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<https://doi.org/10.1057/s41599-024-03512-5>

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Aid allocation across the humanitarian-development-peace nexus: the role of fragility as a donors' motive

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Fragility continues to present major challenges to achieving sustainable development goals (SDGs). International aid, particularly the Official Development Assistance (ODA), is a critical source of finance to deliver humanitarian assistance, development projects, and peace operations in fragile contexts. This study analyses if and how donors are motivated by fragility in their aid allocation across the humanitarian-development-peace nexus. Employing the random-effect Tobit method, the role of fragility as a donors' motive is analysed alongside three conventional categories of motives: self-interest, recipients' needs, and merit. The empirical analysis demonstrates an association between aid allocation across the nexus and fragility, but also a great degree of heterogeneity depending on the donor and the pillar of the nexus. It also detects a significant difference between how the state of fragility correlates with aid allocation and how the degree of fragility does so.

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Introduction

The promise of leaving no one behind is at the heart of the Agenda 2030 for Sustainable Development. The world today, however, still sees millions of people at the grave risk of being left far behind across continents and regions, but most markedly in fragile contexts. In 2020, before the outbreak of the pandemic, three-quarters of the world's extremely poor resided in fragile contexts, and none of these contexts were on track to achieve SDGs on hunger, health, gender equality and women empowerment. The global upheaval caused by the war in Ukraine exacerbates economic instability in poorer, fragile countries. The combined impact of pandemic, climatic, and economic shocks is putting people in fragile contexts at the risk of being left even further behind (Byrd, 2022; Moreira da Silva and da Costa, 2021; OECD, 2020).

Official Development Assistance (ODA) can be a powerful instrument for the international community to tackle fragility. To address the root causes of fragility with a limited amount of funding, however, coordination across sectors and among donors working in fragile contexts is paramount.

Crisis and fragility generate humanitarian needs. Humanitarian action can respond to such needs but cannot prevent crises or end needs by itself without sustainable development and political solutions to conflict addressing the root causes of the crisis. The Humanitarian-Development-Peace (HDP) nexus, hereafter “the HDP nexus” or simply “the nexus”, is an operational imperative for the humanitarian, development, and peace pillars to come together and coordinate for more coherent interventions. For instance, instead of development actors withdrawing when crisis outbreaks and humanitarians come in its replacement, development operations shall maintain their presence during the crisis as much as possible, help resilience to hold, and plan well in advance the transition to development in a predictable manner (Council of the European Union, 2017; IASC, 2016). Fragility and the nexus are particularly relevant to each other as addressing the former often requires support from all three pillars of the latter.

Manifold challenges remain in operationalising the nexus, however, especially in the financing aspect. The humanitarian, development, and peace actors tend to stay in their own silos, and by separating the funding stream between sectors, financing instruments oftentimes widen the gap rather than fill it and hamper collaboration (UNDP, 2019). The International Organization for Migration (IOM)'s nexus operationalisation report recommends that donors adopt funding mechanisms bridging the humanitarian-development-peace spectrum and avoid making gaps between funding streams across the nexus (Perret, 2019).

Despite the importance of understanding financing trends across the nexus to close such gaps in funding, there is still limited empirical evidence on how donors allocate aid across the nexus in response to fragility. This research thus aims to identify potentially differing roles fragility plays as a donors' motive and investigate if and how the allocation of humanitarian, development, and peace ODA is tailored to address fragility. It does so by quantitatively analysing the link between aid allocation across the nexus and indicators of fragility.

This paper is structured as follows. Section “Literature review” reviews the existing body of relevant literature to establish the theoretical and empirical underpinning of the research. Section “Methodological framework” describes the research methodology, including the data operationalisation and econometric estimation method. Section “Results and discussion” presents the results of the quantitative analysis along with a discussion of their policy implications. Section “Conclusion” concludes the research.

Literature review

Common categories of aid allocation variables. The scholarly debate on aid allocation has been inconclusive yet evolving. Initially, donors' self-interests and recipients' needs were two major groups of variables included in quantitative aid allocation studies. Since Burnside and Dollar (2000) showed that aid is effective as long as the recipient country has a suitable policy environment, it became a common practice to include merit as the third group of variables. Both recipients' needs and merit can be considered altruistic motivations, contrasting across studies on donor-recipient interactions (see, e.g., Murshed, 2009, who studied the strategic interactions between donors and recipients). This section starts with a brief review of the existing knowledge in these three categories: self-interest, recipients' needs, and merit. It then introduces and describes fragility, the variable of our principal interest, that is investigated in this paper as the novel factor of aid allocation alongside the more traditional motives.

Donors' self-interests have been frequently found to have effects on aid allocation. A great majority of aid allocation studies include economic motives, such as trade relations, as one of the self-interest variables. Barthel et al. (2014), Furuoka (2017), and Younas (2008) identified a robust link between trade or commercial relations and aid allocation. The geopolitical interest of donors is another element suggested to have a significant impact on aid policies. Alesina and Dollar (2000) found that a disproportionately high volume of US aid was going to Israel and Egypt, and the favoured destinations of French aid were its former colonies. More Japanese, US, and UK aid flow to recipients who align with them in voting at the UN (Alesina and Dollar, 2000; Hoeffler and Outram, 2011). A broader range of geopolitical interests has been defined and studied by, among others, Canavire-Bacarreza et al. (2005), Fuchs and Vadlamannati (2012), Lahiri, Raimondos-Møller (2000), Nagatsuji (2016), Opršal et al. (2020).

The second category of aid allocation motive is recipients' needs, and there is some evidence suggesting donors' need-oriented behaviours. Furuoka (2017) and Thiele et al. (2007) found a negative correlation between the recipient's Gross Domestic Product (GDP) or Gross National Income (GNI) per capita and the amount of aid. It means the poorer the country, the higher the inflowing aid. Feeny and McGillivray (2008) demonstrated that aid flows vary especially depending on the recipient's GNP. Their results pointed to the so-called middle-income bias, where the increase of per capita aid is correlated to the increase of the recipient's per capita income up to a tipping point after which aid starts to decrease (Dowling and Hiemenz, 1985). Part of the explanation for this bias is the concern about recipients' aid absorptive capacity. The middle-income countries are perceived to be capable of spending aid more efficiently than the poorest countries, which makes them donors' favourites.

The size of the population is another important element of recipients' needs. Harrigan & Wang's (2011) study reveals that, on the one hand, the higher per capita amount of British and American aid was distributed to countries with a larger population. On the other hand, the aid of France, Italy, Japan, and multilateral organisations had an opposite trend, namely, the larger the population, the smaller the per capita aid. This correlation between less population and more aid per capita is called population bias. It is partly explained by the higher marginal political benefit donors gain from small countries, but it also points to donors' concern about populous recipients' capacity and administrative expertise to absorb and effectively use additional aid (Dowling and Hiemenz, 1985).

The third category of motive is merit. The Monterrey Consensus, adopted in 2002, suggests that sound policies and

good governance are preconditions for aid effectiveness (United Nations, 2003). It is backed by evidence such as Burnside and Dollar (2000), who established a robust link between aid effectiveness in growth and good fiscal, monetary, and trade policies, making a strong case for systematically conditioning aid on sound policy. It must be noted, however, that merit is not only about recipients' sound institutions capable of using aid effectively. The empirical studies have defined merit in various ways and presented mixed results. In'airat (2014) found that among various aspects of governance, voice and accountability and control of corruption had a particularly strong effect on the allocation of aid, which is, the stronger these aspects of governance, the more aid given. In contrast, Hoeffler and Outram (2011) show that economic policy, democracy, and human rights play a small role in aid allocation policies, with the exception of only a few donors. According to Neumayer (2003a), while civil and political rights did have an impact on most donors' aid, personal integrity rights were considered only by a few of them. Neumayer (2003b) puts forward that neither the respect for human rights nor the level of corruption significantly influenced donors' aid policies. Alesina and Weder (2002) also affirm that there is no evidence that countries with a less corrupt government are rewarded with more aid.

Fragility as a factor of aid allocation across the nexus. One of the unresolved questions of aid in fragile contexts revolves around the state ownership of aid projects. In 2005, the Paris Declaration on Aid Effectiveness outlined five principles of aid effectiveness, one of which is state ownership. The importance of state ownership was reemphasised in the Accra Agenda for Action in 2008 and Busan Partnership Agreement in 2011.

The debate on state ownership and accompanying research focused on fragile states signal a strong link between fragility and merit, including aid effectiveness. Oftentimes, fragile contexts are assumed to be ill-equipped with the absorptive capacity of aid and thus with less merit. It is especially so when fragility and merit are similarly defined based on measures focusing on a country's policy and institutional quality, such as the Country Policy and Institutional Assessment (CPIA) score (Feeny and McGillivray, 2009; McGillivray, 2006). Fragility and merit are, however, both rather complex concepts of which institutional quality is a part but by no means an entirety. Furthermore, studies like Carment et al. (2008) found that aid has a larger impact in more fragile contexts. While it is inconclusive if fragility necessarily reduces merit and aid effectiveness, it plausibly has irrefutable implications on them.

The 9/11 terrorist attacks were a watershed that brought another highly relevant debate on fragility and security to the broader attention of the world. This shocking event reminded the international community of the repercussions of discarding impoverishment and instability in different parts of the world. 'When development and governance fail in a country, the consequences engulf entire regions and leap around the world' (USAID, 2002, p.1). From the donor's perspective, security concerns stemming from fragility matter to two different constituencies: citizens at home and citizens in recipient countries. This puts aid projects in fragile contexts in a perplexing situation as a donor's own security concerns do not necessarily coincide with either a recipient's national security or key development concerns. Furthermore, taking into account the presence of multiple donors in a recipient country whose security interests do not always look alike, it becomes evident how numerous conflicts of interest revolve around the security agenda, even if what they are all trying to do is development (Faust et al., 2015).

From the aid allocation point of view, this controversy over security points towards two facets of fragility. First, the relationship between self-interest and recipients' needs in aid projects within fragile contexts is complex, potentially involving both trade-offs and overlaps. In addition to security concerns, economic and environmental issues, for instance, also have cross-border impacts. Instabilities in fragile states can have global ramifications (USAID, 2005). Global threats such as hard drug trafficking, the spread of HIV/AIDS, and international terrorism to some extent take root in the lack of order and weak rule of law in conflict-affected areas (Collier et al., 2003). These arguments suggest there are overlapping elements between recipients' needs and donors' self-interests. As the symptoms of fragility and its side effects are rarely contained within borders and can affect donor countries, addressing recipients' needs in fragile contexts often is in donors' self-interest too.

Second, working in coordination, both among donors and across humanitarian, development, and peace sectors, is particularly challenging yet important in fragile contexts. As mentioned above, fragility stands side-by-side with a complicated web of interests and interlinked affairs. Nevertheless, protracted crises and the persistence of severe fragility for decades demonstrate that international cooperation where different actors operate in siloes with varying interests, as it has tended to be until today, comes at the cost of effectiveness. Addressing fragility requires a cross-cutting approach across the nexus. For instance, humanitarian needs in fragile contexts are often created by conflict and violence. Without peace, humanitarian needs will persist. Yet, without sustainable development, the hope for lasting peace is slim. It is, therefore, imminent to enhance the coordination among donors and across humanitarian, development, and peace sectors.

The discussion so far has shown how fragility has significant implications on all three motives of aid allocation, i.e. self-interest, recipients' needs, and merit. It is thus challenging and rather inappropriate to classify fragility as either self-interest, recipients' needs, or merit. In addition, with its relevance to the nexus, this study adopts fragility as the distinct variable of our primary interests and tests it alongside the other three aid allocation motives across the nexus, i.e., separately for humanitarian, development, and peace aid (rather than for the aggregate ODA).¹

While there is a rich body of literature on aid allocation, the extent of research conducted with a focus on the interaction between aid and fragility is relatively limited. One of them is Dreher et al. (2009) who used CPIA to define fragile states, focusing on the recipient's policy and institutional quality. The present study, however, considers fragility to be multidimensional, as suggested by Desai and Forsberg (2020), and as a state where differing extents of vulnerabilities exist across multiple dimensions, including state institutions and policies but also in the private, societal, and environmental sectors, for instance.

When fragility is defined this way, there is no study in the authors' knowledge that analyses a link between aid allocation across the nexus and fragility. Yet the recognition of the HDP nexus as a critical approach to addressing fragility has increasingly permeated the discourse within policy-making circles. Schreiber and Swithern (2023) suggest that employing a nexus-oriented strategy may provide a pathway for donors engaged in fragile contexts to surmount prevalent barriers that impede enhanced coordination. Moreover, Hegertun et al. (2023) highlight that the intrinsic complexity of operating within fragile contexts is augmented by the multitude of stakeholders and the concurrent spectrum of activities ranging from peacebuilding and reconstruction to development projects. They point out that the

nexus is an effort to readjust aid operations challenged by this complexity.

Should donors likewise acknowledge the significance of the HDP nexus in addressing fragility, it stands to reason that their allocation of ODA across the nexus may be strategically adapted to respond to fragility. Nonetheless, there exists a substantial gap in empirical data concerning whether such strategic adaptation occurs and, if so, how and to what extent. Therefore, this research aims to fill this knowledge gap and explore the links between fragility and aid allocation across the HDP nexus.

Methodological framework

Data and variables

Dependent variable. This research uses panel data with three dimensions: donor, recipient, and year. The dataset consists of key variables concerning the ODA allocation of 23 DAC donors² to 126 developing countries³ from 2009 to 2019. The dependent variable is the amount of ODA committed from donors to recipients in each pillar of the HDP nexus. Thus, for each model that will be described below, three separate regressions will be run with humanitarian, development, and peace ODA as distinct dependent variables. The humanitarian, development, and peace categories of ODA are defined based on the purpose codes in the Creditor Reporting System (CRS) data (OECD, 2021a), following the categorisation used by the OECD⁴ (OECD, 2021b).

Explanatory variables. The explanatory variables are grouped into donors' self-interests, recipients' needs, and merit categories. Fragility is considered a separate factor alongside the three groups of motives. Self-interest is assessed by four variables. The first one is the value of the exported goods from a donor to a recipient per year. It aims to capture the role of the donors' economic interests in defining their ODA policies. The second variable is the geographical distance between the capital cities of a donor and a recipient. The third one is a binary variable of the existence of colonial ties between a donor and a recipient. Geographical distance and colonial ties account for the donor's geopolitical interests. The last self-interest variable is the recipient countries' amount of CO2 emissions per capita as a proxy for donors' environmental concerns. Unlike other elements in this category, which is primarily about donors' self-interests as individual states, the CO2 variable is treated as an interest of donors as members of the international community whose goal is to collectively address environmental issues. The CO2 variable is also used by other studies on aid allocation, though the motive may differ (Nagatsuji, 2016 classifies it as donors' interest, while Thiele et al. (2007) consider it a recipients' need).

Two variables will be used as proxies for recipients' needs. First, the GDP per capita of recipients accounts for how donors react to recipients' economic needs. Where relevant, the square of the GDP per capita is also employed since the relationship between the recipient's income level and the volume of aid is sometimes found to be non-linear, as the discussion on the middle-income bias in the previous section touched upon. We tested for the presence of such an effect in our data, and we employed this variable in all cases in which the effect was identified. Second, the population variable measures how the size of the population of recipient countries affects donor behaviours.

Merit is proxied by one variable measuring the degree of freedom in recipient countries using the Index of Freedom built by Freedom House (2021a). It is a sum of the scores of political rights and civil liberties ranging theoretically from 0 to 100, with higher scores indicating higher freedoms. Political rights score accounts for the soundness of the electoral process and government functioning, while civil liberty encompasses the

freedom of expression and the rule of law, among others (Freedom House, 2021b).

The key factor unique to this research is fragility, which is measured in two ways. The first model analyses how being identified to be in the "state" of fragility affects ODA policies, deriving data from the OECD's States of Fragility (SoF) series and its predecessor Fragile States Reports (OECD, 2008; OECD, 2010; OECD, 2011; OECD, 2013; OECD, 2014; OECD, 2015; OECD, 2016; OECD, 2018). In their fragility framework, the state of fragility is assessed based on indicators across five dimensions: economic, environmental, political, security, and societal. The binary variable of the state of fragility takes value one when a recipient is classified as being in the state of fragility by the corresponding year's report, and the zero value otherwise. In years when no report was published (for instance, 2017), data from the report published in the previous year (2016) is used.

The second model replaces the state of fragility dummy with the degree of fragility. For this variable, the Fragile States Index (FSI) from the Fund for Peace is used. This index is composed of twelve indicators grouped into five categories: cohesion, economic, political, social, and cross-cutting (Fund for Peace, 2017; Fund for Peace, 2021).

While recognising the existence of several other methods to define and measure fragility, this paper focuses on the OECD's fragility framework and the Fund for Peace's Fragile States Index for a couple of reasons. First, they both consider fragility to be a cross-cutting and complex issue rather than a mere presence of a certain phenomenon, such as conflict. Second, while the former classifies certain contexts as being fragile, the latter gives a specific fragility score to each context. They thus allow this study to conduct a comparative analysis of the link between the state and degree of fragility and aid allocation policies across the HDP nexus while being consistent about the concept of fragility. However, it needs to be acknowledged that there are both theoretical and methodological limitations to these measures of fragility (Bosetti et al., 2016).

Time-variant explanatory variables, namely export, CO2 emissions per capita, GDP per capita, population, freedom, state of fragility, and degree of fragility are lagged by one year. It is because when policymakers decide on the ODA commitment for the year 2009, for instance, they do not have figures for these indicators for the same year 2009. If they consider these variables, they must base their decision on the latest data available, which is usually from the previous year (2008). ODA, export, the distance between capitals, CO2 emissions per capita, GDP per capita, and population variables are used in the logarithmic form to reduce their skewness and to observe the percentage change rather than the unit change.

Empirical model. Aid flow, in principle, does not take a negative value, i.e., the minimum value is zero⁵. In this study, approximately 61%, 86%, and 80% of the development, humanitarian, and peace ODA data, respectively, have zero values. It is thus prudent to opt for limited-dependent variable methods, which can address the truncation of the aid variable rather than the ordinary least square (OLS) or other methods that disregard zero observations. There are three variants of the limited dependent variable approach suitable for aid allocation research, as discussed in Berthélemy (2006a), Berthélemy and Tichit (2004), Canavire-Bacarreza et al. (2005), and Neumayer (2003c). They are the two-part model, Heckman's two-step method, and the Tobit model.

Aid policymaking can be modelled as a two-step process where donors firstly choose to which countries aid will be distributed (eligibility stage) and secondly decide the amount to be allocated in each country (level stage). Reflecting this logic, the two-part

Table 1 Description of variables.

Variable name	Description	Unit	Data source
In_ODA	Official Development Assistance from 23 DAC members	ODA commitment, constant 2019 USD	OECD (2021a)
fragility (state) (L1)	The state of fragility (SoF)	Binary (=1 if a recipient is classified as fragile)	OECD (2008), OECD (2010), OECD (2011), OECD (2013), OECD (2014), OECD (2015), OECD (2016), OECD (2018)
fragility (degree) (L1)	The degree of fragility (FSI)	Index values from 0 (least fragile) to 120 (most fragile)	Fund for Peace (2021)
In_export (L1)	The volume of export from donor to recipient	Constant 2019 USD (current price data converted to constant using the OECD's deflator for resource flows from DAC donors)	United Nations (2021), OECD (2021c)
In_CO2_pc (L1)	The amount of CO2 per capita emitted by recipients	Tons	Crippa et al. (2020)
In_distance	The geographical distance between the capital cities of donor and recipient	Kilometres	Mayer and Zignago (2011)
colony	Binary variable on the presence of colonial tie between donor and recipient	Binary (=1 if a recipient was a colony of a donor)	Mayer and Zignago (2011)
In_gdp_pc (L1)	Recipient's GDP per capita based on purchasing power parity	Constant 2017 international dollars	World Bank (2021a)
(In_gdp_pc) ² (L1)	The square term of log-transformed GDP per capita (<i>included only when the square effect is significant</i>)		World Bank (2021a)
In_population (L1)	The population of the recipient	Number of inhabitants	World Bank (2021b)
freedom (L1)	Index of freedom composed of political rights and civil liberty	Index values from 0 (lowest degree of freedom) to 100 (highest degree of freedom)	Freedom House (2021a)

Note: L1 indicates that the variable is lagged by one year, and In_ indicates that the variable is log-transformed.

model firstly determines the probability of receiving aid and secondly explains the amount of allocation. It assumes the selection of the recipient and the determination of the volume of aid committed are two independent processes (Barthel et al., 2014). However, it is highly conceivable that this assumption is against reality and thus violated. Heckman's two-step method takes procedures similar to the two-step model. This approach requires at least one exclusion variable that affects aid eligibility significantly but does not affect aid volume. Nevertheless, it is challenging to identify variables that fulfil this condition. Heckman's method is, for this reason, difficult to employ. The Tobit model, unlike the previous two, is a one-step method. While it is able to estimate the aid commitment by directly accounting for the censored nature of the dependent variable, it is not subject to the constraints imposed on the first two methods. This study thus adopts the Tobit model in its econometric analysis.

Taking ODA as a dependent variable, the Tobit model can be defined as:

$$ODA_{ijt} = \text{Max}(\beta X_{ijt} + u_{ijt}, 0)$$

where i denotes donor, j denotes recipient, and t denotes time (year). X is a set of explanatory variables, β is a vector of coefficient, and u is an independent and normally distributed error term (Berthélemy, 2006a).

It must be noted, however, that the Tobit model has its restrictions as well. First, it assumes that the variables that affect donors' decisions in the eligibility stage also have an influence in the level stage. Second, these variables are restricted to determine the aid eligibility and commitment with the same sign: either positive or negative. Combining the two assumptions, exogenous variables are restrained to have an identical effect both in the eligibility stage and the level stage. Both assumptions can be plausible, but they are certainly not strong norms, especially the

second one. This must be acknowledged as the first methodological limitation of this research.

Moreover, the Tobit method relies on the assumption of homoskedasticity. The log-transformation of the dependent variable reduces the risk that this assumption is violated. As there are many zero observations in the panel data and the natural logarithm of zero is undefined, one (dollar) is added to every zero observation before log transformation is conducted to retain them in the data (for example, Harmáček et al., 2017). When analysing aid allocation econometrically, the risk of endogeneity issues should be minimised. This research lowers the risk of reverse causality by lagging time-variant explanatory variables, as suggested by Thiele et al. (2007), for instance. However, it is not an exhaustive measure to minimise endogeneity, thereby constituting another methodological limitation.

It is also important to recognise and address the heterogeneity among recipients. These recipient-specific elements, which cannot be controlled for by explanatory variables, are ideally accounted for by introducing recipient-fixed-effects. However, the introduction of fixed-effects that control the cross-sectional heterogeneity of observations in a limited-dependent variable model, such as Tobit, causes a consistency issue called the incidental parameters problem (Berthélemy, 2006b). Therefore, this research opts for the random-effect Tobit model, which has been commonly adopted by other researchers (Dreher et al., 2009; Harrigan and Wang, 2011; Opršal et al., 2017). However, for the main regression, which is based on donor-recipient pairs, we also carry out a robustness check by adding recipients' and donors' fixed-effects. In addition, to detect a donor-specific trend, separate regressions for each donor are performed in both the state of fragility and the degree of fragility models.

The full model of this research can be written as follows (α is the intercept, β s are the regression coefficients, and ε is the error term), and Table 1 briefly describes the variables used in the

Table 2 Regression results—DAC 23 total.						
	Model 1 (state of fragility)			Model 2 (degree of fragility)		
	Humanitarian	Development	Peace	Humanitarian	Development	Peace
L1.fragility	1.644*** (0.316)	−0.110 (0.103)	0.120 (0.167)	0.253*** (0.021)	−0.004 (0.008)	0.107*** (0.013)
L1.ln_export	1.404*** (0.100)	0.542*** (0.036)	0.885*** (0.061)	1.477*** (0.099)	0.542*** (0.036)	0.902*** (0.061)
L1.ln_CO2	−1.470*** (0.337)	−0.358*** (0.126)	−0.001 (0.203)	−1.570*** (0.330)	−0.357*** (0.126)	−0.077 (0.202)
ln_distance	−1.836*** (0.436)	−1.042*** (0.216)	−2.001*** (0.314)	−1.410*** (0.423)	−1.049*** (0.216)	−1.812*** (0.312)
colony	4.815*** (1.290)	6.043*** (0.669)	8.562*** (0.953)	4.699*** (1.242)	6.041*** (0.669)	8.546*** (0.947)
L1.ln_GDP_pc	−3.722*** (0.554)	−1.239*** (0.215)	−2.709*** (0.340)	−1.752*** (0.570)	−1.246*** (0.230)	−1.606*** (0.361)
L1.ln_population	1.757*** (0.178)	1.419*** (0.079)	1.731*** (0.121)	1.398*** (0.174)	1.424*** (0.080)	1.593*** (0.121)
L1.freedom	−0.045*** (0.009)	0.014*** (0.004)	0.017*** (0.006)	0.000 (0.010)	0.014*** (0.004)	0.034*** (0.006)
intercept	−8.183 (6.459)	−3.410 (2.920)	−0.287 (4.374)	−46.605*** (7.189)	−3.079 (3.250)	−18.985*** (4.887)
sigma_u	11.592*** (0.251)	6.436*** (0.105)	9.088*** (0.169)	11.121*** (0.243)	6.438*** (0.105)	9.026*** (0.168)
sigma_e	9.383*** (0.085)	3.889*** (0.021)	5.663*** (0.038)	9.390*** (0.085)	3.889*** (0.021)	5.654*** (0.038)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,478	28,476	28,476	28,478	28,476	28,476
Censored obs.	19,983	7270	13,869	19,983	7270	13,869

Notes: Standard errors are in parentheses. L1. indicates that the variable is lagged by one year, and ln_ indicates that the variable is log-transformed. Level of significance: ***p < 0.01, **p < 0.05, *p < 0.10.

regression analyses. The square of *ln_gdp_pc* is also included in models in which the square term was significant. However, since it was insignificant in most of our regressions, we do not regard it as the default option for our main model which is specified below.

$$\ln_ODA_{(i,j,t)} = \alpha + \beta_1 fragility_{(i,j,t-1)} + \beta_2 \ln_export_{(i,j,t-1)} + \beta_3 \ln_CO2_pc_{(i,j,t-1)} + \beta_4 \ln_distance_{(i,j)} + \beta_5 colony_{(i,j)} + \beta_6 \ln_gdp_pc_{(i,j,t-1)} + \beta_7 \ln_population_{(i,j,t-1)} + \beta_8 freedom_{(i,j,t-1)} + year\ dummy + \varepsilon_{(i,j,t)}$$

Results and discussion

Aggregate aid of 23 DAC donors. The main regression model is based on all donor-recipient pairs—there are 23 DAC members on the donors’ side, and for each of them, there is a maximum of 126 aid recipients (depending on the number of observations). Some variables are specified in dyadic terms (distance between donors and recipients, former colonial relationships, export), some others are recipient-specific (population, GDP per capita, CO2 per capita, freedom), and they are repeated for each donor. In total, at least 28,476 observations were used in these models.

Fragility. Table 2 presents the results of the regression analysis with the DAC 23 total ODA data as a dependent variable. In both models 1 and 2, the fragility variable was positively correlated to humanitarian ODA with statistical significance. Model 1 shows that when a recipient is classified as being in the state of fragility, the inflow of humanitarian aid increases significantly in comparison to those not regarded as fragile. This is also confirmed by model 2, where an increase in the recipient’s degree of fragility (on a scale of 0 as the least fragile to 120 as the most fragile) significantly raises the volume of humanitarian aid.

For development ODA, the signs of the fragility variables are negative, though insignificant, in models 1 and 2. This shows that the volume of development aid is not associated with the degree or state of fragility, which could be due to the prevalent perception that the aid absorption capacity of fragile contexts is often inferior to others (as discussed earlier).

One of the major purposes of peace ODA is to address conflict, human rights, and security concerns. The presence of such issues is highly associated with the state of fragility. However, the state of fragility variable was again insignificant, while that of the degree of fragility was positive and significant. This may suggest that donors base their peace aid policy on the extent rather than the state of

fragility. It can be because being in a state of fragility does not necessarily mean that there are more conflict, security, and human rights-related threats than in other contexts. Rather, the higher the degree of fragility, the higher the chance that such threats are present, which is associated with higher peace aid allocation.

Self-interest, recipients’ needs, and merit. The export variable was positive and highly significant across the nexus and in both models without exceptions. It reveals that ODA is not free from donors’ economic interests in any pillar of the nexus. This is unexpected, especially in the case of humanitarian aid. Four humanitarian principles—humanity, neutrality, impartiality, and independence—constitute the foundations for humanitarian action (OCHA, 2012). Ironically, the pillar that is supposedly the most independent of donors’ commercial interests is found to be dependent on them too.

As for CO2 emissions per capita, the sign is negative and significant across the nexus in both models except for the peace aid. This may indicate that donors reward recipients with low CO2 emissions with more ODA.

Geographical distance is negatively correlated to all three categories of aid, but especially to peace aid. The instability in geographically proximate contexts is more likely to have spillover effects on donor countries. Therefore, the larger volume of peace aid to neighbouring countries can be interpreted as an instrument to maintain or build peace in strategically important areas.

The effect of the colony dummy is very similar to that of distance. The presence of colonial ties is significant across the nexus, indicating that the link established by colonialism still lives on today in development cooperation, as well as in peace and humanitarian support.

The economic need indicator, GDP per capita, shows that donors reflect higher needs and allocate more aid to countries with lower levels of economic development. We also tested for a possible presence of the middle-income bias using a quadratic term of the logged GDP per capita. This effect was found for humanitarian and peace aid allocations with the state of fragility variable. In both such cases, GDP per capita has a positive sign, while its square term has a negative sign (the inclusion of the quadratic term had no effect on the fragility variables). This indicates that the higher the GDP per capita, the more development and peace aid, but after a tipping point, higher GDP is associated with less aid.

Table 3 Regression results—fragility variables in individual donors.

	Model 1 (state of fragility)			Model 2 (degree of fragility)		
	Humanitarian	Development	Peace	Humanitarian	Development	Peace
DAC 23	1.593***	−0.110	0.106	0.253***	−0.004	0.107***
1 Australia	1.080	−0.112	0.874	0.271***	0.009	<u>0.269***</u>
2 Austria	<u>2.373</u>	−0.287	−2.235	<u>0.162*</u>	−0.029	−0.034
3 Belgium	<u>3.098*</u>	0.440	−0.880	<u>0.280***</u>	0.021	0.075
4 Canada	5.096***	−0.186	<u>0.153</u>	0.335***	−0.029	<u>0.118***</u>
5 Switzerland	1.859**	0.316	<u>−1.373*</u>	0.194***	0.018	<u>0.165***</u>
6 Germany	1.958*	−0.041	<u>0.696*</u>	0.311***	0.006	<u>0.116***</u>
7 Denmark	0.809	−2.484*	<u>1.140</u>	0.659***	2.33**	<u>0.124</u>
8 Spain	0.119	<u>0.281</u>	<u>0.096</u>	0.168**	<u>0.038</u>	<u>0.100**</u>
9 Finland	0.511	−0.488	1.555	0.320**	<u>−0.075</u>	0.111
10 France	<u>0.934</u>	0.020	0.865**	0.243***	−0.005	0.067**
11 United Kingdom	1.443	−0.404	<u>−0.296</u>	0.258**	−0.048**	<u>−0.006</u>
12 Greece	1.628	<u>0.290</u>	<u>1.174</u>	0.241	<u>−0.065</u>	
13 Ireland	1.963	<u>1.100</u>	0.914	0.330***	<u>0.163***</u>	0.216***
14 Italy	0.684	0.318	<u>−0.912</u>	0.244***	−0.018	<u>0.051</u>
15 Japan	1.797**	<u>−0.032</u>	<u>0.212</u>	0.208***	<u>−0.024**</u>	<u>0.060**</u>
16 Korea	1.213	<u>−0.410</u>	<u>0.652</u>	0.261***	<u>−0.100***</u>	<u>0.048</u>
17 Luxembourg	<u>2.507*</u>	0.136	<u>0.672</u>	0.404***	−0.081	0.065
18 Netherlands	2.168	−1.223	−1.014	1.027***	0.242***	−0.015
19 Norway	4.243**	<u>−0.237</u>	<u>0.613</u>	0.578***	<u>0.073</u>	0.280***
20 New Zealand	6.437**	<u>−0.203</u>	<u>−3.003</u>	0.622***	−0.005	0.350*
21 Portugal	5.754	−0.913	−2.301	0.934***	−0.080**	0.115
22 Sweden	3.512**	−0.299	<u>0.570</u>	0.457***	−0.064*	<u>0.056</u>
23 United States	0.583	<u>−0.016</u>	0.009	0.143***	<u>0.036**</u>	<u>0.068***</u>

The last column for Greece is empty due to an insufficient number of observations to produce estimates. Level of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Underlined are coefficients from models in which the middle-income bias was identified, and therefore, the square of the logged GDP per capita was used.

The population of a recipient country is positively correlated to ODA across the nexus. It suggests that donors commit more support as the population increases.

The indicator of freedom is positively and significantly correlated to development and peace aid. When a recipient's freedom index score increases, development and peace ODA increases as well. Donors seem to reward higher standards of political rights and civil liberties by granting more development and peace aid. On the contrary, the correlation was negative and significant in the case of humanitarian aid in the regression with the state of fragility, which can be due to the tendency for compromised freedom in crisis-affected areas where humanitarian aid often flows.

Aid of individual DAC donors. To further explore individual donors' motives for aid allocation, we implemented the regression models with the same specification as above for each donor separately. This produces results that are directly comparable across donors. For each donor, a maximum of 126 recipients were included (depending on data availability) over the period 2009–2019. The results of these 137 regression models (6 regressions for each of the 23 donors, minus one regression for which the model did not converge) for the fragility variables are summarised in Table 3 and in the text below (complete results are provided in the on-line annex).

Fragility. The results in Table 3 show how donors react to fragility differently from one another. The only place where they perform almost uniformly is in the fourth column: the effect of the degree of fragility on humanitarian ODA is positive and significant for all donors except Greece for which it is positive but not significant. This implies that practically all donors allocate more humanitarian aid when the degree of fragility increases.

The sign of the state of fragility variable on humanitarian ODA is also positive in all studied DAC members, while it is statistically significant in nine cases. This suggests that nine DAC members may be motivated by both the degree and state of fragility in forming their humanitarian aid policies. Table 4 classifies DAC members into groups based on these and the following findings.

Donors respond to fragility in highly varied manners in their development aid allocation. The state of fragility variable is insignificant for the majority of donors—only Denmark provides significantly less aid to countries in the state of fragility. Similarly, for only nine out of 23 DAC donors, the degree of fragility significantly correlated with development ODA (Table 4). In four of these cases (Ireland, Netherlands, United States, and Denmark), the correlation is positive: these countries give more development aid to countries with a higher degree of fragility. On the other hand, five donors (United Kingdom, Japan, Korea, Portugal, and Sweden) allocate more development aid to less fragile countries. For the rest of the donors, the degree of fragility does not play a significant role in their development aid allocation. It needs to be stressed, however, that in some of these cases, this may be an artefact of the relatively low number of non-zero aid allocations across the nexus.

Peace aid allocations of Germany, France, and Switzerland are significantly associated with the state of fragility variable. In the cases of Germany and France, the coefficients are positive, suggesting that these donors give more peace aid to recipients in a state of fragility, while Switzerland, with a negative coefficient, provides less aid to such recipients. For all other countries, the state of fragility (dummy) is not a significant factor for their peace aid allocation. On the contrary, the degree of fragility seems to correlate much more with individual donors' peace ODA: in eleven cases, donors provide more peace aid to recipients with a higher degree of fragility (Table 4).

Table 4 Patterns of donor's response to fragility.					
Sector	Group	Fragility	Significance	Sign	Donors
Humanitarian	1	State	Yes	+	Belgium, Canada, Switzerland, Germany, Japan, Luxembourg, New Zealand, Norway, Sweden
		Degree	Yes	+	
	2	State	No	+	Australia, Austria, Denmark, Spain, Finland, France, United Kingdom, Ireland, Italy, Korea, Netherlands, Portugal, United States
		Degree	Yes	+	
	3	State	No	+	Greece
		Degree	No	+	
Development	1	State	Yes	–	Denmark
		Degree	Yes	+	
	2	State	No	+/–	Ireland, Netherlands, United States
		Degree	Yes	+	
	3	State	No	+/–	United Kingdom, Japan, Korea, Portugal, Sweden
		Degree	Yes	–	
	4	State	No	+/–	Australia, Austria, Belgium, Canada, Switzerland, Germany, Spain, Finland, France, Greece, Italy, Luxembourg, New Zealand, Norway
		Degree	No	+/–	
Peace	1	State	Yes	–	Switzerland
		Degree	Yes	+	
	2	State	Yes	+	France, Germany
		Degree	Yes	+	
	3	State	No	+/–	Australia, Canada, Spain, Ireland, Japan, New Zealand, Norway, United States
		Degree	Yes	+	
	4	State	No	+/–	Austria, Belgium, Denmark, Finland, United Kingdom, Italy, Korea, Luxembourg, Netherlands, Portugal, Sweden
		Degree	No	+/–	

Self-interest, recipients' needs, and merit. Explanatory variables other than fragility also had highly heterogeneous associations with aid allocation depending on the donor and pillar of the nexus. First, donor-specific regressions indicate that, in fact, for most DAC donors, there is no significant relationship between their humanitarian aid and commercial interests. This is not true for four donors (Switzerland, Ireland, Japan, and Spain) whose humanitarian aid is positively correlated to the export variable with statistical significance in at least one of the models. At the same time, it holds that exports are much more often correlated with development aid allocations.

Second, for many DAC donors, the further from donors' capitals, the less development and/or peace aid is a prevailing rule. However, as for former colonial powers, this effect is sometimes overshadowed by the association with colonial ties. This is especially the case for the development aid of France and the United Kingdom.

Finally, regarding the GDP variable, development aid appears to be motivated by the economic needs of recipients more than other aid flows across the nexus. For some donors, it also plays a role in peace aid allocations, while its effect on humanitarian aid is only marginal. As indicated in Table 3, for some countries, the non-linear middle-income bias was identified across the nexus (but particularly in development and peace aid allocations). However, the possible (non)inclusion of this effect has only a marginal influence on the behaviour of the fragility variables. Additionally, in very few instances, an inverted middle-income bias was identified (i.e., less aid is allocated to middle-income countries compared to other recipients), such as in the case of Spanish development aid or British peace aid.

Robustness checks and heterogeneity issues. As previously stated, our main models do not directly account for the heterogeneity among recipients (or donors); rather, they circumvent this problem because introducing fixed-effects would lead to consistency issues in the Tobit model framework. However, since the main regressions are based on donor-recipient pairs, we perform robustness checks that account for the heterogeneity among recipients as well as donors by adding recipients' fixed-effects and

donors' fixed-effects (using dummy variables for each donor and for each recipient). This step dramatically increases the number of variables entering the models, resulting in a higher computational complexity.

When the fixed-effects are included in the six main models, the fragility variables' effects on aid allocations do not change at all in terms of directions and significances, indicating a reasonable degree of robustness of our original models. Both the state of fragility and degree of fragility are positive and significant in the humanitarian aid regressions, while the degree of fragility is positive and significant also in the peace aid model.

Regarding the other variables, export, distance, and colony remain significant in all models as before. The population variable stays positive and significant in humanitarian aid regressions but loses its significance in both development aid models. Moreover, in both peace aid models, its signs turn negative. The freedom variable is now negative and significant in both humanitarian aid models, insignificant in both development aid regressions, and positive and significant in both peace aid allocations. Additionally, the CO2 factor is no longer significant in any aid regressions.

The effect of GDP changes only in models in which the square is included—both GDP variables lose their significance in the humanitarian and peace aid regressions with the state of fragility. When these models are re-done without the square, the GDP variable is negative and significant as in all other regressions. These results suggest that once the specific, unobserved, time-invariant characteristics of both donors and recipients are controlled, there is no middle-income bias in any aid allocation across the HDP nexus. This means that the economic needs of recipients are reflected in the aid allocations of the DAC donors (as a group).

When tackling the heterogeneity issue, we also tested for the possible inclusion of an additional variable that proxies donors' interests—the UN General Assembly (UNGA) voting pattern similarity between the donors and the recipients. The voting similarity variable (*agree*) is an index going from 0 to 1, and the higher it is, the more similar the voting pattern in each UNGA session is between the donor and the recipient (Bailey et al., 2017).

When this variable is added to the models with fixed-effects, it is positive and significant in all regressions. This indicates that a common voting pattern is associated with higher aid allocations. However, when the variable is included in the models without the fixed-effects, its coefficients are clearly insignificant in the humanitarian and peace aid regressions, while they remain positive and close-to-significant in both development aid models (with both p-values around 0.12). This discrepancy was one reason why we decided not to include the *agree* variable in our models. However, the main reason for omitting this variable from our models was that the authors of the data do not recommend using their index in cross-section time series analyses (see Bailey et al., 2017).

To support and further demonstrate the stability of our results, we conducted an additional series of robustness checks. First, our two dependent variables on fragility serve, to some extent, as a special robustness check per se. While the first set of regressions employs the dummy variable *state of fragility* based on the OECD's States of Fragility series, the second set of regressions uses the *degree of fragility*, as measured by the Fragile States Index. While the significance of the fragility variables varies to some extent across the nexus (as explained earlier), the other factors show stable results, particularly when comparing regressions with the same dependent variables (see Table 2 above).

Second, to test the stability of all results, we re-performed the main regression models, first without the fragility variables. Then we did the regressions again, now only with the fragility variables included. When fragility is the lone explanatory variable, it is always positive and significant. When it is taken out, the other variables keep their signs and significance as in the main regressions, in which the fragility variables are included among the explanatory variables (Table 2). This indicates the stability and robustness of our results for the aggregate DAC donors' humanitarian, development, and peace aid allocations.

Thirdly, we acknowledge that the measures of fragility we use in this paper are conceptually broad, possibly overlapping to some extent with some of the other explanatory variables in our regressions (although the correlations are not that strong, as shown earlier). To account for these possible overlaps, we recalculated the FSI with 9 instead of 12 dimensions, taking out the three that are most closely related to the other explanatory variables used in our models. We subsequently used this reduced FSI in our main regression models. The results are, in terms of signs and significance, identical to those presented (Table 2). The reduced FSI variable stays negative and insignificant in the development aid regression, which confirms that the degree of fragility may not be a relevant factor for the allocation of development aid when all DAC donors are considered in aggregate.

Lastly, we created interaction variables between the state of fragility dummy and all other explanatory variables to further test whether our factors affect aid allocations across the HDP nexus differently for countries that are considered fragile (compared to countries regarded as non-fragile). The state of fragility dummy becomes positive and significant in the humanitarian and peace aid regressions, but it is insignificant in the development aid regression. Compared to the original models, the results differ only for peace aid which was originally insignificant. Since many of the interaction variables are also significant, this may indicate that donors actually differentiate between recipients considered fragile and non-fragile in their allocations, particularly in humanitarian aid. The other regression results remain stable as the signs and statistical significance of the explanatory variables remain largely the same when compared to the original models.

As for the interaction variables, in the humanitarian aid regression, they are significant for export, CO₂, and distance

variables (weakening their effects for fragile recipients compared to non-fragile recipients), as well as for population (reinforcing its effects for fragile recipients) and both GDP variables (reverting the middle-income bias identified for non-fragile countries). In the peace aid regressions, interactions are significant for export (weakening its effects for fragile countries) and both GDP variables (weakening the middle-income bias for fragile recipients). Moreover, the interaction for the population is also significant (reinforcing its effects for fragile countries). None of the interaction variables are significant in the development aid regression.

We also acknowledge that there are certain constraints in using the same model specification for all individual DAC donors to investigate their aid allocations across the HDP nexus. However, the paper does not intend to search for the models that best explain the aid allocations of each individual donor in each pillar of the nexus (which could lead to different models with incomparable results). Instead, the focus of the research is rather exploratory—to examine whether and how fragility is reflected in aid allocations across the HDP nexus; and comparative—to directly compare the results among the DAC donors and across the nexus, with the primary interest in the fragility variables.⁶

Policy implications. This research has produced evidence that the DAC donors' aid allocations across the HDP nexus are significantly associated with the fragility of recipients. How these two factors interact is far from homogenous depending on the donor, pillar of the nexus, and the way the fragility variable is operationalised.

There is no unequivocal answer to how ODA should be allocated across the nexus to tackle fragility. However, the findings on differentiated approaches of the DAC donors have important policy implications. For certain donors, fragility plays a role as their motive in one or two pillars of the nexus, while others react to fragility by tailoring their aid across all pillars of the nexus. For some, the effect of fragility on aid allocation across the nexus is clear, while for others, its extent is limited.

The way donors understand and address fragility is far from unanimous. It is natural for donors to have their own interests and comprehension of recipients' needs, merit, and fragility. It also is a legitimate approach to count on their distinctive capacity and experience in tailoring ODA. However, this cannot come at the expense of coherence and complementarity. The findings of this research provide a clearer picture of the international cooperation scheme and may serve as a stepping-stone to level up the coordination of donors across the HDP nexus. The evidence that DAC donors are, in one way or another, tailoring their ODA allocation across the nexus to address fragility should provide all donors with an incentive to rethink how, while adopting differentiated approaches, each can take part in this collective effort in a way exerting the synergistic effect of ODA.

The relevance of this research's findings is not limited to the fragility agenda. It has also demonstrated how intricate the aid allocation process is. Donors are each motivated by a complex combination of factors differently. Even so, if donors become more familiar with each other's strategies and act better in coordination, the coherence of development cooperation at the global level will be enhanced compared to when donors act in isolation. It is only after donors decide to leave their silos that international cooperation maximises its potential.

Conclusion

This research draws on the growing concern of the impact of fragility as a global challenge. This study developed a unique approach to analysing aid allocation with three innovative features. First, unlike most aid allocation studies focusing on

aggregate ODA, this paper analyses the aid flows separately for humanitarian, development, and peace pillars of the nexus. Second, given its relevance to the nexus, fragility is added as an explanatory variable of our primary interest. We explore how it affects ODA allocation across the nexus alongside the more traditional motives. Third, for explorative and comparative purposes, fragility is measured in two fashions: state and degree.

The research results indicate that DAC donors reflect the fragility of recipient countries in their ODA allocations. However, the degree and manner in which they are motivated by fragility vary substantially depending on how fragility is measured and which pillar of the HDP nexus the aid is allocated to. Likewise, this heterogeneity among donors is detected in how their aid allocation across the nexus is influenced by the other three categories of motives: self-interest, recipients' needs, and merit.

A challenge as global and complex as fragility cannot be sufficiently addressed by an individual country's effort. If the world is to ensure no fragile context will be left behind, then it must be addressed together and better. Since fragility can have cross-border and cross-cutting impacts, the effort to address it should be collective, consistent, and coordinated in a way that ensures each actor plays a pivotal role in generating synergies. When aid flows across the nexus are inconsistent among donors, it will not give the right incentives for implementing partners to operate consistently. However, if donors enhance their understanding of each other and allocate resources to facilitate coordination in the field across humanitarian, development, and peace sectors, then ODA will deliver not only funding but also incentives to work together.

Data availability

The datasets generated during the current study are available from the corresponding author upon request.

Received: 2 February 2023; Accepted: 24 July 2024;

Published online: 14 August 2024

Notes

- 1 Having fragility as an explanatory variable of aid allocation is one possible approach. In our paper, this approach has been specifically adapted to the unique design of the research, which disaggregates ODA into humanitarian, development, and peace ODA, while also acknowledging the particular thematic and policy relevance between fragility and the HDP nexus. However, fragility is a multidimensional concept that can embrace elements of the three more traditional categories, i.e., donors' interests, recipients' needs, and merit. This means that fragility variables have some overlap with variables approximating the other factors. If this overlap was very high, it would not make sense to define fragility as a separate factor of aid allocation. In our case, the overlap is reasonable: the highest correlation is between the degree of fragility and economic needs variable ($r = -0.69$) and merit variable ($r = -0.62$), and it is much lower with the remaining variables (lower than $|0.29|$ in all cases). Therefore, having fragility as a separate category seems to be a legitimate approach.
- 2 Out of the 30 DAC members as of July 2022, 6 of them (Czech Republic, Hungary, Iceland, Poland, Slovak Republic, Slovenia), which joined the DAC after 2009, and the European Union, a multilateral donor, are not included in the study.
- 3 Developing countries included as recipients in this study are all the recipients at least once listed on the DAC list of ODA recipients between 2009 to 2019 (OECD, 2021d), except those that do not have data at all in one or more of the explanatory variables in years 2009–2019 (or 2008–2018 in case of the lagged variable).
- 4 Humanitarian, development, and peace ODA are defined according to the CRS data's purpose codes. ODA with purpose codes 72010, 72040, 72050, 73010, or 74020 is humanitarian ODA, ODA with codes 15110, 15111, 15112, 15113, 15130, 15150, 15152, 15153, 15160, 15170, 15210, 15220, 15230, 15240, 15250, or 15261 is peace ODA, and development ODA covers all the rest.
- 5 The volume of ODA committed is positive in the great majority of cases. However, it can be negative in exceptional cases when, for example, donors cancel commitments from earlier years. This can lead to a negative overall volume committed from a certain

donor to a certain recipient, in a particular year. There are three observations with negative ODA values in the data used in this research: two in the development ODA, and one in the peace ODA. These observations are excluded from the regression process, and therefore, the number of observations in the humanitarian ODA data is 28478, while it is two less (28476) in the development ODA data and one less (28477) in the peace ODA data.

- 6 We also carried out some of the robustness checks for individual countries and their allocations across the HDP nexus. These checks largely support the previous results (presented in Table 3 above), indicating reasonable stability of the models. For example, when we repeat all individual countries' regressions only with the fragility variables in the models, the original results are confirmed in 64% of cases (in terms of signs and significance). In most of the remaining situations (31%), the fragility variable becomes significant with a positive sign (when it was originally insignificant). Only in eight cases, fragility become insignificant when it was originally significant (in six instances, it was originally negative). Similarly, when we perform individual countries' regressions with the reduced FSI, results for the fragility variable are confirmed in 92.5% of cases (in terms of signs and significance).

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Author contributions

KY: research design and conceptualisation, data acquisition and analysis, writing—original draft; ZO: conceptualisation, writing—revisions; JH: data analysis supervision and data analysis, writing—revisions; MS: coordination, writing—revisions.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

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