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Heterogeneous effects of aid-for-trade on donor exports: Why is Japan different?

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Heterogeneous effects of Aid-for-Trade on donor exports: Why is Japan different?

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Abstract

This paper estimates the Aid-for-Trade (AfT)-export elasticity from the donor perspective, using panel data for covering 45 donor countries and 140 recipients over the 2002–2019, focusing on the top-five donor countries: Japan, Germany, France, US, and UK. The method involves estimating a gravity equation with the Poisson pseudo-maximum likelihood (PPML) technique. We find that the mean AfT-export elasticity for the 45 donor countries is zero, but the elasticity for Japan is positive and large. In particular, the findings suggest that Japanese AfT generates net export expansion from the receipient countries, in contrast to Aft from the other top donors that expands net imports from these countries. We further examined the potential mechanism behind the export creation effect of the Japanese AfT using unique contract data on wouldwide infrastructure-related projects in which Japanese AfT is heavily concentrated. The results suggest that the Japanese infrastructure-related AfT works as an informal tying arrangement that closely link aid to donor exports. The focus of Japanese AfT on economic infrastructure offers a model to achieve mutual benefits for both donor and recipient countries.

Keywords: Aid-for-Trade; Gravity equation; Poisson pseudo-maximum likelihood estimator; Japan; Donor export

JEL codes: F35, F14, O11

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1. Introduction

The Aid-for-Trade (AfT) initiative was launched in December 2005 during the World Trade Organization (WTO) Ministerial Meeting held in Hong Kong. The initiative aims to accelerate economic growth and alleviate poverty, promoting integration into the global trade system and helping developing countries strengthen their supply-side and trade-related infrastructures and reduce adjustment costs associated with multilateral trade liberalisation (Hoekman, 2011). AfT targets economic infrastructure, productive capacity, and trade policy and adjustment. Since its launch, the scale of bilateral AfT has continued to grow, reaching US$ 19.5 billion in 2019, equal to 25% of bilateral Official Development Assistance (ODA) on a gross disbursement basis. Empirical evidence has revealed the effectiveness of AfT in expanding recipient export capacity (Calì & te Velde, 2011; Martínez-Zarzoso, Nowak-Lehmann D., & Rehwald, 2017).

From the donor perspective, the question of how much AfT may increase *donor* exports is of great interest. AfT may promote donor exports through various channels (Arvin & Choudhry, 1997; Jepma, 1991; Wagner, 2003). Aid directly links to donor exports with formal or informal tying arrangements. In the long run, aid may create goodwill to purchase goods and services from the donor to secure future aid. In addition, once a recipient country has imported goods and services from the donor through aid, the costs associated with the information barriers decrease, positively affecting current and future donor exports.

Given the growing importance of South-South trade, the nexus between AfT and donor exports has become more critical than ever. The share of Organisation for Economic Cooperation and Development (OECD) countries in total merchandise exports to

developing countries had declined from 58% in 2001 to 41% in 2019 (United Nations Conference on Trade and Development–UNCTAD, 2021). Thus, whether AfT may help secure market access in developing countries through international trade is an agenda of foreign aid policies in donor countries. However, little is known so far about the impact of AfT on exports from the donor countries and the heterogeneity in AfT-export links among donors.

The present study contributes to the literature analysing the effects of AfT (or ODA more generally) on donor exports. We estimates the Aid-for-Trade (AfT)-export elasticity from the donor perspective, using panel data for covering 45 donor countries and 140 recipients over the 2002–2019, focusing on the top-five donor countries: Japan, Germany, France, US, and UK. These five countries account for 80% of total bilateral AfT, and their foreign aid policies are substantially different.

Building upon an emprical approach employed in Hoekman and Shingal (2020), we offer new evidence in the case of Japan. To the best of our knowledge, this is the first study to reveal the heterogeneous effects of AfT on donor exports, considering the top-five donor countries. The novelty of this study is to uncover the potential mechanism behind Japan's strong AfT-export links by using unique contract data on infrastructure-related projects worldwide. Our results enhance the current understanding of how Japanese foreign aid realises domestic economic interests through export promotion, complementing existing evidence that Japanese aid promotes the country's outward foreign direct investments (Kimura & Todo, 2010; Lee & Ries, 2016).

On the one hand, poor economic infrastructure, such as the lack of adequate ports and roads and reliable electricity supply, remains a major bottleneck for trade expansion and economic diversification in low- and middle-income countries (OECD/WTO, 2019). On the other hand, donor countries face pressure on foreign aid budgets and the rise of populist sentiments, leading policymakers to pursue national interests through ODA (Arvin & Lew, 2015). The focus of Japanese AfT on economic infrastructure offers a model to achieve mutual benefits for both donor and recipient countries.

The remainder of this article is organised as follows. Section 2 overviews the previous research. Section 3 describes data used for analyses, followed by the proposed empirical approach to estimating AfT-export elasticities. Section 4 reports the baseline results,

and extends our analysis to explore the mechanism behind the strong export creation effect of the Japanese AfT. Section 5 concludes.

2. Aid-Export Nexus: Prior Evidence[1]

Nilsson (1997) has examined the relationship between gross ODA disbursement and donor exports using a panel dataset covering 15 European donors and 108 recipients for 1975–1992. He has found an elasticity equal to 0.23, suggesting that US$ 1 of ODA increases donor exports by US$ 2.6. Expanding the scope of donors beyond Europe, Wagner (2003) has shown that an elasticity equal to 0.06 and a return of an additional ODA equal to US$ 0.73. He has also investigated the heterogeneity in the ODA-export nexus among donors, mainly focusing on Japan, finding no evidence. Using more recent data, Nowak-Lehmann, Martínez-Zarzoso, Herzer, Klasen, and Cardozo (2013) have found an elasticity of 0.05, while Martínez-Zarzoso, Nowak-Lehmann, Parra, and Klasen (2014a) have reported an elasticity equal to 0.04 and possibly differential returns of ODA among donors.

Several studies have focused on a single donor instead of estimating the average ODA-export elasticity for multiple donors. Zarin-Nejadan, Monterio, and Noormamode (2008) have examined the case of Switzerland. Using a panel dataset covering 99 recipients for 1966–2003, they have found an average ODA-export elasticity of 0.05. Other studies have found an elasticity of 0.13 for Germany (Nowak-Lehmann D., Martínez-Zarzoso, Klasen, & Herzer, 2009), 0.03 for the Netherland (Martínez-Zarzoso, Nowak-Lehmann, & Klasen, 2014b), and 0.08 for Denmark (Hansen & Rand, 2014).

One last strand of the literature closely related to our study has focused on AfT; for instance, using a panel dataset covering 167 importers and 172 exporters for 1990–2005, Helble, Mann, and Wilson (2012) have examined the relationship between gross AfT disbursements and donor exports. They have found an average AfT-export elasticity of 0.004, suggesting that an additional US$ 1 AfT leads to a US$ 1.33 increase in donor exports. Analysing gross AfT commitments, Pettersson and Johansson (2013) have found an elasticity of 0.09, while Hühne, Meyer, and Nunnenkamp (2014) have found an elasticity of 0.03 for total donor exports (rather than bilateral donor exports). In contrast, Hoekman and Shingal (2020) have found negative AfT-export elasticities for both goods (–0.01) and services (–0.04). Unlike other works, they

[1] See Appendix A for details.

explicitly account for multilateral resistance terms by controlling for donor-year and recipient-year fixed effects.

3. Materials and Methods

3.1. Data

We obtained data on bilateral AfT from the Creditor Reporting System (CRS) compiled by the OECD. The CRS records annual flows of ODA from donor to recipient at the item level, allowing to identify any bilateral or multilateral ODA by sector, flow type, channel, and aid type. Utilising the sectors classified by OECD (2021), we defined AfT as the aggregated amounts of bilateral gross ODA disbursement flows in (i) economic infrastructure, (ii) productive capacity, and (iii) trade policy and adjustment.[2] We omitted AfT from multilateral institutions, such as the World Bank. We also collected bilateral ODA, except for bilateral AfT. We measured all aid variables in constant US$ (2019 price).

The AfT variables include missing values that appear not random, potentially resulting in biased estimates. For example, richer recipient countries tend to exhibit more missing observations, as they are less likely to receive aid, or even if they do, the aid amounts are too small to be recorded. To deal with this issue and simultaneously avoid a loss of observations, we added one (US$ 1) to the AfT variables before their logarithmic transformations. We included a dummy variable in the model to account for AfT equal to zero. The proposed approach aligns with prior research, such as Calì, and te Velde (2011) and Lee and Ries (2016). We adopted the same procedure for the sectoral AfT and ODA (excluding AfT) variables.

We obtained data on bilateral trade, measured in current US$, from a merchandise trade matrix compiled by UNCTAD. We utilised annual bilateral trade data between donor and recipient countries reported by the donor. We used the CEPII Gravity Dataset to obtain information on the time-variant status of donor-recipient free trade agreements. We extracted the bilateral nominal exchange rate, measured as national recipient currency per national donor currency (e.g., Indian rupee per US dollar and Zambian kwacha per Japanese yen) from UNCTAD.

[2] See Appendix B for details.

We obtained data on infrastructure-related projects from Plant Exports for 50 Years compiled by the Heavy & Chemical Industries News Agency Co., Ltd. (HCINA) in Japan. This dataset newly records the contracts of infrastructure-related projects worldwide. The HCINA provides information on rough project plans (e.g., construction of hydrogen power plant), contract year and duration, project site (country), contractee, contractor, and service. The HCINA covers 16,681 projects across 200 countries from the period of 1965 to 2014. In most cases, the contractees are public entities, such as national or local governments and public cooperation entities associated with transportation, communication, and utilities, whereas the contractors are private firms. Information on contractors' locations is also available at the country level. The services provided by the contractors include equipment procurement, engineering, construction, operation, technical support, and design. To extend the time horizon, we extracted data from Annual Report on Plant Exports, compiled by the HCINA, for 2015–2019.

Using the HCINA data, we constructed a bilateral variable measuring the number of infrastructure-related projects in the recipient country contracted by firms in the donor country in each (contract) year. There are some caveats to this variable. First, multiple contractors jointly won a single project in some projects, and they were in different donor countries. We counted for each donor country in such cases. Second, when an overseas subsidiary (e.g., a subsidiary of a Japanese firm located in US) won a project, we counted for a donor country based on the overseas subsidiary's location rather than its headquarters. Third, the proposed variable did not include small projects. Finally, data limitation did not allow us to disaggregate this variable by projects and services.

The study's sample period is 2002–2019. We discarded the period before 2002 because the CRS did not allow access to bilateral gross ODA disbursements by sectors in those early years (2019 is the latest year available when writing this paper). The final sample covers 45 donors, including 30 OECD and 15 non-OECD countries (Appendix C). The 30 OECD donor countries are all Development Assistance Committee (DAC) members as of 2021. The recipients are 140 developing countries (Appendix D). Note that 11 recipients in the sample graduated from the DAC list during 2002–2019.[3]

[3] Slovenia in 2003, Bahrain in 2005, Saudi Arabia in 2008, Barbados, Croatia, Oman, and Trinidad and Tobago in 2011, St. Kitts and Nevis in 2014, Chile, Seychelles, and Uruguay in 2018.

Table 1 reports the summary statistics for all variables used for estimations. The mean donor exports to a recipient are US$ 514 million, lower than the mean donor imports from the recipient (US$ 677 million). The mean contract of infrastructure-related projects is far below one, meaning that many observations equal zero for this variable. The scale of AfT and ODA (excluding AfT) is smaller than that of the mean donor exports. The missing observations account for 70% and 40% of the AfT and ODA (excluding AfT) variables, respectively. We do not interpret bilateral exchange rates as currency units differ among donor-recipient pairs.[4] Free trade agreements were in force during 2002–2019 for around 20% of donor-recipient pairs.

Table 1: Aid for Trade: Summary Statistics

	Obs.	Mean	S.D.	Min	Max
Donor exports to the recipient, US$ million	81,152	514	4,583	0	265,435
Donor imports from the recipient, US$ million	81,152	677	8,046	0	563,203
Contracts for infrastructure-related projects	81,152	0.1	0.9	0	90
AfT, US$ million	81,152	3.2	36.6	0	3,383
AfT for economic infrastructure, US$ million	81,152	1.9	28.6	0	2,330
AfT for productive capacity, US$ million	81,152	1.2	11.7	0	1,083
AfT for trade policy and adjustment, US$ million	81,152	0.1	2.4	0	455
ODA (excluding AfT), US$ million	81,152	11	90.3	0	11,134
Dummy if AfT is zero	81,152	0.7	0.5	0	1
Dummy if AfT for economic infrastructure is zero	81,152	0.8	0.4	0	1
Dummy if AfT for productive capacity is zero	81,152	0.7	0.4	0	1
Dummy if AfT for trade policy and adjustment is zero	81,152	0.9	0.3	0	1
Dummy if ODA (excluding AfT) is zero	81,152	0.4	0.5	0	1
Bilateral nominal exchange rates	81,152	24,492	1,354,916	0	97,500,000
Donor-recipient free trade agreement status	81,152	0.2	0.4	0	1

Notes: This table presents summary statistics for the study's sample, based on donor-recipient-year panel data (45 donors, 140 recipients, 2002–2019). We add US$ 1 to all AfT and ODA (excluding AfT) variables. The currency units of bilateral exchange rates differ among donor-recipient pairs.

3.2. Aid-for-Trade: trends, allocations, and AfT-export links

Figure 1 presents the total bilateral AfT for the 45 donors in the sample and its share in ODA during 2002–2019. Bilateral AfT has continued to grow, from US$ 5.5 billion in 2002 to US$ 19.5 billion in 2019, with a faster growth rate than that of ODA. As a result, the share of AfT in ODA reached 25% in 2019. The dips in the AfT share after 2015 reflect a surge in humanitarian and refugee aid due to the European refugee crisis.

[4] The maximum value of bilateral exchange rates (97,500,000) is for Venezuela's Bolívar per UK pound.

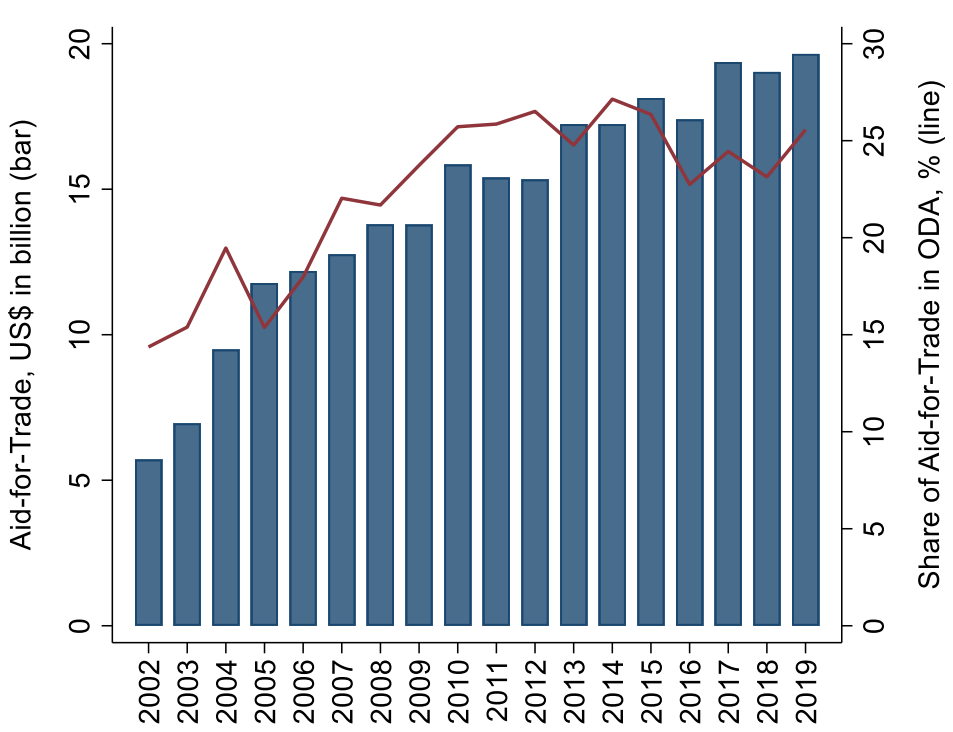

Figure 1. Trends in Bilateral Aid-for-Trade

Notes: The bars present the total disbursements of bilateral AfT flows for the 45 donors in the sample. The line shows the share of AfT in the total disbursement of bilateral ODA flows.

Table 2 reports the aggregated amounts of bilateral AfT during 2002–2019 for all 45 donors and each top-five donor. The results in the first column indicate that the total AfT transferred from donors to recipients amounts to approximately US$ 260 billion globally, with 54% provided in the form of grants. A large part of AfT is allocated to economic infrastructure (61%), followed by productive capacity (37%). The proportion of trade policy and adjustment is marginal. Approximately half of AfT is distributed to East Asia and Pacific or South Asia, and one-third to the Middle East and North Africa or Sub-Saharan Africa.

Japan has contributed approximately US$ 90 billion of bilateral AfT during 2002–2019. The Japanese AfT is characterised by a high concentration in economic infrastructure, the prevalence of loans, and primary distribution to East Asia and Pacific or South Asia. The principal recipient of the Japanese AfT is India (US$ 19 billion), followed by Vietnam (12), Indonesia (7), Bangladesh (5), and Thailand (5).

The US AfT allocation appears to be different from Japan, showing a relatively high proportion of productive capacity, the prevalence of grants, and geographical concentration toward the Middle East and North Africa and South Asia. The primary

recipients of the US AfT are Iraq (US$ 13 billion), Afghanistan (11), Egypt (3), and Pakistan (2).

Table 2: Aid-for-Trade Allocations for All and Top-Five Donors

	All donors	Top-five donors				
	(45)	Japan	US	Germany	France	UK
AfT, US$ billion	261	89	54	34	21	10
AfT in ODA, %	23	45	17	25	20	13
Grants in AfT, %	54	25	98	37	27	75
AfT by sectors, %						
Economic infrastructure	61	82	43	57	69	27
Productive capacity	37	18	52	41	31	68
Trade policy and adjustment	2	0	5	2	0	5
AfT by regions, %						
East Asia and Pacific	24	43	4	19	16	12
Europe and Central Asia	7	6	9	12	7	1
Latin America and Caribbean	9	3	10	14	16	5
Middle East and North Africa	17	7	33	13	25	5
South Asia	24	33	27	24	7	37
Sub-Saharan Africa	19	8	17	17	30	40

Notes: This table reports the aggregated amounts of bilateral AfT disbursement flows during 2002–2019 (2019 price basis). See Appendix B for the details of each AfT sector, Appendix C for the list of donors, and Appendix D for the list of recipients by region.

While Germany and France are similar to Japan in that their AfT is inclined toward economic infrastructure in the form of loans, their geographical distributions are different. The German AfT is relatively equally distributed across regions, while the French AfT is primarily distributed to Sub-Saharan Africa, and the Middle East and North Africa. UK is similar to US, with a high proportion of aid destined for productive capacity and the prevalence of grants. Nearly 80% of the UK AfT is distributed to South Asia and Sub-Saharan Africa.

Figure 2 exhibits donor-recipient paired scatter plots of (i) changes in donor exports to each recipient country between 2002 and 2019 (y-axis), measured by log differences and (ii) the logarithm of accumulated bilateral AfT during 2002–2019 (x-axis). The top-left scatter plot shows no AfT-export link for the 45 donors. However, this result disguises the heterogeneity in AfT-export links among donors. The scatter plots for Japan, Germany, and UK indicate a positive association for Japan. We observe no AfT-export links for France and US.

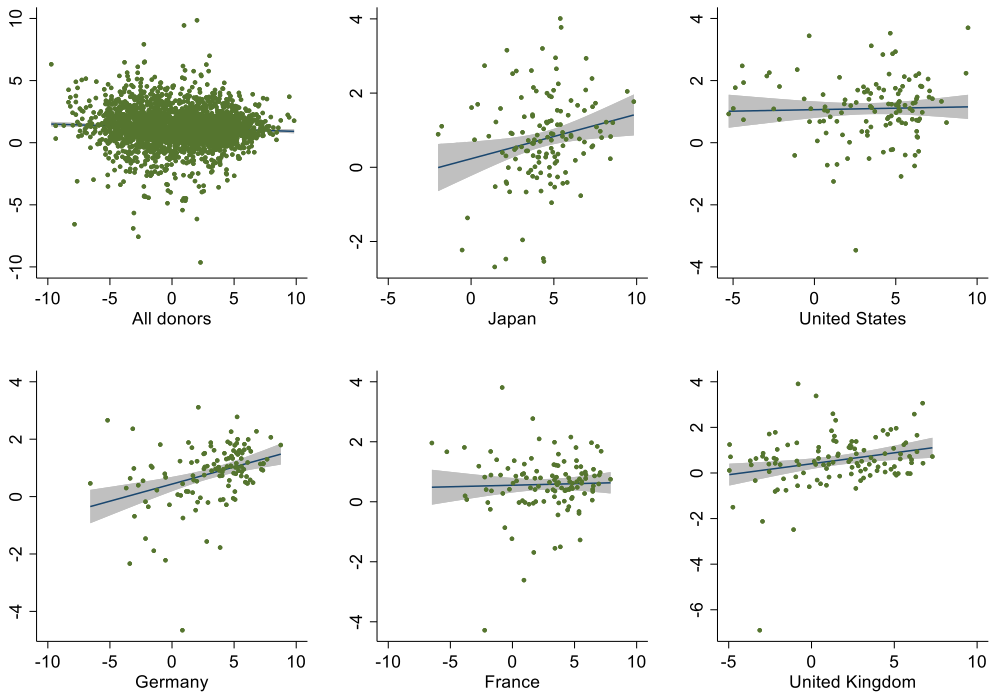

Figure 2. Initial Evidence on AfT-Export Links

Notes: The figure exhibits donor-recipient paired scatter plots of the change in donor exports to the recipients, measured by the logarithm of donor exports to the recipient in 2019 minus the logarithm of donor exports to the recipient in 2002 (y-axis) and the logarithm of accumulated bilateral AfT during 2002–2019 (x-axis).

3.3. Baseline specification and estimation technique

The proposed estimation of the determinants of bilateral exports from the donor to the recipient (*EX*) draws on the 'gravity with gravitas' model developed by Anderson, and van Wincoop (2003):

$$\ln EX_{i,j,t} = \ln GDP_{i,t} + \ln GDP_{j,t} - \ln WGDP_t + (1-\varphi_t)\left[\ln \Phi_{i,j,t} - \ln \delta_{i,t} - \ln \theta_{j,t}\right]. \quad (1)$$

$$\delta_{i,t} = \sum_{j=1}^{c} \left(\Phi_{i,j,t}/P_{j,t}\right)^{1-\varphi_t} \left(GDP_{j,t}/WGDP_t\right). \quad (2)$$

$$\theta_{j,t} = \sum_{i=1}^{e} \left(\Phi_{i,j,t}/\delta_{i,t}\right)^{1-\varphi_t} \left(GDP_{j,t}/WGDP_t\right). \quad (3)$$

where subscripts *i*, *j* and *t* stand for donor, recipient, and year, respectively. The *ln* prefix indicates the natural logarithm. *GDP* is the gross domestic product in each donor and recipient country, *WGDP* is the world's aggregated gross domestic product, φ is a

combination of the intertemporal elasticity of substitution in demand and the elasticity of supply, and Φ indicates trade costs. An essential feature of the Anderson, and van Wincoop (2003) model is the inclusion of multilateral resistance terms (δ and θ) that account for unobserved price indices.

The standard approach for consistently estimating the model is to incorporating multilateral resistance terms is to include donor-year fixed effects ($F_{i,t}$) and recipient-year fixed effects ($F_{j,t}$) (Baier & Bergstrand, 2007; Hoekman & Shingal, 2020). Donor-recipient paired fixed effects ($F_{i,j}$) also account for time-invariant factors such as historical and cultural links between donor and recipient. Including the three fixed effects, Equation (1) reads as follows:

$$\ln EX_{i,j,t} = F_{i,t} + F_{j,t} + F_{i,j} + (1 - \varphi_t)\left[\ln \Phi_{i,j,t}\right]. (4)$$

Equation (4) is augmented by adding the AfT variable (*AfT*) and a vector of other time-varying bilateral variables ($\boldsymbol{X}$) into Φ. The augmented version of the gravity equation reads as follows:

$$\ln EX_{i,j,t} = \beta_1 \ln AfT_{i,j,t} + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j} + \varepsilon_{i,j,t}. (5)$$

Our primary interest is β_1, the AfT-export elasticity. The critical identification issue is that *AfT* may be correlated with time-varying bilateral variables in the error term (ε). Bilateral ODA (excluding AfT) matters because recipients with large AfT inflows tend to receive large amounts of other types of foreign aid, which may also promote donor exports (Bearce, Finkel, Pérez-Liñán, Rodríguez-Zepeda, & Surzhko-Harned, 2013). Due to potential Dutch disease effects, bilateral exchange rates should be controlled (Arellano, Bulíř, Lane, & Lipschitz, 2009). The donor-recipient free trade agreement status should also be considered because trade and aid policies are closely linked (Suwa-Eisenmann & Verdier, 2007). To mitigate the omitted variable bias to the extent possible, we consider all these factors.

We use the PPML technique to address potential heteroskedasticity.[5] Silva and Tenreyro (2006) have shown that the log-linearised gravity equation estimated by

[5] The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity rejects the null hypothesis that the variability of the random error is constant across elements of the vector.

ordinary least squares (OLS) may be highly misleading in the presence of heteroskedasticity. Hence, they propose to use the PPML as a substitute for the standard log-linear model, as the PPML provides a natural way to deal with zero values of the dependent variable. In recent years, the PPML estimator has become a standard technique to estimate a gravity equation (Hoekman & Shingal, 2020; Lee & Ries, 2016).

Adopting the PPML estimator, we rewrite Equation (5) as the multiplicative form of the constant-elasticity:

$$EX_{i,j,t} = \exp\{\beta_1 \ln AfT_{i,j,t} + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\} + \varepsilon_{i,j,t}. \quad (6)$$

Using a donor-recipient-year panel dataset raises two concerns. First, model errors may be correlated for recipients of the same donor due to common shocks such as changes in national aid policies. Second, model errors may be serially correlated over time. Failure to adjust for within-cluster correlations may lead to misleadingly small standard errors. Hence, we report robust standard errors clustered by the donor. The number of clusters is 45, sufficient for the standard cluster adjustment to be reliable (Angrist & Pischke, 2009).

3.4. Alternative specifications

To estimate sectoral AfT-export elasticities, we split the AfT variable (*AfT*) into economic infrastructure (*AfT_EI*), productive capacity (*AfT_PC*), and trade policy and adjustment (*AfT_TPA*). We estimate the following specification:

$$EX_{i,j,t} = \exp\left\{\beta_1 \ln AfT_{EI\,i,j,t} + \beta_2 \ln AfT_{PC\,i,j,t} + \beta_3 \ln AfT_{TPA\,i,j,t} + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\right\} + \varepsilon_{i,j,t}. \quad (7)$$

Equation (6) focuses on same-year effects and ignores lagged effects. However, AfT over previous years may be relevant for the donor exports in the current year due to lingering 'goodwill' effects (Arvin & Choudhry, 1997). To investigate the effect of lagged AfT, we add lagged terms to the model as follows:

$$EX_{i,j,t} = \exp\left\{\beta_j \sum_{j=0}^{3} \ln AfT_{i,j,t-j} + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\right\} + \varepsilon_{i,j,t}. \quad (8)$$

Summing the β coefficients from Equation (8) provides an estimate of the *J*-year AfT-export elasticity. The three-year elasticity, for example, may be calculated as $\beta_0 + \beta_1 + \beta_2 + \beta_3$. We only focus on three lags to avoid losing many observations.

We estimate separate AfT-export elasticities for the top-five donors using the following specification:

$$EX_{i,j,t}$$
$$= \exp\left\{\beta_1 \ln AfT_{i,j,t} + \sum_{d=1}^{5} \omega_d \left(\ln AfT_{i,j,t} \times \rho_d\right) + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\right\} + \varepsilon_{i,j,t}. \quad (9)$$

where ρ_d are top donor dummies: $\rho_1 = 1$ if the donor is Japan (and zero otherwise), $\rho_2 = 1$ if the donor is Germany, $\rho_3 = 1$ if the donor is France, $\rho_4 = 1$ if the donor is US, and $\rho_5 = 1$ if the donor is UK. In this specification, β_1 may be interpreted as the mean AfT-export elasticity for all the donors other than the top-five donors (we call this 'benchmark' elasticity); ω_d measures the different slopes of AfT-export elasticities relative to the benchmark elasticity for each top donor. Thus, $(\beta_1 + \omega_d)$ represent the individual AfT-export elasticities for Japan, Germany, France, US, and UK, respectively.

Finally, to examine the temporal patterns of the AfT-export elasticity, we interact with year dummies (θ_t) for all years with the logarithm of the AfT variable (ln *AfT*), as follows:

$$EX_{i,j,t} = \exp\left\{\sum_{t=2002}^{2019} \beta_t \left(\ln AfT_{i,j,t} \times \theta_t\right) + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\right\} + \varepsilon_{i,j,t}. \quad (10)$$

where β_t indicates the AfT-export elasticity for each year in the sample period.

4. Results

4.1. Estimated AfT-export elasticities

Table 3 presents the PPML estimation results. All estimations use the same donor-recipient-year level panel dataset (45 donors, 140 recipients, 2002–2019). All specifications control for donor-year fixed effects, recipient-year fixed effects, donor-recipient paired fixed effects, and bilateral time-varying controls, including ODA (excluding AfT), the zero AfT dummy, the zero ODA dummy, nominal exchange rates, and the free trade agreement status. The Pseudo R^2 are quite high, indicating the adequate level of the overall goodness-of-fit of the regression. Given the nature of the bilateral dataset, we interpret our estimates as a lower bound of the effects of AfT on donor exports. The first column presents the results of Equation (6), suggesting that a 1% increase in bilateral AfT leads to an 0.008% increase in donor exports to recipients, on average, over 2002–2019 for 4519 donor-recipient pairs. However, the estimate is not statistically distinguishable from zero at the 10% significance level.

The second column reports the result obtained by estimating sectoral AfT-export elasticities based on Equation (7). The coefficient on the logarithm of AfT for economic infrastructure is positive and statistically significant. However, a joint test fails to reject the null hypothesis that the elasticities are equal across the three sectors. The third column reports the result for the distributed lag model in Equation (8). The three-year AfT-export elasticity is 0.011 (=0.009–0.001+0.002+0.001), statistically different from zero at the 5% level. The same-year effect appears to be stronger than the lagged effects.

The fourth column reports the result on the extent to which the AfT-export elasticity differs among the top-five donors relative to the benchmark elasticity for all the donors other than the top-five donors. The benchmark elasticity is 0.003 but statistically indistinguishable from zero. An interesting finding is that the AfT-export elasticities for Japan and France are larger than the benchmark elasticity at significant levels. Assuming that the benchmark elasticity is zero, the estimates suggest that the AfT-export elasticities are 0.022 for Japan and 0.008 for France, respectively. In contrast, we find no evidence of such deviations from the benchmark for Germany, US, and UK.

Based on the mean values of bilateral exports and bilateral AfT during 2002–2019, the estimated elasticity suggests that an additional US$ 1 of Japanese bilateral AfT generates US$ 1.1 of bilateral merchandise exports from Japan to each recipient, on average. The magnitude of the mean export creation effects of Japanese AfT is US$ 40.3 million, equal to 2% of the mean bilateral exports during 2002–2019. For France,

the US$ increase in donor exports per US$ 1 AfT is 0.6, suggesting that bilateral exports generated by AfT amount to US$ 5 million, 0.6% of the mean bilateral exports.

Table 3: AfT-Export Elasticity

Dependent variable: Donor exports to the recipient				
	(1)	(2)	(3)	(4)
Ln AfT	0.008		0.009*	0.003
	(0.005)		(0.005)	(0.005)
Ln AfT_economic infrastructure		0.008*		
		(0.005)		
Ln AfT_productive capacity		0.006		
		(0.004)		
Ln AfT_trade policy and regulation		–0.001		
		(0.006)		
Ln AfT (1-year lag)			–0.001	
			(0.001)	
Ln AfT (2-year lag)			0.002**	
			(0.001)	
Ln AfT (3-year lag)			0.001	
			(0.001)	
Ln AfT × Japan dummy				0.022***
				(0.006)
Ln AfT × Germany dummy				0.002
				(0.002)
Ln AfT × France dummy				0.008***
				(0.002)
Ln AfT × US dummy				0.004
				(0.003)
Ln AfT × UK dummy				0.003
				(0.002)
Pseudo R^2	0.993	0.993	0.994	0.993
Donor-year dummy			Yes	
Recipient-year dummy			Yes	
Donor-recipient paired dummy			Yes	
Bilateral time-varying controls			Yes	
Donors			45	
Recipients			140	
Donor-recipient pairs			4519	
Years			2002–2019	
Observations	81,152	81,109	67,447	81,152

Notes: The table reports the PPML estimation results. Bilateral time-varying controls include ODA (excluding AfT), a dummy for AfT equal to zero, a dummy for ODA (excluding AfT) equal to zero, nominal exchange rates, and the free trade agreement status. We cluster standard errors at the donor level. See Appendix B for AfT, Appendix C for donors, and Appendix D for recipients.
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Figure 3 displays the time pattern of AfT-export elasticities from estimates of Equation (10). Each estimate is the AfT-export elasticity for each year during 2002–2019. The effects of AfT on donor exports are consistently positive over time, with point estimates

ranging from 0.002 to 0.013 and a mean of 0.008. We find larger effects for the period after 2015, with statistically significant estimates.

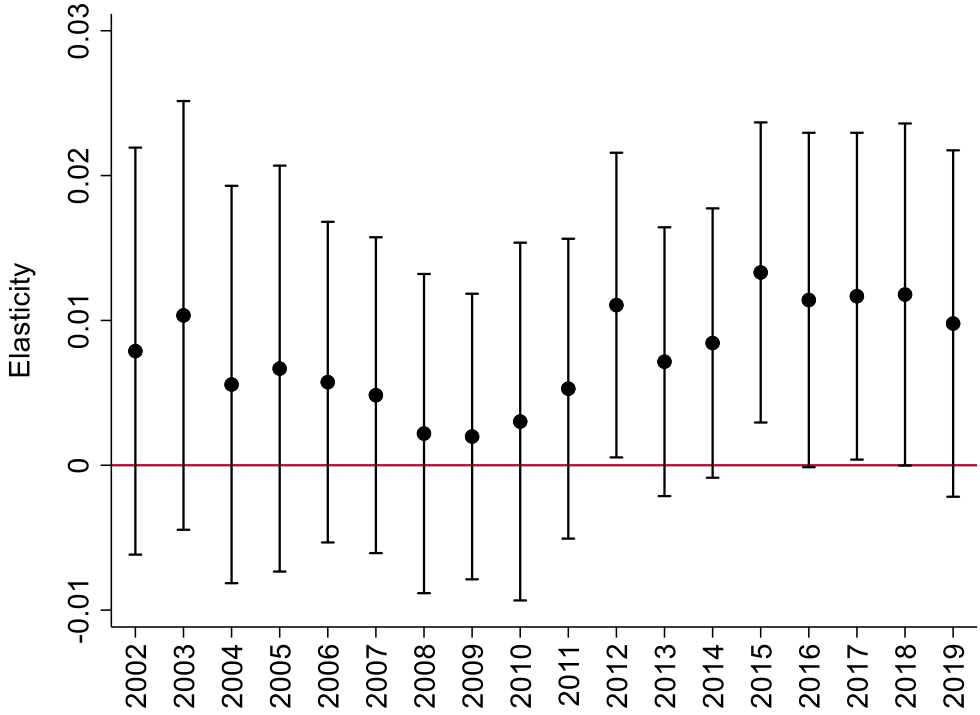

Figure 3. Elasticity by Year

Notes: The figure presents the estimation results for Equation (10) based on a donor-recipient-year level panel dataset (45 donors, 140 recipients, 2002–2019). The dots represent the point estimates, and the vertical bands are 95% confidence intervals. The standard errors are robust to heteroscedasticity and clustered by donor countries.

4.2. Does Japanese AfT increase net exports?

While the estimated export-creating effects mentioned above are gross terms, the *net* effects are more relevant from the balance-of-payment perspective. To evaluate the effect of AfT on donor exports in net terms, we first re-estimate Equations (6) and (9) to obtain AfT-import elasticities, replacing donor exports to the recipient with donor imports from the recipient as the dependent variable. Table 4 presents the results. Unlike the case of donor exports, the mean AfT-import elasticity equals 0.010 for the 45 donors, significant at the 5% level (Column 1). The results in the second column show that the benchmark elasticity for all the donors other than the top-five donors is 0.009. However, AfT-import elasticities do not deviate from the benchmark for the top-five donors, except for UK, which exhibits an AfT-import elasticity equal to 0.004.

Table 4: AfT-Import Elasticity

Dependent variable: Donor imports from the recipient		
	(1)	(2)
Ln AfT	0.010**	0.009*
	(0.004)	(0.005)
Ln AfT × Japan dummy		0.002
		(0.003)
Ln AfT × Germany dummy		0.002
		(0.003)
Ln AfT × France dummy		0.001
		(0.003)
Ln AfT × US dummy		0.001
		(0.003)
Ln AfT × UK dummy		–0.005**
		(0.002)
Pseudo R^2	0.993	0.993
Donor-year dummy	Yes	
Recipient-year dummy	Yes	
Donor-recipient paired dummy	Yes	
Bilateral time-varying controls	Yes	
Donors	45	
Recipients	140	
Donor-recipient pairs	4519	
Years	2002–2019	
Observations	81,152	

Notes: The table reports the PPML estimation results. See Table 3 for the bilateral time-varying controls. We cluster standard errors at the donor level.
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5 summarises the estimates of (i) AfT-export and AfT-import elasticities and (ii) US$ increases per US$1 AfT in terms of donor exports, imports, and net exports.[6] We find that the Japanese AfT generates net donor exports. A US$1 increase in Japanese AfT leads to a US$ 0.5 increase in net exports from Japan to each recipient country, on average. This result is unique, as the AfT expands net imports for the other top donors by US$ 1 for Germany, 0.3 for France, 3.1 for US, and 0.9 for UK.

[6] The estimates of AfT-export elasticities are obtained from Columns 1 and 4 in Table 3 and the estimates of AfT-import elasticities from Table 4. Statistically insignificant coefficients are regarded as zero. The US$ increases per US$ 1 AfT are calculated by using the estimated elasticities and the average values of bilateral trade and AfT during 2002–2019.

Table 5: Estimated Increases in Net Donor Exports per US$ 1 AfT

	Elasticity		US$ increase per US$1 AfT in terms of donor:		
	AfT-export	AfT-import	Export	Import	Net export
All donor countries	0	0.01	0	2.1	–2.1
Japan	0.022	0.009	1.1	0.6	0.5
Germany	0	0.009	0	1	–1.0
France	0.008	0.009	0.6	1	–0.3
US	0	0.009	0	3.1	–3.1
UK	0	0.004	0	0.9	–0.9

Notes: The estimates of AfT-export elasticities are obtained from Columns 1 and 4 in Table 3, and the estimates of AfT-import elasticities from Table 4. We regard statistically insignificant coefficients as zero. We calculate the US$ increases per US$ 1 AfT by using the estimated elasticities and the average values of bilateral trade and AfT during 2002–2019.

4.3. Why is the export creation effect of Japanese AfT strong?

This study hypothesises that Japan's AfT-export solid nexus is associated with the Japanese AfT being highly concentrated in economic infrastructure. As shown in Table 2, 82% of the Japanese AfT is allocated to economic infrastructure during 2002–2019. The other top donors' economic infrastructure shares are much lower: 57% for Germany, 69% for France, 43% for US, and 27% for UK. Japanese firms have a competitive advantage in economic infrastructure, making them more likely to win a contract over a Japanese aid project. This mechanism may work as an implicitly tied aid, promoting procurements of goods and services from Japan (Arvin & Choudhry, 1997; Jepma, 1991; Wagner, 2003).

AfT-export links may also be strengthened by formal tying arrangements, where a recipient receiving tied aid is required to use those funds to acquire goods and services from the donor. However, formal tying arrangements have decreased over time across donors, including Japan. The average shares of formal tying arrangements in total bilateral ODA commitments during 2002–2019 were 15% for the 45 donors, 9% for Japan, 4% for Germany, 5% for France, 37% for US, and 0% for UK (OECD, 2022). Thus, formal tying arrangements appear to play a less critical role in explaining the uniqueness of Japan's AfT-export links.

To explore the potential mechanism behind Japan's AfT-export links, we test the hypothesis that the Japanese bilateral AfT for economic infrastructure is associated with

an increase in contracts for infrastructure-based projects obtained by Japanese firms. To this end, we estimate the following specification:

$$CIP_{i,j,t} = \exp\left\{\beta_1 \ln AfT_{EI\,i,j,t} + \sum_{d=1}^{5} \omega_d \left(\ln AfT_{EI\,i,j,t} \times \rho_d\right) + \boldsymbol{\gamma X}_{i,j,t} + F_{i,t} + F_{j,t} + F_{i,j}\right\} + \varepsilon_{i,j,t}. \quad (11)$$

where *CIP* stands for the number of contracts for infrastructure-based projects in recipient country *j* received by firms located in donor country *i* in year *t*, and *AfT_EI* is the bilateral AfT disbursement for economic infrastructure. The other variables are identical to Equation (9).

The first column reports the estimation result. The bilateral AfT for economic infrastructure is not associated with the contracts of infrastructure-related projects for all the donors other than the top-five donors. However, we find robust evidence that the Japanese effect deviates from the benchmark. These results suggest that a 1% increase in the Japanese AfT for economic infrastructure leads to a 0.06% increase in the number of contracts for infrastructure-related projects received by Japanese firms. This result implies that a US$ 500 million AfT for economic infrastructure is associated with a single contract. We find no such positive aid effects for the other top donors.

The second column presents additional evidence supporting our hypothesis. The results suggest that a 1% increase in the AfT for economic infrastructure is associated with an increase in donor exports by 0.006%, on average, for all the donors other than the top-five donors. Only the Japanese effect deviates from the benchmark, with an AfT-export elasticity of 0.015. The AfT effects for the other top donors are either approximately equal to the benchmark (France and US) or smaller (Germany and UK) relative to the benchmark.

Table 6: Effects of AfT for Economic Infrastructure on Contracts of Infrastructure-Related Projects

Dependent variables:	Contracts for infrastructure-related projects	Donor exports to recipients
Ln AfT_economic infrastructure	0.017	0.006**
	(0.016)	(0.003)
Ln AfT_economic infrastructure × Japan dummy	0.057***	0.009**
	(0.001)	(0.004)
Ln AfT_economic infrastructure × Germany dummy	–0.001	–0.006**
	(0.001)	(0.002)
Ln AfT_economic infrastructure × France dummy	0.001	0.001
	(0.002)	(0.002)
Ln AfT_economic infrastructure × US dummy	–0.008***	0.000
	(0.002)	(0.002)
Ln AfT _economic infrastructure × UK dummy	0.001	–0.003*
	(0.001)	(0.002)
Pseudo R^2	0.601	0.993
Donor-year dummy	Yes	
Recipient-year dummy	Yes	
Donor-recipient pair dummy	Yes	
Bilateral time-varying controls	Yes	
Donors	45	
Recipients	140	
Donor-recipient pairs	4519	
Years	2002–2019	
Observations	81,152	

Notes: The table reports the PPML estimation results. See Table 3 for the bilateral time-varying controls. We cluster standard errors at the donor level.
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

5. Conclusion

Since it was launched in 2005, the Aid-for-Trade (AfT) initiative has continued to grow, becoming an essential part of foreign aid policies across donor countries. The expansion of AfT has occurred for altruistic reasons as well as with regard to donors' self-benefits. This study analysed the association between AfT and donor exports, specifically focusing on Japan, the top AfT donor.

We found that the AfT-export elasticity of Japan is large suggesting that the Japanese AfT generates a net export expansion, in contrast to other major donors, where the AfT induces net imports. We explored the potential mechanism behind the strong export creation effect of the Japanese AfT by analysing rich contract data on infrastructure-

related projects worldwide. The resulsts indicate that since the Japanese AfT is highly concentrated in economic infrastructure, it may work as an informal tying arrangement that closely links aid to donor exports.

The Public Opinion Survey On Diplomacy conducted in September 2021 by the Japanese government showed that almost 90% of Japanese citizens supported Japan's development cooperation, and 42% of the supporters expected ODA to be utilised to stimulate the Japanese economy, promoting overseas activities of Japanese firms and local governments (Cabinet Office, 2022). In line with Lee and Ries (2016), who have found a positive relationship between the Japanese AfT and outward foreign direct investments, our empirical results show that the Japanese AfT brings economic benefits to domestic firms, as expected by the public, making a budgetary request for foreign aid more convincing.

While the use of unique contract data on infrastructure-related projects enabled us to examine the mechanism behind the Japan's strong link between aid and exports, it remains unclear as to what types of projects are more closely associated with Japanese aid. The current study also did not analyse the long-run mechanism such as goodwill effects. Examination of those topics would be an interesting avenue for futhre research.

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Appendix A. Summary of Previous Research

Authors	Panel data	Estimation methods	Aid variables	Control variables	Elasticity	US$ increase per US$ 1 aid
Nilsson (1997)	15 donors, 108 recipients, 1975–1992	OLS	Gross ODA disbursement	GDP, per capita income, distance	0.230	2.6
Wagner (2003)	20 donors, 109 recipients, 1970–1990	OLS	Gross ODA disbursement	GDP, per capita income, distance, remoteness, language, donor-recipient pair dummy	0.062	0.7
Zarin-Nejadan et al. (2008)	Switzerland, 99 recipients, 1966–2003	OLS	Net ODA disbursement	GNI, Net ODA from other DAC countries, recipient dummy	0.045	n.a.
Nowak-Lehmann et al. (2009)	Germany, 77 recipients, 1962–2005	OLS	Gross ODA disbursement	GDP, population, ODA from other European donors, exchange rates, recipient dummy	0.130	1.5
Helble et al. (2012)	167 importers, 172 exporters, 1990–2005	OLS	Gross AfT disbursement	GDP, tariff rates, ODA (excluding AfT), year dummy, bilateral time-varying 5-year dummy	0.004	1.3
Silva and Nelson (2012)	180 importers, 180 exporters, 1962–2000	OLS	Net ODA disbursement	GDP, distance	0.025	n.a.
Nowak-Lehmann et al. (2013)	21 donors, 123 recipients, 1988–2007	OLS	Gross ODA disbursement	GDP, per capita income, exchange rates, donor-recipient pair dummy, year dummy	0.050	n.a.
Pettersson and Johansson (2013)	184 importers, 184 exporters, 1990–2005	OLS	Gross AfT commitment	GDP, population, distance, contiguity, colony, language, regional trade agreement, exporter dummy, importer dummy, year dummy	0.091	n.a.
Martínez-Zarzoso et al.(2014a)	Netherland, 130 recipients, 1973–2009	OLS, GMM	Net ODA disbursement	ODA from other donors, income, exchange rates, free trade agreement, recipient dummy, year dummy	0.034	0.3
Martínez-Zarzoso et al. (2014b)	21 donors, 132 recipients, 1988–2007	GMM	Net ODA disbursement	GDP, per capita income, distance, border, language, colony, regional trade agreement, exchange rates, ODA from other donors	0.039	0.5

Hansen and Rand (2014)	Denmark, 144 recipients, 1981–2010	OLS, GMM	Net ODA disbursement	GDP, population, ODA from other donors, recipient dummy, year dummy	0.075	0.3
Hühne et al. (2014)	152 recipients, 1990–2010	OLS, GMM	Gross AfT disbursement	GDP, market access, year dummies, recipient dummies	0.033	n.a.
Hoekman and Shingal (2020)	28 donors, 162 recipients, 2002–2010	PPML	Gross AfT disbursement	Free trade agreement, donor-year dummy, recipient-year dummy, donor-recipient pair dummy	–0.012 (goods) –0.038 (services)	n.a.

Notes: OLS stands for ordinary least square, GMM for generalised method of moments, and PPML for Poisson pseudo-maximum likelihood.

Appendix B. Definition of Aid-for-Trade

Sectors	Sub-sectors	Descriptions
Economic infrastructure	Transport and storage	Policy and administrative management/Road, rail, water, and air transports/Storage/Education and training in transport and storage
	Communications	Policy and administrative management/Telecommunications/Radio, television, and print media/Information and communication technology
	Energy generation, distribution, and efficiency	Policy and administrative management/Education, training, and research/Energy conservation and demand-side efficiency/Hydro, biofuel, coal-fired, oil-fired, natural gas-fired, fossil fuel, non-renewable waste-fired, hybrid energy, and nuclear energy electric power plants/Solar, wind, marine, and geothermal energy/Heat plants/District heating and cooling/Electric power transmission and distribution/Retail distribution of gas, liquid, or solid fossil fuels/Electric mobility infrastructures
Productive capacity	Banking and financial services	Policy and administrative management/Monetary institutions/Formal and informal sector financial intermediaries/Education and training in banking and financial services
	Business and other services	Privatisation/Business development services/Responsible business conduct
	Agriculture	Policy and administrative management/Education, training and research/Land and water resources/Food crop production/Industrial and export crops/Livestock/Agrarian reform/Plant and post-harvest protection and pest control/Financial services/Co-operatives
	Forestry	Forestry policy and administrative management/Forestry development/Fuelwood and charcoal/Forestry education and training/Forestry research/Forestry services
	Fishing	Policy and administrative management/Education, training, and research

	Industry	Policy and administrative management/Small and medium-sized enterprises development/Agriculture, forest, textile, chemical, metal, electric and transport equipment industries/ Education, training, and research
	Mineral resources and mining	Policy and administrative management/Mineral prospection and exploration for coal, oil, and gas/Ferrous and nonferrous metals/Precious metals/Industrial, fertiliser, and offshore minerals
	Tourism	Tourism policy and administrative management
Trade policy and adjustment	Trade policy and regulations and trade-related adjustment	Policy and administrative management/Trade facilitation/Regional trade agreements/Multilateral trade negotiations/Education and training/Trade-related adjustment

Source: OECD (2021)

Appendix C. Donor Countries

OECD (30)		Non-OECD (15)
Australia	Italy	Azerbaijan
Austria	Japan	Bulgaria
Belgium	Korea, Rep.	Croatia
Canada	Luxembourg	Cyprus
Czech Republic	Netherlands	Kazakhstan
Denmark	New Zealand	Kuwait
Estonia	Norway	Latvia
Finland	Poland	Lithuania
France	Portugal	Malta
Germany	Slovak Republic	Qatar
Greece	Spain	Russian Federation
Hungary	Sweden	Saudi Arabia
Iceland	Switzerland	Thailand
Ireland	UK	Turkey
Israel	US	United Arab Emirates

Notes: This table lists the 45 donors in our sample during 2002–2019.

Appendix D. Recipient Countries

East Asia and Pacific (23)	South Asia (8)	Europe and Central Asia (17)	Middle East and North Africa (16)	Sub-Saharan Africa (43)		Latin America and Caribbean (33)	
Cambodia	Afghanistan	Albania	Algeria	Angola	Malawi	Antigua and Barbuda	Paraguay
China	Bangladesh	Armenia	Bahrain	Benin	Mali	Argentina	Peru
Fiji	Bhutan	Azerbaijan	Djibouti	Botswana	Mauritania	Barbados	St. Kitts and Nevis
Indonesia	India	Belarus	Egypt	Burkina Faso	Mauritius	Belize	St. Lucia
Kiribati	Maldives	Bosnia and Herzegovina	Iran	Burundi	Mozambique	Bolivia	St. Vincent and the Grenadines
North Korea	Nepal	Croatia	Iraq	Cameroon	Namibia	Brazil	Suriname
Lao PDR	Pakistan	Georgia	Jordan	Cape Verde	Niger	Chile	Trinidad and Tobago
Malaysia	Sri Lanka	Kazakhstan	Lebanon	Central African Republic	Nigeria	Colombia	Turks and Caicos Isl.
Marshall Islands		Kyrgyz	Libya	Chad	Rwanda	Costa Rica	Uruguay
Micronesia		Macedonia	Malta	Comoros	Sao Tome and Principe	Cuba	Venezuela
Mongolia		Moldova	Morocco	Congo	Senegal	Dominica	
Myanmar		Slovenia	Oman	Cote d'Ivoire	Seychelles	Dominican Republic	
Nauru		Tajikistan	Saudi Arabia	Equatorial Guinea	Sierra Leone	Ecuador	
Palau		Turkey	Syria	Eritrea	Somalia	El Salvador	
Papua New Guinea		Turkmenistan	Tunisia	Gabon	South Africa	Grenada	
Philippines		Ukraine	Yemen	Gambia	Tanzania	Guatemala	
Samoa		Uzbekistan		Ghana	Togo	Guyana	
Solomon Isl.				Guinea	Uganda	Haiti	
Thailand				Guinea-Bissau	Zambia	Honduras	
Tonga				Kenya	Zimbabwe	Jamaica	
Tuvalu				Lesotho		Mexico	
Vanuatu				Liberia		Nicaragua	
Vietnam				Madagascar		Panama	

Notes: The table lists 140 recipients in our sample during 2002–2019. Some countries graduated from the DAC List of Recipient countries; Slovenia in 2003, Bahrain in 2005, Saudi Arabia in 2008, Barbados, Croatia, Oman, and Trinidad and Tobago in 2011, St. Kitts and Nevis in 2014, Chile, Seychelles, and Uruguay in 2018.