RIETI Discussion Paper Series 22-E-100

Heterogeneous Effects of Aid-for-Trade on Donor Exports: Why is Japan different?

NISHITATENO, Shuhei
RIETI

UMETANI, Hayato
Kobe University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 22-E-100

October 2022

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

Shuhei NISHITATENO
Kwansei Gakuin University and RIETI

Hayato UMETANI
Kobe University

Abstract

This study estimates the Aid-for-Trade (AfT)-export elasticity from the donor perspective, using panel data covering 45 donor and 140 recipient countries over the 2002–2019 period, focusing on the top-five donors: Japan, Germany, France, US, and UK. The method involves estimating a structural gravity equation with the Poisson pseudo-maximum likelihood (PPML) technique. We find that the AfT-export elasticity for Japan is positive and large. In particular, the findings suggest that Japanese AfT generates net export expansion from the recipient countries, in contrast to AfT from the other top donors, which 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 worldwide 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 links aid to donor exports. The focus of Japanese AfT on economic infrastructure offers a model for achieving mutual benefits for both donor and recipient countries.

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

JEL codes: F35, F14, O11

* This study is conducted as a part of a Project at the Research Institute of Economy, Trade and Industry (RIETI). The authors are grateful for helpful comments and suggestions by the Discussion Paper seminar participants at RIETI.

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, & 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. Using panel data for the 2002–2019 period, covering 45 donors and 140 recipients, we estimate the AfT-export elasticity from the donor perspective, 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. Our approach involves estimating a structural gravity equation with the Poisson pseudo-maximum likelihood (PPML) technique.

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 find Japan's strong AfT-export links and to uncover the potential mechanism 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. Expanding the scope of donors beyond Europe, Wagner (2003) has shown that an elasticity equal to 0.06. He has also investigated the heterogeneity in the ODA-export nexus among donors, mainly focusing on Japan, finding no evidence. Using more recent data, other studies have reported an elasticity between 0.02 and 0.05 (Silva & Nelson, 2012; Nowak-Lehmann, Martínez-Zarzoso, Herzer, Klasen, & Cardozo, 2013; Martínez-Zarzoso, Nowak-Lehmann, Parra, & Klasen, 2014b).

Several studies have focused on a single donor instead of estimating the average ODA-export elasticity for multiple donors. Zarin-Nejadan, Monterio, & Noormamode (2008)

[1] See Appendix A for details. For the purpose of this paper, the appendix lists emprical research analyzing AfT-"donor" export links only. For AfT-"recipient" export links, see Calì & te Velde (2011) and Martínez-Zarzoso, Nowak-Lehmann, & Rehwald (2017).

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 0.05–0.13 for Germany (Martínez-Zarzoso, Nowak-Lehmann, Klasen, & Larch, 2009; Nowak-Lehmann, Martínez-Zarzoso, Klasen, & Herzer, 2009; Martínez-Zarzoso, Nowak-Lehmann, Klasen, & Johannsen, 2016), 0.03 for the Netherland (Martínez-Zarzoso, Nowak-Lehmann, & Klasen, 2014a), 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, & Wilson (2012) have examined the relationship between gross AfT disbursements and donor exports. They have found an average AfT-export elasticity of 0.004. Analysing gross AfT commitments, Pettersson & Johansson (2013) have found an elasticity of 0.09, while Hühne, Meyer, & Nunnenkamp (2014) have found an elasticity of 0.03 for total donor exports (rather than bilateral donor exports). In contrast, Hoekman & Shingal (2020) have found negative AfT-donor export elasticities for both goods and services.

The recent papers, such as Hoekman & Shingal (2020) and Kruse & Martínez-Zarzoso (2021), have drawn from the latest developments in the empirical gravity literature to obtain reliable estimates of the link between bilateral AfT (or ODA) and donor exports within a theoretically-consistent econometric specification. One important aspect is that time-varying donor and recipient fixed effects are included in their specifications in order to control for the unobservable multilateral resistance terms.[2] In addition, donor-

[2] Other studies in the literature have also controlled for time-variant multilateral resistance

recipient pair dummies are included to account for the endogeneity of aid variables. Lastly, these recent studies employ the PPML estimator that deal with some estimation issues, including heteroscedasticity in trade data and zero trade flows. As will be explained in details in the next section, our estimation approach draws upon Hoekman & Shingal (2020) and Kruse & Martínez-Zarzoso (2021).

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.[3] 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

terms by including donor-recipient pair dummies (Nowak-Lehmann et al., 2013), or recipient dummies in the recipient-year panel setting (Martínez-Zarzoso et al., 2014a).

[3] See Appendix B for details.

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, & te Velde (2011) and Lee & Ries (2016). We adopted the same procedure for the sectoral AfT and ODA (excluding AfT) variables.[4]

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 WTO's RTA-IS database 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.

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 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

[4] An alternative approach is to simply drop the observations when the AfT or ODA variables have a missing value. The estimations based on this approach provides a consistent result with our main finding (i.e., strong export creation effects of Japanese AfT). The results are available upon request. We prefer not to use the listwise deletion approach, mainly because 70% of the observations were omitted, leading to less precise estimations with larger standard errors.

contractors' locations is also available at the country level. Note that the HCINA covers both Japanese and non-Japanese contractors, including 72 nationalities. 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.[5]

[5] 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$ 523 million, lower than the mean donor imports from the recipient (US$ 696 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.[6] Free trade agreements were in force during 2002–2019 for around 20% of donor-recipient pairs.

[Insert Table 1]

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.

[Insert Figure 1]

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

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

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.

[Insert Table 2]

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).

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. We observe no AfT-export links for France and US.

[Insert Figure 2]

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 structural gravity system (Anderson & van Wincoop, 2003; Yotov, Piermartini, Monteiro, & Larch, 2016):

$$EX_{i,j,t} = \frac{Y_{i,t}E_{j,t}}{G_t}\left[\frac{T_{i,j,t}}{\delta_{i,t}\theta_{jt}}\right]^{1-\sigma} . (1)$$

where subscripts *i, j* and *t* stand for donor, recipient, and year, respectively. *Y* is the donor's nominal income, *E* is the recipient's nominal expenditure, and *G* is the sum of all donors' nominal income. *T* indicates bilateral trade costs, δ is outward multilateral resistance, θ is inward multilateral resistance, and σ is the elasticity of substitution among different varieties.

For the purpose of this study, we treat the bilateral AfT flow (AfT) as a key determinant of bilateral trade costs (T). The bilateral AfT could increase the donor exports through reduced bilateral trade costs in various channels. For example, formal or informal tying

arrangements helps reduce the donor's transaction costs associated with industrial goods used for infrastructure projects in recipient country. Developments of trade-related infrastructures in recipient country also helps mitigate transportation costs.

There are several estimation challenges to obtain a reliable estimate of partial equilibrium effects of the bilateral AfT on donor exports within the structural gravity equation shown in Equation (1). First, the multilateral resistance terms are not directly observable. Second, the AfT variable might be endogenous, owing to reverse causality and omitted variables. A donor country tends to provide more aids with a trading partner (Alesina & Dollar, 2000; Younas, 2008). The AfT variable might be correlated with other trade cost determinants. Third, trade data are plagued by heteroscedasticity.

To address the estimation challenges above, we estimate the following specification, adopting the PPML estimator:

$$EX_{i,j,t} = \exp\big[F_{i,t} + F_{j,t} + F_{i,j} + \beta_1 \ln AfT_{i,j,t} + \beta_2 \ln ODA_{i,j,t} + \beta_3 ECR_{i,j,t} + \beta_4 FTA_{i,j,t} + \beta_5 Zero\_AfT_{i,j,t} + \beta_6 Zero\_ODA_{i,j,t}\big] \times \varepsilon_{i,j,t}. \quad (2)$$

The ln prefix indicates the natural logarithm. Donor-year fixed effects ($F_{i,t}$) and recipient-year fixed effects ($F_{j,t}$) are included to account for the multilateral resistance terms ($\delta_{i,t}$, θ_{jt}) (Baier & Bergstrand, 2007). The donor- and recipient-year fixed effects also absorb the size variables ($Y_{i,t}, E_{j,t}, G_t$) from the structural gravity model as well as all other observable and unobservable country-specific characteristics, which vary across these dimensions, including population sizes, income levels, and donors' aid

policies (Yotov, Piermartini, Monteiro, & Larch, 2016).[7] We also include donor-recipient paired fixed effects ($F_{i,j}$) to eliminate unobservable cross-sectional covariates that might influence the bilateral AfT and donor exports, simultaneously. The donor-recipient paired fixed effects absorb all bilateral time-invariant covaraites, meaning that the standard trade cost determinants (e.g., bilateral geographical distance, colonial ties, and common languages) do not appear in the model.

In order to test whether the specification (2) has properly accounted for possible reverse causality between AfT and donor exports through the three fixed effects ($F_{i,t},\ F_{j,t},\ F_{i,j}$), we examine the specification where the lead terms of the AfT variable (up to 4-year lead) is included. Appendix E reports the results. Panel A reports the specifications without the three fixed-effects, bilateral time-varying controls, and zero AfT/ODA dummies. We find evidence that the current donor exports are positively associated with the future AfT flows, regardless of the years of leads. Panel B reports the specifications with these all factors, finding no such evidence. This reduces the concern over the endogeneity of the AfT variable in our estimation.

However, we are still concerned that the AfT variable ($\ln AfT$) may be correlated with time-varying bilateral variables in the error term (ε). To mitigate the omitted variable bias to the extent possible, we consider the following factors; bilateral ODA excluding AfT (*ODA*), bilateral exchange rates (*ECR*), and donor-recipient free trade agreement status (*FTA*). *ODA* 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

[7] The recipient-year fixed effects also capture the impact of China's foreign aids during our sample period.

potential Dutch disease effects, *ECR* should be controlled (Arellano, Bulíř, Lane, & Lipschitz, 2009). *FTA* should also be considered because trade and aid policies are closely linked (Suwa-Eisenmann & Verdier, 2007). As discussed above, we also include a dummy if the AfT variable is zero (*Zero_AfT*) and a dummy if the ODA variable is zero (*Zero_ODA*).

We employ the PPML technique to address potential heteroskedasticity.[8] Santos Silva & Tenreyro (2006) have shown that the log-linearised gravity equation estimated by 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 the partial equilibrium effects of foreign aid within a stractual gravity equation (Lee & Ries, 2016; Harada & Nishitateno, 2021; Hoekman & Shingal, 2020; Kruse & Martínez-Zarzoso, 2021).

Using a donor-recipient-year panel dataset raises the concern that model errors may be serially correlated over time. Failure to adjust for within-cluster correlations may lead to misleadingly small standard errors. One standard approach is to cluster standard errors at the donor-recipient level. However, such a single-way clustering in the three-way fixed effects PPML specification leads to downward biases due to incidential parameter problems (Weidner & Zylkin, 2021). To address this issue, following Egger & Tarlea (2015), we employ a multi-way clustering in the donor, the recipient, and the year, as well as every combination of the three (donor-recipient, donor-year, and recipient-year)

[8] 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.

throughout our analyses.

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:

$$EX_{i,j,t} = \exp\left[F_{i,t} + F_{j,t} + F_{i,j} + \beta_1 \ln AfT\_EI_{i,j,t} + \beta_2 \ln AfT\_PC_{i,j,t} + \beta_3 \ln AfT\_TPA_{i,j,t} + \boldsymbol{\gamma X}_{i,j,t}\right] \times \varepsilon_{i,j,t}. \quad (3)$$

where $\boldsymbol{X}$ is a vector of other time-varying bilateral varaibles (ln*ODA*, *ECR*, *FTA*, *Zero_AfT*, and *Zero_ODA*).

Equation (2) 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:

$$EX_{i,j,t} = \exp\left[F_{i,t} + F_{j,t} + F_{i,j} + \sum_{j=0}^{3} \beta_j \ln AfT_{i,j,t-j} + \boldsymbol{\gamma X}_{i,j,t}\right] \times \varepsilon_{i,j,t}. \quad (4)$$

Summing the β coefficients from Equation (4) 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:

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

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:

$$EX_{i,j,t} = \exp\left[F_{i,t} + F_{j,t} + F_{i,j} + \sum_{t=2002}^{2019} \beta_t \left(\ln AfT_{i,j,t} \times \theta_t\right) + \boldsymbol{\gamma X}_{i,j,t}\right] \times \varepsilon_{i,j,t}. \quad (6)$$

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

4. Results

4.1. Baseline estimates

Table 3 presents the baseline estimates, adopting the PPML estimator to Equation (2). All estimations use the same donor-recipient-year level panel dataset (45 donors, 140 recipients, 2002–2019). The third column presents our preferred specification that

accounts for the three fixed effects. The Pseudo R^2 is quite high, indicating the adequate level of the overall goodness-of-fit of the regression. The results suggest that a 1% increase in bilateral AfT leads to an 0.01% increase in donor exports to recipients, on average, over 2002–2019 for 4390 donor-recipient pairs. Given the nature of the bilateral dataset, we interpret the estimate as a lower bound of the effects of AfT on donor exports.

[Insert Table 3]

The first and second columns of Table 3 show that the AfT-export elasticities are substantially overestimated in the absence of the bilateral time-varying factors and the three fixed effects. The fourth column reports the specification that accounts for the donor-recipient linear time trends. The estimated AfT-export elasticity is zero both economically and statistically. The bilateral time trends help mitigate the potential endogeneity biases, whereas they reduce the within variation in bilateral trade, making it difficult to uncover the effects of AfT on donor exports (Kruse & Martínez-Zarzoso, 2021).

Table 4 reports the results for alternative specifications. Note that we suppress the coefficients for the bilateral time-varying controls and the zero AfT/ODA dummies to save space. The first column reports the result obtained by estimating sectoral AfT-export elasticities based on Equation (3). The coefficients on AfT for economic infrastructure and productive capacity in the logarithm form are positive and statistically significant. However, a joint test fails to reject the null hypothesis that the elasticities are equal across the three sectors. The second column reports the result for the distributed lag model in Equation (4). The three-year AfT-export elasticity is 0.013

(=0.012–0.001+0.001+0.001), statistically different from zero at the 1% level. The same-year effect appears to be stronger than the lagged effects.

[Insert Table 4]

The third column of Table 4 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 0.005 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 0.021 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.

Figure 3 displays the time pattern of AfT-export elasticities from estimates of Equation (6). 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 0.004 to 0.014 and a mean of 0.009. We find larger effects for the period

after 2015, with statistically significant estimates.

[Insert Figure 3]

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 (2) and (5) to obtain AfT-import elasticities, replacing donor exports to the recipient with donor imports from the recipient as the dependent variable. The fourth and fifth columns of Table 4 presents the results. Similar to the case of donor exports, the mean AfT-import elasticity equals 0.010 for the 45 donors, significant at the 5% level (Column 4). The results in the fifth 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.

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.[9] 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 2 for UK.[10]

[9] The estimates of AfT-export elasticities are obtained from Column 3 in Tables 3 and 4 and the estimates of AfT-import elasticities from Columns 4 and 5 in 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.

[10] The net import does not mean welfare loss for donor countries. In the structural gravity model considered in this study, theoretically, lower trade costs through AfT are welfare-enhancing in both cases where the donor exports and imports would increase (Anderson & van Wincoop, 2003).

[Insert Table 5]

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:

$$CIP_{i,j,t} = \exp\left[F_{i,t} + F_{j,t} + F_{i,j} + \beta_1 \ln AfT\_EI_{i,j,t} + \sum_{d=1}^{5} \omega_d \left(\ln AfT\_EI_{i,j,t} \times \rho_d\right) + \boldsymbol{\gamma X}_{i,j,t}\right] \times \varepsilon_{i,j,t}. \quad (7)$$

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 (5).

The first column of Table 6 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.

[Insert Table 6]

The second column of Table 6 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 0.007%, on average, for all the donors other than the top-five donors. Only the Japanese effect positively 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, US and UK) or smaller

(Germany) relative to the benchmark.

4.4. Additional analyses

We have uncovered the Japan's unique linkages between AfT and donor exports and between AfT and infrastructure-based projects. However, how Japanese infrastructure projects associated with AfT link to Japanese exports remains unclear. It is likely that heavy machinery and equipment used for infrastructure construction account for a certain portion of its channels. It is also possible that aid-funded construction of infrastructure reduces intra-national transportation costs and trade costs with neighboring countries, promotes the production of Japanese overseas affiliates, and increases their imports of intermediate goods from Japan (Nishitateno, 2013, 2015).

To examine the potential channels, we re-estimate Equation (5) for machinery and equipment that accounted for 60% of total Japanese exports to the recipient during 2002–2019, by total (final goods + parts and components), final goods, and parts and components. Table 7 reports the results. We find evidence that the AfT-export elasticity for Japan deviates from the benchmark in total machinery and equipment, and this deviation mainly emanates from final goods, rather than parts and components. Thus, increased imports of heavy machinery and equipment (e.g., excavator, crane, and carrier) from Japan appears to be a key channel in which Japanese infrastructure projects associated with AfT had promoted Japanese exports to the recipient.

[Insert Table 7]

The estimations for the structural gravity equation in this study have been based on either donor exports to the recipient, or donor imports from the recipient. The original gravity system, however, describes bilateral trade flows between all country pairs,

implying that our estimations might not properly account for countries' embedding in the world economy (i.e., multilateral resistances). In order to address this issue, we re-estimate Equation (5), using the sample including all country pairs (not only donor to recipient, but also donor to donor, and recipient to recipient), for (i) total (exports + imports), (ii) exports, and (iii) imports.

Table 8 reports the results. The uniqueness of Japanese AfT effects is not so evident, when the outcome variable is total bilateral trade (Column 1). Estimating exports and imports separately, however, we find evidence on the strong export creation effects of Japanese AfT (Column 2). However, no such a deviating effect is found for Japanese imports (Column 3). These findings are consistent with our key findings with the sample limiting to bilateral trade flows between donors and recipients, alleviating the concern over the treatment of multilateral resistance.

[Insert Table 8]

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 increased 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 results 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 & 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.

References

Alesina, A., & Dollar, D. (2000). Who gives foreign aid to whom and why? *Journal of Economic Growth, 5*(1), 33–63. doi: https://doi.org/10.1023/A:1009874203400

Anderson, J. E., & van Wincoop, E. W. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, *93*(1), 170–192. doi:10.1257/000282803321455214

Arellano, C., Bulíř, A., Lane, T., & Lipschitz, L. (2009). The dynamic implications of foreign aid and its variability. *Journal of Development Economics, 88*(1), 87–102. doi:10.1016/j.jdeveco.2008.01.005

Arvin, B. M., & Choudhry, S. A. (1997). Untied aid and exports: Do untied aid disbursements create goodwill for donor exports? *Canadian Journal of Development Studies/Revue Canadienne d'Études du Développement, 18*(1), 9–22. doi:10.1080/02255189.1997.9669692

Arvin, B. M., & Lew, B. (2015), *Handbook on the economics of foreign aid.* Cheltenham and Northampton: Edward Elgar Publishing.

Baier, S. L., & Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics, 71*(1), 72–95. doi:10.1016/j.jinteco.2006.02.005

Bearce, D. H., Finkel, S. E., Pérez-Liñán, A. S., Rodríguez-Zepeda, J., & Surzhko-Harned, L. (2013). Has the new aid for trade agenda been export effective? Evidence on the impact of US AfT allocations 1999–2008. *International Studies Quarterly, 57*(1), 163–170. doi:10.1111/isqu.12027

Cabinet Office. (2022, March 20). Overview of the Public Opinion Survey on Diplomacy. Retrieved from https://survey.gov-online.go.jp/index-gai.html

Calì, M., & te Velde, D. W. (2011). Does aid for trade really improve trade performance? *World Development, 39*(5), 725–740. doi:10.1016/j.worlddev.2010.09.018

Egger, P. H., & Tarlea, F. (2015). Multi-way clustering estimation of standard errors in gravity models. *Economics Letters, 134*, 144–147. doi: https://doi.org/10.1016/j.econlet.2015.06.023

Hansen, H., & Rand, J. (2014), *Danish exports and Danish bilateral aid: Evaluation study*. DANIDA, Ministry of Foreign Affair of Denmark. Retrieved from https://silo.tips/download/danish-exports-and-danish-bilateral-aid-evaluation-study-2014-2

Harada, K., & Nishitateno, S. (2021). Measuring trade creation effects of free trade agreements: Evidence from wine trade in East Asia. *Journal of Asian Economics*, 74, 101308. doi: https://doi.org/10.1016/j.asieco.2021.101308

Helble, M., Mann, C. L., & Wilson, J. S. (2012). Aid-for-trade facilitation. *Review of World Economics, 148*(2), 357–376. doi:10.1007/s10290-011-0115-9

Hoekman, B. (2011). Aid for trade: Why, what, and where are we? In W. Martin & A. Mattoo (Eds.), *Unfinished business? The WTO's Doha agenda* (pp. 233–253). The World Bank.

Hoekman, B., & Shingal, A. (2020). Aid for trade and international transactions in goods and services. *Review of International Economics, 28*(2), 320–340. doi:10.1111/roie.12452

Hühne, P., Meyer, B., & Nunnenkamp, P. (2014). Who benefits from aid for trade? Comparing the effects on recipient versus donor exports. *Journal of Development Studies, 50*(9), 1275–1288. doi:10.1080/00220388.2014.903246

Jepma, C. J. (1991), *The tying of aid*. Paris: OECD. Retrieved from https://www.worldcat.org/title/tying-of-aid/oclc/23359461

Kimura, H., & Todo, Y. (2010). Is foreign aid a vanguard of foreign direct investment? A gravity-equation approach. *World Development, 38*(4), 482–497. doi:10.1016/j.worlddev.2009.10.005

Kruse, Hendrik W., & Martínez-Zarzoso, I. (2021). Transfers in the gravity equation. *Canadian Journal of Economics, 21*, 410–442. doi: https://doi.org/10.1111/caje.12500

Lee, H.-H., & Ries, J. (2016). Aid for trade and greenfield investment. *World Development, 84*(C), 206–218. doi:10.1016/j.worlddev.2016.03.010

Martínez-Zarzoso, I., Nowak-Lehmann D., F., & Rehwald, K. (2017). Is aid for trade effective? A panel quantile regression approach. *Review of Development Economics, 21*(4), e175–e203. doi:10.1111/rode.12322

Martínez-Zarzoso, I., Nowak-Lehmann, F., & Klasen, S. (2014a), *Dutch exports and Dutch bilateral aid (Mimeo)*.

Martínez-Zarzoso, I., Nowak-Lehmann, F., Parra, M. D., & Klasen, S. (2014b). Does aid promote donor exports? Commercial interest versus instrumental philanthropy. *Kyklos, 67*(4), 559–587. doi:10.1111/kykl.12068

Nilsson, L. (1997). Aid and donor exports: The case of the EU countries. In L. Nilsson (Ed.), *Essays on North–South trade*. Lund Economic Studies 70, Luud.

Nishitateno, S. (2013). Global production sharing and the FDI–trade nexus: New evidence from the Japanese automobile industry. *Journal of the Japanese and International Economies*, 27, 64–80. doi: https://doi.org/10.1016/j.jjie.2013.01.001

Nishitateno, S. (2015). Network effects on trade in intermediate goods: Evidence from the automobile industry. *Japanese Economic Review*, 66 (3), 354–370. doi: https://doi.org/10.1111/jere.12049

Nowak-Lehmann D., F., Martínez-Zarzoso, I., Klasen, S., & Herzer, D. (2009). Aid and trade—A donor's perspective. *Journal of Development Studies, 45*(7), 1184–1202. doi:10.1080/00220380902952407

Nowak-Lehmann, F., Martínez-Zarzoso, I., Herzer, D., Klasen, S., & Cardozo, A. (2013). Does foreign aid promote recipient exports to donor countries? *Review of World Economics, 149*(3), 505–535. doi:10.1007/s10290-013-0155-4

Organisation for Economic Cooperation and Development (OECD). (2021, August 1). Sectors and definitions (xls). Retrieved from https://www.oecd.org/dac/aft/

Organisation for Economic Cooperation and Development (OECD). (2022, February 1). OECD. Stat: Aid (ODA) tying status [DAC7b]. Retrieved from https://stats.oecd.org/

Organisation for Economic Cooperation and Development/World Trade Organization. (OECD/WTO). (2019), *Aid for trade at a glance 2019: Economic diversification and empowerment (xx ed.).* Paris: OECD Publishing.

Pettersson, J., & Johansson, L. (2013). Aid, aid for trade, and bilateral trade: An empirical study. *Journal of International Trade and Economic Development, 22*(6), 866–894. doi:10.1080/09638199.2011.613998

Santos Silva, J. M. C., & Tenreyro, S. (2006). The log of gravity. *Review of Economics and Statistics, 88*(4), 641–658. doi:10.1162/rest.88.4.641

Silva, S.J., & Nelson, D. (2012). Does aid cause trade? Evidence from an asymmetric gravity model. *The World Economy, 35* (5), 545–577. doi: https://doi.org/10.1111/j.1467-9701.2011.01431.x

Suwa-Eisenmann, A., & Verdier, T. (2007). Aid and trade. *Oxford Review of Economic Policy, 23*(3), 481–507. doi:10.1093/oxrep/grm028

United Nations Conference on Trade and Development (UNCTAD). (2021, December 1). International merchandise trade. Retrieved from https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en

Wagner, D. (2003). Aid and trade—An empirical study. *Journal of the Japanese and International Economies, 17*(2), 153–173. doi:10.1016/S0889-1583(03)00010-8

Weidner, M., & Zylkin, T. (2021). Bias and consistency in three-way gravity models. *Journal of International Economics, 132*, 103513. doi: https://doi.org/10.1016/j.jinteco.2021.103513

Younas, J. (2008). Motivation for bilateral aid allocation: altruism or trade benefits, *European Journal of Political Economy, 24* (3), 661–674. doi: https://doi.org/10.1016/j.ejpoleco.2008.05.003

Yotov, Y.V., Piermartini, R., Monteiro, J.-A., & Larch, M. (2016). *An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model*. Geneva: UNCTAD. Retrieved from https://www.wto.org/english/res_e/booksp_e/advancedwtounctad2016_e.pdf

Zarin-Nejadan, M., Monterio, J.-A., & Noormamode, S. (2008). The impact of official development assistance on donor country exports: Some empirical evidence for Switzerland. Retrieved from http://www.unine.ch/files/live/sites/irene/files/shared/documents/Publications/Rapports/MZ-rapport-DDC-2008.pdf. Switzerland: Institute for Research in Economics (Irene), University of Neuchatel.

Table 1: Summary Statistics

	Mean	S.D.	Min	Max
Donor exports to the recipient, US$ million	523	4,663	0	265,435
Donor imports from the recipient, US$ million	696	8,206	0	563,203
Contracts for infrastructure-related projects	0.1	1.0	0	90
AfT, US$ million	3.3	37.3	0	3,383
AfT for economic infrastructure, US$ million	2.0	29.2	0	2,330
AfT for productive capacity, US$ million	1.2	12.0	0	1,083
AfT for trade policy and adjustment, US$ million	0.1	2.4	0	455
ODA (excluding AfT), US$ million	11.2	91.8	0	11,134
Dummy if AfT is zero	0.7	0.5	0	1
Dummy if AfT for economic infrastructure is zero	0.8	0.4	0	1
Dummy if AfT for productive capacity is zero	0.7	0.4	0	1
Dummy if AfT for trade policy and adjustment is zero	0.9	0.3	0	1
Dummy if ODA (excluding AfT) is zero	0.4	0.5	0	1
Bilateral nominal exchange rates	24,479	1,354,873	0	97,500,000
Donor-recipient free trade agreement status	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). The number of observations for all variables is 77,941. We add US$ 1 to all AfT and ODA (excluding AfT) variables. The currency units of bilateral exchange rates differ among donor-recipient pairs.

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.

Table 3: Baseline Estimates

Dependent variable: Donor exports to the recipient				
	(1)	(2)	(3)	(4)
Ln AfT	0.327***	0.149***	0.010**	–0.000
	(0.039)	(0.055)	(0.004)	(0.004)
Dummy if AfT is zero	3.139***	1.455*	0.114**	–0.026
	(0.742)	(0.838)	(0.048)	(0.045)
Ln ODA excluding AfT		0.249***	0.001	–0.001
		(0.067)	(0.005)	(0.004)
Dummy if ODA excluding AfT is zero		3.088***	0.030	0.004
		(0.971)	(0.062)	(0.042)
Exchange rates		–0.000*	–0.000	–0.000**
		(0.000)	(0.000)	(0.000)
Free trade agreement status		1.115***	0.210***	–0.001
		(0.298)	(0.036)	(0.065)
Pseudo R^2	0.176	0.251	0.994	0.998
Donor-year dummies	No	No	Yes	Yes
Recipient-year dummies	No	No	Yes	Yes
Donor-recipient paired dummies	No	No	Yes	Yes
Donor-recipient linear time trends	No	No	No	Yes
Donors		45		
Recipients		140		
Donor-recipient pairs		4390		
Years		2002–2019		
Observations		77,941		

Notes: The table reports the PPML estimation results, based on Equation (2). We cluster standard errors at the donor-, recipient-, and year-level as well as every combination of the three (donor-year, recipient-year, and donor-recipient). 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.

Table 4: Alternative Specifications

Dependent variables:	Donor exports to the recipient			Donor imports from the recipient	
	(1)	(2)	(3)	(4)	(5)
Ln AfT		0.012***	0.005	0.010**	0.009*
		(0.003)	(0.004)	(0.005)	(0.005)
Ln AfT_economic infrastructure	0.008*				
	(0.004)				
Ln AfT_productive capacity	0.008*				
	(0.005)				
Ln AfT_trade policy and regulation	–0.001				
	(0.006)				
Ln AfT (1-year lag)		–0.001			
		(0.002)			
Ln AfT (2-year lag)		0.001			
		(0.001)			
Ln AfT (3-year lag)		0.001			
		(0.001)			
Ln AfT × Japan dummy			0.021***		0.001
			(0.007)		(0.003)
Ln AfT × Germany dummy			0.002		0.003
			(0.003)		(0.004)
Ln AfT × France dummy			0.008**		0.001
			(0.004)		(0.004)
Ln AfT × US dummy			0.004		0.001
			(0.004)		(0.007)
Ln AfT × UK dummy			0.003		–0.004
			(0.003)		(0.003)
Pseudo R^2	0.993	0.994	0.994	0.993	0.993
Donor-year dummies			Yes		
Recipient-year dummies			Yes		
Donor-recipient paired dummies			Yes		
Bilateral time-varying controls			Yes		
Zero AfT/ODA dummies			Yes		
Donor-recipient pairs	4390	4,366	4390	4,391	4,391
Observations	77,905	63,482	77,941	77,982	77,982

Notes: Bilateral time-varying controls include ODA (excluding AfT), nominal exchange rates, and the free trade agreement status. Zero AfT/ODA dummies include a dummy for AfT equal to zero and a dummy for ODA (excluding AfT) equal to zero. We cluster standard errors at the donor-, recipient-, and year-level as well as every combination of the three (donor-recipient, donor-year, and recipient-year). All specifications use donor-recipient-year panel data (45 donors, 140 recipients, 2002–2019). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

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	0.010	0.010	1.6	2.1	–0.5
Japan	0.021	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	0.009	0	2	–2.0

Notes: The estimates of AfT-export elasticities are obtained from Column 3 in Tables 3 and 4, and the estimates of AfT-import elasticities from Columns 4 and 5 in 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.

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	0.018	0.007***
	(0.016)	(0.003)
Ln AfT_economic infrastructure × Japan dummy	0.057***	0.008*
	(0.010)	(0.004)
Ln AfT_economic infrastructure × Germany dummy	–0.001	–0.006*
	(0.002)	(0.004)
Ln AfT_economic infrastructure × France dummy	0.000	0.000
	(0.006)	(0.003)
Ln AfT_economic infrastructure × US dummy	–0.009*	–0.000
	(0.004)	(0.004)
Ln AfT _economic infrastructure × UK dummy	0.001	–0.004
	(0.003)	(0.002)
Pseudo R^2	0.603	0.994
Donor-year dummies	Yes	
Recipient-year dummies	Yes	
Donor-recipient pair dummies	Yes	
Bilateral time-varying controls	Yes	
Zero AfT/ODA dummies	Yes	
Donor-recipient pairs	4390	
Observations	77,925	

Notes: See notes in Table 4 for the bilateral time-varying controls and the zero AfT/ODA dummies. We cluster standard errors at the donor-, recipient-, and year-level as well as every combination of the three (donor-recipient, donor-year, and recipient-year). All specifications use donor-recipient-year panel data (45 donors, 140 recipients, 2002–2019).
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7: Effects of AfT on Donor Exports in Machinery and Equipment

Dependent variables:	Donor exports to the recipient in machinery and equipment		
	Total (Final goods +Parts and components)	Final goods	Parts and components
Ln AfT	0.012***	0.007	0.032***
	(0.005)	(0.006)	(0.012)
Ln AfT × Japan dummy	0.010**	0.010**	–0.011
	(0.004)	(0.004)	(0.014)
Ln AfT × Germany dummy	–0.004	–0.000	–0.027***
	(0.005)	(0.004)	(0.007)
Ln AfT × France dummy	0.011**	0.014**	-0.001
	(0.005)	(0.005)	(0.007)
Ln AfT × US dummy	0.003	0.006	–0.016
	(0.005)	(0.005)	(0.013)
Ln AfT × UK dummy	–0.003	–0.001	–0.015***
	(0.005)	(0.005)	(0.006)
Pseudo R^2	0.992	0.990	0.991
Donor-year dummies	Yes		
Recipient-year dummies	Yes		
Donor-recipient paired dummies	Yes		
Bilateral time-varying controls	Yes		
Zero AfT/ODA dummies	Yes		
Donor-recipient pairs	4318		
Observations	77,049		

Notes: See notes in Table 4 for the bilateral time-varying controls and the zero AfT/ODA dummies. We cluster standard errors at the donor-, recipient-, and year-level as well as every combination of the three (donor-recipient, donor-year, and recipient-year). All specifications use donor-recipient-year panel data (44 donors, 139 recipients, 2002–2019). Total in machinery and equipment is SITC 7, parts and components are SITC 759 + 764 + 772 + 776, and final goods are SITC 7 excluding parts and components.
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 8: Effects of AfT on Bilateral Trade Including All Country Pairs

Dependent variables:	Total (exports + imports)	Exports	Imports
Ln AfT	0.006*	0.004	0.005
	(0.003)	(0.005)	(0.006)
Ln AfT × Japan dummy	0.010**	0.025***	0.005
	(0.004)	(0.009)	(0.006)
Ln AfT × Germany dummy	0.001	0.000	0.005
	(0.003)	(0.005)	(0.004)
Ln AfT × France dummy	0.004**	0.007	0.005**
	(0.002)	(0.005)	(0.002)
Ln AfT × US dummy	0.011**	0.007**	0.011
	(0.005)	(0.003)	(0.007)
Ln AfT × UK dummy	–0.004	0.001	–0.007
	(0.003)	(0.004)	(0.005)
Pseudo R^2			
Donor-year dummies	Yes	Yes	Yes
Recipient-year dummies	Yes	Yes	Yes
Donor-recipient paired dummies	Yes	Yes	Yes
Bilateral time-varying controls	Yes	Yes	Yes
Zero AfT/ODA dummies	Yes	Yes	Yes
Exporter-Importer pairs		39,516	
Observations		702,442	

Notes: See notes in Table 4 for the bilateral time-varying controls and the zero AfT/ODA dummies. We cluster standard errors at the exporter-, importer-, and year-level as well as every combination of the three (exporter-recipient, exporter-year, and importer-year). All specifications use exporter-importer-year panel data (209 exporters, 212 importers, 2002–2019).
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

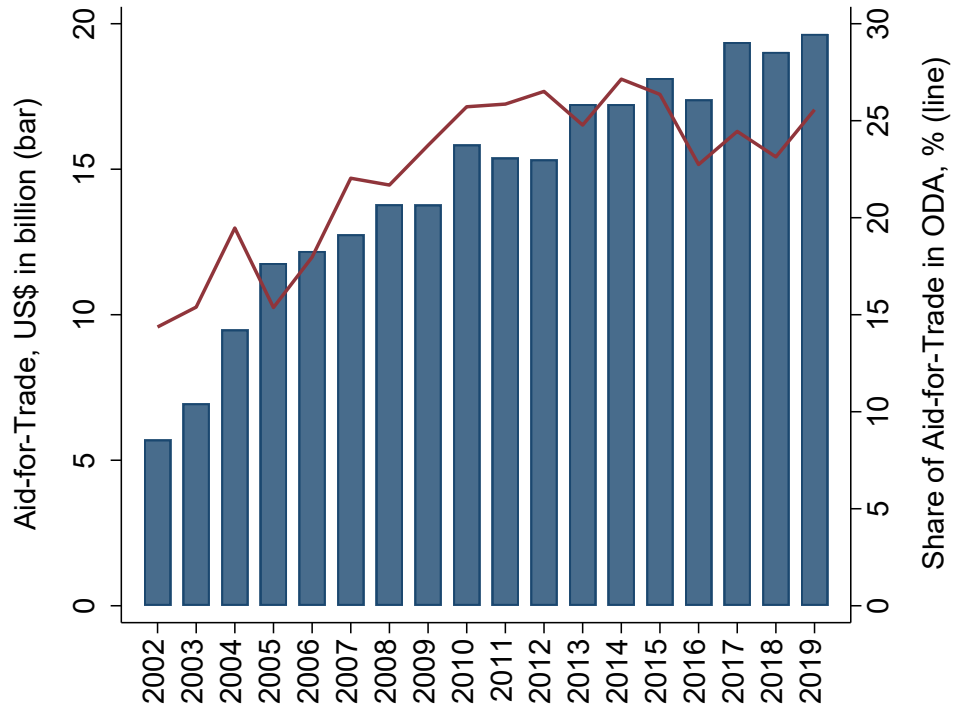

Figure 1. Trends in Bilateral Aid-for-Trade

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.

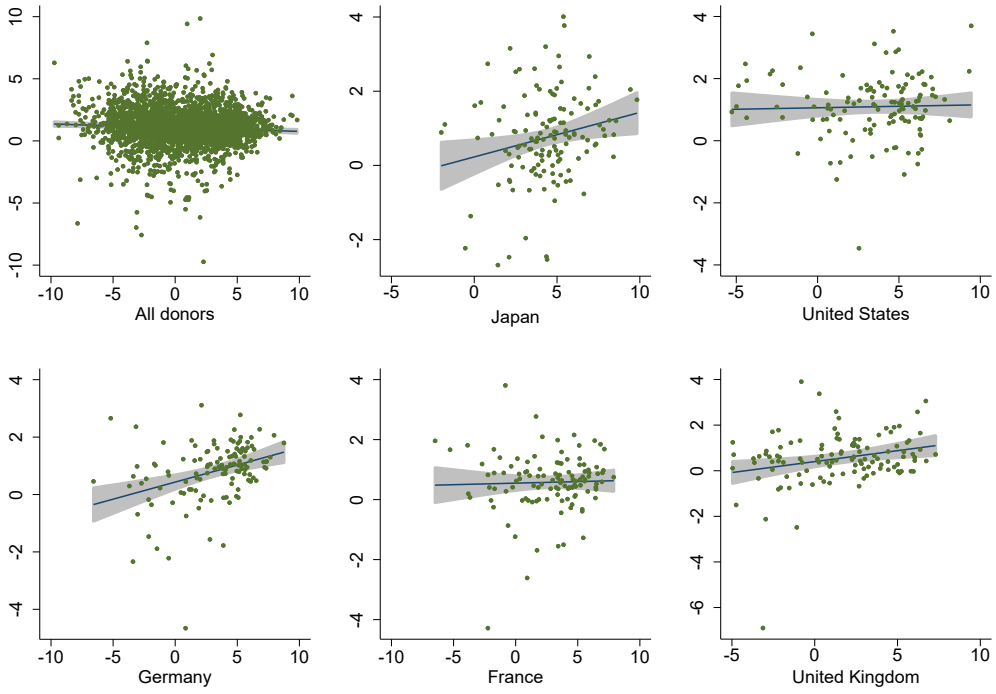

Figure 2. Initial Evidence on AfT-Export Links

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).

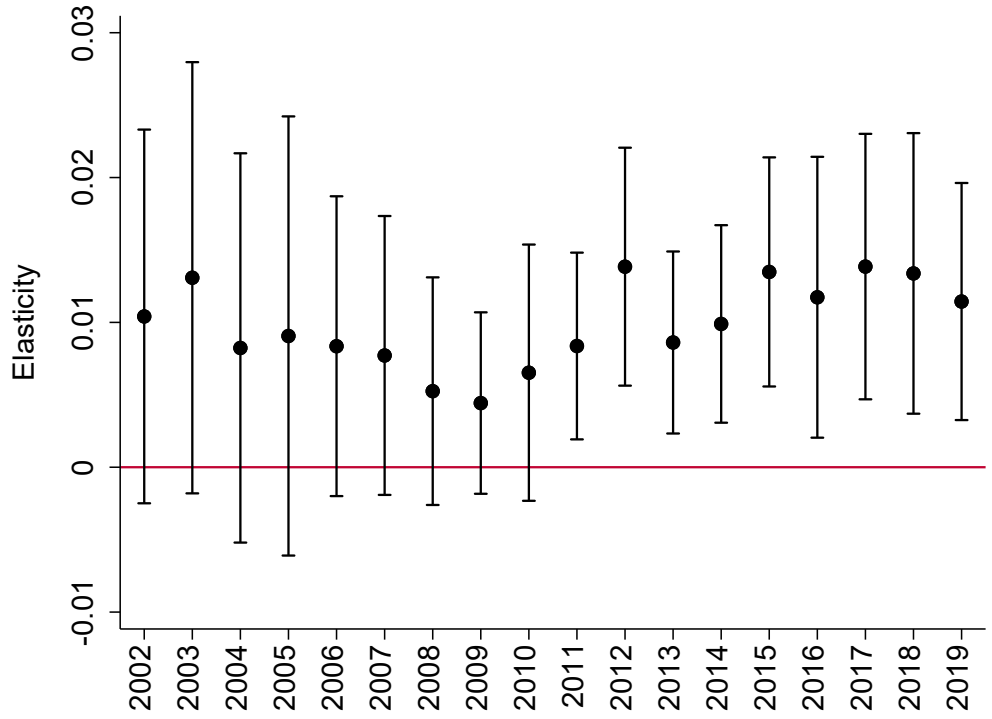

Figure 3. Elasticity by Year

Notes: The figure presents the estimation results for Equation (6) 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 the donor-, recipient-, and year-level as well as every combination of the three (donor-recipient, donor-year, and recipient-year).

Appendix A. Summary of Previous Research

Authors	Panel data	Estimation methods	Aid variables	Control variables	Elasticity
Nilsson (1997)	15 donors, 108 recipients, 1975–1992	OLS	Gross ODA disbursement	GDP, per capita income, distance	0.23
Wagner (2003)	20 donors, 109 recipients, 1970–1990	OLS	Gross ODA disbursement	GDP, per capita income, distance, remoteness, language, donor-recipient pair dummies	0.062
Zarin-Nejadan et al. (2008)	Switzerland, 99 recipients, 1966–2003	OLS	Net ODA disbursement	GNI, Net ODA from other DAC countries, recipient dummies	0.045
Martínez-Zarzoso et al.(2009)	Germany, 138 recipients, 1962–2005	OLS	Gross ODA disbursement	GDP, population, ODA from other European donors, exchange rates, free trade agreements, independence, WTO memberships, recipient dummies, year dummies	0.051
Nowak-Lehmann et al. (2009)	Germany, 77 recipients, 1962–2005	Dynamic OLS	Gross ODA disbursement	GDP, population, ODA from other European donors, exchange rates, recipient dummies	0.13
Helble et al. (2012)	172 exporters,167 importers, 1990–2005	OLS	Gross AfT disbursement	GDP, tariff rates, ODA (excluding AfT), year dummies, bilateral time-varying 5-year dummies	0.004
Silva & Nelson (2012)	180 exporters, 180 importers, 1962–2000	OLS	Net ODA disbursement	GDP, distance, border, language	0.018
Nowak-Lehmann et al. (2013)	21 donors, 123 recipients, 1988–2007	DFGLS	Gross ODA disbursement	GDP, per capita income, ODA from other donors, ODA from multilateral institutions, exchange rates, donor-recipient pair dummies	0.05
Pettersson & Johansson (2013)	184 exporters, 184 importers, 1990–2005	OLS	Gross AfT commitment	GDP, population, distance, contiguity, colony, language, regional trade agreement, exporter dummies, importer dummies, year dummies	0.091
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 dummies, year dummies	0.034
Martínez-Zarzoso et al. (2014b)	21 donors, 132 recipients, 1988–2007	OLS	Net ODA disbursement	GDP, per capita income, distance, border, language, colony, free trade agreement, exchange rates, ODA from other donors, ODA from multilateral institutions	0.039
Hansen & Rand (2014)	Denmark, 144 recipients, 1981–2010	OLS, GMM	Net ODA disbursement	GDP, population, ODA from other donors, recipient dummies, year dummies	0.075
Hühne et al. (2014)	152 recipients, 1990–2010	OLS, GMM	Gross AfT disbursement	GDP, market access, recipient dummies, year dummies	0.033
Martínez-Zarzoso et al.(2016)	Germany, 75 recipients, 15 industries, 1978–2011	DFGLS	Net ODA disbursement	Recipient GDP, German GDP, ODA from other DAC countries, exchange rates, free trade agreement, recipient dummies, year dummies	0.062
Hoekman & Shingal (2020)	28 donors, 162 recipients, 2002–2010	PPML	Gross AfT disbursement	Free trade agreement, donor-year dummies, recipient-year dummies, donor-recipient pair dummies	–0.012 (goods) –0.038 (services)

Kruse & Martínez-Zarzoso (2021)	132 exporters, 132 importers, 1995–2012	PPML	ODA	Free trade agreement, currency unions, WTO membership, exporter-year dummies, importer-year dummies, exporter-importer pair dummies, bilateral time trends	n.a.

Notes: OLS stands for ordinary least square, GMM for generalised method of moments, DFGLS stands for Dynamic Feasible Generalized Least Squares, 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.

Appendix E. Lead Effects of Aid-for-Trade

Dependent variable: Donor exports to the recipient				
	(1)	(2)	(3)	(4)
Panel A. No controls				
Ln AfT (1-year lead)	0.134***			
	(0.024)			
Ln AfT (2-year lead)		0.133***		
		(0.024)		
Ln AfT (3-year lead)			0.132***	
			(0.024)	
Ln AfT (4-year lead)				0.130***
				(0.023)
Observations	73,035	68,672	64,333	60,006
Panel B. With controls				
Ln AfT (1-year lead)	0.002			
	(0.001)			
Ln AfT (2-year lead)		0.002		
		(0.001)		
Ln AfT (3-year lead)			0.001	
			(0.002)	
Ln AfT (4-year lead)				0.000
				(0.002)
Observations	73,007	68,614	64,264	59,906

Notes: The table reports the PPML estimation results. Panel A reports the specifications without the three fixed-effects, bilateral time-varying controls, and zero AfT/ODA dummy. Panel B reports the specifications with these controls. The three-fixed effects include donor-year, recipient-year, and donor-recipient pair fixed effects. Bilateral time-varying controls include ODA (excluding AfT), nominal exchange rates, and the free trade agreement status. Zero AfT/ODA dummy include a dummy for AfT equal to zero and a dummy for ODA (excluding AfT) equal to zero. We cluster standard errors at the donor-, recipient-, and year-level as well as every combination of the three (donor-recipient, donor-year, and recipient-year).
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix F. Effects of Aid-for-Trade on Trade by Different Periods

Dependent variables: Donor exports to the recipient		
Ln AfT	–0.010	0.005
	(0.006)	(0.004)
Ln AfT × Japan dummy	0.010**	0.018*
	(0.005)	(0.010)
Ln AfT × Germany dummy	0.010***	0.004
	(0.004)	(0.003)
Ln AfT × France dummy	0.012***	0.007
	(0.002)	(0.006)
Ln AfT × US dummy	0.015**	0.002
	(0.006)	(0.004)
Ln AfT × UK dummy	0.010***	–0.003
	(0.003)	(0.004)
Pseudo R^2	0.995	0.995
Donor-year dummies	Yes	Yes
Recipient-year dummies	Yes	Yes
Donor-recipient paired dummies	Yes	Yes
Bilateral time-varying controls	Yes	Yes
Zero AfT/ODA dummies	Yes	Yes
Exporter-Importer pairs	4,360	4,363
Periods	2002–2009	2010–2019
Observations	34,478	43,163

Notes: See notes in Table 4 for the bilateral time-varying controls and the zero AfT/ODA dummies. We cluster standard errors at the exporter-, importer-, and year-level as well as every combination of the three (exporter-recipient, exporter-year, and importer-year).
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix G. Effects of Aid-for-Trade on Infrastructure Projects by Different Periods

Dependent variables: Contracts for infrastructure-related projects		
Ln AfT_economic infrastructure	–0.001	0.012
	(0.006)	(0.013)
Ln AfT_economic infrastructure × Japan dummy	0.004	0.070***
	(0.004)	(0.009)
Ln AfT_economic infrastructure × Germany dummy	–0.001	0.000
	(0.002)	(0.003)
Ln AfT_economic infrastructure × France dummy	0.007	–0.007*
	(0.004)	(0.003)
Ln AfT_economic infrastructure × US dummy	–0.002	–0.009
	(0.003)	(0.006)
Ln AfT_economic infrastructure × UK dummy	0.002	–0.003
	(0.005)	(0.003)
Pseudo R^2	0.700	0.624
Donor-year dummies	Yes	Yes
Recipient-year dummies	Yes	Yes
Donor-recipient paired dummies	Yes	Yes
Bilateral time-varying controls	Yes	Yes
Zero AfT/ODA dummies	Yes	Yes
Exporter-Importer pairs	4,384	4,373
Periods	2002–2009	2010–2019
Observations	34,656	43,260

Notes: See notes in Table 4 for the bilateral time-varying controls and the zero AfT/ODA dummies. We cluster standard errors at the exporter-, importer-, and year-level as well as every combination of the three (exporter-recipient, exporter-year, and importer-year).
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.