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CORRUPTION, TERRORISM AND ILLICIT FINANCIAL FLOWS RELATED TO EXTRACTIVE COMMODITY TRADE IN AFRICA

Forthcoming: Resources Policy

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Abstract

The purpose of this study is to assess the incidence of illicit financial flows (IFFs) on terrorism in Africa, contingent on corruption-control. The study utilizes data from 38 African counties spanning from 2002 - 2021. In order to increase room for policy implications, the overall IFFs measure is decomposed into two main sub-components, namely: illicit financial inflows and illicit financial outflows. The empirical evidence is also based on: (i) baseline regressions, (ii) estimations with the lagged independent variables in order to control for the simultaneity dimension of endogeneity, as well as (iii) GMM in order to account for both the simultaneity and unobserved heterogeneity dimensions of endogeneity. The robustness of the empirical analysis is further improved by limiting the sample to the Sahel countries in which most of the terrorism has been documented over the past decades. It is apparent from the findings that corruption-control effectively moderates IFFs, especially illicit financial inflows, in order to engender an overall negative effect on the outcome variable or terrorism. For the most part, the corruption-control policy thresholds are within policy range. Policy implications are discussed.

Keywords: terrorism; illicit capital flows; extractive commodities; corruption; Africa
JEL Classification: C50; D74 ; F23; N40 ; O55

1. Introduction

The purpose of the present study is to assess the incidence of illicit financial flows (IFFs) on terrorism in the African continent, contingent on corruption-control. The positioning of the study is motivated by three main factors in the extant policy and scholarly literature on the subject, especially as it pertains to *inter alia*: (i) growing levels of terrorism in the African continent, compared to the rest of the world; (ii) the negative incidence of IFFs on economic development prospects of the continent and (iii) gaps in the relevant literature on the subject. The corresponding three motivational strands are expanded in what follows in the same chronology as highlighted.

First, on the extant levels of terrorism in the African continent, according to Emeka *et al*. (2024a), terrorism is one of the many barriers to integration that the global economy faces, having a substantial impact on both human life and material well-being (Global Terrorism Database, GTD, 2023; Asongu, 2021). Terrorism was cited as the cause of 8,352 deaths in 2023, the highest level since 2017 (GTD, 2023). Indeed, the infamous World Trade Center attack on September 11 2001, the London-United Kingdom attack in 2017, and the Vienna strikes in 2020 demonstrate how susceptible even robust economies are to terrorism. Jihadist organizations such as Jama'at Nusrat al-Islam wal-Muslimin (JNIM), Islamic State Sahel Province (ISSP), and Islamic State West Africa Province (ISWAP) have established terrorism networks in Africa, Asia, the Americas, and Europe (Kohnert, 2022). These groups often utilize porous borders, weak security architecture, ungoverned spaces, and illegitimate military juntas to execute terrorism plots. Numerous studies in the literature have linked internal and external events, including political instability, religious extremism, socioeconomic inequality, and geopolitical tensions, to the causes of terrorist attacks in various parts of the world (Deflem, 2020; Shootings, 2022; Nwala, 2023; Onireti, 2024). As substantiated in Section 2.1 on stylized facts pertaining to terrorism in Africa, the phenomenon has been growing in the continent relative to other regions in the world.

Second, with respect to the negative incidence of IFFs on economic development prospects of the continent, IFFs significantly impair developing nations' capacity to offer their population essential goods and services, according to the United Nations (2022). The enjoyment of fundamental freedoms and rights, including the right to health and education, is significantly impacted by this scourge. If left unchecked, IFFs can also lead to war, social upheaval, and public discontent. Furthermore, the growing propensity of nations, particularly those in Africa, to borrow money on frequently burdensome and exploitative conditions as a coping mechanism is partially attributable to revenue deficits brought on by IFFs. This narrative is consistent with contemporary literature on the negative consequences of IFFs in developing countries (Collin, 2020; Hunter, 2019; Thiao, 2021; Babatayo & Audu, 2023; Afolabi, 2024).

Third, regarding the corresponding gaps in the extant literature that the present study fills, it is worthwhile to note that the attendant literature is critically discussed in Section 2.3. As it stands, the corresponding literature has not focused on the problem statement being considered in this study (Collin, 2020; Hunter, 2019; Thiao, 2021; Babatayo & Audu, 2023; Afolabi, 2024). The closest study in the literature to the present exposition is Onanuga et al. (2021), which has assessed the relationship between terrorism and financial flows in Africa. By calculating cross-country data on financial flows and terrorist indices, Onanuga et al. (2021) have extended the literature on the relationship between terrorism and financial flows from an empirical perspective. The growth in terror occurrences, foreign direct investment, remittance inflow, and portfolio investment were found to have a long-term negative association when the Pooled Mean Group (PMG) estimation approach was used. According to short-term estimates, military spending in Africa is beneficial and statistically significant for all financial flow indices, including portfolio investment, government development assistance, remittances, and foreign direct investment. Based on the findings, the authors advise counterterrorism policymakers to implement targeted, specific measures that address the socioeconomic causes of terrorism, enhance fiscal responsibility, manage inflation, and improve financial flows to Africa.

Departing from Onanuga et al. (2021), the purpose of this study is to assess the incidence of IFFs on terrorism in Africa, contingent on corruption-control. There is thus a premise that the hypothetical unfavorable incidence of IFFs on terrorism can be dampened by corruption-control, which is employed as moderating or policy variable. The focus of the study is on 38 African countries with data for the period 2002-2021. In order to increase room for policy implications, the overall IFFs measure is decomposed into two main sub-components, namely: illicit financial inflows and illicit financial outflows. The empirical evidence is provided with: (i) baseline regressions, (ii) estimations with the lagged independent variables in order to control for the simultaneity dimension of endogeneity, as well as (iii) GMM in order to account for both the simultaneity and unobserved heterogeneity dimensions of endogeneity. Based on the findings, the study recommends counter-IFFs policies.

The rest of the study is structured in the following manner. The extant stylized facts, theoretical underpinnings, and related literature are covered in Section 2 while the data and methodology are engaged in Section 3. The empirical results and corresponding discussion are covered in Section 4. Section 5 concludes with implications and future research directions.

2. Stylized Facts, Theoretical Underpinnings and Empirical Literature

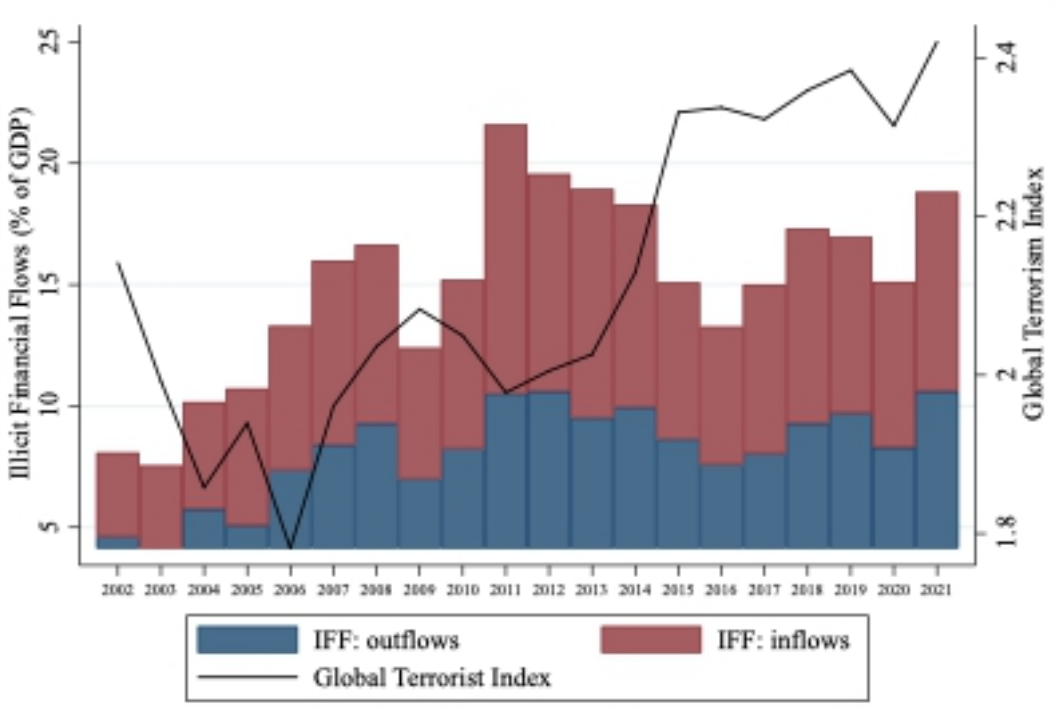
2.1 Stylized Facts on Terrorism and Illicit Financial Flows Africa

On the first strand, with respect to stylized facts on terrorism in Africa, according to Emeka et al. (2024a), terrorism in Africa is not a one-time occurrence; rather, it has grown progressively over time, with groups such as Al-Shabab, Ansar al-Sunna, the Islamic State of West African Province (ISWAP), and the Islamic State in Iraq and Syria (ISIS) responsible for violence in multiple countries across the continent (Asongu & Biekpe, 2018). For example, in the early 1990s, Africa accounted for only 5% of worldwide terrorism incidences; by 2021, it accounted for 45% of global terrorist deaths (GTD, 2023). Furthermore, terrorist assaults in the region increased from 381 in 2015, resulting in 1,394 fatalities, to 7,108 in 2020, with 12,519 fatalities (GTD, 2023). As Kohnert (2022) points out, terrorist actions have had a considerable impact on many African economies, including Somalia, Kenya, Mali, Nigeria, Burkina Faso, South Sudan, Libya, Chad, and Egypt. For example, in Nigeria and Niger, groups such as the Boko Haram have caused extensive displacement, food insecurity, and higher child death rates (Dingji-Maza et al., 2020). Similarly, Burkina Faso, Mali, and Somalia have seen major displacement and property devastation (Lofane, 2022; Issaev et al., 2022). Furthermore, growing terrorism worries have resulted in increased security spending in Mozambique and South Sudan (Meservey, 2021). According to the literature (e.g., Emeka et al., 2024b; Iheonu & Ichoku, 2023, 2022; Asongu et al., 2018a, 2018b), weak governance, characterized by corruption, impunity, and disorganization, is a significant contributor to terrorism in Africa, resulting in widespread insecurity among the population.

With respect to the second strand on the stylized facts of IFFs in Africa, according to the United Nations (2022), IFFs represent a significant problem to African countries because they deprive these countries from the ability to earn the income needed to meet their expenditure demands and support long-term development ambitions. According to the narrative, the United Nations Conference on Trade and Development (UNCTAD) estimates that IFFs in Africa total $88.6 billion each year, accounting for around 3.7% of the continent's total GDP. Curbing IFFs has the potential to cut the continent's financial gap by 33%. IFFs deplete foreign exchange reserves, skew asset values, distort competition, and impair countries' ability to maintain economic and financial stability. As a result, African countries have constraints in meeting promises made under various regional and international frameworks, such as the 2030 Agenda for Sustainable Development and Agenda 2063 of the African Union (AU). The United Nations (2022) report focuses on IFFs associated with aggressive tax planning and other unlawful economic practices in Africa. Commercial practices account for the majority of IFFs from Africa (65%), followed by crime (30%) and corruption (5%). The report provides a comprehensive overview of the size and distribution of IFFs in Africa, explores several types of

IFFs resulting from tax and illicit commercial practices, and evaluates existing initiatives in Africa to combat tax and commercial-related IFFs.

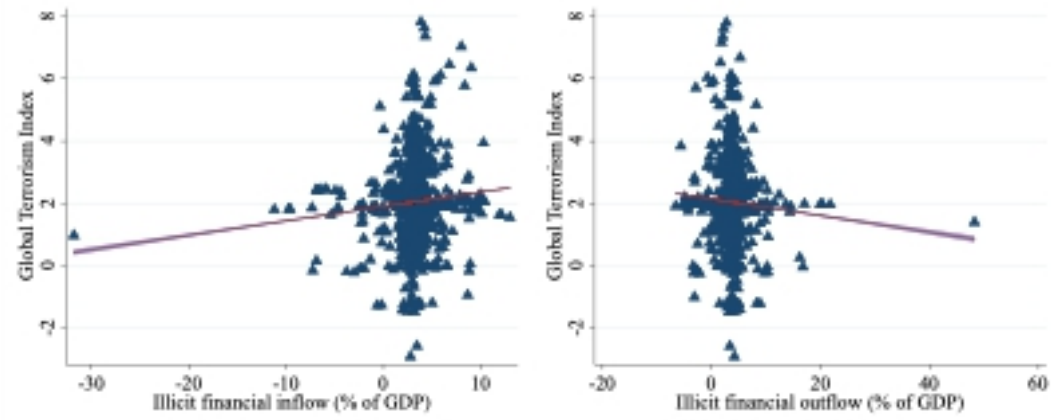
Figure 1: Evolution of extractive commodity trade misinvoicing in Africa over 2002-2021.



Source: Authors' calculations based on data from UN comtrade and Institute for Economics and Peace.

Finally, to visually illustrate the relationship between illicit financial flows and terrorism, Figure 1 shows the evolution of illicit financial flows related to extractive commodity trade in Africa over 2002-2021 together with the trend of Global Terrorism Index over time. Both indicators are averaged over all countries in the sample of Global terrorism index and illicit financial flows (as percent of GDP) from 2002 to 2021. The figure shows a positive association between terrorist activity and illicit financial flows related to trade of extractive commodities in Africa over the period over 2002-2021. Figure 2 also shows a weak positive correlation after controlling for the country-fixed effects between terrorism and illicit financial inflows (as percent of GDP) on the one hand, while on the other hand, there is a weak negative correlation between terrorism and illicit financial outflows (as percent of GDP) in Africa over the same period.

Figure 2: Relationships between terrorism and extractive commodity trade misinvoicing in African countries over 2002-2021



Source: Authors' calculations based on data from UN comtrade and Institute for Economics and Peace.

2.2 Theoretical Underpinnings and Intuition

With respect to the theoretical underpinnings, according to Efobi and Asongu (2016) and Onanuga et al. (2021), financial flows are closely related to risk-averse behaviors on the part of investors attempting to maximize expected returns from both planned and unanticipated risky investments. The von Neumann and Morgenstern's (1945) decision theory is used to back up the claim. The idea assumes that foreign investors, diaspora workers, and donor agencies sending funds to Africa (remittances, FDI, ODA, portfolio investment) are risk-averse and want the highest possible return on investment. The reverse is also true because IFFs provide those with the capital to engage in risk activities such as the funding of terrorists' activities. Accordingly, it worthwhile to note that the choice of the von Neumann and Morgenstern's (1945) decision theory which focuses on rational decision-making under uncertainty is fundamentally consistent with the study because the nexus between terrorism and IFF is a good case of rational decision-making under uncertainty, not least, because IFFs are bound to rationally increase in the face of terrorism uncertainty in order to avoid potential losses from investment.

The underlying theoretical premise is consistent with the literature (Kfir, 2018; Asongu, 2022), especially as it pertains to showing how terrorists' illicit trade generates significant financial resources for terrorism in the Sahel region, particularly during insurgent attacks that are repressive. The authors also identified poor governance and imbalances in regional opportunities as a major driver of growing terrorism. Illicit transfers involving both formal and informal transactions have also been documented to finance terrorism in the Sahel region (Alda & Sala, 2014; Harmon, 2016; Asongu, 2022).

2.3 Empirical Literature

IFFs are not a brand-new idea. Rather, they have become more significant and well-known recently. Financial markets are becoming increasingly globalized, which has expanded their significance both politically and economically (GFI, 2013). To comprehend the detrimental effects of IFFs on national and international economies, it is relevant to understand how the underlying flows affect the relevant economies. For the underlying to be established, several scholars have worked to clarify the underlying flows and examined how they affect other macroeconomic factors over the years. Given the foregoing, this section consists of a succinct overview of the literature that has been published recently on IFFs to document the nexuses.

Collin (2020) defines it as illicit funds that cross international borders. Numerous researchers are interested in examining this idea as a crucial component of a range of events and activities. For instance, Signé and Madden (2020) have examined policy measures to curtail illicit inflows and evaluated the sources and destinations of these outflows, providing an updated evaluation of IFFs from Africa between 1980 and 2018. One consistent result from their research over the past ten years has been the rise in illegal capital outflows to emerging and developing economies coinciding with an increase in commerce between Africa and these nations. In another study, Hunter (2019) offers a summary of the kind and extent of the ensuing IFFs activities and offers a number of recommendations for potential areas for action to try to lower the dangers connected to IFFs. Mogomotsi *et al*. (2020) examine IFFs in Botswana using document analysis and an institutional approach in an effort to evaluate the impact of IFFs in Africa. The results demonstrate the tremendous efforts that have been done over the years to fight money laundering and related offenses.

Furthermore, Thiao (2021) discovered in his research that there was a large and negative impact of IFFs on government revenue, and that this impact was connected to per capita income, governance, and corruption. The author has emphasized that the relationship between IFFs and government revenue is mostly dependent on per capita income. Babatayo and Audu (2023) provide evidence through their findings that, while illegal money flows have a favorable impact on non-oil revenue, they have a detrimental impact on Nigeria's oil revenue. According to Afolabi (2024), there is a long-term and short-term expectation that domestic investment in the four economic areas of Sub-Saharan Africa (SSA) will be displaced by IFFs. The implications of IFFs on Kenya's economic growth have been examined by Wanjau and Tobias (2020) in their study based on three factors that influence economic growth, such as the impact of money laundering, accounting fraud, and business misinvoicing. From the results, Kenya's economic growth is negatively impacted by each of these three factors that determine IFFs.

Eneji et al. (2022) have investigated the direct relationships between the quality of governance, IFFs and economic growth. Their findings show that the detrimental effects of illegal cash flows on economic growth are moderated by high governance quality. The findings of Afolabi et al. (2024) show that there is an increase in IFFs, which negatively impacts national governments' tax income in the seven resource-rich African nations. Osayi and Idume (2024) have found that there is a noteworthy positive correlation between IFFs; which are gauged by tax evasion and avoidance and economic progress in Nigeria. This conclusion was drawn from their empirical investigation. Investigating the impact of capital flight on economic growth in Nigeria, Daasi (2024) has shown a generally negative and statistically significant effect of capital flight on economic growth. Silberberger and Madrueño (2023) have evaluated the relationship between illicit financial flows and economic growth in developing nations. They demonstrate through their findings that, when accounting for the influence of national institutions and governance, the overall negative impact of IFF is negative. Furthermore, they demonstrate through their robustness that the negative impact does not alter.

According to a study by Bawa and Ogwiji (2022), there is a slight but favorable correlation between economic growth and convictions as well as illicit cash flows gathered by the Economic and cash Crimes Commission. Ortega et al. (2020) conduct an empirical analysis of the relationship that exists between the provision of basic health services in low- and middle-income countries and illicit cash flows. Following the analysis, it is determined that the latter has negative impacts on nations, which are too impoverished to raise the funds required to pay for the provision of basic public goods and services. Indeed, a 0.46 percentage point (pp) decline in family planning coverage, a 0.31 percentage point decrease in the percentage of women receiving antenatal care, and a 0.32 percentage point decrease in the level of child immunization coverage rates were linked to an annual increase of one percentage point (pp) in the ratio of IFFs to total trade. After evaluating current methods for controlling their flow and preventing the use of assets for money laundering, Rysin and Rysin (2021) clarify that insufficient market surveillance experience and ineffective regulation make virtual assets vulnerable to being used in the transfer of illicit funds, especially in money laundering schemes.

3. Data and Methodology

3.1 Data

The data used for this study is from 38 African countries for the period 2002 to 2021. Moreover, the adopted periodicity as well as geographical scope is contingent on data availability constraints at the time of the study. Hence, the premise of limiting the study to the sampled countries under consideration is motivated by the fact that the relevant data is not available of all sampled African countries, especially as it pertains to data on illicit financial flows and terrorism. Countries with a constant value of zero for the dependent variable (terrorism) over all years during the periods 2002-2021 are also discarded.

We measure Illicit financial flows (IFFs) by trade misinvoicings in extractive commodities based on the partner country method, as presented in the following section. Extractive commodities appear to be more prone to smuggling and have been linked to Illicit financial flows (IFFs), corruption and illicit arms trafficking (Berman et al., 2017). Illicit financial flows related to extractive commodities are measured by trade misinvoicing in some specific commodities based on the partner country method, as in Ndikumana (2016). This method involves assessing commodity specific trade gaps by comparing the import (or export) values of each of these commodities reported by one country with the comparable export (or import) values recorded by its partner country. Trade misinvoicing is one of the largest components of measurable illicit financial flows (IFFs). Data on exports and imports directly reported by countries are available on UNcomtrade database. Exports are usually reported as FOB and imports as CIF. Country, partner, and year specific CIF/FOB ratios, derived from the International Transport and Insurance Cost for Merchandise Trade database of the OECD, are used to correct for the asymmetry caused by valuation differences. While the periodicity is 2002 to 2021, the study uses filled-in forwards based on 2000 to 2021 data to account for missing CIF/FOB values in the reporter, partner, and commodity axes. The sample includes relevant primary commodities, which catalyze IFFs and comprise of contemporary extractive commodities (Schuster & Davis, 2020). The list of commodities covered as classified by 4-dgits HS code can be found in Appendix Table A5. Using commodity specific CIF values, instead of a constant and fixed value, allows for a more accurate estimate of the mirror trade gap.

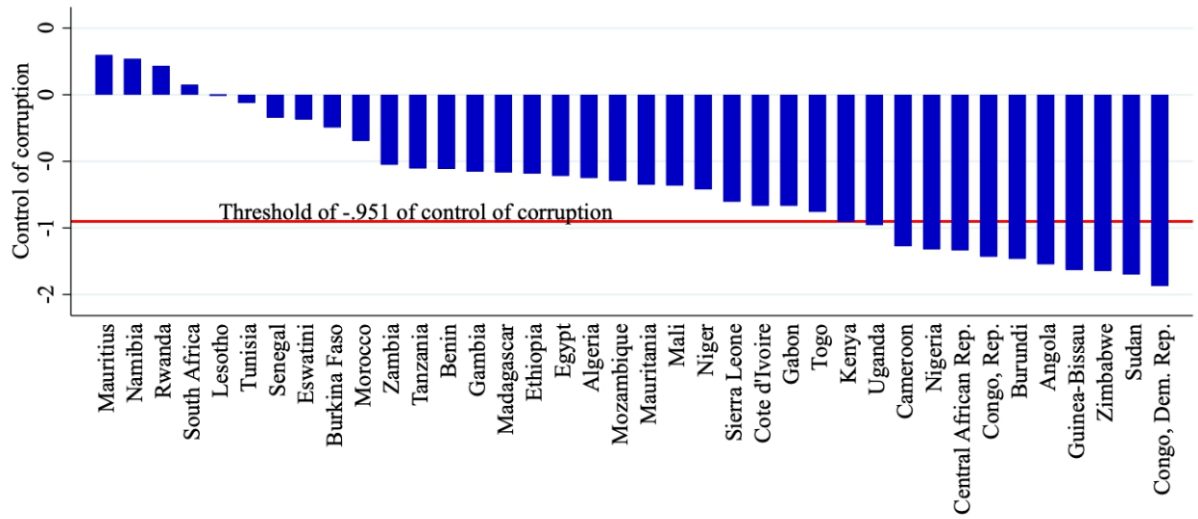
Consistent with Tahir et al. (2019), we proxy the level of terrorist activity by the Global Terrorism Index (GTI). The value of this variable is based on four indicators, including the total number of terrorist incidents, the total number of fatalities caused by terrorism, the total number of injuries caused by terrorism, and the approximate level of total property damage from terrorist incidents. The Global Terrorism Index (GTI) rates each country on a scale of 0 to 10, with 0 indicating no terrorist activity and 10 indicating the most severe level of terrorist activity. This

variable is constructed by the Institute for Economics and Peace using primary data from the Global Terrorism Database (GTD). The latter defines terrorism as the use of illegal force and violence by a nonstate actor to achieve a political, economic, religious, or social goal through fear, coercion, or intimidation.

The variable of control of corruption is taken from the World Governance Indicators (WGI) database of the World Bank. The country's score for each indicator is scaled from approximately -2.5 (highest corruption) to 2.5 (lowest corruption). The concept of corruption control refers to the degree to which public authority is manipulated for private gain, encompassing both minor and major manifestations of corruption.

The population's level of education is measured by the mean years of schooling for adults aged 25 and older. This variable comes from the United Nations Development Programme (UNDP). The remaining control variables are taken from the World Development Indicators database (WDI) of the World Bank. The growth rate of real GDP per capita is measured using GDP per capita in constant 2015 US dollars. Natural resource endowments are measured by natural resource rents as a percentage of GDP. Military expenditure includes all current and capital expenditures on the armed forces. This variable is also expressed as a percentage of GDP. The number of sampled countries are disclosed in Appendix Table A1 while the definitions and corresponding sources of the variables are provided in Table A2. Appendix Table A3 discloses the summary statistics whereas Table A4 shows the correlation coefficients between the main variables. Appendix Table A5 provides insights into commodities of interest and their derivative products that are used in the computation of IFFs as well as the two main sub-components, namely: illicit financial inflows and illicit financial outflows. Table A6 lists the main raw materials of each sampled country. Finally, Figure 3 shows the list of countries that make up the baseline estimation sample, together with the average over the period 2002-2021 of control of corruption.

Figure 3: Control of corruption in Africa: average over 2002-2021



Source: Authors' calculations based on data from WDI.

3.2 Methodology

3.2.1 Fixed Effects

Our empirical methodology is based on the theoretical (Freytag et al., 2011; Acemoglu and Robinson, 2012) and empirical literature (Asongu et al., 2017; Tahir et al., 2019). We specify the following estimation in Equation (1):

$$\boldsymbol{T_{i,t} = \gamma_0 + \gamma_1 IFF_{i,t} + \gamma_2 CC_{i,t} + \gamma_3 (IFF_{i,t} \times CC_{i,t}) + \theta X_{i,t} + \alpha_i + \lambda_t + \varepsilon_{i,t}} \quad \mathbf{(1)}$$

where the dependent variable $\boldsymbol{T_{i,t}}$ is a measure of terrorist index and $\boldsymbol{\gamma_0}$ is the constant term. The variable $\boldsymbol{IFF_{i,t}}$ is a measure of illicit financial flows (% of GDP) and $\boldsymbol{CC_{i,t}}$ is the control of corruption index. The vector $\boldsymbol{X_{i,t}}$ is a set of control variables that include socio-economic variables (namely, the growth rate in real GDP per capita, natural resource rents, military expenditure, and mean years of school). The term $\boldsymbol{\alpha_i}$ are unobservable country-specific fixed effects, $\boldsymbol{\lambda_t}$ are year fixed effects, and $\boldsymbol{\varepsilon_{i,t}}$ are error terms. Subscripts c and *t* are country and time indicators, respectively. We are particularly interested in the marginal effect of Illicit financial flows on the terrorist index, given by $\boldsymbol{\partial T/\partial IFF = \gamma_1 + \gamma_3 CC}$ in the case of the linear model. The parameter $\boldsymbol{\gamma_1}$ is the marginal effect of $\boldsymbol{IFF}$ when the variable $\boldsymbol{CC}$ is zero. The standard error of the marginal effect of $\boldsymbol{IFF}$ on $\boldsymbol{T}$ depends on the two parameters $\boldsymbol{\gamma_1}$ and $\boldsymbol{\gamma_3}$ as well as on $\boldsymbol{CC}$ and $\boldsymbol{cov(\gamma_1, \gamma_3)}$. If the covariance term is negative, then it is possible for the marginal effect to be significant for substantively relevant values of $\boldsymbol{CC}$, despite the insignificance of the entire model's parameters (Brambor et al., 2016). Our baseline estimations of the model parameters rely on the fixed and random effects techniques as the cross-sectional dimension (N) of the data is relatively larger than the time dimension (T). This later is

small (T<=20) so that issue of non-stationarity does not arise. The baseline estimations are performed using contemporaneous explanatory variables and then using the explanatory variables in lagged form (*t-1*) to reduce problems associated with reverse causation. Following Keneck-Massil and Foudjo (2025) and Olaniyi and Odhiambo (2025). The threshold is computed for specifications for which illicit financial flows and its interaction term are both significant.

In the specified model, we expect illicit financial flows to have a positive sign, while we expect more control of corruption to reduce terrorist activity. Indeed, illicit financial flows play a key role in the financing of terrorism (Freytag et al., 2011). It can also argued be that the persistence of extractive institutions and corruption fosters an environment conducive to the emergence of violent conflicts, including terrorism. Therefore, an increase in corruption is expected to make terrorism more likely through the increasing illicit financial flows, which are potential sources of terrorism financing across the borders. Furthermore, mitigating corruption is expected to ensure an equitable and efficient allocation of resources and foster trust in public institutions (Okoro 2014). Poor socioeconomic conditions may reflect high levels of unemployment and low levels of economic participation, making terrorism more attractive (Blomberg et al., 2004). Finally, increasing military spending may make terrorism less appealing by increasing its direct costs (Freytag et al, 2011). We then expect a negative sign for this variable.

3.2.2 Generalized Method of Moments

In our baseline specification in Table 2, all explanatory variables enter the model in lagged form (*t-1*) to avoid problems associated with reverse causation. In alternative specification, we use contemporary variables but we assume that they are all endogenous. In particular, we use the difference Generalized Method of Moments (GMM) of forward orthogonal deviations (FOD) estimator to address endogeneity issues. The forward orthogonal deviations estimator does not require the additional mean-stationarity assumption of the system GMM estimator (which is not the case in macro-data). Moreover, since our panel data contain gaps, the FOD-GMM maximizes the sample size compared to the first difference GMM.

Consistent with Roodman (2009) and Ndour and Asongu (2024), the estimation procedure for the standard system GMM can be summarized as follows in Equation (2) and Equation (3) in levels and first difference, respectively:

$$T_{i,t} = \emptyset_0 + \emptyset_1 T_{i,t-1} + \emptyset_2 IFF_{i,t} + \emptyset_3 CC_{i,t} + \emptyset_4 Inter_{i,t} + \beta X_{i,t} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$\Delta T_{i,t} = \emptyset_1 \Delta T_{i,t-1} + \emptyset_2 \Delta IFF_{i,t} + \emptyset_3 CC_{i,t} + \emptyset_4 Inter_{i,t} + \beta \Delta X_{i,t} + \Delta\lambda_t + \Delta\varepsilon_{i,t} \quad (3)$$

Δ denotes the first difference operator along the time dimension and *Inter* represents the interaction between IFF and CC. Compared to Equation (1), these equations additionally include the lag of the dependent variable. For the estimation by the GMM in system, the explanatory variables treated as endogenous in the equation in first differences are instrumented by their past values in level, and the explanatory variables treated as endogenous in the equation in level are instrumented by their current past values in difference.

3.2.3 Measuring Illicit Financial Flows

In this study, we focus on illicit financial flows related to extractive commodity trade, in Schuster & Davis (2020), instead of illicit financial flows related to the overall merchandise trade. Following Ndikumana (2016), for country i, commodity c, and partner j in year t, export misinvoicing, noted $DX^{c}_{i,j,t}$, is given by Equation (4) below:

$$DX^{c}_{i,j,t} = M^{c}_{j,i,t} - CIF^{c}_{i,j,t}.X^{c}_{i,j,t} \quad (4)$$

where $M^{c}_{j,i,t}$ represents the value of imports by country j from country i as reported by country j, $X^{c}_{i,j,t}$ is the value of exports by country i to country j as reported by country i, and $CIF^{c}_{i,j,t}$ is the freight and insurance factor for transporting commodity c from country i to country j. Similarly, for a country i, commodity c, and partner j in year time t, import misinvoicing, noted $DM^{c}_{i,j,t}$, is calculated as follows in Equation (5):

$$DM^{c}_{i,j,t} = M^{c}_{i,j,t} - CIF^{c}_{j,i,t}.X^{c}_{j,i,t} \quad (5)$$

Where $M^{c}_{i,j,t}$ is the value of imports by country i from country j as reported by country i, $X^{c}_{j,i,t}$ is the value of exports by country j to country i as reported by country j, and $CIF^{c}_{j,i,t}$ is the freight and insurance factor for transporting commodity c from country j to country i. A negative value of $DM^{j}_{c,i,t}$ signifies import underinvoicing, and the reverse implies import overinvoicing. Also, an inverse $DX^{j}_{c,i,t}$ value reflects export overinvoicing, meanwhile the reverse shows export underinvoicing. The sum of export underinvoicing and import overinvoicing represents Illicit financial outflows, and Illicit financial inflows are the sum of import under-invoicing and export overinvoicing, which is summed over commodities and partners. The overall amount of illicit financial flows in a country is given by the sum of the inflows and outflows.

4. Empirical Results

The purpose of the present section is to assess the incidence of IFFs on terrorism in the African continent, contingent on corruption-control. In order to increase room for policy implications, the presentation of results is divided into two main sections, especially as it pertains to: (i) the effect of IFFs on terrorism in the African continent and (ii) the incidence of IFFs in the Sahel region where the concern of terrorism is comparatively more apparent. The two sub-sections are expanded in what follows in the same chronological order as highlighted.

4.1. Effect of Illicit Financial Flows on Terrorist Activity in Africa: The Role of Corruption-control

The findings in this section are disclosed in Tables 1-3. Table 1 provides the baseline results while Table 2 incorporates a dimension of endogeneity, especially as it relates to the simultaneity dimension by means to regressing the outcomes variable on lagged non-contemporary independent variables. The Hausman specification test for choosing between the fixed effects and the random effects is also performed. The hypothesis of the Hausman test is that the random effects model is preferred to the fixed effects one. A standard assumption in estimating panel data models with fixed or random effects is that the error terms are independent across individuals or cross-sections. We also examined the validity of this assumption by using the testing procedure proposed by Pesaran (2021). The null hypothesis of the test is the cross-sectional independence of the model error term. The associated p-values are reported in the bottom of Tables 1 and 2. In all specifications, the Hausman test rejects the null hypothesis of random effects at the 5 percent level, while we cannot reject the null hypothesis of cross-sectional independence of the errors terms at the 5 percent level. Moreover, Table 3 goes a step further in accounting for endogeneity, not least because, the corresponding GMM results are tailored to account for both the unobserved heterogeneity in terms of time fixed effects as well as simultaneity or reverse causality, essentially because the estimation exercise is tailored such that internal instruments are employed to account for simultaneity.

In the light of the above, the findings in Table 1 are disclosed in five main specifications. The first specification involves findings of the overall model based on overall illicit financial flows, whereas the remaining two specifications pertain to results focused on respectively: illicit financial inflows and illicit financial outflows, in this order. In an attempt to avoid pitfalls of interactive regressions documented in Brambor *et al*. (2006), the study computes net effects of the IFFs as well as corresponding corruption-control thresholds in order to provide policy makers with more insights on how to fight terrorism in the sampled countries. The procedure for computing net effects and corresponding thresholds is consistent with the extant contemporary literature on the subject (Asongu & Odhiambo, 2020, 2021).

To put the above computation insights into more perspective, in the second column of Table 2, the marginal effect of a change in illicit financial flows ($\boldsymbol{IFF}$) on terrorism activity ($\boldsymbol{T}$), given by $\boldsymbol{\partial T/\partial IFF = \gamma_1 + \gamma_3 CC}$, depends on the value of the control of corruption, the conditioning variable. It is worthwhile to note that the latter is also considered as a moderating or policy variable in the estimation exercise. A negative sign for $\boldsymbol{\gamma_3}$ implies that the marginal effect of illicit financial flows on terrorist activity is decreasing with the level of control of corruption. As the control of corruption is ranged approximatively between -2.5 and 2.5 by construction, whatever the parameter $\boldsymbol{\gamma_1}$ is positive or negative, there exist a threshold of the control of corruption so that the marginal effect is zero. This implies that the threshold is computed as $\boldsymbol{CC^{\star} = -\gamma_1/\gamma_3}$, as long as this value lies between -2.5 and 2.5. When the parameter gamma is negative, a value of control of corruption above the threshold implies a negative marginal effect of IFF on terrorism while a value below the threshold implies a positive marginal effect. The Average Marginal Effect (AME) of IFF is computed as the marginal effect of illicit financial flows ($\boldsymbol{IFF}$) at every observed value of control of corruption ($\boldsymbol{CC}$) and averaged across the resulting effect estimates. In the case of linear model, this is equal to the marginal effects of Illicit financial flows at the sample mean value of control of corruption ($\boldsymbol{CC}$), i.e., $\boldsymbol{AME = \gamma_1 + \gamma_3 \times mean(CC)}$.

The following findings can be established from Table 1 on linkages between IFFs, terrorism and corruption-control: (i) there is a consistent net negative effect of IFFs and especially illicit financial inflows on terrorism and (ii) there are certain critical levels of corruption-control that should be exceeded in order for corruption-control to effectively moderate IFFs for an overall negative effect on the outcome variable or terrorism. It is relevant to note that, while the corresponding corruption-control thresholds are negative, these can still be considered as worthwhile policy thresholds, not least, because consistent with the summary statistics that is employed in the computation of the attendant AME, corruption-control or the moderating variable ranges from -2.5 to +2.5. It follows that given the average low levels of corruption-control in the sampled countries; negative corruption-control thresholds could still be considered as worthwhile policy thresholds. By extension, in order for the computed threshold to be policy-relevant, they should be within that statistical range of the corresponding corruption-control variable as disclosed in the summary statistics.

Table 1. Effect of Illicit Financial Flows on terrorist activity in Africa: the role of corruption-control (2002-2021). Fixed effects estimation using contemporaneous explanatory variables

Dep. var.: Gobal Terrorism Index	(1)	(2)	(3)
Control of Corruption (CC)	0.695	0.488	0.451
	(0.461)	(0.482)	(0.436)
Illicit financial flows (% of GDP)	**-0.045****		
	(0.018)		
CC # Illicit financial flows (% of GDP)	**-0.048****		
	(0.023)		
Illicit financial inflows (% of GDP)		**-0.066*****	
		(0.023)	
CC # Illicit financial inflows (% of GDP)		**-0.075*****	
		(0.028)	
Illicit financial outflows (% of GDP)			**-0.058**
			(0.046)
CC # Illicit financial outflows (% of GDP)			**-0.045**
			(0.047)
Growth rate of real GDP per capita	0.033	0.035	0.034
	(0.023)	(0.022)	(0.023)
Natural resources rents (% of GDP)	0.069**	0.064**	0.074**
	(0.028)	(0.027)	(0.027)
Military expenditure (% of GDP)	0.454**	0.442*	0.428*
	(0.222)	(0.222)	(0.220)
Mean years schooling	0.376	0.375	0.343
	(0.433)	(0.431)	(0.431)
Constant	-0.814	-0.940	-0.771
	(1.869)	(1.892)	(1.861)
Average marginal effect of IFF	-0.017*	-0.020	-0.031
Threshold for the ME of IFF	-0.951	-0.876	na
Countries\Observations	38\653	38\653	38\653
P-value of Hausman test	0.002	0.008	0.000
P-value of cross-sectional dependence test	0.695	0.697	0.454

Notes: *** (**) (*) denotes significance at the 1 (5) (10) percent level. Robust standard errors in parentheses are clustered at the country level. Threshold for the marginal effect of IFF corresponds to the level of control of corruption for which the marginal effect (ME) of IFF is zero. na: not applicable because the threshold does not lie in the range of minimum and maximum values of the threshold variable or because the marginal effect is not decreasing with the level of control of corruption (CC) or because at least one of the estimated coefficients needed for the computation of net effects and threshold is not significant. In all

Regarding the remaining control variables, the estimated parameter related to natural resources rents is statistically significant and the 5 percent significance level and has the expected signs in all regressions, especially as it relates to the previous discussion in the data and methodology section. However, the estimated parameter related to military expenditure (% of GDP) is statistically significant at least at a 10 percent significance level but with an unexpected sign. Growth rate of real GDP per capita and mean years of schooling have unexpected signs even if there are not statistically significant.

Table 2. Effect of Illicit Financial Flows on terrorist activity in Africa: the role of corruption-control (2002-2021). Fixed effects estimation using lagged explanatory variables

Dep. var.: Gobal Terrorism Index	(1)	(2)	(3)
L.Control of Corruption	0.667	0.468	0.485
	(0.473)	(0.498)	(0.447)
L.Illicit financial flows (% of GDP)	**-0.044****		
	(0.018)		
L.CC # L.Illicit financial flows (% of GDP)	**-0.045****		
	(0.022)		
L.Illicit financial inflows (% of GDP)		**-0.061*****	
		(0.021)	
L.CC # L.Illicit financial inflows (% of GDP)		**-0.068****	
		(0.025)	
L.Illicit financial outflows (% of GDP)			**-0.061**
			(0.044)
L.CC # L.Illicit financial outflows (% of GDP)			**-0.049**
			(0.048)
L.Growth rate of real GDP per capita	0.031	0.033	0.031
	(0.022)	(0.022)	(0.022)
L.Natural resources rents (% of GDP)	0.068**	0.063**	0.072**
	(0.029)	(0.029)	(0.029)
L.Military expenditure (% of GDP)	0.508**	0.498**	0.488**
	(0.223)	(0.223)	(0.219)
L.Mean years schooling	0.369	0.371	0.343
	(0.449)	(0.449)	(0.447)
Constant	-1.025	-1.165	-0.979
	(1.962)	(1.990)	(1.950)
Average marginal effect of IFF	-0.016	-0.020	na
Threshold for the ME of IFF	-0.967	-0.895	na
Countries\Observations	38\620	38\620	38\620
P-value of Hausman test	0.003	0.001	0.000
P-value of cross-sectional dependence test	0.765	0.962	0.938

Notes: *** (**) (*) denotes significance at the 1 (5) (10) percent level. Robust standard errors in parentheses are clustered at the country level. L. denotes the first lag. Threshold for the marginal effect of IFF corresponds to the level of control of corruption for which the marginal effect (ME) of IFF is zero. na: not applicable because the threshold does not lie in the range of minimum and maximum values of the threshold variable or because the marginal effect is not decreasing with the level of control of corruption (CC) or because at least one of the estimated coefficients needed for the computation of net effects and threshold is not significant. In all specifications, we control for a full set of year fixed effects.

The findings provided in Table 2 are tailored to account for the simultaneity dimension of endogeneity, especially as it pertains to regressing the contemporary outcome variable on non-contemporary independent variables of interest as well as control variables. Following the same reporting elements of style as in Table 1, the AME of IFF and corresponding corruption-control threshold are computed. From the corresponding findings, the AME are consistently negative while the corruption-control are within statistical range with the exception of that which is related to the third specification or fourth column for which the computation is not feasible because at least one estimated coefficient relevant for such computation is not significant.

Table 3. Effect of Illicit Financial Flows on terrorist activity in Africa: the role of corruption-control (2002-2021). GMM estimation using contemporaneous explanatory variables

Dep. var.: Gobal Terrorism Index	(1)	(2)	(3)
L.Global Terrorism Index	0.839***	0.953***	0.835***
	(0.168)	(0.321)	(0.139)
Control of Corruption (CC)	-0.217	-0.872	0.007
	(2.073)	(1.527)	(1.171)
Illicit financial flows (% of GDP)	**-0.014**		
	(0.052)		
CC # Illicit financial flows (% of GDP)	**-0.020**		
	(0.049)		
Illicit financial inflows (% of GDP)		**0.068**	
		(0.145)	
CC # Illicit financial inflows (% of GDP)		**0.047**	
		(0.056)	
Illicit financial outflows (% of GDP)			**-0.082**
			(0.062)
CC # Illicit financial outflows (% of			**-0.071**
			(0.072)
Growth rate of real GDP per capita	-0.004	0.001	-0.008
	(0.019)	(0.028)	(0.023)
Natural resources rents (% of GDP)	0.006	-0.011	0.021
	(0.019)	(0.027)	(0.029)
Military expenditure (% of GDP)	0.214	0.160	0.167
	(0.223)	(0.477)	(0.286)
Mean years schooling	0.084	-0.197	-0.021
	(0.722)	(0.572)	(0.684)
Average marginal effect of IFF	-0.002	0.040	-0.040
Threshold for the ME of IFF	na	na	na
Countries\Observations	38\586	38\586	38\586
laglimits	(2 16)	(2 6)	(2 18)
Arellano-Bond test for AR(1)\AR(2): p-	0.00\0.40	0.01\0.46	0.00\0.28
Hansen test of overid. Statistic\p-	13.76\0.47	7.76\0.10	11.54\0.78

Notes: *** (**) (*) denotes significance at the 1 (5) (10) percent level. All models are estimated using two-step System-GMM with Windmeijer-corrected standard errors reported in parentheses. L. denotes the first lag. Threshold for the marginal effect (ME) of IFF corresponds to the level of control of corruption (CC) for which the marginal effect of IFF is zero. na: not applicable because the threshold does not lie in the range of minimum and maximum values of the threshold variable or because the marginal effect is not decreasing with the level of control of corruption (CC) or because at least one of the estimated coefficients needed for the computation of net effects and threshold is not significant. In all specifications, we control for a full set of year fixed effects. The lag length for instruments

From the fixed effect model, an increase of 1 point of control of corruption will reduce the terrorist activity as the illicit financial flows share (in percent of GDP) increases by 1 percentage point. The estimation results support the hypothesis that the effect of illicit financial flows depends on the control of corruption. The control of corruption threshold value -0.951 implies that countries with an average index of the control of corruption less than -0.951 points have positive marginal effect of IFF on terrorism, while countries with an average index of the control of corruption more than -0.951 points have negative marginal effect of IFF on terrorism.

According to Figure 3, most of countries have average value of control of corruption above the threshold of -0.951. The following countries have average value of control of corruption below the threshold: Burundi, Cameroon, Central African Republic, Democratic Republic of Congo, Congo, Guinea-Bissau, Madagascar, Nigeria, Sudan, Uganda, and Zimbabwe.

4.2 Restriction to the Sahel Region and Further Discussion of Results

In order to assess the validity of the findings established in the preceding section, the analysis is restricted to the Sahel region where terrorism is comparatively more apparent. These Sahel countries are 10 in number, namely: Burkina Faso, Cameroon, Chad, The Gambia, Guinea, Mali, Mauritania, Niger, Nigeria and Senegal. Chad and Guinea do not enter in the estimation sample because these countries do not report enough observations for data on trade related illicit financial flows. We then have eight countries in this restricted sample spanning over twenty years. Tables 4 and 5 report the estimation results for this sub-sample of countries based on fixed effects regressions using Driscoll and Kraay (1998) standard errors that are robust to cross-sectional dependence, as we reject the null hypothesis of cross-sectional independence in all specifications. The Driscoll and Kraay (1998) regressions provides accurate standard error estimates with little loss in efficiency when the number of time periods is large relatively to the number of individuals that is being observed and when there is cross-sectional dependence in the error terms. The results in Table 4 and Table 5 broadly confirm the baseline findings established in previous tables for the 38 sampled African countries.

Overall, the findings are broadly consistent with the extant literature on the negative consequences of IFFs (Collin, 2020; Hunter, 2019; Thiao, 2021; Babatayo & Audu, 2023; Afolabi, 2024), especially as it pertains to causing political instability and funding terrorism activities (Onanuga et al.., 2021). This also confirms evidence that in the Sahel, terrorism is financed by illicit transfers that include both formal and informal transactions (Alda & Sala, 2014; Harmon, 2016; Asongu, 2022). Moreover, the findings also broadly support the perspective that good governance, in terms of corruption-control can be used to fight terrorism (Emeka et al., 2024b; Iheonu & Ichoku, 2023, 2022; Asongu et al., 2018a, 2018b) through the IFFs channel.

In terms of theoretical implications, the findings in this study have extended a strand of literature on the nexus between IFFs and risk averse behavior in terms of both planned and unanticipated risky investments (Efobi & Asongu, 2016; Onanuga et al., 2021), to the theoretical stance that IFFs can be a significant source of funding terrorism activities and good governance can help in alleviating the scourge, especially by means of corruption-control. The theoretical underpinning is in line with previous research (Kfir, 2018; Asongu, 2022), particularly when it comes to demonstrating how the illegal trade of white and blue collar terrorists contributes significantly to the funding of terrorism in the continent in general and

particularly in the Sahel region. Accordingly, IFFs specifically in extractive commodities are an important source of terrorism financing in Africa. For instance, based on interviews and survey, Teichmann (2018) provides evidence of the link between money laundering and financing terrorism through the financial services industry and its affiliates. This connection between IFFs and terrorism is also established by Chandra (2020).

5. Concluding implications and Future Research Directions

5.1 Conclusion

The purpose of the study is to assess the incidence of illicit financial flows (IFFs) on terrorism in Africa, contingent on corruption-control. There is thus a premise that the hypothetical unfavorable incidence of IFFs on terrorism can be dampened by corruption-control, which is employed as a moderating or policy variable. The focus of the study is on 38 African countries with data for the period 2002-2021. In order to increase room for policy implications, the overall IFFs measure is decomposed into two main sub-components, namely: illicit financial inflows and illicit financial outflows. The empirical evidence is also based on: (i) baseline regressions, (ii) estimations with the lagged independent variables in order to control for the simultaneity dimension of endogeneity as well as the (iii) GMM in order to account for both the simultaneity and unobserved heterogeneity dimensions of endogeneity. The robustness of the empirical analysis is further improved by limiting the sample to the Sahel countries in which most of the terrorism has been documented over the past decades. It is apparent from the findings that corruption-control effectively moderates IFFs and especially illicit financial inflows in order to engender an overall negative effect on the outcome variable or terrorism. Moreover, critical levels of corruption-control that are relevant in order for the considered policy or moderating variable to interact with IFFs for the overall negative effect on terrorism are provided. For the most part, the corruption-control policy thresholds are within policy range. Policy implications are discussed. (Based on the findings, the study recommends counter-IFFs policies).

5.2 Policy Implications

The corresponding policy implications are broadly consistent with Asongu (2022) with the exception that the corresponding policy implications should be contingent on robust corrupt-control to align with the established findings in this study. First, the telecommunications industry in these economies is the focus of the first policy implication for the governments of the various states that are impacted. In this regard, SIM (Subscriber Identity Module) cards for telephones should only be offered to individuals, who possess valid national identity cards or foreign passports, as well as national units that are set up to monitor all communications, particularly in areas that are occupied by terrorist organizations, in order to restrict communication among terrorist groups. Hence, corruption in the attribution of SIM cards should be fought, not least because SIM cards that cannot be directly traceable to specific individuals can be used in IFFs with the ultimate aim of funding terrorism.

Communications related to the funding of terrorist operations or plans for terrorist attacks will be monitored under this strategy. In addition, sampled countries should improve their cyber

security measures. This is especially crucial because the majority of these terrorist organizations plan their assaults online. To support terrorist plots, for example, the Al-Qaeda terrorist network makes significant use of the Internet. Al-Qaeda used the Internet to recruit people, plan operations, send emails, and make bookings online prior to the 9/11 attacks in the United States. Even though many countries have laws protecting the privacy of people's communications, making some of these measures hard to implement, it is necessary to work with law enforcement agencies and the parliament to change these laws to restrict their use when there is a clear threat of terrorism. Accordingly, communication is essential for the funding of terrorism by means of IFFs and mastering the underlying communication instrument is better in the absence of a corrupt government.

Policy makers should also ensure effective border control. For example, the MNLA operates in Northern Mali, and the bulk of its members are said to be former Liberian war fighters, who fled after Gadhafi was slain. This is in contrast to the majority of terrorists fighting in the Sahel that have migrated from other regions or neighboring nations. Enforcing border security and internal checks within national economies are two strategies to reduce this unlawful movement, which can be associated with IFFs and potentially engender political instability and terrorism. In this regard, residents, who do not have a permission, ought to be taken into custody and questioned. However, this will only work if the attendant economies have low levels of corruption. One of the UNODC's responsibilities is to combat corruption; in order to fulfill this duty, the organization should improve cooperation and capacity building with national anti-corruption agencies.

From the businesses that manufacture weapons to the units of use, arm registration processes ought to be improved. All nations and organizations ought to be involved in this regard. Addressing answers to the following queries, among others, would be necessary to put such a suggestion into practice. Who has made fake weapons? How much of it has been faked? Which locations do these weapons go to? Are they properly registered in the nations where they are going? Why are these weapons being acquired? How does corruption facilitate the trade of these weapons? In this regard, the sampled economies ought to improve their control over the use of weapons and ammunition. These would lessen the trafficking of weapons, which is one way that these terrorist groups raise money.

Requiring the central banks of Sahelian nations, African countries and the rest of the world to assume responsibility for cryptocurrency emissions is the final but certainly not the least possible policy. Cryptocurrency is now private money, and there are no controls in place to efficiently handle the flow of funds into and out of these digital wallets. In this regard, if no efficient control system is established, terrorists might readily use cryptocurrencies as a substitute and/or

contemporary method of funding terrorism. If the underlying controls are to be robust, they must be free from corruption.

5.3 Limitations and Future Research Directions

The findings in this study evidently allow space for improvement, especially as it concerns, understanding why some nexuses are unexpected. Moreover, with data availability, it will be worthwhile to assess if the established nexuses in this study withstand empirical scrutiny when viewed in the lenses of other developing regions in the world. Furthermore, reconsidering how the established linkages affect the United Nations (UN) sustainable development goals (SDGs) should be an interesting future research direction, especially as it pertains to informing policy makers on how Africa's achievement of the attendant SDGs can be influenced by downsides from terrorism and IFFs. Due to the complexity to collect more refined data on terrorism-related IFFs, future research could explore the use of network analysis, pattern recognition in financial transactions, or incorporation of intelligence data to provide a more precise understanding of the IFF-terrorism nexus.

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Appendices

Table 4: Effect of Illicit Financial Flows on terrorist activity in the Sahel region: the role of corruption-control (2002-2021). Fixed effects estimation using contemporaneous explanatory variables

Dep. var.: Gobal Terrorism Index	(1)	(2)	(3)
Control of Corruption (CC)	1.987	1.606	1.392
	(2.026)	(1.735)	(2.183)
Illicit financial flows (% of GDP)	**-0.154***		
	(0.066)		
CC # Illicit financial flows (% of GDP)	**-0.183****		
	(0.064)		
Illicit financial inflows (% of GDP)		**-0.182****	
		(0.066)	
CC # Illicit financial inflows (% of GDP)		**-0.258*****	
		(0.049)	
Illicit financial outflows (% of GDP)			**-0.170**
			(0.109)
CC # Illicit financial outflows (% of GDP)			**-0.220**
			(0.154)
Growth rate of real GDP per capita	-0.037	-0.039	-0.038
	(0.078)	(0.077)	(0.076)
Natural resources rents (% of GDP)	0.133**	0.116*	0.131**
	(0.053)	(0.053)	(0.044)
Military expenditure (% of GDP)	1.218*	1.167*	1.346**
	(0.540)	(0.571)	(0.490)
Mean years schooling	0.737*	0.786*	0.743**
	(0.360)	(0.358)	(0.305)
Constant	-1.678	-1.983	-2.276
	(2.176)	(2.201)	(1.937)
Average marginal effect of IFF	-0.035	-0.014	-0.027
Threshold for the ME of IFF	-0.840	-0.704	na
Countries\Observations	8\141	8\141	8\141
P-value of cross-sectional dependence test	0.083	0.013	0.033

Notes: *** (**) (*) denotes significance at the 1 (5) (10) percent level. Standard errors in parentheses are robust to cross-sectional dependence. L. denotes the first lag. Threshold for the marginal effect of IFF corresponds to the level of control of corruption for which the marginal effect (ME) of IFF is zero. na: not applicable because the threshold does not lie in the range of minimum and maximum values of the threshold variable or because the marginal effect is not decreasing with the level of control of corruption (CC) or because at least one of the estimated coefficients needed for the computation of net effects and threshold is not significant. In all specifications, we control for a full set of year fixed effects.

Table 5: Effect of Illicit Financial Flows on terrorist activity in the Sahel region: the role of corruption-control (2002-2021). Fixed effects estimation using lagged explanatory variables

Dep. var.: Gobal Terrorism Index	(1)	(2)	(3)
L.Control of Corruption	1.728	1.844	1.201
	(2.008)	(1.698)	(2.274)
L.Illicit financial flows (% of GDP)	**-0.127***		
	(0.063)		
L.CC # L.Illicit financial flows (% of GDP)	**-0.114**		
	(0.070)		
L.Illicit financial inflows (% of GDP)		**-0.097**	
		(0.082)	
L.CC # L.Illicit financial inflows (% of GDP)		**-0.226****	
		(0.091)	
L.Illicit financial outflows (% of GDP)			**-0.185**
			(0.135)
L.CC # L.Illicit financial outflows (% of GDP)			**-0.149**
			(0.195)
L.Growth rate of real GDP per capita	-0.011	-0.018	-0.013
	(0.059)	(0.058)	(0.060)
L.Natural resources rents (% of GDP)	0.139**	0.093*	0.153***
	(0.046)	(0.040)	(0.038)
L.Military expenditure (% of GDP)	1.513**	1.697**	1.642**
	(0.455)	(0.509)	(0.475)
L.Mean years schooling	0.769**	0.905**	0.781**
	(0.290)	(0.323)	(0.251)
Constant	-2.253	-3.011	-2.918
	(1.877)	(2.036)	(1.750)
Average marginal effect of IFF	-0.053	0.051	-0.087***
Threshold for the ME of IFF	-1.115	na	na
Countries\Observations	8\134	8\134	8\134
P-value of cross-sectional dependence test	0.011	0.010	0.010

Notes: *** (**) (*) denotes significance at the 1 (5) (10) percent level. Standard errors in parentheses are robust to cross-sectional dependence. L. denotes the first lag. Threshold for the marginal effect of IFF corresponds to the level of control of corruption for which the marginal effect (ME) of IFF is zero. na: not applicable because the threshold does not lie in the range of minimum and maximum values of the threshold variable or because the marginal effect is not decreasing with the level of control of corruption (CC) or because at least one of the estimated coefficients needed for the computation of net effects and threshold is not significant. In all specifications, we control for a full set of year fixed effects.

Table A1: Number of observations per country in the baseline estimation sample

Country	Number of observations	Country	Number of observations	Country	Number of observations
Angola	18	Gambia	16	Rwanda	20
Burundi	17	Guinea-Bissau	6	Sudan	12
Benin	16	Kenya	17	Senegal	20
Burkina Faso	20	Lesotho	20	Sierra Leone	5
Central African Rep.	19	Morocco	20	Eswatini	20
Cote d'Ivoire	19	Madagascar	20	Togo	17
Cameroon	20	Mali	14	Tunisia	20
Congo, Dem Rep.	7	Mozambique	20	Tanzania	20
Congo, Rep.	11	Mauritania	17	Uganda	20
Algeria	16	Mauritius	20	South Africa	20
Egypt	20	Namibia	20	Zambia	18
Ethiopia	20	Niger	17	Zimbabwe	17
Gabon	17	Nigeria	17		

Note: The maximum number of observations a country can have in the estimation sample is 20.

Table A2: Data description and sources

Indicator	**Variable description**	**Source**
Illicit Financial Flows related to commodity	Extractive commodity trade misinvoicing is used as the first measure of illicit financial flows. The illicit financial flows in a country are measured as the sum of illicit inflows and outflows. Illicit outflows are computed by summing export under-invoicing and import over-invoicing. Illicit inflows are computed by adding up import under-invoicing and export over-invoicing and summing over commodities and partners.	Authors' calculation from UN Comtrade database and OECD International Transport and Insurance Cost for Merchandise Trade database
Global Terrorism Index	The **Global Terrorism Index** is a measure of terrorist activity. It is based on the number of deaths, incidents, hostages and injuries from terrorism, weighted over a five-year period. The country's score ranges from 0 (no terrorism) to 10.	Global Terrorism Database (2022)—processed by Institute for Economics and Peace (IEP)
Control of corruption	The control of corruption refers to the degree to which public authority is manipulated for private gain, encompassing both minor and major manifestations of corruption. The country's score is ranged from approximately -2.5 (highest corruption) to 2.5 (lowest corruption).	Worldwide Governance Indicators (WGI), World Bank
Natural resource rents (% of GDP)	Natural resource rents are expressed as a percentage of GDP.	World Development Indicators (WDI)
Military expenditure (% of GDP)	All current and capital expenditures on the armed forces, expressed as a percentage of GDP.	World Development Indicators (WDI)

Real GDP per capita Growth rate (%)	Growth rate of GDP per capita in constant 2015 US dollar.	World Development Indicators (WDI)
Mean years of schooling	Mean years of schooling is the average number of years of education completed by a country's adult population aged 25 and older, not including years spent repeating grades.	United Nations Development Programme (UNDP)

Source: Authors

Table A3: Summary statistics of the main variables (2002-2021)

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Global Terrorism Index	760	2.123	2.332	0.000	8.802
Illicit financial flows (% of GDP)	694	15.020	16.285	0.409	123.867
Illicit financial inflows (% of GDP)	694	6.877	11.454	0.022	99.971
Illicit financial outflows (% of GDP)	694	8.144	7.523	0.159	56.743
Control of Corruption	760	-0.668	0.512	-1.600	0.776
Growth rate of real GDP per capita	760	1.536	4.235	-36.825	19.508
Military expenditure (% of GDP)	716	1.713	1.088	0.142	6.659
Natural resources rents (% of GDP)	760	10.877	9.892	0.002	53.315
Mean years schooling	756	4.902	2.254	0.977	11.610

Source: Authors' computations.

Table A4: Correlation matrix for the main variables (2002-2021)

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Global Terrorism Index	1.00								
2. Illicit financial flows (% of GDP)	-0.20	1.00							
3. Illicit financial inflows (% of GDP)	-0.11	0.92	1.00						
4. Illicit financial outflows (% of GDP)	-0.26	0.78	0.47	1.00					
5. Control of Corruption	-0.27	-0.10	-0.10	-0.06	1.00				
6. Growth rate of real GDP per capita	0.06	-0.05	-0.02	-0.08	0.16	1.00			
7. Military expenditure (% of GDP)	0.13	0.12	0.10	-0.11	-0.09	-0.10	1.00		
8. Natural resources rents (% of GDP)	0.11	0.30	0.20	-0.36	-0.45	-0.04	0.32	1.00	
9. Mean years schooling	-0.03	0.10	0.03	0.18	0.12	-0.13	-0.01	-0.00	1.00

Table A5: Commodities of interest and their derivative products (4-digit HS)

Commodity group	Ore & primary form	Articles thereof	Waste and scarps	Oxides
Gold		7108		
Platinum & palladium		7110		
Silver		7106		
Precious metal ore	2616		7112	
Diamonds	7102			
Copper	2603	7401-7403, 7405-7412	7404	
Iron	2601	7201-7203, 7205-7212	7204	2821
Aluminium	2606	7601, 7603-7609	7602	2818
Manganese	2602	8111		2820
Uranium & thorium	2612	2844		
Cobalt	2605	8105		2822
Titanium	2614	8108		2823
Chromium	2610			2819
Molybdenum	2613	8102		
Rare-earth metals (Cadmium, indium and lithium)		2805, 8107, 8112		
Conflict minerals ex. Gold (Tin, tantalum, and tungsten)		8001-8007, 8103, 8101		
Petroleum oils & gas	2709	2710, 2711		
Zinc	2608	7901-7907		2817

Source: Authors based on classification by Schuster and Davis (2020).

Table A6: List of commodity groups by country

Country Name	Commodity groups
Angola	Diamonds, Petroleum oils & gas
Burundi	Conflict minerals ex. Gold, Diamonds, Gold, Iron, Petroleum oils & gas
Benin	Copper, Gold, Petroleum oils & gas
Burkina Faso	Conflict minerals ex. Gold, Gold, Iron, Petroleum oils & gas
Central African Rep.	Aluminium, Diamonds, Gold, Iron, Petroleum oils & gas
Cote d'Ivoire	Conflict minerals ex. Gold, Gold, Petroleum oils & gas
Cameroon	Aluminium, Gold, Petroleum oils & gas
Congo, Dem. Rep.	Cobalt, Copper
Congo, Rep.	Copper, Petroleum oils & gas
Algeria	Petroleum oils & gas
Egypt	Aluminium, Copper, Iron, Petroleum oils & gas
Ethiopia	Gold, Iron, Petroleum oils & gas
Gabon	Manganese, Petroleum oils & gas
Guinea	Aluminium, Copper, Diamonds, Gold, Petroleum oils & gas
Gambia	Conflict minerals ex. Gold, Copper, Gold, Iron, Petroleum oils & gas, Titanium
Guinea-Bissau	Aluminium, Gold, Iron, Petroleum oils & gas

Kenya	Gold, Iron, Petroleum oils & gas
Lesotho	Diamonds, Iron, Petroleum oils & gas
Morocco	Gold, Iron, Petroleum oils & gas
Madagascar	Cobalt, Gold, Iron, Petroleum oils & gas
Mali	Gold, Petroleum oils & gas
Mozambique	Aluminium, Chromium, Iron, Petroleum oils & gas
Mauritania	Copper, Gold, Iron, Petroleum oils & gas
Mauritius	Diamonds, Iron, Petroleum oils & gas
Namibia	Conflict minerals ex. Gold, Copper, Diamonds, Petroleum oils & gas, Uranium & thorium
Niger	Gold, Petroleum oils & gas, Uranium & thorium
Nigeria	Petroleum oils & gas
Rwanda	Aluminium, Gold, Iron, Petroleum oils & gas
Sudan	Gold, Petroleum oils & gas
Senegal	Gold, Iron, Petroleum oils & gas
Sierra Leone	Aluminium, Diamonds, Iron, Petroleum oils & gas, Titanium
Eswatini	Aluminium, Diamonds, Gold, Iron, Petroleum oils & gas
Togo	Gold, Iron, Petroleum oils & gas
Tunisia	Copper, Iron, Petroleum oils & gas
Tanzania	Copper, Gold, Petroleum oils & gas, Precious metal ore
Uganda	Cobalt, Gold, Iron, Petroleum oils & gas
South Africa	Cobalt, Diamonds, Gold, Iron, Petroleum oils & gas, Platinum & palladium
Zambia	Cobalt, Copper, Petroleum oils & gas
Zimbabwe	Copper, Diamonds, Gold, Iron, Petroleum oils & gas

Note: This table lists the raw materials of each sampled country and for which the IFF is at least 5% of the total IFF for a given year.