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Abstract

This paper introduces model uncertainty into the empirical study on the determinants of development aid at the regional level. This is done by adopting a panel Bayesian model averaging approach applied to the data of G5 Sahel countries, spanning the period 1980–2018. Our results suggest that among the regressors considered, those reflecting terrorist attacks, trade stakes including military expenditure, socioeconomic prospects and institutional conditions tend to receive high posterior inclusion probabilities. The study explores the relationship between these regressors and foreign aid by employing the fully modified ordinary least squares (FMOLS), the continuously updated fully modified (CUP-FM), the dynamic ordinary least squares (DOLS) long-run estimators, and the Dumitrescu and Hurlin (2012) panel causality test. The results highlight three concerns that may justify aid flows towards G5 Sahel countries: (a) peace and security considerations, (b) the economic interest of donors, and (c) recipient economic needs. The paper recommends that Sahel countries should strengthen international cooperation for security and peace, in compliance with goal 16 of the 2030 Agenda for Sustainable Development of the United Nations (UN) and goal 13 of the African Union's (AU) Agenda 2063.

Key words: *Bayesian model averaging; Foreign aid; Instability; Security and peace; G5 Sahel.*

JEL Classification: *C11; F35; F51; H56; P26.*

1. Introduction

For several decades, developing countries have benefited from important flows of international aid with the objective to respond to a conventional dichotomous view: (i) the promotion of economic growth, and (ii) the reduction of poverty and social exclusion (Bayale 2020; Sachs, 2016; Deaton, 2013; Burnside and Dollar, 2000). Nowadays, these international aid flows are consistent with multiple policy considerations that are often dictated by the political, institutional and socioeconomic environment (Kaufmann et al, 2019; Findley, 2018; Brown, 2005). In the economic literature, it appears that the theoretical determinants of development aid allocation are truly complex and difficult to clarify. These range from donor generosity to selfish interests (Bayale, 2020; Bandyopadhyay and Vermann, 2013; Bandyopadhyay and Wall, 2007; Berthélemy, 2006; Neumayer, 2003). Some empirical studies find that the volume of foreign aid or international aid to a recipient country depends on the intensity with which it supports the interests of its donors, perhaps in the area of international politics or the strengthening of economic interests through trade (Bayale, 2020; Dollar and Levin, 2006; Alesina and Dollar, 2000). Other empirical findings argue that, according to the logic of need, international aid towards developing countries is aimed at improving the standard of living of residents in these countries (Gamso and Yuldashev, 2018; Cardwell and Ghazalian, 2018; Page and Shimeles, 2015; Bandyopadhyay and Vermann, 2013; Collier and Dollar, 2002).

Nevertheless, with the reshaping of foreign aid over the past decade and taking into account some strategic and geopolitical considerations, other determinants have emerged in the literature. These include the increase in migration flows and preservation of global public services or goods (Bayale, 2020). Some studies highlight the fact that an increase in the emigration rate is likely to increase aid to migrants' countries of origin (Dreher et al, 2019; Clemens and Postel, 2018; Sachs, 2016). Therefore, increasing rural development aid, for example, could reduce international migration (Gamso and Yuldashev, 2018). Other studies show that international aid is moving towards the preservation of global public services or goods (Sullivan et al, 2020; Bayale, 2020; Marniesse, 2005; Severino, 2001). These global public services or goods are shared by both developed and developing countries and include peace and security, a stable environment, health and education. As such, developed countries cannot expect tangible results in these areas without collaborating with developing countries.

With regard to stability, peace and security in particular, it should be noted that the G5 Sahel[1] region is facing major challenges, the most important of which are terrorism, violence and transnational organized crime. Additionally, there is the resurgence of armed rebellions and inter-communal conflicts. These two threats are intertwined and create a context of recurring instability in this specific zone (Sullivan et al, 2020; Bayale, 2020; Pannier and Schmitt, 2019).

Data from the Global Terrorism Database (GTD) indicates that there were six terrorist attacks in the G5 Sahel zone in 2010. This number increased to 83 in 2015, and 218 in 2018 (GTD, 2020). This situation requires new institutional responses, not only from the countries concerned, but also from the international community. The involvement of the concerned states to stem the phenomenon necessitates the definition of a solid institutional framework with the objective to provide a regional and coordinated response to the security and violence challenges, as well as threats from armed terrorism and violent groups operating in the region. It has also been exemplified by a significant increase in defence and security forces, and military spending in these countries (Laville, 2016). The support of the international community is manifested through international aid flows. For example, according to the World Bank database, foreign aid flows to G5 Sahel countries have experienced unprecedented growth in recent decades. From US$289.85 million in 2000, it rose to US$414.22 million in 2005 and then to US$748.24 million in 2010. In 2018, total foreign aid flows into the Sahel was US$1,322.47 million (WDI, 2020). Average aid flows to sub-Saharan Africa was US$205.273 million in 2000, US$478.694 million in 2005, US$643.871 million in 2010 and US$698.385 million in 2017 (OECD, 2022). Hence, international aid to the G5 Sahel region has risen almost five-fold in less than 20 years and remained above the average for sub-Saharan African countries.

International aid seems to have been a direct, important and exceptional source of income for these countries, especially in recent years. Given these stylized facts on the one hand, and the current security and peace situation in the G5 Sahel region on the other hand, there are legitimate and relevant concerns that necessitates a holistic look at the main drivers of foreign aid flows towards G5 Sahel countries. This is the specific subject of this paper.

The motivation for this study is to make a significant contribution to the literature in two ways. First, to the best of our knowledge, an empirical analysis on the subject seems to be non-existent in the G5 region that is facing unprecedented security, violence, socioeconomic and environmental challenges. Most studies that have been consulted have focused on developing countries. This study seeks to fill this gap in the existing empirical knowledge by examining the effects and relationships between several socioeconomic and institutional characteristics of countries and foreign aid in the G5 Sahel region over the period 1980-2018. Second, it contributes to a better and more precise understanding of factors shaping the increase of international aid in this specific region, by offering novel quantitative evidence. Previous studies have used haphazard approaches in analyzing the determinants of foreign aid, however, the Bayesian model averaging (BMA) approach improves on the earlier approaches

by sequentially selecting key determinants based on posterior inclusion probabilities. This is a key methodological contribution of the study. Therefore, findings from the study could enable policymakers in the region and donors to make more informed decisions related to the conduct of international cooperation.

By applying a panel BMA approach, the key determinants reflecting terrorist attacks, trade stakes, military expenditure, socioeconomic prospects and institutional conditions tend to receive high posterior inclusion probabilities. Moreover, the study uses the fully modified ordinary least squares (FMOLS), the continuously updated fully modified (CUP-FM) and the dynamic ordinary least squares (DOLS) long-run estimators to explore the relationship between these regressors and international aid. Finally, the Dumitrescu and Hurlin (2012) panel causality test is applied. Empirical results highlight three concerns that may justify aid flows towards G5 Sahel countries: (a) peace and security considerations, (b) interest of donors (self-interest), and (c) recipient economic needs. Appropriate policy recommendations are based on these results. The rest of this paper is organized as follows: Section 2 presents the background and a brief literature review. In Section 3 we present the empirical strategy, data sources and variables. The results from our empirical analysis are presented in Section 4. Finally, Section 5 concludes and presents policy implications.

2. Literature review

Based on the seminal study of Dudley and Montmarquette (1976), several other studies have found that some determinants of international aid allocation are linked to donors' economic interests and recipient countries' characteristics and socioeconomic needs. For example, by extending the study of Dudley and Montmarquette (1976), Trumbull and Wall (1994) developed an aid allocation model and found that donors consider the historical and strategic interests as well as geographical differences among recipient nations. Hence, poorer nations may not necessarily receive more aid from an altruistic donor.

Furuoka (2017) examines and compares determinants of China's and Japan's foreign aid allocations in Africa. He found that the provision of foreign aid by China and Japan was primarily driven by the aid donors' self-interest. Additionally, the size of the population in a recipient country was also an important element to determine China's and Japan's aid allocations. Furthermore, the findings suggest that Japan tended to pay more attention to the aid recipient countries' needs as well as to the quality of governance and institutions in these countries (Bayale, 2020). Similarly, Oh et al (2015) analysed how the aid allocation pattern of the OECD DAC's emerging donor Korea is different from that of Greece. The authors found that Greece and Korea display similar patterns of aid disbursement. They favour recipients with higher income levels, larger populations, closer trade ties, better social development and more protection of freedom and human rights.

In addition to the aforementioned studies, Bandyopadhyay and Vermann (2013) focused on both donor motivation and the consequences of receiving international aid from developing nations. They found that while aid in the 1960s focused more on development, recent aid has increasingly reflected strategic considerations. Their findings show that since the terrorist attacks of September 2001, the objective of reducing terrorism has been of increasing interest for donors giving aid to developing nations. Bandyopadhyay and Wall (2007) also analysed the determinants of aid in the post-cold war era using linear regressions. They found that foreign aid and per capita income were negatively related, while aid was positively related to infant mortality, human rights and government effectiveness.

When examining the role of foreign aid and the fight against terrorism in developing countries, Azam and Delacroix (2006) found a positive empirical relationship between the level of foreign aid received by a country and the number of terrorist attacks originating from it. For Azam and Thelen (2008, 2010), foreign aid received reduces the incidence of terrorist attacks from recipient countries. This is because international aid may mitigate the negative consequences of terrorism in developing nations (Bandyopadhyay et al, 2014).

By focusing on the assessment of the motivations of Official Development Assistance (ODA) granted by rich countries to developing countries, Berthélemy (2006) finds that international aid motives combine self-interest and altruistic objectives. The author also showed that Switzerland, Austria, Ireland and most Nordic countries are among the most altruistic. However, Australia, France, Italy, and to some extent Japan and the United States, are among the most egoistic in terms of motivations behind ODA. This is in line with Brown's (2005) findings, which indicate that competing economic, commercial and strategic interests prevent donors from making a more positive contribution in promoting democratization in sub-Saharan Africa. According to Sullivan et al (2020), military assistance provided to the government of a country emerging from the turmoil of civil war could enable the state to establish a monopoly on the legitimate use of force, leading to a more durable peace and greater humanitarian security.

Recently, Martinez-Zarzoso (2019) estimated the trade effects of foreign aid using a structural gravity model. The author indicates that development aid has a robust direct effect on donor exports. In addition, although aid effects are heterogeneous and vary by region, it has an indirect positive effect on income levels in recipient countries.

Regarding migration concerns, Lanati and Thiele (2018) analysed the aid-migration link using a substantially extended and adjusted econometric approach based on a gravity model of international migration. The findings reveal that, in contrast to the previous literature, the authors obtained evidence of a negative relationship between the total aid a country receives and emigration rates. By comparing the effects of rural and urban development aid on international migration, Gamso and Yuldashev (2018) show that aid and investments in agricultural-sector capacity building lead to reductions in emigration from developing countries.

Most of the empirical studies surveyed do not take into account all the variables that are likely to determine international aid to developing countries, particularly fragile and conflict-affected countries like those in the G5 Sahel region. For example, variables such as arms imports, military expenditure and natural resources rents are not taken into account in these studies. Unlike these studies, methodologically a BMA model was applied in our study to address the uncertainty associated with the choice of variables that determine international aid. Inspired by Bayes' theory of probabilities (Bayes, 1763; Laplace, 1774) and applied in the field of exact sciences, in particular, physics, medicine and artificial intelligence, this approach classifies the variables by order of importance in relation to their explanatory power. It therefore makes it possible to define a parsimonious model.

3. Materials and methods

This section presents the empirical model of the study. Data sources and variables of the model are also presented.

Bayesian model averaging

The methodology used in this paper follows the work of Zeugner and Feldkircher (2015), who offer a new version of the implementation of R packages of the panel BMA. This approach addresses model uncertainty in a canonical regression problem. As specified in Equation 1, suppose a linear model structure with y as the dependent variable (foreign aid), α_γ as the constant, β_γ the coefficients, and ε as a normal (iid) error term with variance σ^2:

$$y = \alpha_\gamma + X_\gamma \beta_\gamma + \varepsilon\,, \qquad \varepsilon \sim N(0; \sigma^2 I) \tag{1}$$

A problem arises when there are many potential explanatory variables in matrix X; which variables from $X_\gamma \in \{X\}$ should be included in the model? And how important are they? The direct approach to conducting an inference on a single linear model that includes all variables is inefficient or even non-feasible with a limited number of observations (Moral-Benito, 2015; Bayale et al, 2021). The BMA tackles the problem by estimating models for all possible combinations of $\{X\}$ and constructing a weighted average across all of them. If X contains K potential variables, this means estimating 2^K variable combinations and thus 2^K models (Zeugner and Feldkircher, 2015; Raftery et al, 2017; Nagou et al, 2021). The model weights for this averaging stem from the posterior model probabilities that arise from Bayes' theorem:

$$p(M_\gamma|y,X) = \frac{p(y|M_\gamma,X)\,p(M_\gamma)}{p(y|X)} = \frac{p(y|M_\gamma,X)\,p(M_\gamma)}{\sum_{s=1}^{2^K} p(y|M_s,X)\;p(M_s)} \tag{2}$$

where $p(y/X)$ denotes the integrated likelihood, which is constant across all models and is thus simply a multiplicative term (Zeugner and Feldkircher, 2015; Okafor and Piesse, 2017). Therefore, the posterior model probability (PMP) is proportional to the integrated likelihood $p(y/M_\gamma, X)$, which reflects the probability of the data

given model M_γ. The marginal likelihood of model M_γ is multiplied by its prior model probability $p(M_\gamma)$ indicating how probable the researcher thinks model M_γ is before looking at the data. The difference between $p(y/X)$ and $p(y/M_\gamma, X)$ is that integration is once for the model space ($p(y/X)$) and once for a given model over the parameter space $p(y/M_\gamma, X)$. By re-normalizing the product from the above, one can infer the PMPs and thus the model weighted posterior distribution for any statistic θ:

$$p(\theta|y,X) = \sum_{\gamma=1}^{2^K} p(\theta|M_\gamma, y, X) \frac{p(M_\gamma|\, y, X)\, p(M_\gamma)}{\sum_{s=1}^{2^K} p(M_s|p(M_s))} \quad (3)$$

The model prior $p(M_\gamma)$ has to be elicited by the researcher and should reflect prior beliefs.

A popular choice is to set a uniform prior probability for each model $p(M_\gamma) \propto 1$ to represent the lack of prior knowledge. The specific expressions for the marginal likelihoods $p(M_\gamma|y, X)$ and the posterior distributions $p(\theta|M_\gamma, y, X)$ depend on the chosen estimation framework. The standard in the literature is to use a Bayesian regression linear model with a specific prior structure called Zellner's g prior, which is a relatively well-understood and convenient prior with suitable properties,[2] such as invariance under rescaling and translation of the covariates and automatic adaptation to situations with near collinearity between different covariates (Steel, 2020; Kaplan and Huang, 2021; Bayale et al, 2021). For each individual model M_γ, suppose a normal error structure as in Equation 1. The need to obtain posterior distributions requires the specification of the priors on the model parameters (Zeugner and Feldkircher, 2015; Okafor and Piesse, 2017; Sanso-Navarro and Vera-Cabello, 2020). We place "improper" priors on the constant and error variance, which means they are evenly distributed over their domain: $p(\alpha_\gamma) \propto 1$; in other words, complete prior uncertainty where the constant is located. Likewise, set $p(\sigma) \propto \sigma^{-1}$. The crucial prior is the one on the regression coefficients β_γ. Before looking at the data (y, X), we formulate our prior assumptions on coefficients into a normal distribution with a specified mean and variance (Zeugner and Feldkircher, 2015; Bayale, 2020). It is common to assume a conservative prior mean of zero for the coefficients to reflect that not much is known about them. Their variance structure is defined according to Zellner's g as follows:

$g\sigma^2 (X_\nu{}^T X_\nu)^{-1} g\sigma^2 (X_\nu{}^T X_\nu)^{-1}$is:

$$(\beta_\gamma|g) \sim N\left(0, g\sigma^2 (X_\gamma{}^T X_\gamma)^{-1}\right) \quad (4)$$

This means that we assume that the coefficients are zero, and that their variance-covariance structure is broadly in line with that of the data X_γ. The hyperparameter g embodies how certain we are that coefficients are indeed zero: a small g means

small prior coefficient variance and therefore implies we are quite certain that the coefficients are indeed zero. By contrast, a large g means that the researcher is very uncertain that coefficients are zero (Zeugner and Feldkircher, 2015; Raftery et al, 2017). The posterior distribution of coefficients reflects prior uncertainty: given g, it follows a t-distribution with the expected value $E(\beta_\gamma|y,X,g,M_\gamma) = \frac{g}{1+g}\hat{\beta}_\gamma$, where $\hat{\beta}_\gamma$ is the standard OLS estimator for model γ. The expected value of coefficients is thus a convex combination of the OLS estimator and prior mean. The more conservative g, the more important the prior is, and the more the expected value of coefficients is shrunk toward the prior mean zero. As $g \to \infty$, the coefficient estimator approaches the OLS estimator. Similarly, the posterior variance of β_γ is affected by the choice of g:

$$COV(\beta_\gamma|y,X,g,M_\gamma) = \frac{(y-\bar{y})^T(y-\bar{y})}{N-3}\frac{g}{1+g}\left(1-\frac{g}{1+g}R_\gamma^2\right)\left(X_\gamma{}^T X_\gamma\right)^{-1} \quad (5)$$

In other words, the posterior covariance is similar to that of the OLS estimator times a factor that includes g (Zeugner and Feldkircher, 2015; Sanso-Navarro and Vera-Cabello, 2020). For BMA, this prior framework results in a very simple marginal likelihood $p(y|M_\gamma,X,g)$, which is related to the R-squared and includes a size penalty factor adjusting for model size $k_\gamma k_\gamma$:

$$p(y|M_\gamma,X,g) = (y-\bar{y})^T(y-\bar{y})^{-\frac{N-1}{2}}(1+g)^{-\frac{k_\gamma}{2}}\left(1-\frac{g}{1+g}\right)^{-\frac{N-1}{2}} \quad (6)$$

Hence, the crucial choice here concerns the form of the hyperparameter g. A popular "default" approach is the "unit information prior" (UIP), which sets $g = N$ common for all models and thus attributes about the same information to the prior as is contained in one observation (Zeugner and Feldkircher, 2015; Raftery et al, 2017; Bayale, 2020; Kaplan and Huang, 2021; Nagou et al, 2021). In this paper, we employed the panel BMA approach in the linear regression framework to draw conclusions regarding the significance of particular potential regressors with the use of either an averaged t statistic or a Bayesian posterior probability for each variable.[3]

Panel data model specification

After the BMA regressions, we followed the panel data approach used in the majority of studies (Sullivan et al, 2020; Bayale, 2020; Bandyopadhyay and Wall, 2007; Azam and Delacroix, 2006; Berthélemy, 2006), focusing on the relationship between various factors and foreign aid. Hence, let Y represent an observation and X represent a $p \times 1$ vector of covariates where we aim to investigate the degree of association to Y through the linear panel data model specified as follows:

$$Y = \gamma X + \epsilon, \quad (7)$$

where $\gamma\gamma$ is a $1 \times p$ parameter vector of fixed effects, ϵ is a random effect and X a vector of explanatory variables (potential determinants of foreign aid). Explanatory variables will be those selected by the BMA approach. After selecting the variables, it is obvious that the X of Equation 7 is less or equal to the X_γ of the equation 1 ($X \leq X_\gamma$). A more adequate specification of Equation 7 will be given after applying the appropriate statistical and economic tests.

Data sources and variables

Our study consists of the G5 Sahel countries that are Burkina Faso, Chad, Mali, Niger and Mauritania, covering the period 1980–2018, for which data was available. Based on some studies (Bayale, 2020; Furuoka, 2017; Bandyopadhyay and Vermann, 2013; Bandyopadhyay and Wall, 2007; Berthélemy, 2006) that identified theoretical and empirical links between foreign aid and socioeconomic prospects, trade stakes and institutional conditions, a set of 22 potential regressors of international aid is considered from several datasets.

Data from the World Development Indicators (WDI) database of the World Bank, the Institute for Employment Research (IAB) brain-drain data, the Stockholm International Peace Research Institute (SIPRI) and the International Country Risk Guide (ICRG) datasets, the Global Terrorism Database (GTD) and the United States Security and Defense Assistance database, as well as the United Nations (UN) and the African Union (AU) websites are used. We extracted data on foreign aid (net Official Development Assistance, ODA) from the WDI database. It also contains data on socioeconomic indicators such as real gross domestic product (GDP) per capita, natural resources rents and oil rents, GDP growth rate, population, unemployment (labour force), infant mortality rate and fiscal balance, inflation (CPI index), public debt and trade variables. These variables are extracted based on the standard literature (Bayale, 2020; Dreher et al, 2019; Bandyopadhyay and Vermann, 2013; Berthélemy, 2006).

Our dependent variable is net ODA received. It corresponds to disbursements of loans made on concessional terms and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients, measured in United States Dollar (US$) for each G5 Sahel country in the study period (WDI, 2020).

Other datasets used are the SIPRI, GTD, IAB brain-drain data and US Security and Defense Assistance database. Based on the literature (Sullivan et al, 2020; Martinez-Zarzoso, 2019; Lanati and Thiele, 2018; Bandyopadhyay and Wall, 2007), we extracted important data series from these databases, such as military expenditure and arms imports, terrorist attacks, emigration rate and US security assistance, respectively, and from the freedom index from Freedom House (FH). Data on regional security initiatives is from desk research on the UN and AU websites.

A last group of variables reflecting institutional and political aspects includes internal conflict, government stability, socioeconomic conditions and corruption indexes from the ICRG dataset. According to Bayale (2020), Sullivan et al (2020), Bandyopadhyay and Wall (2007) and Berthélemy (2006), instructional and/or political factors may also generate different incentives to borrow or to benefit from foreign aid.

The description of the whole set of regressors considered in the empirical analysis is presented in Table 1.

Table 1: Variable description and sources

N°	Variable	Description	Sources*
1	faid	Official Development Assistance (US$ millions)	World Bank (WDI)
2	rgdpc	Real gross domestic product per capita (US$)	World Bank (WDI)
3	natres	Total natural resources rents (% of GDP)	World Bank (WDI)
4	gdpg	Gross domestic product growth rate (%)	World Bank (WDI)
5	popul	Population (millions)	World Bank (WDI)
6	unemp	Unemployment, total (% of total labour force, ILO)	World Bank (WDI)
7	oilre	Oil rents (% of GDP)	World Bank (WDI)
8	infmr	Infant mortality rate (per 1000)	World Bank (WDI)
9	fisdef	Current account balance (% of GDP)	World Bank (WDI)
10	inflr	Inflation, CPI index (%)	World Bank (WDI)
11	debt	Public debt (% of GDP)	World Bank (WDI)
12	topen	Trade openness (% of GDP)	Calculated from WDI
13	emgr	Emigration rate (per 1,000)	IAB brain-drain
14	miexp	Military expenditure (US$ millions)	SIPRI data
15	armim	Arms imports (1,000)	SIPRI data
16	terat	Terrorist attacks (number of terrorism incidents)	GTD data
17	ussa	US security assistance (US$ millions)	US-SDA data
18	reginit	Regional security initiatives	UN & AU
19	freed	Freedom index	Freedom House
20	intconf	Internal conflict index	ICRG data
21	goverst	Government stability index	ICRG data
22	second	Socioeconomic conditions index	ICRG data
23	corrup	Corruption index	ICRG data

* WDI is the World Development Indicators database of the World Bank; IAB brain-drain data is the Institute for Employment Research (IAB) brain-drain data; SIPRI is Stockholm International Peace Research Institute; GTD is Global Terrorism Database; US-SDA is US Security and Defense Assistance database, UN is United Nations and AU is African Union, and ICRG is International Country Risk Guide.

Note: The sample period is 1980 to 2018. The data panel used for our analyses is not balanced because of missing data on some variables of certain countries in the sample such as Chad and Mauritania. These variables concern military expenditure, arms imports, emigration rate and institutional variables.

4. Empirical results

This section presents and discusses empirical results of the study.

BMA approach results

In line with the aim of this study, Table 2 shows the results obtained from applying the BMA approach in a panel data regression framework for G5 Sahel countries. The upper part of Table 2 shows the variable names and their corresponding statistics, while the lower part of the table presents model size and model priors, such as the number of observations (195), the number of models simulated (21,336) and the posterior expected model size, which is equal to 10.09 in this study. From Table 2, the first three columns report, for each variable, the posterior model probability (PIP) and the mean and standard deviation of estimated coefficients when foreign aid for the G5 Sahel region is considered. These latter figures can be interpreted, respectively, as a BMA point estimation and a standard error (Cazachevici et al, 2020; Bayale, 2020; Sanso-Navarro and Vera-Cabello, 2020; Zeugner and Feldkircher, 2015).

Table 2: Bayesian model averaging results (baseline estimates)

Variables	PIPs	Post Mean	Post SD	Cond.Pos.Sign	Idx
terat	1.000	0.112	0.140	1.000	1
topen	1.000	0.198	0.036	1.000	2
miexp	1.000	0.504	0.086	1.000	3
emgr	1.000	0.591	0.985	1.000	15
rgdpc	1.000	-0.579	0.789	0.000	16
natres	1.000	0.303	0.599	1.000	17
infmr	1.000	0.555	0.048	1.000	22
inflr	0.975	-0.493	1.446	0.000	19
gdpg	0.947	-0.133	0.0489	0.000	21
intconf	0.737	-0.769	1.567	0.000	20
goverst	0.639	-0.922	2.645	0.000	4
popul	0.538	-0.004	0.001	0.000	10
debt	0.307	0.020	0.069	1.000	14

freed	0.182	-0.093	0.381	0.000	6
i_ctry	0.071	-0.009	0.044	0.000	23
armim	0.063	0.001	0.065	1.000	11
reginit	0.057	0.002	0.012	1.000	5
ussa	0.055	0.133	0.735	1.000	8
second	0.053	-0.039	0.225	0.041	18
fisdef	0.051	0.002	0.014	1.000	12
oilre	0.048	0.000	0.000	0.974	13
unemp	0.042	-0.003	0.023	0.000	9
corrup	0.031	-0.030	0.399	0.000	7
Mean no. regressors		10.097	Model pace 2^K		4.2e+06
No. models visited		21,336	No. Obs.		195

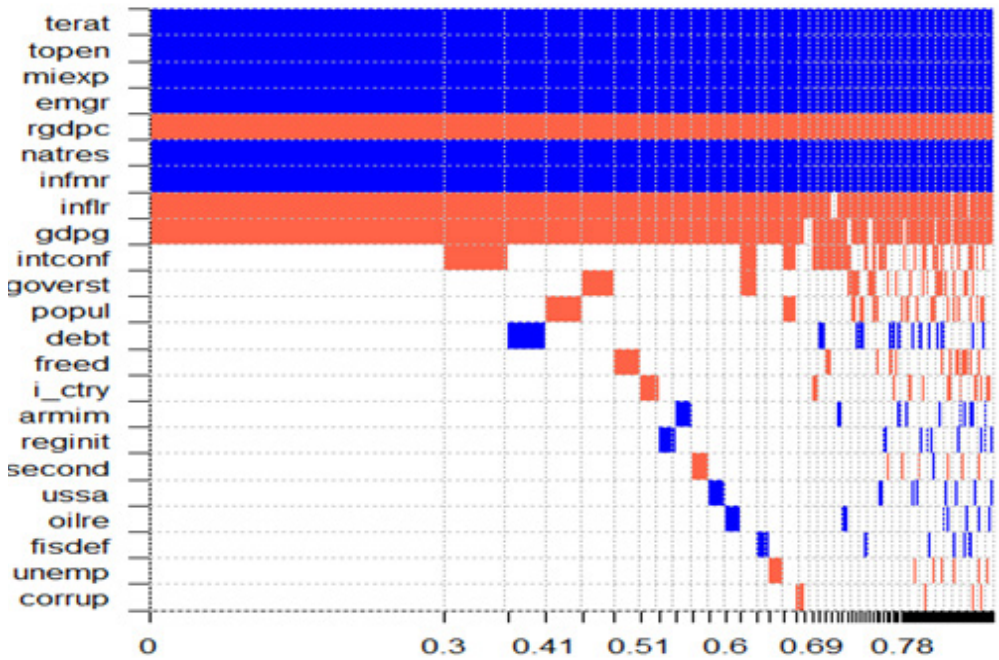
Note: **PIPs** denote the posterior inclusion probabilities of each variable. **Mean and SD** are the posterior mean and standard deviation of each coefficient from model averaging, respectively. **Cond.Pos.Sign** is the conditional posterior probability inclusion, sign certainty and **Idx** denotes the index (order) of the variables in our database under baseline estimates. **faid** is official development assistance, **terat** is terrorist attacks, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **gdpg** is gross domestic product growth rate, **popul** is population, **unemp** is unemployment, **oilre** is oil rents, **infmr** is infant mortality rate, **fisdef** is current account balance, **inflr** is inflation, **debt** is public debt, **topen** is trade openness, **emgr** is emigration rate, **miexp** is military expenditure, **armim** is arms imports, **ussa** is US security assistance, **reginit** is regional security initiatives, **freed** is freedom index, **intconf** is internal conflict index, **goverst** is government stability index, **second** is socioeconomic conditions index and **corrupt** is corruption index.

It can be observed that terrorist attacks, trade openness, military expenditure, emigration rate, real GDP per capita, total natural resources rents and infant mortality rates are priority variables that are included in the models ($PIPs = 100\%$). Apart from this first group of variables, high PIPs are also observed for inflation (CPI index), GDP growth rate, internal conflict, government stability indexes and population ($PIPs > 50\%$). Public debt, the freedom index and other regressors registered lower PIPs ($PIPs < 50\%$). When looking at the posterior mean of each coefficient of the identified variables from model averaging, we note that real GDP per capita, inflation, GDP growth rate, internal conflict and government stability indexes, and population are regressors with high PIPs and have a negative influence on foreign aid flows in G5 Sahel countries. Moreover, some regressors such as the freedom index, socioeconomic conditions index, unemployment rate and corruption index inhibit international aid towards these countries, but with much lower PIPs. By contrast, terrorist attacks, trade openness, military expenditure, emigration rate, total natural resources rents and infant mortality rate are increasing (attract) foreign aid in G5 Sahel countries.

A visual summary of the results described above is presented in Figure 1, showing the cumulative baseline model probabilities. Each graph ranks vertically the potential determinants of foreign aid according to their PIPs. Selected models are ordered horizontally, taking into account their posterior probability, which is proportional to the column width. A coloured rectangle reflects that the variable is included in the model and indicates the sign of its estimated influence (blue when positive and

red when negative). Each specification – terrorist attacks, trade openness, military expenditure, emigration rate, real GDP per capita, total natural resources rents and infant mortality rate – is consistently included in all selected models. The best model will include these variables with 0.3 posterior model probability, whereas the second group of variables that includes GDP growth rate, internal conflict, and government stability indexes and population, could be included in the extended model with 0.6 posterior model probability. Thus, following Cazachevici et al (2020) and for the precision of our analyses, we used variables from BMA with PIPs above 50% $(PIP > 50\%)$.

Figure 1: Cumulative model probabilities (baseline model)



Note: Figure 1 is the image plot. Blue corresponds to a positive coefficient, red to a negative coefficient, and white to non-inclusion of the respective variable. The horizontal axis is scaled by the models' posterior model probabilities under baseline estimates. **faid** is official development assistance, **terat** is terrorist attacks, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **gdpg** is gross domestic product growth rate, **popul** is population, **unemp** is unemployment, **oilre** is oil rents, **infmr** is infant mortality rate, **fisdef** is current account balance, **inflr** is inflation, **debt** is public debt, **topen** is trade openness, **emgr** is emigration rate, **miexp** is military expenditure, **armim** is arms imports, **ussa** is US security assistance, **reginit** is regional security initiatives, **freed** is freedom index, **intconf** is internal conflict index, **goverst** is government stability index, **second** is socioeconomic conditions index and **corrupt** is corruption index.

Beyond these results, the distribution of posterior model size and the posterior predictive density graph (Appendix, Figure A1) indicate that the model achieved a decent level of correlation among analytical likelihoods and iteration counts with a comparatively small number of sampling draws. Moreover, the density of foreign aid for the G5 Sahel region is high (similar to the mode of the predictive density). There are no significant outliers in aid data. Therefore, the whole distribution of the forecast is consistent.

To ensure the robustness of the analysis on the selected drivers of foreign aid in G5 Sahel countries, the square values of the following control variables are taken into account: terrorist attacks, real GDP per capita, infant mortality and trade openness. The quadratic forms of these three variables were introduced to test the nonlinearity hypothesis (Bayale, 2020). Beyond that, we included Libya in the study sample, given the fact that this country remains one of the most significant concerns for the countries of the Sahelian regional system. Due to its geographic centrality in the region, the enduring instability in Libya directly affects the security of its neighbouring countries. Anecdotally, the 2011 war in Libya accelerated a process of disintegration of the Sahel that started in the early 2000s when the then Salafist Group for Preaching and Combat (GSPC), which became Al-Qaeda in the Islamic Maghreb (AQIM), established itself in northern Mali and then started attacking the weak regional states, including Mauritania, Mali, Niger and other G5 Sahel countries (Bayale, 2020).

After including Libya in the sample and the other additional variables mentioned, we reran our model. The sensitivity analysis and robustness check results are tabulated in Table 3, which does not warrant much comment. The PIPs values and the sign of the post mean the coefficients are consistent with our expectations. The results seem to highlight the existence of a non-linear relationship between the volume of foreign aid received by the G5 Sahel countries and their medical needs (infant mortality), which appear in the variables where PIPs are above 0.5, including the square values of real GDP per capita. Hence, the changes introduced do not alter the main conclusions drawn about the regressors with a more robust relationship with foreign aid based on the output in Table 1. It can be observed that terrorist attacks, trade openness, military expenditure, emigration rate, real GDP per capita, total natural resources rents, infant mortality rate, inflation, GDP growth rate, internal conflict, government stability indexes and population have kept their high PIPs ($PIPs > 50\%$), as well as the nature of their signs or effects.

Table 3: Bayesian model averaging results (robustness check analyses)

Variables	PIPs	Post Mean	Post SD	Cond.Pos.Sign	Idx
terat	1.000	0.105	0.145	1.000	1
miexp	1.000	0.469	0.086	1.000	3
emgr	1.000	0.633	0.984	1.000	17
rgdpc	1.000	-0.561	0.801	0.000	18
natres	1.000	0.376	0.615	1.000	19
infmr2	1.000	-0.618	1.125	0.000	22
infmr	1.000	0.575	0.050	1.000	26
topen	1.000	0.181	0.036	1.000	2
rgdpc2	0.971	-0.171	0.055	0.000	12
gdpg	0.632	-0.072	0.064	0.000	25
popul	0.611	-0.003	0.002	0.000	11
inflr	0.601	-0.127	1.704	0.000	21

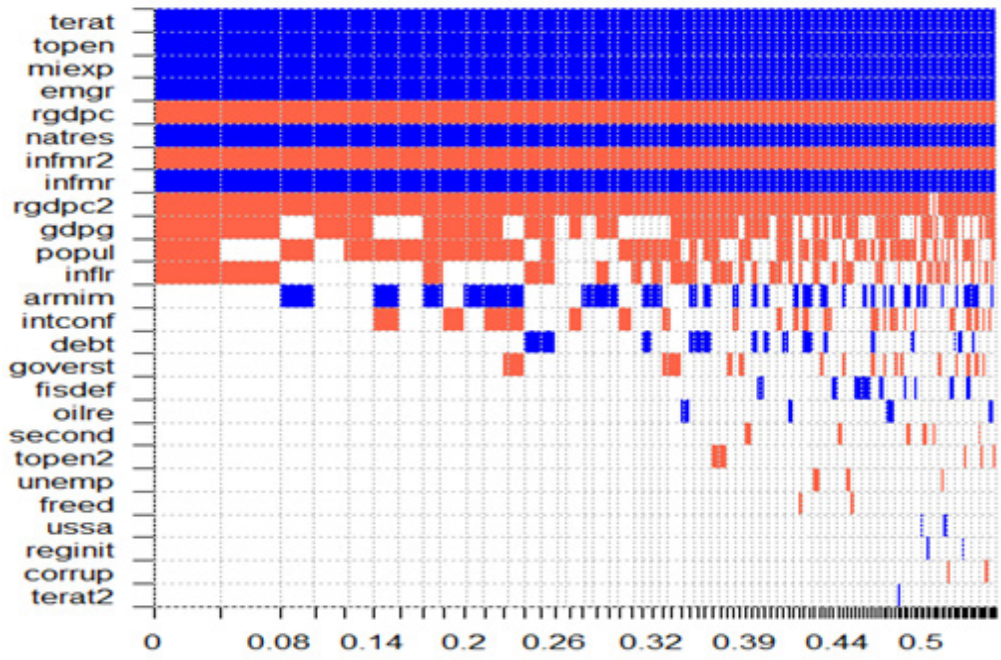
armim	0.566	0.161	0.219	1.000	13
intconf	0.507	-0.885	1.648	0.000	23
debt	0.404	0.047	0.106	1.000	16
goverst	0.274	-0.119	2.972	0.000	4
fisdef	0.114	0.007	0.025	1.000	14
topen2	0.081	-0.018	0.073	0.000	9
oilre	0.076	0.004	0.001	0.999	15
second	0.066	-0.053	0.261	0.029	20
freed	0.064	-0.064	0.309	0.000	6
unemp	0.063	-0.007	0.035	0.001	10
reginit	0.048	0.002	0.010	1.000	5
corrup	0.042	-0.088	0.596	0.000	7
ussa	0.039	0.818	5.738	1.000	8
terat2	0.036	0.009	0.009	0.967	24
i_ctry	0.034	0.002	0.021	0.851	27
Mean no. regressors		12.345	Model pace 2^K		6.7e+07
No. models visited		37,844	No. Obs.		234

Note: **PIPs** denote the posterior inclusion probabilities of each variable. **Mean and SD** are the posterior mean and standard deviation of each coefficient from model averaging, respectively. **Cond.Pos.Sign** is the conditional posterior probability inclusion, sign certainty and **Idx** denotes the index (order) of the variables in our database under robustness checks analyses. **faid** is official development assistance, **terat** is terrorist attacks, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **gdpg** is gross domestic product growth rate, **popul** is population, **unemp** is unemployment, **oilre** is oil rents, **infmr** is infant mortality rate, **fisdef** is current account balance, **inflr** is inflation, **debt** is public debt, **topen** is trade openness, **emgr** is emigration rate, **miexp** is military expenditure, **armim** is arms imports, **ussa** is US security assistance, **reginit** is regional security initiatives, **freed** is freedom index, **intconf** is internal conflict index, **goverst** is government stability index, **second** is socioeconomic conditions index and **corrupt** is corruption index. Finally, X^2 is squared values of X.

Furthermore, Figure 2 and Figure A2 in the Appendix show that the results remain stable when considering changes in the model specification and sample composition. Therefore, the selected foreign aid determinants based on the baseline

analyses are consistent and robust.

Figure 2: Cumulative model probabilities (robustness check analyses)



Note: Figure 2 is the image plot. Blue corresponds to a positive coefficient, red to a negative coefficient, and white to non-inclusion of the respective variable. The horizontal axis is scaled by the models' posterior model probabilities under robustness checks analyses. **faid** is official development assistance, **terat** is terrorist attacks, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **gdpg** is gross domestic product growth rate, **popul** is population, **unemp** is unemployment, **oilre** is oil rents, **infmr** is infant mortality rate, **fisdef** is current account balance, **inflr** is inflation, **debt** is public debt, **topen** is trade openness, **emgr** is emigration rate, **miexp** is military expenditure, **armim** is arms imports, **ussa** is US security assistance, **reginit** is regional security initiatives, **freed** is freedom index, **intconf** is internal conflict index, **goverst** is government stability index, **second** is socioeconomic conditions index and **corrupt** is corruption index. X^2 is squared values of X.

Panel data regression analysis

Knowing that the estimates provided in Tables 2 and 3 cannot be interpreted in the usual regression model partial derivative sense, in this subsection we provide direct impact estimates that describe how changes in the selected explanatory variables affect the level of foreign aid in G5 Sahel countries. Based on the results of the BMA approach, we specify the following empirical Equation 8, derived from Equation 7:

$$faid_{it} = \alpha_i + \gamma_1 terat_{it} + \gamma_2 topen_{it} + \gamma_3 miexp_{it} + \gamma_4 emgr_{it} + \gamma_5 rgdpc_{it} + \gamma_6 natres_{it} + \gamma_7 infmr_{it} + \gamma_8 inflr_{it} + \gamma_9 gdpg_{it} + \gamma_{10} intconf_{it} + \gamma_{11} goverst_{it} + \gamma_{12} popul_{it} + \varepsilon_{it}, \quad (8)$$

where AID is foreign aid (Official Development Assistance); TER represents terrorist attacks; $OPEN$ indicates trade openness; $MEXP$ is military expenditure; EMG represents the emigration rate; $GDPC$ indicates the real GDP per capita; NAT is total natural resources rents; $INFM$ represents the infant mortality rate; INF indicates inflation (CPI index); $GDPG$ is GDP growth rate; $INTC$ represents internal conflict index; GOV indicates government stability index and POP is the population, while ε_{it} is the error term. Based on the BMA outputs and the economic literature, the expected signs of the explanatory variables' coefficients are assumed as follows: γ_1, γ_2, γ_3, γ_4, γ_6 and $\gamma_7 > 0$, whereas γ_5, γ_8, γ_9, γ_{10}, γ_{11} and $\gamma_{12} < 0$. Bayale (2020), Martinez-Zarzoso (2019), Furuoka (2017) and Bandyopadhyay and Vermann (2013) observed that the donors' self-interest variables such as trade openness and arms imports that underlies military expenditure can stimulate international development aid in recipient countries whereas real GDP per capita, GDP growth rate, internal conflict and government stability indexes, and population size may reduce foreign aid (Berthélemy, 2006). For Bandyopadhyay, Sandler and Younasz (2014), Bandyopadhyay and Wall (2007) and Azam and Delacroix (2006), terrorist attacks and infant mortality may spur international aid in developing countries, especially in unstable countries such as the G5 Sahel countries (Azam and Thelen, 2008, 2010). Furthermore, we argue that the natural resources rents may increase aid whereas inflation may reduce it. This is because most countries with natural resources remain in poverty. With regard to emigration, we concur with Lanati and Thiele (2018) and Gamso and Yuldashev (2018) that it may increase international aid in G5 Sahel countries.

Results

The empirical estimates start with a preliminary analysis of the variables under consideration; the descriptive statistics and correlation analysis are reported in Table 4. International aid to G5 Sahel countries is really important. On average, each country had received UD$544.75 million annually. As the literature has shown, these countries are plagued by conflicts, instability and terrorist attacks. The region has recorded an average of 22 attacks annually. According to the Global Terrorism Database (GTD), the distribution of terrorist attacks in the G5 Sahel region indicates that, over the period of analysis, Mauritania is the least affected country by terrorism with 29 attacks and 143 deaths. The most affected country is Mali, with 753 terrorist attacks and 2,719 deaths, compared to 1,675 deaths in Niger, 1,431 in Chad, and 849 in Burkina Faso (GTD, 2020). Therefore, on average, 10.92% of the region's GDP is devoted to military spending.

The average of the GDP per capita, emigration rate and infant mortality is US$643.69, 16 per 1,000 of the population and almost 188 per 1,000 children, respectively. For an average population of more than 9.83 million, the G5 Sahel zone does not present a good level of institutional quality indicators. Government stability and internal conflict indexes have average values of 6.24 and 6.96, respectively. These are below 12, which is the highest scale according to the ICRG database of Political Risk Services. This

implies that the region is institutionally unstable. Moreover, the standard deviations show low deviations, indicating that the data points tend to be close to the mean. Furthermore, almost all explanatory variables have low correlation coefficients. These variables are positively correlated to international aid except GDP per capita, inflation, GDP growth, internal conflict and governance stability indexes, and the population. Finally, the values of skewness kurtosis indicate that almost all variables are normally distributed because they are closer to 0 and 3, respectively. However, the variables are moderately skewed and most of the variables are positively skewed. The kurtosis of foreign aid, terrorist attacks, military expenditure, natural resources, GDP growth and governance stability index, and the remaining variables are platykurtic.

Table 4: Descriptive statistics and correlation matrix

Variables	faid	terat	topen	miexp	emgr	rgdpc	natres	infmr	inflr	gdpg	intconf	goverst	popul
Mean	544.75	22.03	34.82	10.92	15.94	643.69	9.81	187.82	2.69	4.64	6.96	6.24	9.83
Median	485.37	20.17	30.88	6.35	13.56	543.02	7.28	186.70	2.50	4.70	6.00	5.50	9.59
Maximum	1322.4	63	83.31	66.18	24.50	1369.1	94.94	236.00	6.00	13.63	11.00	12.00	21.61
Minimum	189.48	4	14.31	1.33	11.69	322.77	1.25	59.10	0.00	-12.71	3.33	3.33	1.78
Std. Dev.	25.47	15.72	14.21	12.66	7.92	291.61	10.56	22.61	1.24	5.37	1.92	1.59	4.91
Skewness	0.95	5.75	1.07	2.64	0.79	0.89	2.72	0.28	0.41	1.05	-0.11	-1.29	0.14
Kurtosis	3.25	3.11	2.96	3.95	2.36	2.71	3.53	2.15	2.81	3.08	2.38	3.24	2.26
Observations	165	1326	142	151	150	165	1326	165	1326	165	165	165	165
Correlation													
faid	1.00												
terat	0.25	1.00											
topen	0.05	-0.16	1.00										
miexp	0.17	0.22	-0.13	1.00									
emgr	0.19	0.24	0.01	0.18	1.00								
rgdpc	-0.11	-0.08	0.01	0.19	0.51	1.00							
natres	0.05	0.16	-0.14	0.17	-0.06	0.01	1.00						
infmr	0.27	0.09	0.06	-0.01	0.13	0.07	0.05	1.00					
inflr	-0.06	0.07	0.18	-0.03	0.04	0.04	-0.12	0.08	1.00				
gdpg	-0.16	-0.27	0.06	-0.21	-0.12	0.09	0.10	0.12	-0.15	1.00			
intconf	-0.10	-0.08	0.03	0.06	0.01	0.09	-0.04	0.13	0.43	0.03	1.00		
goverst	-0.05	-0.10	-0.11	0.01	0.04	0.11	-0.01	0.13	-0.24	0.27	0.21	1.00	
popul	-0.04	0.08	-0.08	-0.03	-0.11	-0.17	0.10	-0.16	-0.10	0.02	-0.16	-0.04	1.00

Note: **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

A cross-sectional dependence test is one of the most important diagnostics that a researcher should investigate before performing a panel data analysis. In this

paper, the Breusch and Pagan (1980) LM test, Pesaran (2004) scaled LM test, Pesaran (2004) CD test and Baltagi et al (2012) bias-corrected scaled LM test are performed, and their results are presented in Table A1 in the Appendix. The findings from these cross-sectional dependence tests recommend that the null hypothesis of none cross-sectional dependence can be rejected at a 1% level of significance. This implies that if a shock occurs in one country, its spillover effect can be felt in the rest of the G5 Sahel countries. We, therefore, need to proceed with tests and estimation techniques that can take account of cross-sectional dependence. The existence of cross-sectional dependence requires a unit root test that allows for cross-sectional dependence, while investigating stationarity in panel data. Therefore, the study conducts a CIPS panel unit root test developed by Pesaran (2007). The results are presented in Table A2 in the Appendix. It can be observed that the null hypothesis of non-stationary can be rejected at the 1% significance level, not at the level but the first difference. This result supports the evidence for a possible cointegration relationship between foreign aid and its explanatory variables and, therefore, requires an investigation into whether a cointegration relationship exists.

To do this, we performed a Westerlund (2007) panel cointegration test that examines the existence of long-run relationships among integrated variables, even with the existence of cross-sectional dependence. Westerlund (2007) proposes four panel cointegration test statistics with a bootstrapping option that tests for the existence of long-run relationships among integrated variables. The panels (P_r , P_α) and (G_r , G_α), which are also group statistics The results given in Table 5 indicate that the null hypothesis of no cointegration can be rejected. This implies that cointegration exists among international aid and other variables of the model. Hence, there exists a long-run relationship among study variables (Appendix, Table A3).

Table 5: FMOLS, CUP-FM and DOLS estimates

Variable	Baseline model			Robustness checks		
	FMOLS	CUP-FM	DOLS	FMOLS	CUP-FM	DOLS
terat	0.04***	0.05***	0.05***	0.06***	0.05***	0.05***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
topen	0.93***	1.01***	0.95***	0.86***	0.74***	0.75***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
miexp	0.87***	0.79***	0.79***	0.93***	0.92***	0.92***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
emgr	0.45***	0.48***	0.43***	0.34***	0.39***	0.40***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rgdpc	-1.72***	-1.38***	-1.39***	-1.32***	-1.51***	-1.52***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)
natres	0.82***	0.86***	0.87***	0.94***	1.01***	1.02***
	(0.003)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)

infmr	0.04***	0.06***	0.06***	0.05***	0.07***	0.06***
	(0.004)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
inflr	-	-	-	-0.30**	-0.24**	-0.25**
	-	-	-	(0.031)	(0.029)	(0.029)
gdpg	-	-	-	-0.06**	-0.08**	-0.07**
	-	-	-	(0.028)	(0.037)	(0.029)
intconf	-	-	-	-1.06**	-1.02**	-1.11**
	-	-	-	(0.021)	(0.018)	(0.014)
goverst	-	-	-	-0.24**	-0.24**	-1.25**
	-	-	-	(0.043)	(0.026)	(0.024)
popul	-	-	-	-1.05*	-1.05**	-1.06**
	-	-	-	(0.059)	(0.041)	(0.026)
Ajusted R^2	0.61	0.58	0.59	0.64	0.63	0.63
Obs	195	195	195	195	195	195
Country	5	5	5	5	5	5

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

Given the results of the cointegration test, the paper investigates the long-run analysis within the variables of the model. To do this, econometric tools such as the fully modified ordinary least squares (FMOLS), continuously updated fully modified (CUP-FM) and the dynamic ordinary least squares (DOLS) estimators are employed. According to Kumar and Smyth (2007) and Tugcu (2018), the FMOLS, CUP-FM and DOLS are highly efficient in handling the issue of endogeneity among regressors and serial correlations in the error terms. However, Bai and Kao (2006) argue that, among the fully modified methodologies, the CUP-FM estimator has an advantage over the others in terms of considering the possible cross-sectional dependence. In fact, the FMOLS and CUP-FM methods use non-parametric approach controls for the endogeneity problem and autocorrelation, whereas the DOLS method eradicates the concerns through a parametric approach by including lags and leads of the explanatory variables (Bai and Kao, 2006). For Tugcu (2018), the DOLS method gives better results and high efficiency in the case of small samples. This technique is capable of accounting for cross-sectional dependence in panel data and handling cross-sectional dependence based on obtaining both country-specific coefficients and producing unbiased, efficient and consistent estimates. The weighted criteria of the DOLS, FMOLS and CUP-FM methods control heterogeneity in the long-run variance and cointegrated panels (Stock and Watson, 1993).

Table 5 illustrates the results of the FMOLS, CUP-FM and DOLS estimators. Also, sensitivity and robustness analyses were performed by adding five explanatory variables to the model: inflation, GDP growth, internal conflict, government stability

index and population, based on the BMA method results. It can be observed from the baseline model's results that all coefficients are significant. However, only the coefficients of GDP per capita, inflation, GDP growth, internal conflict, government stability indexes and population are negative. The remaining variables have positive coefficients, irrespective of the estimation method applied. This means that terrorist attacks, trade openness, military expenditure, emigration rate, natural resources rents and infant mortality acted as stimulators of international aid in G5 Sahel countries over the period analysed.

In particular, terrorist attacks have a positive and significant effect on foreign aid. This suggests that the increase in terrorist attacks in these countries is leading donors to increase their aid. This aid can take the form of material, military and humanitarian help. Azam and Delacroix (2006) found a positive empirical relationship between the level of foreign aid received by a country and the number of terrorist attacks originating from it. In fact, since the terrorist attacks of September 2001, the objective of reducing terrorism has been of increasing interest among donors giving aid to developing nations and, in recent years, national security has been at the forefront of foreign policy concerns. As such, it is possible to use aid to reduce terrorist threats (Bandyopadhyay and Vermann, 2013). These results are in line with those of Azam and Thelen (2008, 2010) who showed that the level of foreign aid (military aid) may help recipient countries to reduce terrorist attacks. Thus, international aid can appear robust in ameliorating the adverse effect of domestic terrorism in developing nations (Bandyopadhyay, Sandler and Younas, 2014). In the case of G5 Sahel countries, it is well known that the region is experiencing an increase in attacks from militant Islamist groups coupled with cross-border challenges such as trafficking, migration and displacement. Therefore, as peace and security are global public services or goods (Bayale, 2020), an increase in terrorist attacks would increase international aid from donor countries. These findings are held irrespective of the estimator used.

Trade openness is positively and significantly correlated with foreign aid. Hence, the elasticity of aid to trade intensity, which measures trade between these countries and their donors, has a positive and significant coefficient. This means that the volume of aid increases as trade relations between these countries and their donors intensify. It is then relevant to realize that the commercial interests of donors may essentially determine the allocation of development aid towards G5 Sahel countries, whatever the model and the methodological approach applied. Hence, aid may be used to deepen commercial linkages with a recipient, and not only political alliances (Bayale, 2020). According to Furuoka (2017), the provision of foreign aid by China and Japan was primarily driven by the aid donors' self-interest, especially trade stakes. Our findings are also in line with those of Martinez-Zarzoso (2019) on the trade effects of foreign aid in 125 recipient countries. Martinez-Zarzoso (2019) showed that trade, especially exports, are determinants of development aid in the recipient countries. Military expenditure has a positive and significant effect on international aid. In G5 Sahel countries, a significant part of military expenditure is used for the importation of arms (SIPRI, 2019). Therefore, the increase in arms import demand

by recipient countries will increase their military expenditure that is associated with attracting foreign aid, thus strengthening trade relations (Bayale, 2020, Furuoka, 2017; Neumayer, 2003). Our results imply that a donor's foreign assistance policy based, in part, on its self-interest will typically be biased toward countries that tend naturally to have more trade with it.

In this study, aid beneficiaries' needs and performance (G5 Sahel countries) are taken into account by including the emigration rate, GDP per capita and infant mortality. Our findings show that an increase in the emigration rate is associated with an increase in aid because the coefficient of this variable is positive and significant. This result corroborates the studies of Dreher et al (2019) and Lanati and Thiele (2018). These authors found that, in most cases, the relationship between aid and the emigration rate was mixed (Bayale, 2020). The coefficient of the infant mortality rate is also positive and significant. This implies that an increase in the infant mortality rate in the G5 Sahel countries leads to an increase in international aid, while it is notable that real GDP per capita has a negative and significant coefficient. In fact, GDP per capita and the infant mortality rate represent the socioeconomic needs variables. They may determine the allocation of aid to these G5 Sahel countries. These results are robust when the DOLS approach is applied. Our results are consistent with those of Bandyopadhyay and Wall (2007) who investigated the determinants of external assistance in post-conflict countries. They find that in low-income countries, the infant mortality rate (children under 5 years old) and GDP per capita strongly determine the aid flows that the countries received. Against our expectations, we observe that the abundance of natural resources attracts international aid. This result corroborates the results of Dobronogov and Keutiben (2014) who found that several resource-rich, low-income countries receive amounts of foreign aid that are similar to or larger than their actual or potential revenues from natural resources. Similar to GDP per capita, it can be observed that GDP growth, inflation and population have negative and significant coefficients.

Regarding the institutional explanatory variables, our results show that foreign aid is quite responsive to internal conflict and government effectiveness, which showed negative and significant coefficients. One of the most plausible explanations for these results is that, in recent years, the G5 Sahel countries have faced major security challenges and threats, whereas the institutional quality conditions influence the international aid allocation (Burnside and Dollar, 2000). Thus, our results are consistent with Berthélemy (2006) who finds that aid allocation depends on the political environment in the recipient country.

Furthermore, we include lagged regressors in the model, in particular, lagged in time of the dependent variable (*faid*), to test whether the current level of aid in Sahel countries is heavily determined by that of past periods (Table 6). The inclusion of the lag of aid can be justified by the fact that besides foreign aid conditionalities and some potential constraints of donors, aid disbursements usually lag behind commitments.

Taking into account the regressors, our argument is that some socioeconomic and institutional conditions of G5 Sahel countries in past periods could determine

the current level of aid. The findings show that the level of aid in a given year in these countries is partly determined by that of the previous year. This is an interesting result, which is consistent with that of Berthélemy, who provided an empirical assessment of the motivations of aid granted by rich countries to developing countries (Berthélemy, 2006). Regarding the other regressors, the results do not indicate a drastic change compared to the previous one (Table 6).[4]

Table 6: FMOLS, CUP-FM and DOLS estimates

Variable	Baseline model			Robustness checks		
	FMOLS	CUP-FM	DOLS	FMOLS	CUP-FM	DOLS
faid (lagged)	0.28***	0.24***	0.25***	0.29***	0.25***	0.26***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
terat (lagged)	0.05**	0.05***	0.06***	0.06**	0.06***	0.05***
	(0.021)	(0.000)	(0.000)	(0.019)	(0.000)	(0.000)
topen (lagged)	0.98**	1.00**	1.05**	0.96**	1.03**	1.01**
	(0.021)	(0.019)	(0.023)	(0.021)	(0.018)	(0.017)
miexp (lagged)	0.82**	0.78**	0.79**	0.83**	0.72**	0.75**
	(0.022)	(0.021)	(0.015)	(0.019)	(0.018)	(0.022)
emgr (lagged)	0.47**	0.43**	0.44**	0.39**	0.41**	0.42**
	(0.041)	(0.039)	(0.042)	(0.038)	(0.041)	(0.042)
rgdpc (lagged)	-1.53**	-1.37**	-1.38**	-1.52**	-1.38**	-1.39**
	(0.016)	(0.022)	(0.019)	(0.014)	(0.013)	(0.014)
natres (lagged)	0.83**	0.87**	0.89**	0.84**	0.91**	0.92**
	(0.031)	(0.037)	(0.039)	(0.031)	(0.032)	(0.031)
infmr (lagged)	0.07**	0.06**	0.05**	0.08**	0.07**	0.06**
	(0.024)	(0.022)	(0.021)	(0.016)	(0.018)	(0.012)
inflr (lagged)	-	-	-	-0.28	-0.23	-0.24
	-	-	-	(0.131)	(0.121)	(0.132)
gdpg (lagged)	-	-	-	-0.06**	-0.07**	-0.07**
	-	-	-	(0.028)	(0.037)	(0.029)
intconf (lagged)	-	-	-	-1.05**	-1.01**	-1.03**
	-	-	-	(0.021)	(0.018)	(0.014)
goverst (lagged)	-	-	-	-0.24**	-0.24**	-1.25**
	-	-	-	(0.043)	(0.026)	(0.024)
popul (lagged)	-	-	-	-1.07	-1.05	-1.06
	-	-	-	(0.099)	(0.163)	(0.176)
Ajusted R^2	0.68	0.66	0.64	0.69	0.72	0.71
Obs	195	195	195	195	195	195
Country	5	5	5	5	5	5

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

Still within the robustness analysis, we performed regressions on Africa's fragile and conflict-affected countries (20 countries) included in the 2020 list of the World Bank (WDI, 2020). We divided this sample into two sub-samples: the G5 Sahel countries and the non-G5 Sahel countries (others) to conduct a comparative analysis. The results given in Table A4 of the Appendix are consistent with our conclusions on aid drivers in Africa's fragile and conflict-affected countries. It can be observed that there are no major changes in terms of aid motives, apart from the fact that emigration rate, inflation, gross domestic product growth rate and population are not statistically significant. Moreover, some variables such as military expenditure, real GDP per capita and natural resources rents appear to have a significantly greater impact on the G5 sample than on the non-G5 sample. This slight difference of the magnitude of the coefficient (effects) could be explained by the fact that the countries in these two sub-samples receive different amounts of aid. Moreover, the intensity of terrorism differs from one country to another. Furthermore, slight differences may arise from the donors' side as these countries receive aid from different donors with different interests.

For more dynamic analysis, further country-wise analyses were performed through a DOLS estimator, with the results presented in Table 7. It can be observed that terrorist attacks, trade openness, military expenditure, emigration rate and infant mortality have positive and significant effects on international aid, whereas real GDP per capita, inflation, GDP growth, internal conflict and government stability indexes, and population negatively affect or diminish foreign aid. The effects of all these variables are confirmed individually for all G5 Sahel countries. Likewise, natural resources rents have a positive and significant effect on aid in almost all G5 Sahel countries. Clearly, the individual country analyses exhibited in Table 7 are strongly consistent with the results of the panel estimation in Table 6. This indicates that our analyses are valid.

Table 7: DOLS results by country

Variables	Burkina Faso	Chad	Mali	Mauritania	Niger
terat	0.99***	0.89***	1.03***	0.83***	1.01***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
topen	0.59***	0.43***	0.57***	0.49***	0.46***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
miexp	0.71***	0.95***	0.92***	0.89***	0.87***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
emgr	0.04***	0.08***	0.05***	0.06***	0.07***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rgdpc	-1.69**	-2.21***	-2.35**	-1.12***	-3.64**
	(0.018)	(0.004)	(0.017)	(0.001)	(0.044)
natres	0.64***	1.08**	0.77**	0.68***	1.96**
	(0.000)	(0.003)	(0.033)	(0.000)	(0.041)
infmr	0.01***	0.03**	0.05***	0.02**	0.01***
	(0.000)	(0.028)	(0.000)	(0.035)	(0.000)

inflr	-0.11**	-0.14**	-0.09***	-0.07	-0.18***
	(0.037)	(0.022)	(0.004)	(0.000)	(0.002)
gdpg	-0.87**	-0.56**	-0.09***	-0.18***	-0.51**
	(0.025)	(0.034)	(0.000)	(0.000)	(0.019)
intconf	-0.94**	-1.88**	-0.83**	-0.69***	-1.93**
	(0.038)	(0.047)	(0.029)	(0.004)	(0.039)
goverst	-0.44**	-0.81*	-0.29**	-0.35**	-0.73*
	(0.039)	(0.087)	(0.042)	(0.022)	(0.086
popul	-1.09	-1.07**	-1.11	-1.01*	-1.06**
	(0.227)	(0.031)	(0.501)	(0.067)	(0.019)

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. CI is Côte d'Ivoire and Guinea B is Guinea Bissau. For the variables, **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

As mentioned, the FMOLS, CUP-FM and DOLS methods only provide information about the long-run relationship. It is, therefore, crucial to detect the causality direction for such long-run relationships.

To unearth the causal nexus between aid and its main determinants in G5 Sahel countries, we employed the panel causality test developed by Dumitrescu and Hurlin (2012). The Dumitrescu and Hurlin (DH) panel causality test is a Granger non-causality test procedure that is capable of accounting for individual differences (heterogeneity) across cross-sections (countries) and overcomes the problem of cross-sectional dependence in cross-country panel models. The test considers the heterogeneity of the causal relationship and the heterogeneity of the regression model used for testing for causality. The DH panel causality test relies on a block bootstrapping approach, which corrects the empirical critical values of the panel causality test statistic in order to deal with the cross-sectional dependence problem.

Table 8 presents the causality test results. By considering the direction of causality between international aid and the explanatory variables, it can be observed from the results that bidirectional causality does exist between trade openness and foreign aid. Also, military expenditure and international aid cause each other in a bidirectional fashion. This implies that international aid may be an instrument that promotes the development of trade and geopolitical interests. Moreover, bidirectional causality is detected between inflation and foreign aid. However, unidirectional causalities run from terrorist attacks, emigration rate and infant mortality toward international aid flows.

Furthermore, unidirectional causalities flow from foreign aid towards real GDP per capita and GDP growth rate. This means that aid may promote economic development in G5 Sahel countries. Combined with the previous results (Tables 5, 6 and 7), it can be deduced that international aid to the G5 Sahel countries is determined by the preservation of peace and security in these countries, the economic interests (that is self-interest) of donor countries as well as the economic needs of recipient (G5 Sahel) countries. Therefore, in their allocation decisions donors take into account both the interests of donors, and the recipient merits and/or recipient needs.

Table 8: Pairwise Dumitrescu-Hurlin panel causality tests

Null hypothesis	W-Stat.	Zbar-Stat.	Prob.
terat does not homogeneously cause ***faid***	5.462***	2.201***	(0.000)
faid does not homogeneously cause ***terat***	3.868	1.214	(0.114)
topen does not homogeneously cause ***faid***	5.467***	2.872***	(0.004)
faid does not homogeneously cause ***topen***	6.030***	3.595***	(0.000)
miexp does not homogeneously cause faid	4.905**	2.181**	(0.019)
faid does not homogeneously cause ***miexp***	6.306***	3.062***	(0.000)
emgr does not homogeneously cause ***faid***	5.672***	2.388***	(0.006)
faid does not homogeneously cause ***emgr***	1.306	-0.825	(0.408)
rgdpc does not homogeneously cause ***faid***	1.399	-0.742	(0.457)
faid does not homogeneously cause ***rgdpc***	6.397***	3.033***	(0.000)
natres does not homogeneously cause ***faid***	3.115	1.448	(0.131)
faid does not homogeneously cause ***natres***	2.084	-0.133	(0.893)
infmr does not homogeneously cause ***faid***	5.384***	3.021***	(0.000)
faid does not homogeneously cause ***infmr***	1.759	-0.423	(0.672)
inflr does not homogeneously cause ***faid***	6.115***	3.671***	(0.000)
faid does not homogeneously cause ***inflr***	5.703***	3.082***	(0.002)
gdpg does not homogeneously cause ***faid***	3.416	1.827	(0.084)
faid does not homogeneously cause ***gdpg***	5.856***	2.336***	(0.005)
intconf does not homogeneously cause ***faid***	1.821	-0.448	(0.653)
faid does not homogeneously cause ***intconf***	2.357	0.168	(0.866)
goverst does not homogeneously cause ***faid***	3.987	1.557	(0.119)
faid does not homogeneously cause ***goverst***	1.489	-0.662	(0.507)
popul does not homogeneously cause ***faid***	2.712	0.423	(0.671)
faid does not homogeneously cause ***popul***	1.368	-0.771	(0.440)

Note: **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

5. Conclusion and policy implication

In recent years, the G5 Sahel countries have experienced several security challenges that threaten their stability, peace and security. At the same time, several developed countries and multilateral institutions provide important official development assistance flows to these countries, with a variety of reasons to justify these foreign aid flows. In this study, we investigated the determinants of international aid in G5 Sahel countries for the period 1980–2018, with annual frequency. To do this, we first applied a Bayesian Model Averaging (BMA) approach within a panel data regression framework to identify the most important factors or variables that influence the foreign aid flows, based on the posterior inclusion probabilities (PIPs), the mean and standard deviation coefficients for each variable of the initial model. Second, we checked dependencies across countries and applied a second-generation panel unit root test that controls for cross-sectional dependence. Due to the existence of non-stationary variables, the cointegration relationship is approved by controlling for cross-sectional dependence in the study. Based on the confirmation of a cointegration relationship, we performed the fully modified ordinary least squares (FMOLS), continuously updated fully modified (CUP-FM) and the dynamic ordinary least squares (DOLS) estimators to produce long-run cointegration parameters for our estimations. Finally, we detected causality direction for these long-run relationships using Dumitrescu and Hurlin's (2012) panel causality test.

The empirical findings strongly support the fact that, among the set of 22 regressors considered, those reflecting terrorist attacks, trade stakes including military expenditure, socioeconomic prospects and institutional conditions tend to have high posterior inclusion probabilities. Specifically, terrorist attacks, trade openness, military expenditure, emigration rate, infant mortality and natural resources rents especially seem to attract foreign aid, whereas real GDP per capita and growth, inflation, internal conflict and government stability indexes and population are significantly negative and seem to curb international aid. Therefore, the results highlight three concerns that may determine aid flows towards G5 Sahel countries: peace and security considerations, economic interest of donors, and recipient economic needs.

Based on these important results, some appropriate economic policy implications are offered: (i) although it is difficult to strike a balance between the interests of donors and beneficiaries, it is important that the motivation to provide aid should be in harmony with recipient need considerations, (ii) the establishment of an

emergency and specific fund for non-radicalization awareness in Africa's fragile and conflict-affected countries is recommended; this fund will make it possible to set up monitoring and awareness committees in order to improve communication around the issue of terrorism among the population, and (iii) greater involvement of the international community in the development and security of the Sahel in accordance with the 13th goal of the Agenda 2063 of the African Union (AU) and the 16th goal of the 2030 Agenda for Sustainable Development (SDGs), adopted by all United Nations (UN) Member States in 2015.

Notes

1 The G5 Sahel is a subregional organization established in 2014 as an intergovernmental partnership between Burkina Faso, Chad, Mali, Mauritania and Niger to foster economic cooperation and security in the Sahel and to respond to humanitarian and security challenges, including from militant Islamist groups (Africa Center for Strategic Studies, ACSS, 2019).

2 The econometric literature offers alternative model priors (uniform, strong-heredity and dilution-defined tessellation priors). However, the sensitivity of BMA results to the specification of Zellner's g prior is well documented in the literature. Thus, it allows the user to carry out a serious sensitivity analysis and manage the multicollinearity issue and the weighting of correlated interactions between variables (Feldkircher and Zeugner 2012, Moser and Hofmarcher, 2014; Zeugner and Feldkircher, 2015; Steel, 2020).

3 For further information, refer to one of the papers which incorporated this technique: Zeugner and Feldkircher, 2015; Okafor and Piesse, 2017; Sanso-Navarro and Vera-Cabello, 2020; Bayale, 2020, Bayale et al, 2021; Nagou et al, 2021.

4 The lag number was chosen based on ARDL estimates and economic intuition.

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Appendix

Table A1: Cross-sectional dependence (CD) test

	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
faid	5846.36	90.53	89.51	33.82
	(0.000)	(0.000)	(0.000)	(0.000)
terat	5927.33	92.12	91.11	42.18
	(0.000)	(0.000)	(0.000)	(0.000)
topen	7019.33	113.75	112.73	18.94
	(0.000)	(0.000)	(0.000)	(0.000)
miexp	4028.05	54.52	53.49	28.18
	(0.000)	(0.000)	(0.000)	(0.000)
emgr	7048.58	114.33	113.31	41.08
	(0.000)	(0.000)	(0.000)	(0.000)
rgdpc	21021.05	391.03	390.01	119.77
	(0.000)	(0.000)	(0.000)	(0.000)
natres	13762.88	247.29	246.27	103.93
	(0.000)	(0.000)	(0.000)	(0.000)
infmr	7094.21	115.24	114.22	19.78
	(0.000)	(0.000)	(0.000)	(0.000)
inflr	5393.39	81.56	80.54	16.91
	(0.000)	(0.000)	(0.000)	(0.000)
gdpg	29132.51	551.66	550.64	168.01
	(0.000)	(0.000)	(0.000)	(0.000)
intconf	3231.76	38.75	37.73	6.58
	(0.000)	(0.000)	(0.000)	(0.000)
goverst	2124.25	16.82	15.79	6.63
	(0.000)	(0.000)	(0.000)	(0.000)
popul	6445.45	102.39	101.37	15.96
	(0.000)	(0.000)	(0.000)	(0.000)

Note: Values in parentheses are the p-values.
*** denotes significance at 1%. **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

Table A2: Cross-sectionally augmented IPS test (CIPS) panel unit toot test

Variables	Level		First difference	
	Without trend	With trend	Without trend	With trend
faid	-2.07	-1.74	-3.46	-3.06
	(0.196)	(0.259)	(0.000)	(0.000)
terat	-2.96	-2.07	-3.36	-3.27
	(0.236)	(0.269)	(0.000)	(0.000)
topen	-2.45	-2.07	-3.28	-3.75
	(0.246)	(0.304)	(0.000)	(0.000)
miexp	-1.97	-1.82	-4.06	-4.01
	(0.166)	(0.189)	(0.000)	(0.000)
emgr	-2.05	-2.02	-4.61	-3.89
	(0.376)	(0.199)	(0.000)	(0.000)
rgdpc	-2.68	-2.13	-5.456	-4.84
	(0.198)	(0.154)	(0.000)	(0.000)
natres	-1.25	-1.19	-3.85	-3.24
	(0.186)	(0.159)	(0.000)	(0.000)
infmr	-2.26	-1.31	-4.79	-3.27
	(0.194)	(0.621)	(0.000)	(0.000)
inflr	-2.62	-1.79	-3.65	-3.23
	(0.997)	(0.216)	(0.000)	(0.000)
gdpg	-2.35	-2.17	-4.28	-4.09
	(0.201)	(0.247)	(0.000)	(0.000)
intconf	-2.64	-2.158	-4.94	-3.93)
	(0.074)	(0.068)	(0.000)	(0.000)
goverst	-2.58	-2.15	-4.26	-4.17
	(0.188)	(0.208)	(0.000)	(0.000)
popul	-1.95	-1.24	-3.84	-2.74
	(0.442)	(0.893)	(0.000)	(0.000)

Note: For significance, the critical values in case of no trend are -2.67, -2.82 and -3.1 at 10%, 5%, and 1%, respectively. The critical values in case of no trend are -2.10, -2.22 and -2.44 at 10%, 5% and 1%, respectively. **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

Table A3: Westerlund (2007) panel cointegration test

statistics	P_r	P_α	G_r	G_α
Values	-12.58	16.53	7.18	24.01
P-values (1)	(0.000)	(0.000)	(0.000)	(0.000)
P-values (2)	(0.000)	(0.000)	(0.018)	(0.011)

Note: In this test, the average lag length selected by the AIC information criterion is 3. The width of the Bartlett kernel window is set to 2. P-values (2) is based on the bootstrap method while P-values (1) is not.

Table A4: Further sensitivity and robustness check estimates

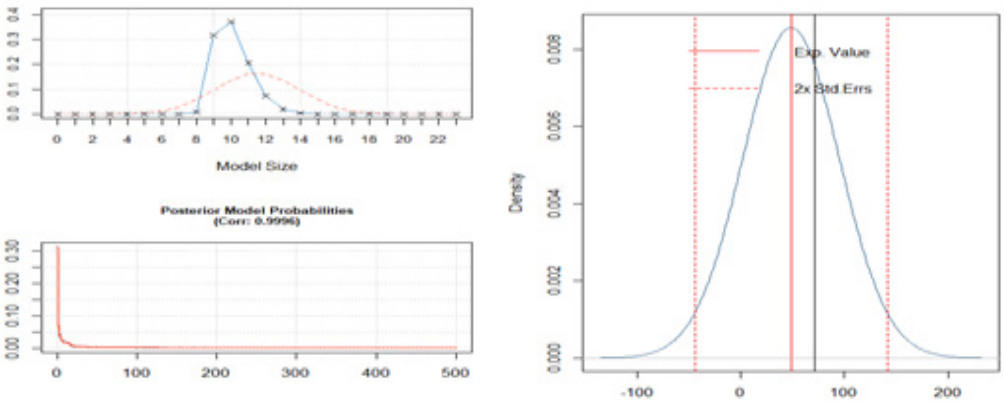
Variables	Full sample	Non-G5 Sahel	G5 Sahel
	CCEMG	CCEMG	DOLS
terat	0.07**	0.03**	0.05***
	(0.022)	(0.039)	(0.000)
topen	0.68***	0.72***	0.75***
	(0.000)	(0.000)	(0.000)
miexp	0.45**	0.51**	0.92***
	(0.041)	(0.029)	(0.000)
emgr	0.08*	0.09*	0.40***
	(0.077)	(0.068)	(0.000)
rgdpc	-0.98**	-0.82**	-1.52***
	(0.042)	(0.039)	(0.000)
natres	0.06**	0.04**	1.02***
	(0.018)	(0.013)	(0.000)
infmr	0.12***	0.09***	0.06***
	(0.000)	(0.000)	(0.000)
inflr	-0.18*	-0.34*	-0.25**
	(0.083)	(0.052)	(0.029)
gdpg	-0.03	-0.01*	-0.07**
	(0.194)	(0.081)	(0.029)
intconf	-1.26**	-1.32**	-1.11**
	(0.037)	(0.022)	(0.014)
goverst	-0.32**	-0.26**	-1.25**
	(0.043)	(0.021)	(0.024)
popul	-1.09*	-1.13*	-1.06**
	(0.058)	(0.061)	(0.026)
Wald test	17.23	13.89	-
Prob	(0.003)	(0.016)	-
Ajusted R^2	-	-	0.63
Obs	780	585	195
Country	20	15	5

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Full sample: According to The World Bank (WDI, 2020), the list of Africa's fragile and conflict-affected countries for the year 2020 includes 20 countries. **CCEMG** is the common correlated effects mean-group estimator proposed by Pesaran (2006). **faid** is official development assistance, **terat** is terrorist attacks, **topen** is trade openness, **miexp** is military expenditure, **emgr** is emigration rate, **rgdpc** is real gross domestic product per capita, **natres** is total natural resources rents, **inflr** is inflation, **gdpg** is gross domestic product growth rate, **intconf** is internal conflict index, **goverst** is government stability index, **popul** is population.

Figure A1: Distribution of posterior model size and posterior predictive density graph under baseline estimates

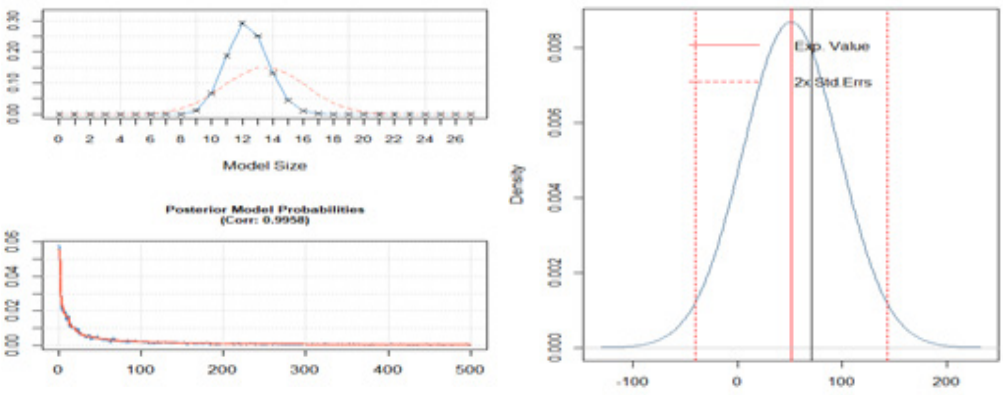
(2.1) Size and index of models **(2.2) Response variable**



Note: Figure 2.1 contains distribution of posterior model size and convergence plot of 100 models. Figure 2.2 is posterior predictive density for foreign aid in G5 Sahel countries; solid red lines denote the expected value of the forecast, dashed red lines a +/- 2 standard deviations interval, under baseline estimates.

Figure A2: Distribution of posterior model size and posterior predictive density graph under robustness checks analysis

(3.1) Size and index of models **(3.2) Response variable**



Note: Figure 3.1 contains distribution of posterior model size and convergence plot of 100 models. Figure 3.2 is posterior predictive density for foreign aid in G5 Sahel countries; solid red lines denote the expected value of the forecast, dashed red lines a +/- 2 standard deviations interval, under robustness checks analyses.

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