213]	[0.0131]	[0.0172]	[0.0258]	[0.0242]
ltodadacr	-0.0237	-0.0284	0.0349	-0.0142	-0.0235
	[0.0162]	[0.0224]	[0.0441]	[0.0368]	[0.0275]
aft_share	0.140	-0.0166	-0.0122	0.0876	0.0265
	[0.0990]	[0.0416]	[0.0712]	[0.152]	[0.135]
lyr	0.591***	0.319***	0.303**	0.220	0.478***
	[0.111]	[0.106]	[0.150]	[0.223]	[0.0994]
lexrn	0.136	0.0345	0.118	0.0425	0.0300
	[0.0847]	[0.0619]	[0.0811]	[0.124]	[0.0686]
fta	0.106*	0.0514	-0.233**	0.124	-0.00611
	[0.0555]	[0.0963]	[0.108]	[0.0983]	[0.0848]
Pseudo R^2	0.992	0.979	0.974	0.959	0.973
Observations	1,739	991	1,138	1,485	1,519

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Following model (2), underlying data in current USD. See Appendix 2 for definitions and abbreviations.

Appendix 9: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Production</u> sectors

DNK	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
Agriculture	-0.20	**	580		-117	7.65	-896	-73
Forestry	0.00		50		n.a.	n.a.	n.a.	n.a.
Fishing	-0.10		718		n.a.	n.a.	n.a.	n.a.
Mining	-0.14	**	13		-2	0.87	-2	-2
Food	-0.05		2466		n.a.	n.a.	n.a.	n.a.
Textiles	0.02		171		n.a.	n.a.	n.a.	n.a.
Wood	-0.01		63		n.a.	n.a.	n.a.	n.a.
Paper	0.05		80		n.a.	n.a.	n.a.	n.a.
Printing	0.09	**	14		1	7.06	8	1
CokePetro	0.14	*	50		7	1.06	7	4
Chem	0.02		1752		n.a.	n.a.	n.a.	n.a.
Pharma	0.03		5733		n.a.	n.a.	n.a.	n.a.
RubberP	0.02		279		n.a.	n.a.	n.a.	n.a.
Nonmet	0.04		65		n.a.	n.a.	n.a.	n.a.
BasicM	0.13	***	588		77	4.23	326	37
MetalPro	0.08	***	495		39	6.31	248	23
Computer	-0.03	*	1589		-55	4.04	-222	-36
Electrical	-0.01		590		n.a.	n.a.	n.a.	n.a.
Machines	0.11	***	2230		245	4.24	1041	136
Transport	0.12	***	177		22	4.22	91	10
Other Trans	0.11	***	510		55	5.67	309	32
Furnit	0.04		152		n.a.	n.a.	n.a.	n.a.
Total			18,366	846	272		912	132

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 10: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Services</u> sectors

DNK	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
RepairInst	-0.01		233		n.a.	n.a.	n.a.	n.a.
Waste	-0.183		1		n.a.	n.a.	n.a.	n.a.
Constr	0.09	***	797		72	7.10	511	47
Landtransp	-0.0283		381		n.a.	n.a.	n.a.	n.a.
Watertransp	-0.00585		11828		n.a.	n.a.	n.a.	n.a.
Airtransp	-0.0198		491		n.a.	n.a.	n.a.	n.a.
Post&Courier	-0.0539		18		n.a.	n.a.	n.a.	n.a.
HotelsRest	0.0209		1427		n.a.	n.a.	n.a.	n.a.
Publish	-0.23	***	19		- 4	8.04	- 34	- 4
Audiovisual	-0.079		22		n.a.	n.a.	n.a.	n.a.
Teleco	0.0245		43		n.a.	n.a.	n.a.	n.a.
ITServ	-0.007		521		n.a.	n.a.	n.a.	n.a.
Finance	-0.0078		178		n.a.	n.a.	n.a.	n.a.
Insurance	-0.04	*	90		- 4	5.84	- 22	- 3
PublicAdmin	0.08	***	99		8	7.62	59	6
HealthSocial	0.07	**	76		5	11.47	61	4
Other	0.0201		1347		n.a.		*no data*	
IP	0.0214		677		n.a.		*no data*	
Total			18,246	846	77.03		575	50.59

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 11: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Production</u> sectors

NLD	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
Agriculture	0.02		2,282		n.a.	n.a.	n.a.	n.a.
Forestry	0.04		457		n.a.	n.a.	n.a.	n.a.
Fishing	0.03		473		n.a.	n.a.	n.a.	n.a.
Mining	0.01		276		n.a.	n.a.	n.a.	n.a.
Food	0.02		10,363		n.a.	n.a.	n.a.	n.a.
Textiles	0.07	***	1,028		77	5.21	400	36
Wood	0.19	***	62		12	6.32	73	7
Paper	0.09	***	788		72	4.07	293	33
Printing	0.13	***	74		10	6.39	61	6
CokePetro	0.00		6,256		n.a.	n.a.	n.a.	n.a.
Chem	0.06	***	7,893		475	2.00	948	155
Pharma	0.01		3,245		n.a.	n.a.	n.a.	n.a.
RubberP	0.06	***	928		60	4.11	246	28
Nonmet	0.07	***	253		18	5.73	102	10
BasicM	0.09	***	2,879		272	3.69	1,004	128
MetalPro	0.05	**	1,281		64	5.31	341	35
Computer	0.06	***	6,892		432	1.92	831	105
Electrical	0.08	***	1,458		110	4.04	446	63
Machines	0.07	***	15,650		1,024	3.79	3,883	497
Transport	0.05	*	2,586		139	3.80	527	60
Other Trans	0.17	***	1,573		259	4.35	1,130	121
Furnit	0.08	***	268		22	13.49	292	16
Total			66,964	1,054	3,045		10,576	1,299

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 12:PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Services</u> sectors

NLD	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
RepairInst	0.09	***	1,986		184	6.79	1,251	118
Waste	0.0901		85		n.a.	n.a.	n.a.	n.a.
Constr	0.16	***	1,497		239	7.47	1,789	151
Landtransp	0.15	***	1,382		202	7.71	1,556	144
Watertransp	0.07	***	4,681		315	4.21	1,323	158
Airtransp	0.11	***	3,056		324	4.37	1,417	159
Post&Courier	0.0771		171		n.a.	n.a.	n.a.	n.a.
HotelsRest	0.08	***	3,235		273	15.48	4,226	203
Publish	0.06	*	1,746		107	6.61	/	/
Audiovisual	0.14	***	188		26	8.31	214	19
Teleco	0.09	***	809		76	3.00	228	52
ITServ	0.15	***	4,735		729	7.58	5,528	592
Financ	0.06	**	801		47	3.65	172	41
Insurance	0.07	***	237		18	6.19	109	15
PublicAdmin	0.08	***	612		51	7.65	393	42
HealthSocial	0.0809		461		n.a.	n.a.	n.a.	n.a.
Other	0.14	***	12,417		1,763		*no data*	
IP	0.09	***	7,367		668		*no data*	
Total			45,464	1,054	5,022		18,206	1,695

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 13: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Production</u> sectors

NOR	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
Agriculture	-0.06		3		n.a.	n.a.	n.a.	n.a.
Forestry	0.36	***	0		0	5.96	1	0
Fishing	-0.10	**	2898		0	3.92	n.a.	n.a.
Mining	0.24	***	2228		528	1.25	662	477
Food	-0.06		347		n.a.	n.a.	n.a.	n.a.
Textiles	0.19	***	28		5	6.08	32	4
Wood	-0.22	***	40		-9	6.70	-59	-6
Paper	0.09		183		n.a.	n.a.	n.a.	n.a.
Printing	0.07		6		n.a.	n.a.	n.a.	n.a.
CokePetro	-0.52	***	1211		0	2.36	n.a.	n.a.
Chem	0.00		1787		n.a.	n.a.	n.a.	n.a.
Pharma	0.04		537		n.a.	n.a.	n.a.	n.a.
RubberP	0.01		169		n.a.	n.a.	n.a.	n.a.
Nonmet	0.06		54		n.a.	n.a.	n.a.	n.a.
BasicM	-0.04		865		n.a.	n.a.	n.a.	n.a.
MetalPro	0.10	***	292		30	5.42	163	21
Computer	0.04		659		n.a.	n.a.	n.a.	n.a.
Electrical	0.09	***	583		55	4.31	237	34
Machines	0.00		1489		n.a.	n.a.	n.a.	n.a.
Transport	-0.01		203		n.a.	n.a.	n.a.	n.a.
Other Trans	-0.14	**	1254		-179	4.13	-741	-112
Furnit	0.16	***	59		9	6.26	58	7
Total			14,895	2,141	440		354	423

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 14:PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Services</u> sectors

NOR	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
RepairInst	0.05	**	246		12	4.79	56	8
Waste	0.18		0		n.a.	n.a.	n.a.	n.a.
Constr	-0.13	***	297		-37	5.66	-210	-27
Landtransp	0.09	***	153		14	6.08	83	10
Watertransp	0.04	***	2,988		134	3.70	494	83
Airtransp	0.03		392		n.a.	n.a.	n.a.	n.a.
Post&Courier	-0.07	*	33		-2	8.61	-20	-2
HotelsRest	0.01		1,446		n.a.	n.a.	n.a.	n.a.
Publish	-0.03		7		n.a.	n.a.	n.a.	n.a.
Audiovisual	-0.16	***	17		-3	5.24	-15	-2
Teleco	0.00		132		n.a.	n.a.	n.a.	n.a.
ITServ	0.00		363		n.a.	n.a.	n.a.	n.a.
Finance	-0.02		227		n.a.	n.a.	n.a.	n.a.
Insurance	-0.05	**	154		-8	2.63	-21	-7
PublicAdmin	-0.01		39		n.a.	n.a.	n.a.	n.a.
HealthSocial	-0.01		58		n.a.	n.a.	n.a.	n.a.
Other	0.06	***	1,357		88		*no data*	
IP	-0.01		93		n.a.		*no data*	
Total			8,001	2,141	196		366	62.98

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 15: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Production</u> sectors

SWE	Aid elasticities		Exports 2024	ODA 2024	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(mbillion USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
Agriculture	0.05		9		n.a.	n.a.	n.a.	n.a.
Forestry	-0.19		0		n.a.	n.a.	n.a.	n.a.
Fishing	0.06		5		n.a.	n.a.	n.a.	n.a.
Mining	0.14	**	546		77	3.91	303	57
Food	0.10	***	557		57	7.33	421	39
Textiles	0.16	***	127		20	6.95	141	12
Wood	0.05		725		n.a.	n.a.	n.a.	n.a.
Paper	0.15	***	3033		446	4.97	2214	301
Printing	0.14	***	23		3	8.00	25	2
CokePetro	0.11	**	549		60	1.43	86	15
Chem	0.04	*	2061		91	3.09	280	73
Pharma	0.11	***	2803		297	3.42	1017	193
RubberP	0.05	**	520		24	6.02	147	16
Nonmet	0.05	*	83		4	5.76	26	3
BasicM	0.14	***	2126		289	4.30	1244	150
MetalPro	0.08	***	1000		83	6.62	551	57
Computer	0.11	***	1677		186	3.13	583	129
Electrical	0.16	***	1312		213	5.32	1132	123
Machines	0.04	*	5716		225	5.36	1204	145
Transport	0.16	***	4277		697	4.52	3154	388
Other Trans	0.11	***	295		32	4.74	151	24
Furnit	-0.02		108		n.a.	n.a.	n.a.	n.a.
Total			27,553	1,920	2,806		12,680	1,727

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 16: PDFGLS estimation results for sectoral exports for the period 2005-2024 – <u>Services</u> sectors

SWE	Aid elasticities		Exports	ODA	Added Exports	JobxOut. Multipl.	Jobs created	Value Added
SECTORS:	*(beta coefficients)*	*signi-ficance*	*(million USD)*	*(million USD)*	*(million USD)*	*(per 1 million of output)*	*(number of jobs)*	*(million USD)*
RepairInst	0.17	***	206		34	7.47	254	24
Waste	0.14		0		n.a.	n.a.	n.a.	n.a.
Constr	0.12	***	189		23	7.70	174	17
Landtransp	0.13	***	209		27	7.36	195	19
Watertransp	0.02		1200		n.a.	n.a.	n.a.	n.a.
Airtransp	0.11	***	557		60	5.46	325	38
Post&Courier	-0.01		47		n.a.	n.a.	n.a.	n.a.
HotelsRest	0.09	***	1730		152	11.77	1,794	121
Publish	0.06		50		n.a.	n.a.	n.a.	n.a.
Audiovisual	-0.08	*	1301		-107	7.37	-792	-87
Teleco	0.02		283		n.a.	n.a.	n.a.	n.a.
ITServ	0.07	***	3301		246	6.24	1,532	213
Finance	-0.04		388		n.a.	n.a.	n.a.	n.a.
Insurance	0.07	***	184		13	4.96	65	12
PublicAdmin	0.15	***	385		58	7.93	461	48
HealthSocial	0.10	***	274		29	11.42	326	25
Other	0.07	***	2789		198		*no data*	
IP	0.12	***	1519		175		*no data*	
Total			14,612	1,920	905		4,334	430

<u>Note:</u> Coefficients of leads and lags of explanatory Standard errors and vars in first differences not shown, to save space. *** p<0.01, ** p<0.05, * p<0.1 where JoboxOut. multipl.= $job\_mult * (I - A)^{-1}$ in (8). n.a. denotes non-applicable, since the respective estimated coefficient is not statistically significant at conventional levels.

Appendix 17: Job and Value-Added Contributions to GDP by Donor – Goods and Services

Donors:		**Exports**	**ODA**	**Added Exports**	**Jobs created**	**Value Added**
	Sector	million USD	million USD	million USD	Number	million USD
DEU	Goods	278,012	10,310	53,096	338,015	34,979
	Services	70,932	10,310	4,073	40,918	2,783
	Total	**348,944**	**10,310**	**57,169**	**378,933**	**37,762**
DNK	Goods	18,366	846	272	912	132
	Services	18,246	846	77.03	575	50.59
	Total	**36,612**	**846**	**349**	**1,487**	**183**
NLD	Goods	66,964	1,054	3,045	10,576	1,299
	Services	45,464	1,054	5,022	18,206	1,695
	Total	**112,428**	**1,054**	**8,067**	**28,782**	**2,994**
NOR	Goods	14,895	2,141	440	354	423
	Services	8,001	2,141	196	366	62.98
	Total	**22,896**	**2,141**	**636**	**720**	**486**
SWE	Goods	27,553	1,920	2,806	12,680	1,727
	Services	14,612	1,920	905	4,334	430
	Total	**42,165**	**1,920**	**3,711**	**17,014**	**2,157**

Note: Based on the computed values for goods and services separately in the last row of tables 8 and 9 for Germany (GER) and Tables in Appendices 9-16 for Denmark (DNK), the Netherlands (NLD), Norway (NOR) and Sweden (SWE).