

Impact of “Jihadist” Attacks on Military Expenditures of Mali and Burkina Faso: A Synthetic Control Method Approach

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Abstract

The outbreak of Jihadism in the Sahara desert changed the economic and security landscape of the countries located in this area, and among the economies that have been affected are Mali and Burkina Faso. The upsurge of extreme violence led these countries to rethink their defense strategies in order to face the rising threat of this new form of terrorism. Using the synthetic control method on a panel data set ranging from 1990 to 2022, this paper estimates the nexus between jihadist attacks and the military expenditures in Burkina Faso and Mali. Our findings support that the terrorist activities have increased our variable of interest by 105 percent in Burkina Faso and 145 percent in Mali.

Keywords

Military Expenditures, Jihadism, Burkina Faso, Mali, SCM

1. Background of the Study

In March 2011, France launched a military operation in Libya under the command of NATO, which led to Gaddafi's death. Second to this event, some Tuaregs enrolled in the Libyan army under Gaddafi's rule invaded the north of Mali, heavily armed. From January 2012, they launched a rebellion to claim a secular Tuareg state, in an ill-defined territory they called Azawad. This was the beginning of the latest Tuareg rebellion, the precursor to a succession of diverse crises. Regions like Timbuktu, Gao, and Kidal, covering 65% of the national territory, will be occupied by armed jihadist groups who have opportunistically used the Tuareg revolt to exploit the weaknesses of the Malian army (Haidara, 2015). These include al-Qaeda in the Islamic Maghreb (AQIM), the Movement for Unity and Jihad in West Africa (MUJAO), and Ansar Dine (the Defenders of the Faith). A partner-

ship initially linked the two actors, before the jihadists drove the Tuaregs out of several localities they occupied together. The terrorist groups that just took control of the north will later expand to the center of Mali and the neighbouring countries, Burkina Faso and Niger (Haidara, 2023).

From 2015 onward, there emerged what several observers described as a “contagion of insecurity from Mali to surrounding countries”, particularly Burkina Faso. Burkina Faso has lost its reputation as a calm and relatively stable country within a troubled Sahelian region. It has slowly turned into another centre for extremist movements, marked by the November 2015 kidnapping of a Romanian worker involved in a manganese extraction operation in the north-eastern locality of Tambao, close to the Malian frontier, followed by an assault on a gendarmerie base in the south-western town of Samorogouan and the deaths of three officers and one civilian at the hands of armed attackers in October of the same year (Haidara, 2024). On 27 November 2015, armed men ambushed a van transporting cash from the Inata gold site situated in the northern Soum province. By 2019, Burkina Faso alone accounted for half of the 4000 violent incidents logged across the area.

Table 1 & Table 2 are statistics summarizing the number of attacks perpetrated by the jihadist factions from 2012 to 2020 and their corresponding casualties. As the growing number of events suggests a spread of jihadists, it will trigger a reaction from local authorities to fight and contain the jihadist threat.

The starting point of the response to the security crisis was “Operation Serval”. It could be traced to the time of the request by the Malian authorities for air support to stop the columns of jihadists who, after nearly ten months of occupation (from April 2012 to January 2013) of the main regions of northern Mali, were descending towards the south of the country. Launched in January 2013 and conducted as part of French military intervention in Mali, Operation Serval ended in July 2014 when the forces engaged in the country became part of a regional operation: Operation Barkhane (Togola & Okur, 2023).

Table 1. Summary table of security events in Mali from 2012 to 2020.

Year	Number of Events	Number of Fatalities
2012	278	538
2013	311	883
2014	152	382
2015	178	428
2016	167	320
2017	478	950
2018	754	1762
2019	663	1489
2020	1100	2848
	Total: 4081	Total: 9600

Source: ACLED <https://acleddata.com>.

Table 2. Summary table of security events in Burkina Faso from 2015 to 2020.

Year	Number of Events	Number of Fatalities
2015	116	23
2016	204	81
2017	203	116
2018	395	306
2019	704	1551
2020	652	2370
Total: 2274		Total: 4447

Source: ACLED <https://acleddata.com>.

Other initiatives were launched in addition to the missions of the national armies in the context of counterterrorism and the stabilisation of Mali, which is viewed as the focal point of the security crisis in the Sahel. In this perspective, the African-led International Support Mission for Mali (MISMA) was created on 20 December 2012 by UN Resolution 2085. MISMA was later replaced by the United Nations Multidimensional Integrated Stabilisation Mission in Mali (MINUSMA), through Resolution 2100, on 25 April 2013 (Thérroux-Bénoni, 2014). The UN peacekeeping operation in Mali seeks to secure the country, while committing Mali to a political dialogue with a view to holding elections and conducting “credible” negotiations with the groups in northern Mali. Despite these initiatives, the security context continued to deteriorate in central Mali, in the Sahel region of Burkina Faso and in the Tillabéri region of Niger.

An additional regional security framework was adopted: the establishment of the joint G-5 Sahel force. The G-5 Sahel operates as an intergovernmental platform between Burkina Faso, Mali, Mauritania, Niger and Chad designed to advance both economic development and collective security collaboration (Dakono, 2022). In 2017, the G-5 Sahel created the Joint Force, which was to consist of 5000 troops from the armed forces of the five member countries, with the mission of combating violent extremist groups. Operations undertaken by the Joint Force concentrate on frontier territories and are divided into three distinct operational sectors: a western sector commanded from Mauritania, a central sector operating from Niamey, and an eastern sector administered by Chad. The initiative has received the support of France and the international community through the Alliance for the Sahel, the Coalition for the Sahel, the European Union (EU), the African Union (AU), the Economic Community of West African States (ECOWAS) and the United Nations (UN) via the United Nations Multidimensional Integrated Stabilisation Mission in Mali (MINUSMA), but it is still struggling to reach its full operational capacity, let alone produce satisfactory results, while terrorist groups continue to push forward, as evidenced by the upsurge in attacks, kidnappings and hostage-taking in the region.

By June 2020, based on information retrieved from the MINUSMA and French

Ministry of Armed Forces online platforms, there were 12,438 UN peacekeepers and 1712 police personnel assigned to MINUSMA, 4500 French military forces within Operation Barkhane, 5000 to 10,000 personnel projected for the G-5 Sahel Joint Force (FC-G5S), 580 military staff working with the European Union Training Mission (EUTM Mali) and numerous American and European contingents providing indirect and direct assistance to counterterrorism undertakings in the wider Sahel security theatre as well overall.

In an attempt to estimate the effect of jihadist attacks on military expenditures of Mali and Burkina Faso, the current study performs an SCM analysis using a panel of selected African countries over 32 years. Our findings reveal that terrorist activities increased by 105 percent and 140 percent in the military expenditures of Burkina and Mali within 10 years.

The contribution of this paper can be unfolded in three sections. Firstly, this article provides a clear connection between insecurity and military expenditures by showing the causality between the two variables. A second contribution lies in the variation of the military expenditure, as the SCM model uncovers the real effect of the terrorist attacks, 105 percent and 145 percent increase in the military expenditures of Burkina Faso and Mali. Thirdly, this paper comes in addition to the existing literature on insecurity in the Sahara region and other related topics.

2. Methodology

The Synthetic Control Method (SCM), introduced by [Abadie and Gardeazabal \(2003\)](#), is a novel microeconomic technique frequently applied in comparative case studies. SCM was used to assess the economic impact of terrorism in Spain. Since then, it has been employed in various contexts: [Abadie, Diamond, and Hainmueller \(2010\)](#) analyzed the effect of California's Tobacco Control Program on smoking rates; [Lee \(2011\)](#) examined inflation targeting policies; [Billmeier and Nannicini \(2013\)](#) studied the effects of economic liberalization; and [Gharehgozli \(2017\)](#) evaluated the Economic Cost of Sanctions on Iran. SCM works by constructing a synthetic control unit, a weighted combination of control units, to replicate the characteristics of the treated unit before an intervention. This allows researchers to estimate what would have happened to the treated unit had the intervention not occurred.

Consider a setting with $J + 1$ units, where only unit $j = 1$ undergoes treatment after time T_0 , while the remaining J units act as controls. Let Y_{it}^I denote the outcome for the treated unit post-intervention, and Y_{it}^N represent the counterfactual outcome without treatment. [Abadie et al. \(2010\)](#) propose the following model to estimate these outcomes:

$$Y_{jt} = \delta_t + \tau_{jt} D_{jt} + \Theta_t Z_j + \lambda_t \Theta_j + \varepsilon_{jt} \quad (1)$$

In this model, Z_j is a vector of independent variables, Θ_t represents parameters, ϕ_j captures unit-specific unobservables, λ_t is a common time-varying factor, ε_{jt} is a transitory shock with mean zero, and D_{jt} is a treatment indicator (1 for the treated unit, 0 otherwise). The treatment effect τ_{jt} is then estimated for $t = T_0 + 1$,

$T_0 + 2, \dots, T$.

Although $Y_{1t}^1 = Y_{1t}$ is observable, estimating the treatment effect is challenging due to the unobserved nature of Y_{1t}^N . To address this, [Abadie and Gardeazabal \(2003\)](#) define a weight vector $W = (w_2, \dots, w_{J+1})$, where each $w_j > 0$ and $\sum_{j=2}^{J+1} w_j = 1$. These weights are used to construct a synthetic control unit that closely mirrors the treated unit's pre-intervention characteristics. For the pre-treatment period $t \in [1, T_0]$, an optimal weight vector $W^* = (w_2^*, \dots, w_{J+1}^*)$ is determined as:

$$Y_{1t} = \sum_{j=2}^{J+1} w_j^* Y_{jt} \quad (2)$$

$$Z_1 = \sum_{j=2}^{J+1} w_j^* Z_{jt} \quad (3)$$

Here, Z_{jt} includes covariates unaffected by treatment. Once W^* is identified, the post-intervention treatment effect is estimated as:

$$\tau_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \quad (4)$$

To achieve an accurate match, weights are selected such that the synthetic unit resembles the treated unit prior to intervention. Let $X_1 = (Z_1, Y_{11}, \dots, Y_{1T_0})$ be the vector of pre-treatment features for unit $j = 1$, and $X_0 = (Z_j, Y_{jt}, \dots, Y_{jT_0})$ be the corresponding matrix for control units $j \in [2, J + 1]$. The weights are chosen to minimize the distance between X_1 and $X_0 W$, under the constraint $w_j > 0$ and $\sum w_j = 1$.

$$\min \|X_1 - X_0 W\| = \min \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \quad (5)$$

To solve this minimization problem, [Abadie et al. \(2010\)](#) introduce a diagonal, positive semi-definite matrix V , which helps minimize the mean squared prediction error during the control period. The matrix V is crucial, as each diagonal entry reflects the importance of the corresponding pre-intervention variable.

3. Data and Variables

The empirical analysis is based on annual country level panel data for the period 1990-2022. As terrorist threats manifested 2012 in Mali and 2015 in Burkina, this yields a pre-intervention period of more than 20 years. Our donor pool includes African countries: Malawi, Rwanda, Madagascar, Uganda, Sierra Leone, Tanzania, Mozambique, Senegal, Cameroon, Angola, Morocco, Ghana, Nigeria, Tunisia, Algeria, Namibia, and South Africa. The countries were mainly selected based on the availability of data. The variables used in our analysis are listed in the data appendix along with descriptions and data sources. The outcome variable of interest, Y_{jt} , is the Military expenditure for country j at time t .

4. Results

Table 3 reports the donor countries and their corresponding weights used to construct the synthetic controls for Burkina Faso and Mali. For Burkina Faso, the synthetic counterpart is primarily a weighted combination of Senegal (46.7%),

Malawi (28.8%), and Rwanda (24.5%). In contrast, Synthetic Mali draws most heavily from Malawi (44.1%), Rwanda (35.4%), and Madagascar (9.8%), with minor contributions from several other African countries. The prominence of similar countries in both donor pools highlights regional structural similarities in defense spending and macroeconomic patterns prior to the rise of terrorism.

Table 3. Donor pool countries and share of each in the construction of the synthetic Mali and synthetic Burkina Faso.

Burkina Faso		Mali	
Country	Weight	Country	Weight
Senegal	0.4670	Malawi	0.4410
Malawi	0.2880	Rwanda	0.3540
Rwanda	0.2450	Madagascar	0.0980
		Uganda	0.0240
		Sierra Leone	0.0230
		Tanzania	0.0100
		Mozambique	0.0080
		Senegal	0.0080
		Cameroon	0.0070
		Angola	0.0050
		Morocco	0.0040
		Ghana	0.0040
		Nigeria	0.0030
		Tunisia	0.0030
		Algeria	0.0030
		Namibia	0.0030
		South Africa	0.0020

Source: Author's calculations.

Table 4. Military expenditure predictor means.

Countries	Variables	Treated	Synthetic	Average
Burkina Faso	• Military expenditure as percentage of GDP	1.3607	1.3604	1.8860
	• GDP per capita	486.8787	722.2220	1699.7939
	• Population in the largest city	43.5407	41.2830	27.7705
Mali	• Military expenditure as percentage of GDP	1.4260	1.4305	1.8503
	• GDP per capita	468.0001	471.2906	1493.0108
	• Foreign direct investment	2.008e+08	2.016e+08	9.914e+08

Source: Author's calculations.

Table 4 compares the pre-treatment averages of key predictors, military expenditure as a share of GDP, GDP per capita, and additional socioeconomic indicators for the actual and synthetic units of both Burkina Faso and Mali. In both cases, the synthetic controls replicate the pre-intervention characteristics closely, suggesting a strong pre-treatment fit. This alignment indicates that the selected donor pools and weights successfully captured the fundamental determinants of defense spending prior to the onset of widespread terrorist activity. The pre-treatment goodness of fit validates the use of these synthetic controls as credible counterfactuals for post-intervention comparison.

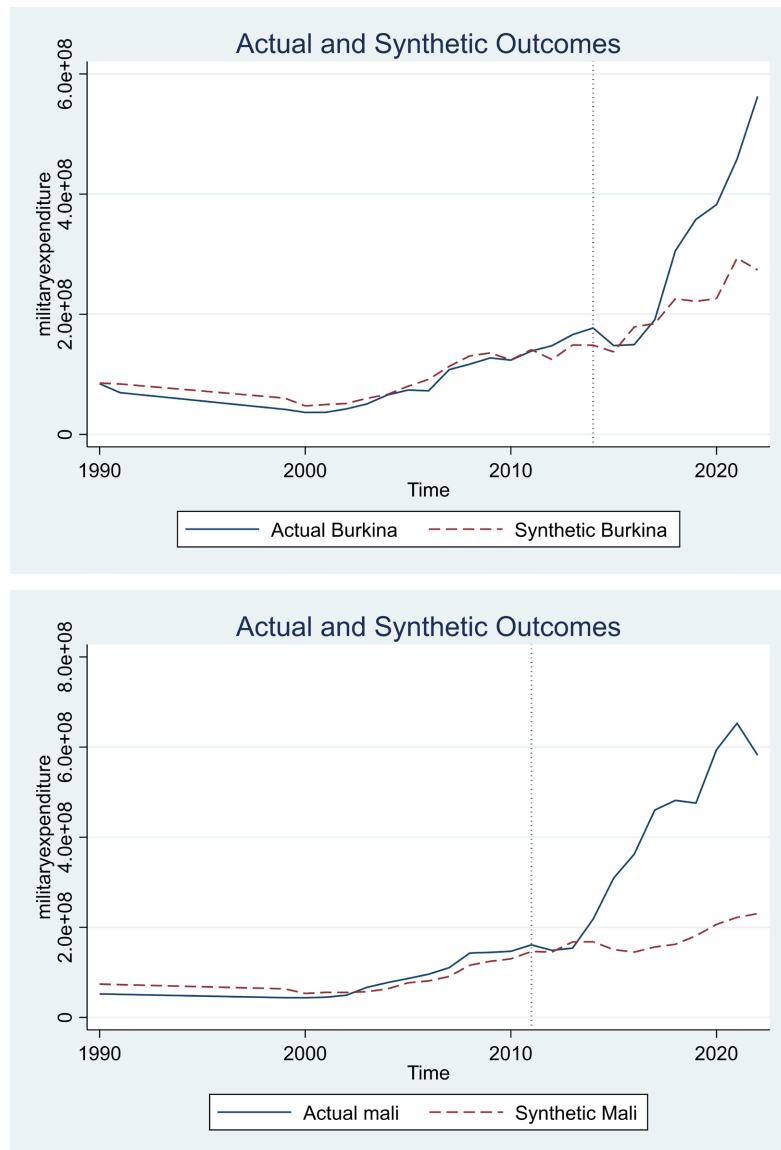


Figure 1. Real outcomes vs Synthetic outcomes. Source: Author's calculations.

Figure 1 depicts the trajectories of military expenditure for Burkina Faso and Mali alongside their respective synthetic counterparts from 1991 to 2022. Our estimate of the effect of terrorist activities launched in Mali and Burkina respectively

in 2012 and 2015 is the difference between the military expenditure of the countries and their synthetic replicates. For both countries, the synthetic series track the actual data closely before the increase in terrorist incidents, reflecting accurate reconstruction of pre-intervention dynamics. However, following the escalation of terrorism, the actual military expenditures diverge upward from their synthetic counterparts. This divergence implies that both Burkina Faso and Mali substantially increased their defense spending beyond what would have been expected in the absence of terrorism.

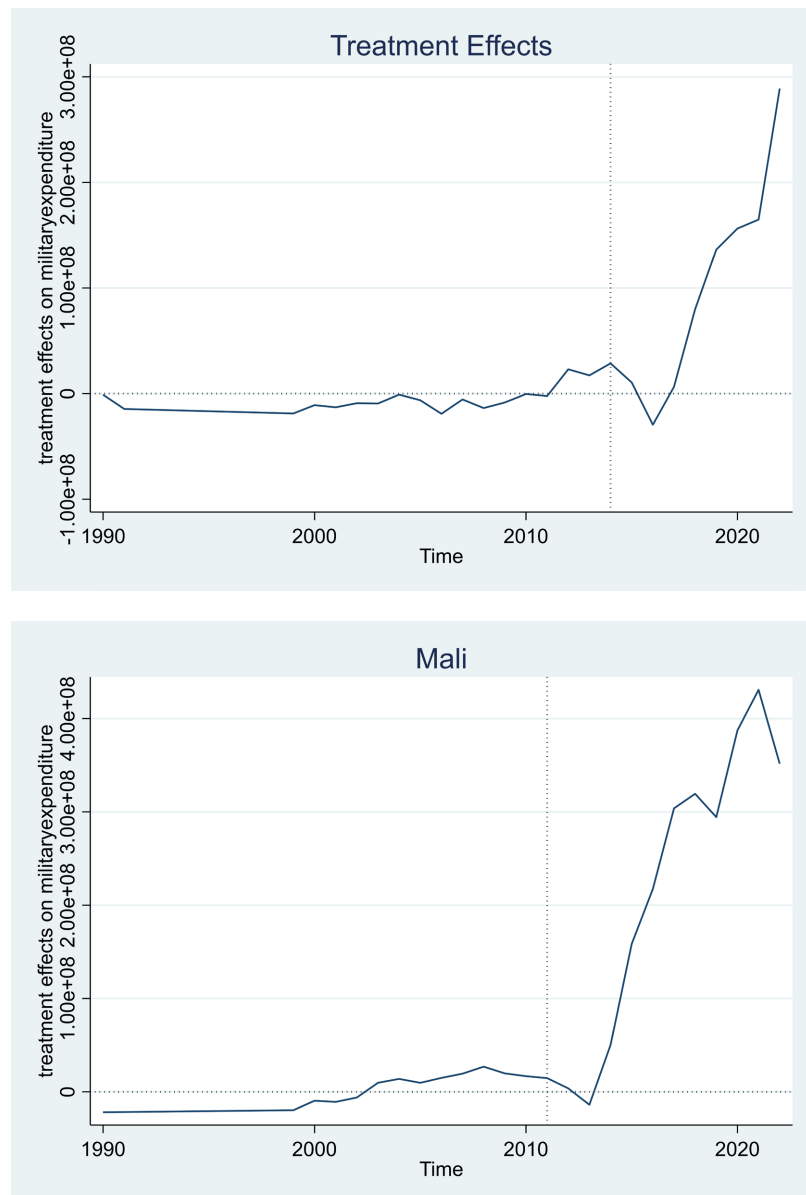


Figure 2. Gap between the real outcomes and the synthetic outcomes. Source: Authors calculations.

Figure 2 presents the corresponding gap plots, showing the annual differences between actual and synthetic military expenditure levels. In both countries, the

post-terrorism period is marked by positive and widening gaps, indicating persistent increases in defense spending. The military expenditures of Burkina Faso in 2022 were 562.5 million dollars, which we estimate to be 288.8 million dollars more than the value it would have been had there been no security challenges imposed in or after 2015. In the case of Mali, the military expenditures were 580 million dollars, which represents 344 million dollars more than its synthetics. This is equal to a 105 percent, respectively 145 percent increase in military expenditure over the course of seven, respectively ten years of continuous terrorist attacks in Burkina Faso and Mali.

5. Placebo Studies

To evaluate the reliability of the result that we obtained in the previous section using the synthetic control method, we run two types of placebo studies (Heckman & Hotz, 1989; Abadie et al., 2015). First, we perform the “in-time placebo” study in which we repeat the synthetic control method but reassign the treatment period to 2010 for Burkina and 2008 for Mali, almost five and four years before the terrorism actually took place.

Figure 3 displays the result of our “in-time placebo” study. In Burkina Faso, the synthetic control perfectly resembles the actual military expenditure for the entire period of 1991 to 2010, as well as 2010 to 2015. Same results were found in the case of Mali, where no substantial difference was found between the synthetic and real military expenditures in both periods of 1991 to 2008 and 2008 to 2012. For both Burkina Faso and Mali, no significant divergence is observed in the placebo period, confirming that the estimated post-terrorism effects are not driven by random variation.

Next, the in-space placebo test applies the same SCM procedure to other countries in the donor pool, assigning the intervention to them iteratively. Ultimately, we expect the method to estimate insignificant effects for the other countries compared to Burkina Faso and Mali. In other words, when randomization is not an option and there is no distribution for the estimated effect to check the significance, we can rely on a distribution of the estimated placebo effects created by this study. We expect the estimated effect for the treated countries to be an outlier in the distribution of the placebo effects.

In **Figure 4**, we exclude the gap plots for all the countries with an MSPE (total discrepancy between the country and its synthetic version for the pre-sanction period) of 3 times or higher than the countries of interest before running the placebo test. The remaining countries would be those with a better fit of synthetic control. These countries would be more likely to report a higher placebo effect and are better candidates to include in the placebo distribution. In **Figure 5**, we set the cutoff to be an MSPE of 10 times or higher than the treated countries. By leaving out the countries with a high MSPE in **Figure 4** and **Figure 5**, we observe that Burkina Faso and Mali are still outliers among the countries that would potentially report a higher placebo effect.

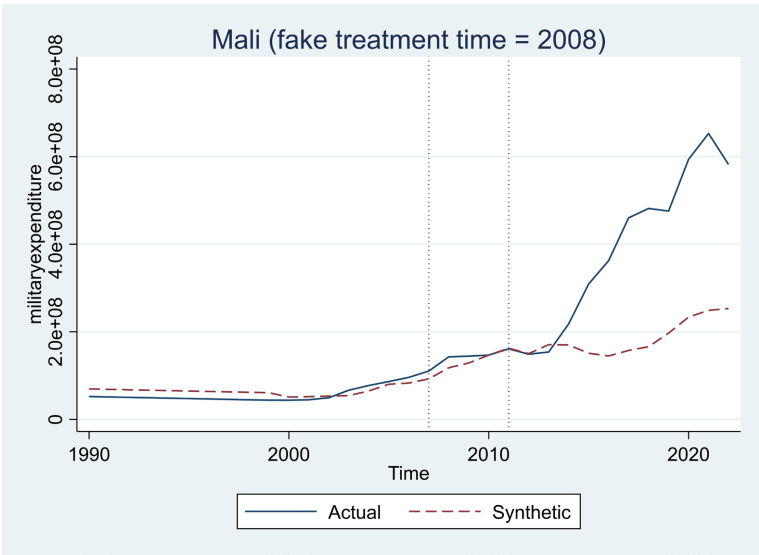
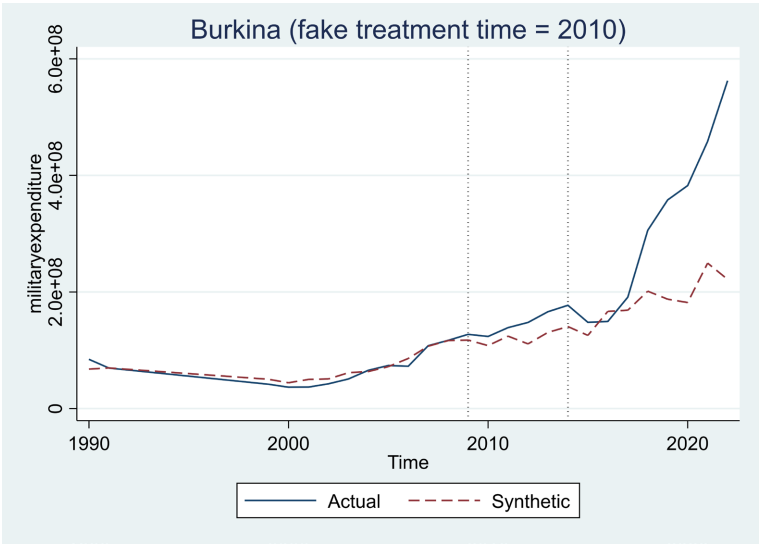
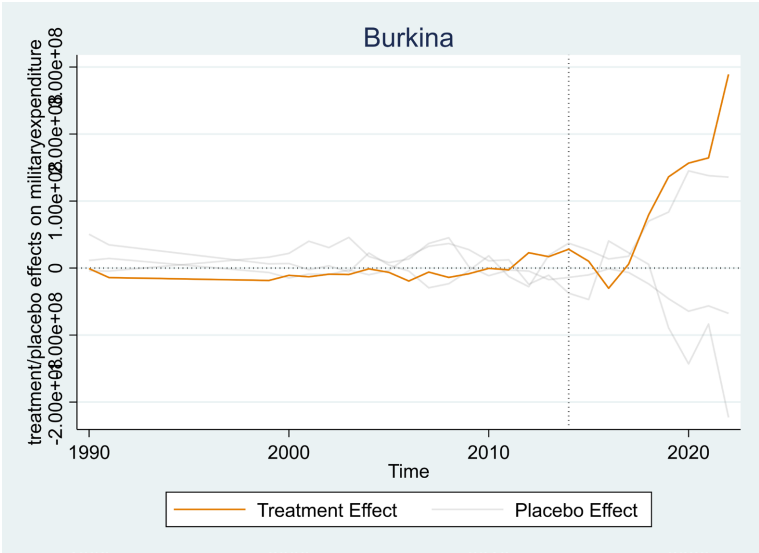


Figure 3. In-time Placebo effect. Source: Author's calculations.



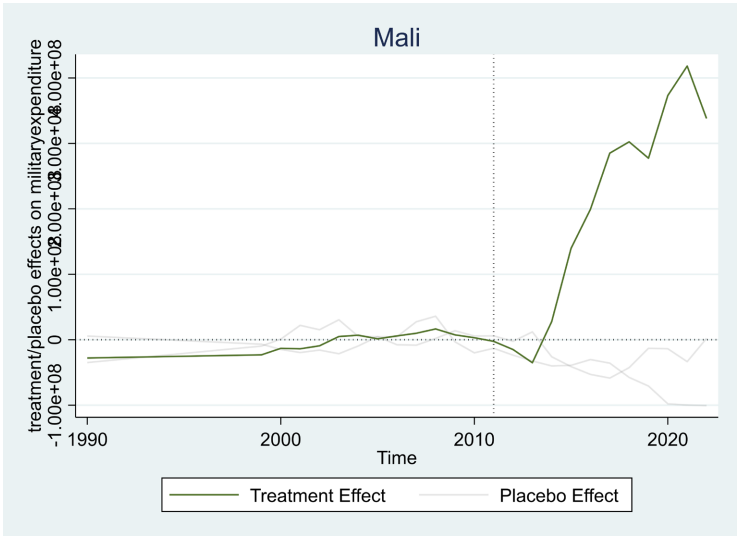


Figure 4. In-space Placebo effect cutoff = 3. Source: Author’s calculations.

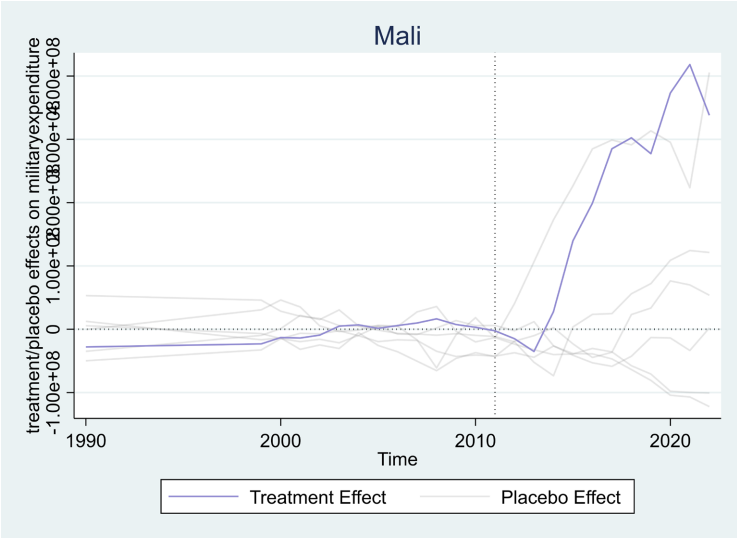
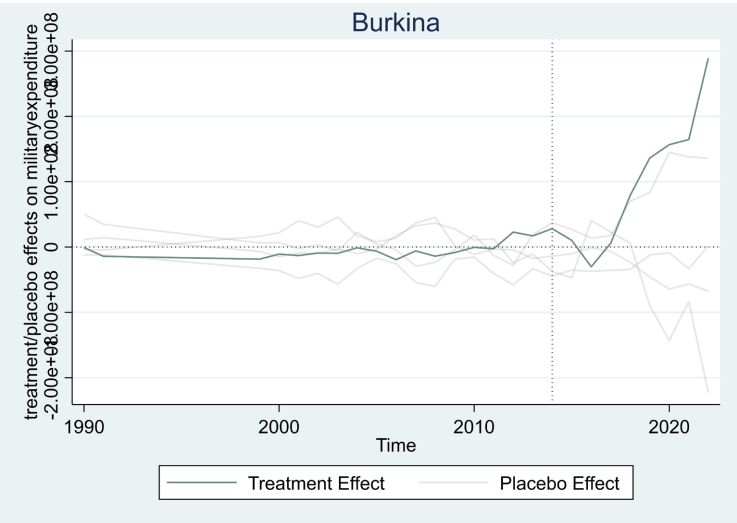


Figure 5. In-space Placebo effect cutoff = 10. Source: author’s calculations.

One way to evaluate the treated countries' gap relative to the gaps obtained from the placebo runs is to look at the distribution of the ratios of posttreatment MSPE to pretreatment MSPE. The main advantage of looking at ratios is that it obviates choosing a cutoff for the exclusion of ill-fitting placebo runs. **Figure 6** displays the distribution of the post/pretreatment ratios of the MSPE for the treated countries, Mali and Burkina Faso, and all their respective control states. The ratios for Burkina and Mali clearly stand out in the figure: the posttreatment MSPE is about 109 times and 484 times the MSPE for the pretreatment period. No control state achieves such a large ratio. If one were to assign the intervention at random in the data, using all control units, the probability of obtaining a post/pretreatment MSPE ratio as large as Mali's or Burkina's is $1/18 = 0.0556$.

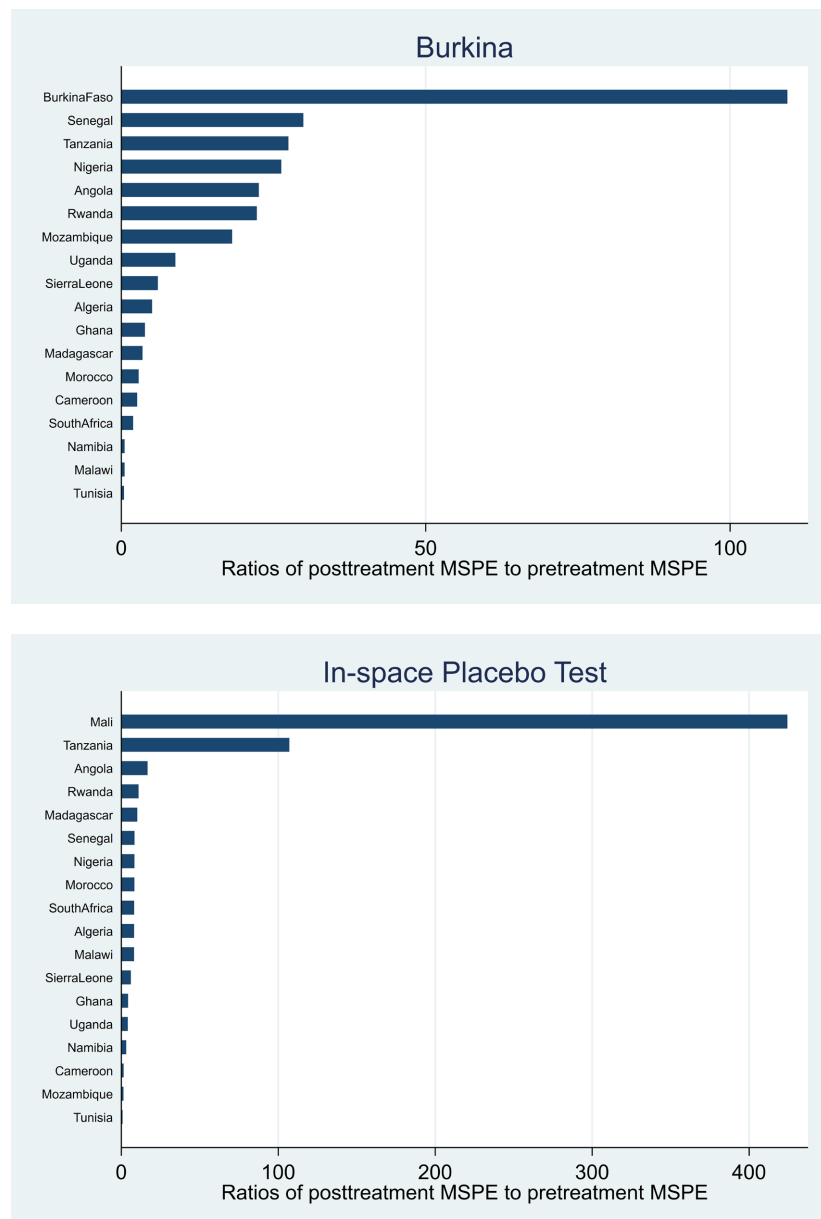


Figure 6. Ratios of post/pretreatment MSPE. Source: author's calculations.

6. Conclusion

We apply the synthetic control method to study the impact of jihadist attacks on the military expenditure of Mali and Burkina Faso. As their geographical positions suggest, these countries play a critical role in maintaining stability in the West African region. We use a data-driven synthetic control unit constructed as a weighted average of the donor countries to estimate the positive effects of jihadist attacks on the military expenditures of these countries. We estimate that recent sanctions caused a 105 percent and 145 percent rise in military expenditures of Burkina Faso and Mali over the course of 10 years.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

- **Military expenditure** (current USD): Military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces, including peacekeeping forces; defense ministries and other government agencies engaged in defense projects; paramilitary forces, if these are judged to be trained and equipped for military operations; and military space activities. Such expenditures include military and civil personnel, including retirement pensions of military personnel and social services for personnel; operation and maintenance; procurement; military research and development; and military aid (in the military expenditures of the donor country). Excluded are civil defense and current expenditures for previous military activities, such as for veterans' benefits, demobilization, conversion, and destruction of weapons. This definition cannot be applied for all countries, however, since that would require much more detailed information than is available about what is included in military budgets and off-budget military expenditure items.

Source: World Development Indicators.

- **Military expenditure as a percentage of GDP**

Source: World Development Indicators

- **GDP per capita** (current US\$): Gross domestic product is the total income earned through the production of goods and services in an economic territory during an accounting period. It can be measured in three different ways: using either the expenditure approach, the income approach, or the production approach. The core indicator has been divided by the general population to achieve a per capita estimate. This indicator is expressed in current prices, meaning no adjustment has been made to account for price changes over time. This indicator is expressed in United States dollars.

Source: World Development Indicators.

- **Population in the largest city:** Population in largest city is the urban population living in the country's largest metropolitan area.

Source: World Development Indicators

- **Foreign Direct Investment:** Foreign direct investment refers to direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy. Ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship. Data are in current U.S. dollars.

Source: World Development Indicators.