COOPERATION BETWEEN NATIONAL ARMIES : EVIDENCE FROM THE SAHEL BORDERS

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LIDAM Discussion Paper IRES
2024 / 05

UCLouvain

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IRES | Louvain Institute of Data Analysis and Modeling in economics and statistics

Cooperation between National Armies: Evidence from the Sahel borders*

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April 24, 2024

Abstract

The effectiveness of security operations often depends on cooperation between different national armies. Such cooperation can be particularly important when international borders are porous. In this project, we investigate how the creation of an international armed force that could operate across international borders (the G5-Sahel Joint Force) affected conflict dynamics in the Sahel region. Relying on a regression discontinuity design, we find that the G5 mission lowered the intensity of conflict locally in its zone of operation, especially along border segments more porous due to their geographical features or ethnic composition. Further analysis of geographical conflict propagation patterns indicates that the G5-Sahel force facilitated security operations in border areas.

Keywords: Counterinsurgency, Civil Conflict

JEL Classification: D72, D74, L23

*This research was supported by ANR grant COOPCONFLICT and EUR grant ANR-17-EURE-0001. "This work was supported by the Fonds de la Recherche Scientifique – FNRS/FWO under Grant EOS Project 3078531 "Winners and Losers from Globalization and Market Integration: Insights from Micro-Data". Any errors remain our own. We are grateful to seminar participants at PSE, the Stockholm School of Economics (SITE), IRSEM, CERDI, and TSE, and the University of Lausanne, for their insightful comments on this project.

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1 Introduction

Borderlands tend to concentrate violence, as evidenced by the fact that 18.7% of recorded violent events in 2023 occurred within 50 km of an international land border, despite these areas accounting for only 5.8% of the world population [1]. Border areas are more prone to violence due to their distinctive political and economic peripheral situations. Additionally, international borders, often coinciding with ethnic boundaries, materialise points of contact between state and non-state actors with potentially diverging interest (Mueller et al., 2022). Beyond these factors, the very discontinuity in state authority at international borders can itself generate conflict dynamics. Security operations are often constrained by international borders. Different countries may not share the same interests in conflicts, and armed groups can use neighbouring territories as a safe haven. Such safe havens have emerged along the border between Afghanistan and Pakistan, or the one between Venezuela and Colombia (Martínez, 2017). However, even if the interests of neighbouring countries are broadly aligned, armed groups could exploit frictions in information-sharing between neighbours, legal constraints on armed forces crossing borders, or a failure to internalise the displacement of conflict across borders. Since 1945, more than 55% of insurgencies that have operated across international borders (Cunningham et al., 2013).

A context that illustrates these frictions clearly is the ongoing Jihadist conflict in the Sahel. This conflict spans several West-African nations and is most intense around the region's porous borders. Particularly, the three-border region, where Mali, Niger, and Burkina Faso converge without distinct physical demarcation, has become the focal point of most violence in the Sahel.

While all major West-African national armies have been involved militarily in a fight against these groups, these unconcerted efforts have failed to contain the proliferation

[1] 31% of recorded violent events in 2023 occurred within 10 km of an international land border, despite these regions accounting for only 23% of the world population

of violence from Mali to neighbouring countries. Our paper investigates if improved cooperation between national armies in the Sahel region makes security operations more effective.

We focus in particular on the creation of a multi-national military force that could cross international borders, known as the 'G5 Sahel' Joint Force. Launched in 2017, this force has prioritized operations in the tri-border region of Mali, Niger, and Burkina Faso. Its primary mandate was to combat terrorism, trans-border crime, and human trafficking [2] Comprising 5,400 personnel from the national armies of Mali, Burkina Faso, Niger, Mauritania, and Chad, the Joint Force conducted regular border patrols and conducted joined and coordinated cross-border operations.

A priori, the effect of this mission on conflict dynamics is unclear. On the one hand, the mission solved legal constraints on operations in border areas, it may have increased troop levels and improved communication between national armies. In addition, it could have led to an internalisation of the externalities that characterize security provision in border areas. On the other hand, the create of the Joint Force might have introduced new coordination frictions between the army units from different countries.

Relying on data from the Armed Conflict Location and Event Database (ACLED), we assess the effect of the introduction of the G5 Joint Force on the basis of two empirical exercises. First, we exploit the limitation of the zone of operation of the G5 Joint Force to a 50 kilometer bandwidth around the concerned borders. Using a regression discontinuity around the zone of operation, we show that conflict is less intense where the G5 mission is active. This result does not seem to be driven by geographical displacement. We observe less violence initiated by Jihadist groups, and less violence initiated by security forces against ethnic militia. As the mandate of the G5 Joint Force was restricted to combating terrorists groups, these results suggest that the G5 mission operated in line with its objectives and achieved a degree of effectiveness in the outcomes we measure.

[2] I Additionally, the Joint Force was tasked with supporting the restoration of state authority and the implementation of development projects and humanitarian operations

Heterogeneity analysis reveals that violence drops more strongly in the operating zone of the G5 Sahel Joint Force where the borders are most porous, i.e. when the same ethnic group is present on both sides of the border and the border does not align with a major river.

To shed more light on the underlying mechanism, we conduct a second exercise in which we try to assess more directly if the G5 mission facilitated security operations in border areas. We focus on major French attacks on jihadist groups. We expect these attacks to trigger the movement of jihadist groups and new security operations. In the aftermath of these trigger attacks, we do see less security operations in border areas when the G5 mission is not active. However, when the G5 mission is active, this effect disappears. These findings offer additional support for the idea that the G5 force facilitated security operations in border areas.

Our paper adds to a small literature in economics and political science that studies the effect of borders on conflict outcomes with granular conflict data. Martínez (2017) shows that the presidency of Hugo Chavez in Venezuela increased the presence of FARC rebels in Colombian municipalities along the border. Studying the geography of conflict, Mueller et al. (2022) argue that raising physical barriers at ethnic frontiers could reduce conflict. Blair (2023) provides evidence from Iraq showing how border protections reduce the victimization of civilians by rebel fighters. However, this paper does not look at how borders affect the propagation of groups whose objectives are not limited to one country. In addition, the role of a cross-national force is particularly interesting as a policy intervention, as the construction of fences is practically not feasible in many settings, and may hamper with economic activity in border areas.

To our knowledge, our paper is the first to measure the effect of military cooperation between national armies on the conflict dynamics in border areas. We add to the large literature on the empirical study of conflict using econometric methods. This literature has studied the effects of economic shocks on conflict extensively (e.g. Miguel et al., 2004;

Ferrara and Harari, 2018; Dube and Vargas, 2013; Berman et al., 2015; Vanden Eynde, 2016). The role of religious and ethnic diversity (e.g. Montalvo and Reynal-Querol, 2005; Esteban et al., 2012), as well as the role of political institutions as drivers of civil conflict (Besley and Persson, 2011) have also been studied at length.[3] In parallel, there is increasing evidence on how development interventions affect conflict (Berman et al., 2011; Crost and Johnston, 2014; Fetzer, 2020)). The role of media and information interventions are also increasingly studied. For example, (Armand et al., 2020) find that radio campaigns can contribute to demobilization of armed groups.[4] Finally, and closest to the current project, a very recent literature evaluates the effect of military interventions. For example, Dell and Querubin (2018) find that aerial bombing campaigns by the US in Vietnam increased the support for communist insurgents. There is not much work studying in the organizational aspects of war and military planning.[5] Fetzer et al. (2021) study changes in military cooperation in the context of the security transition from NATO to the Afghan National Army in Afghanistan. This paper finds that the security transition improved security in a first stage, but worsened outcomes when NATO troops were withdrawn physically. The authors argue that these patterns are consistent with the Taliban lying low strategically to facilitate of the withdrawal. There is a broader question under which conditions external military interventions can be effective (For a recent survey, see Rohner, 2024). In the African continent, there is evidence military UN peacekeeping missions help to reduce conflict (Hultman et al., 2014). They also appear to protect the civilian population against rebel abuse, but not against abuse by government

[3] A number of recent papers have highlighted how specific sub-national institutions can spur or mitigate conflict (e.g. Shapiro and Vanden Eynde, 2023; Fetzer and Kyburz, 2023), or how institutional arrangements arise in war settings (Sanchez de la Sierra, 2020; Dincecco et al., 2022).

[4] For related work on the role of media, see: Yanagizawa-Drott (2014); Durante and Zhuravskaya (2018); Adena et al. (2015). While communication technology touches on a very important aspect of war, the focus of this existing work is on persuasion or coordination outside of the security forces. In contrast, this paper focuses on military cooperation.

[5] Exceptions are Ager et al. (2022), who study the role of incentives for fighter pilots in the German air force during World War II, and Acemoglu et al. (2020) who study the incentive for Colombian soldiers to target civilians and claim them as rebel fatalities. However, the focus of our paper is not on individual incentives, but on military cooperation.

forces (Fjelde et al., 2019). Of course, these settings are distinct from the one of military cooperation between neighbouring countries which we focus on in the current paper. Given the importance of international alliances for the effective provision of security, the questions addressed by our paper are particularly relevant - for the Sahel region and beyond.

As far as work on the Sahel region is concerned, our paper is also one of the first quantitative empirical studies of conflict in the region. Focusing on the seasonal migration of herders (transumant pastoralists), McGuirk and Nunn (2022) find that rainfall deficiency has exacerbated the conflict between pastoralists and agriculturalists. While these authors do not explicitly restrict their analysis the Sahel region, the processes they study are particularly important in the region we study. In Mali, Richard (2022) finds that the insecurity induced by the conflict hampers seasonal migration and, hence, reduces lean season consumption in village usually relying on this type of migration and an income source. Calvo et al. (2020) study the effect of conflict in Mali on social capital. They find that conflict exposure increases engagement political associations, which could deepen the conflict to the extent that these organizations act as interest groups for particular ethnic groups. Premand and Rohner (2023) study a large-scale conditional cash transfer scheme in Niger, and find that this programme increased conflict intensity. These recent contributions all shed light on important aspects of the conflict. However, our paper is the first to focus on the security operations in this conflict.

2 Background

The Sahel region has been plagued by conflict in recent years, with armed groups operating across borders and increasing violence since the 2012 Tuareg-led rebellion in Mali. This rebellion was followed by the proliferation of armed groups, including ethnic militias and jihadist groups. The concentration of violent events has been particularly high in

the three-borders area, spreading from Mali to neighboring Niger and Burkina Faso.This region is inhabited by various ethnic groups, including the Fulani and Tuareg, who constitute a majority in the area but are ethnic minorities in their respective home countries. As a result, it has become a recruitment target for jihadist groups. Over the past year, 31% of conflict-related fatalities in these countries occurred within 50 kilometers of these unmarked borders [6].

To address this instability, several international peacekeeping and counter-terrorism missions have been launched in the region. In January 2013, the French launched Operation Serval to regain control of the north of Mali, which was followed by the Barkhane operation, which has maintained a lasting presence in the country until its complete withdraw in May 2022. In April 2013, the United Nations deployed the Multidimensional Integrated Stabilization Mission in Mali (MINUSMA).

In February 2014, the G5-Sahel was created to facilitate military cooperation between Mali, Burkina Faso, Niger, Mauritania, and Chad. The G5-Sahel Joint Force was established by a UN resolution in June 2017,[7] and its command became active in September of that year. While the G5S initiative was strongly supported by France, analysts underline that the initiative came largely from the participating countries themselves (Touchard, 2018). Morevoer, the G5S force was operationally independent from the French military mission, altough some operations were conducted in coordination with Barkhane [8], and reports from meetings of the highest decision instance of the organisation report participation of Chief of Staff of the French Armed Forces and the commander of the Barkhane force operating in the Sahel [9]. Furthermore, the UN mission in Mali played an essential role for the local logistical support of the G5 Joint Force.

The G5-Sahel force had a mandate focused on combating terrorist groups and trafficking gangs in border areas. It gave national armies the possibility to operate outside

[6] 56.7% within 100 kilometers, 10.1% within 10 kilometers
[7] UN Resolution 2364 (2017).
[8] ACLED
[9] G5 Sahel, 24 October 2019 https://cdg5s.org/fr/node/1335

of the national territory, within pre-defined operation zones. In those zones, the force was also tasked with restoring state authority, and supporting development and humanitarian interventions (Touchard, 2018).

The Joint Force of the G5 Sahel was composed of 5,400 men across eight battalions, comparable to the size of the Barkhane force. The battalions were distributed around three operations areas, with a Malian and a Mauritanian battalion operating jointly in the Western operation zone at the border between Mali and Mauritania, four battalions with troops from Mali, Burkina Faso, Niger and Chad based in the Central Zone, at the border between Mali, Niger and Burkina Faso (the three-borders area), and a Nigerian and Chadian battalion based in the Eastern operation zone at the border between Chad and Niger. In G5 Sahel internal unclassified documents we have access to, 14 operations were reported in the Central Zone between 2017 and 2020, while only five and four operations were conducted respectively in the Western and Eastern operation zone during the same period.

The planning of operations, along with other operational responsibilities such as coordinating resources from member countries and ensuring effective communication and cooperation between operational zones, fell under the purview of the Commander of the Joint Force, and had to be approved by the Council of Defense and Security (CDS), composed of the Chief of Staff of national Armed Forces of its members, and meeting on a regular basis twice per year. However, internal reports from the G5 Sahel suggest that, in practice, heads of national armed forces retained control over operational responsibilities and often engaged in bilateral dealings rather than utilizing G5 Sahel institutions. Despite these shortcomings, the G5S mission facilitated communication between army units along the border. For example, reports mention the creation of a phone book covering the border zones with mobile numbers of officers along the border, which improves the reactivity of forces in these areas (Boeke and Chauzal, 2017).

For each of the three zones of operation, the G5S had a dedicated command. Com-

manders of these operation zones were in charge of tactical decisions, such as planning routine operations such as patrols or conducting spontaneous operations either to exploit a temporary vulnerability of an terrorist groups (called "opportunistic operations"), or respond to urgent needs of civilian protections.

Among the operations conducted by the Joint Force listed in in its internal documents or documented in the ACLED data were regular patrols in border areas, as well as spontaneous or planned joint cross-border operations. These operations involved airstrikes on armed group positions, conducted in cooperation with Barkhane, as well as the neutralization or arrest of terrorists and seizure of weapons.

The operating zones for the G5-Sahel mission were initially defined as buffers of 50 km around the international borders the borders, but in January 2020, an announcement was made to extend the operating zone to 100 km.[10] As the implementation of this extension is unclear,[11] the focus in our empirical analysis remains on the 50km buffer zone in the time period between September 2017 and January 2020.

We do not have access to the exact geographical locations for all G5-Sahel operations operations. However, in figure A 1 we map all the events reported in the ACLED data that mention the G5-Sahel force explicitly or that involve G5-Sahel members operating outside of their national territories. The spatial distribution of these events is consistent with a focus of the G5 Sahel joint force on the three-borders region between Mali, Niger and Burkina Faso, and with a restriction of operations within the 50 km buffer zone around these borders. For most of our empirical analysis, we will hence focus on this Central zone.

The activities of the G5 Sahel force were temporarily disrupted in June 2018, when a major suicide attack hit the G5 Sahel Joint Force headquarters. The resulting damage

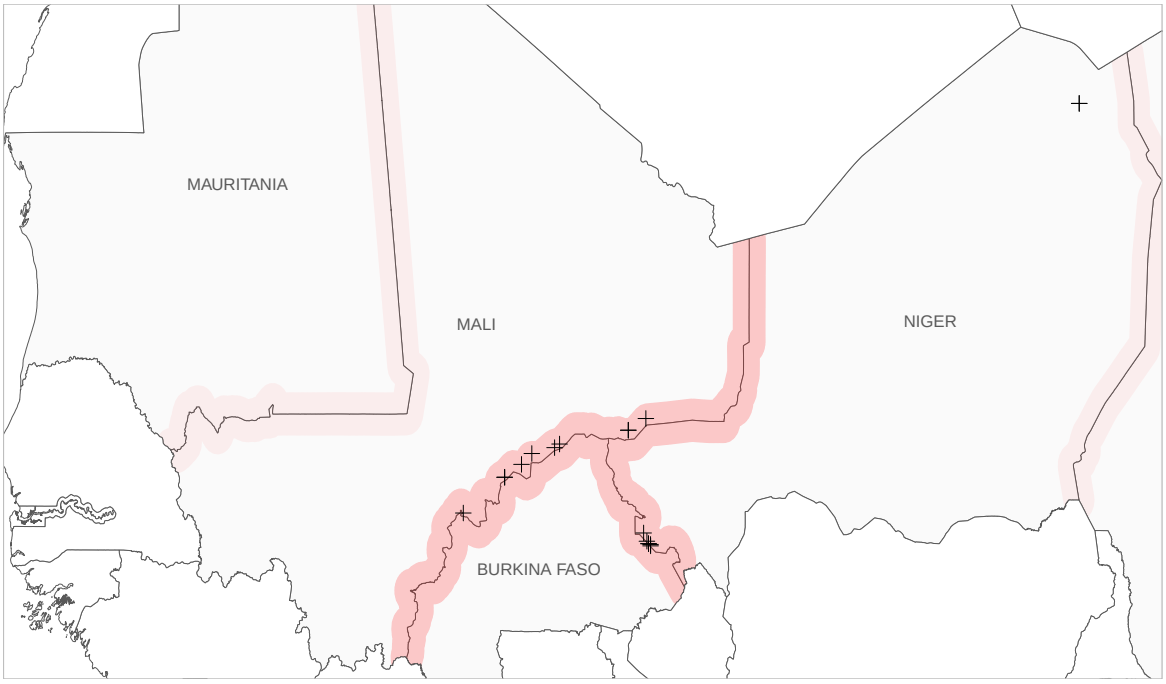
[10] G5 Sahel, 26 January 2020, https://www.g5sahel.org/les-chefs-d-etat-major-des-pays-du-g5-sahel-rendent-plus-operationnelle-la-force-conjointe.

[11] We observe not a single trans-border operation outside of the 50km buffer in the ACLED data. As late as December 2021, the French UN delegation website described the G5 mission as being active in a 50km zone (https://onu.delegfrance.org/france-s-action-in-the-sahel.)

Figure 1: Foreign Military Operations in Sahel regions

Panel A: Foreign Military Operations before G5-Sahel Joint Force Creation

Panel B: Foreign Military Operations during G5-Sahel period



Notes: Foreign Military Operations include all events involving G5 Sahel or G5-Sahel country members military forces outside of their national territory. The red shaded areas represent the 50 km operation zones around borders where the G5-Sahel operated officially between January 2017 and January 2020.

led to a suspension of activities until January 2019. The most active period of the G5-Sahel seem to have been between Agust 2019 and July 2021 under the command of General Oumarou Namata Gazama, Deputy Chief of Niger's Army, with 11 large-scale operations conducted during the period, besides routine and opportunistic operations [12]. From 2020 onward, two military coups in Mali generated tensions with the international community. The country finally left the G5-Sahel in May 2022, leading to the de facto end of the organization. Nevertheless, the G5-Sahel Joint Force was an essential part of international efforts to restore stability to the region for more than 5 years. Our paper attempts to assess its effect on conflict dynamics.

3 Theoretical Framework

The provision of security in border areas entails specific challenges. Armed groups may be more mobile than security forces, who are not allowed to cross borders. Anticipating the possibility of armed groups to flee to safe havens, security forces may decide not to intervene in border zones.[13] In addition, investments in security in border areas may have externalities for neighbouring countries which are not taken into account when countries decide on how much investments to make in border zones. For all these reasons, security provision might be under-optimal in border areas.

The G5-Sahel mission could have increased or decreased conflict intensity, depending on the mechanism of influence. First of all, counter-terrorism forces could be a deterrent or neutralize armed groups, leading to a reduction in observed violence. However, counter-terrorism operations are also likely to result in greater fatalities among armed group members, and they could lead to violent escalation. Similarly, counter-terrorism

[12]Source: Closing statement of the term of General Oumarou Namata Gazama as Commander-in-Chief of the G5 Sahel Joint Force, 31st July 2021

[13]Theoretically, the possibility of displacement could also lead to a number of security operations in border zones that is above its optimal level, as neighbouring countries compete to try to push groups across the border. However, this mechanism seems most plausible when investments in security and displacement are long-lived, which is not the case in the context of the Sahel.

forces could be an additional risk factor for civilians. These may become collateral victims, or could suffer from retaliation of armed groups against suspected collaborators. Moreover, organizational frictions between national armies could reduce the effectiveness of the joint force. Descriptive accounts point at severe coordination problems in terms of equipment and command structures (Touchard, 2018).

In thinking about the impacts of the G5 mission, the effects could be direct, involving the operations of G5-Sahel units, but also indirect when they involve other units whose behaviour changes in response to the presence of the G5-Sahel mission. For example, the improved communication between border forces that the G5S mission facilitated is likely to affect all units.

Our empirical approach will not enable a fine distinction between all mechanisms. However, the sign of the net effects we estimate, in combination with a detailed analysis of different types of violence, will help us to narrow down the mechanisms underlying our findings. In addition, heterogeneous effects can shed some further light on the causal channels. If the G5 mission improves military coordination in border areas where militants are more mobile, we could expect the impacts to be most pronounced where it is also easier for armed groups to move without being detected or interrupted – for example in rugged areas.

4 Data

Our main source of violence data is ACLED (Armed Conflict Location Event Data). ACLED is a database that tracks and records information on armed conflicts and political violence around the world. The data is sourced from a variety of sources, including traditional media, social networks, NGOs, international organizations, and local partners. For each violent event, the ACLED data records the number of fatalities that occurred. The events are also geo-coded, meaning that their location is identified and

mapped. The locality of the events is coded at different levels of precision. This coding precision will be important for our study, as our regression discontinuity approach will exploit fine geographical variation. In addition to its localisation, each ACLED event is dated precisely. Further sub-categories are created based on the actors involved in each event. These sub-categories help to differentiate between different types of violence, such as conflicts between state and non-state actors or violence between different non-state actors. Overall, the ACLED data provides a comprehensive and detailed record of violent events and their associated actors, fatalities, and locations. It is important to acknowledge that such data may be subject to biases and limitations. While ACLED relies on various sources to compile its database of conflict events and casualties, this reliance on often fragmented and incomplete information can lead to underreporting or overreporting of casualties, particularly in areas with limited media coverage or where access is restricted. While the reported fatalities are likely to be biased as underscored by the ACLED data description as "prone to manipulation by armed groups, and occasionally the media", this noisy measure may still contain some information about conflict intensity, and has been shown to correlate strongly with climatic shocks (e.g. Ferrara and Harari, 2018), population displacement (e.g. Tai et al., 2022). and child health (e.g. Tapsoba, 2023). As a robustness check, we also use a transformation of the fatality variables recording whether any event with any fatality is reported.

We map the ACLED data and use information on the operation zones of the G5-Sahel mission that we obtained from official documents. To this mapped violence data, we add granular data on nightlight emissions and geographical features such as road access, urbanization, ruggedness and closeness to rivers. These additional variables will be used to support the validity of our empirical approach.

Figure A 1 shows the trends in violence, based on the ACLED data, in the "central operation zone", i.e. the three border area of Burkina Faso, Mali, and Niger. Violence is clearly trending upwards from early 2017 onwards. This increase is particularly

pronounced in areas very close (within 15 km) to the international borders, while the broader operation zone of the G5 mission follows a trend that is similar to the one observed for the areas outside of the G5 operation zone. While this graph illustrates the overall conflict dynamics and is important for the context of our study, we do not think it allows us to identify the effect of the G5-Sahel mission. The low levels of violence before the launch of the G5-Sahel force in September 2017 make the setting ill-suited for a difference-in-difference approach. Moreover, the G5-mission was created in anticipation of the conflict becoming more gradually intense in the border areas, and the strategies of various actors may have contributed to this intensification. Hence, estimating the effect of cooperation between national armies necessitates a more granular approach. We develop such empirical strategies in the next section.

To characterize borders' porosity as well as potential logistical support available to the Joint Force, we use three additional data sources on the spatial distribution of ethnic groups from Desmet et al. (2020), on major rivers flows using the river network in Africa produced by the World Agro-forestry center, and on the location of UN-Peacekeeping Missions in Mali using The Geo-PKO dataset (Cil et al., 2020).

5 Empirical strategy

We will study the effect of the G5 Sahel mission through the lens of two empirical exercises.

5.1 Discontinuity around G5 operation zones.

First, we will use a regression discontinuity design to assess whether violence levels are different in the operation zones of the G5-mission. We are interested in comparing areas where national armies cooperate to areas that are under the sole responsibility of national army units. The precise definition of the operation zone of the G5 mission offers

a plausibly exogenous assignment to these two security environments. In particular, we leverage the spatial discontinuity created by the limitation of the G5-Sahel operation zone within 50 km of G5-Sahel countries' borders:

$$\begin{aligned} y_i = \alpha + \beta Border_i + \delta\left(Distance_i - z_0\right) \\ + \delta' Border_i \cdot \left(Distance_i - z_0\right) + \delta_b + \eta_c + \epsilon_i \end{aligned} \tag{1}$$

In this specification, the outcome y_i is our measure of conflict at the grid-cell i level. z_0 refers to the limit of the buffer zone, at 50 km. $Distance_i$ measures the distance to the 50km buffer limit. We could expect this running variable to correlate with conflict outcomes - for example, conflict could be systematically more intense when we are closer to the international border. In our empirical approach, we want to control for such impacts, and evaluate instead whether the operation zone of the G5 creates a discontinuous change in conflict outcomes. The discontinuity is be captured in the equation by $Border_i$, which indicates whether grid-cell is less than 50km from the border. We also include border segment fixed effects δ_b and country fixed effects η_c. We allow for a data-driven choice of two bandwiths for optimal mean squared error (MSE) point estimation with Calonico-Cattaneo-Titiunik procedure (Calonico et al., 2014). As the RD approach relies on a fine coding of conflict events, we use granular gridcells (0.025 by 0.025 degrees), and we focus on ACLED events with the highest precision level for our main results. We show findings for alternative coding as robustness checks. To support the validity of the RD approach, we will show continuity of geographical characteristics and pre-G5 levels of violence around the border of the operation zone.

5.2 Response to trigger events

To shed further light on the mechanisms underlying the RD results, we will rely on a second empirical exercise. Here, we study how the response of violence to trigger events

differs in border areas and depending on whether the G5 mission is active or not. As trigger events, we focus on major French operations against Jihadist groups, which we identify as operations that claim at least 5 fatalities. These events are followed by a marked intensification of conflict, as shown in figure A 6 in the online appendix. In a triple difference approach, we will compare the response to trigger events between border and non-border areas, and when the G5-Sahel mission is active versus not active. As for the RD results, we use 0.025 by 0.025 degree grid-cells. We restrict ourselves to trigger operations that are less than 250km from the three-border area. Then, we construct a window of 8 weeks,[14] and a geographical circle of a 100km radius, around each trigger operation. Figure 2 illustrates the spatial definition of trigger operations and border areas.When gridcells are part of multiple event windows, we keep only the first window for that gridcell.[15] In total, our sample has 48 trigger operations, and 20 of these take place when the G5-Sahel mission is not active.

The resulting estimating equation is:

$$y_{i,p,t} = \zeta Border_i * Post_{t,p} + \chi Border_i * Post_{t,p} * G5_t + \eta_i + \gamma_{p,t} + \epsilon_{i,p,t} \tag{2}$$

In this equation, $y_{i,p,t}$ is a measure of conflict at time t in gridcell i for a window around operation p. t is measured in two-week periods. The outcome $Border_i$ indicates whether grid-cell is less than 50km from the international border, so within the operation zone of the G5-Sahel force. $Post_{t,p}$ is one in the time periods after the trigger operation. $G5_t$ is an indicator for when the G5 Force is active.[16] We also include operation by time fixed effects ($\gamma_{p,t}$), as well as gridcell level fixed effects (η_i). We cluster standard errors at the

[14] We exclude the day of the trigger event and the day after, to avoid mechanical effects.

[15] This approach prevents us from using already treated gridcells as a control in future comparisons. As has been highlighted by the recent literature on difference-in-difference methods, such comparisons could introduce negative weights in the estimated treatment effect (de Chaisemartin and D'Haultfoeuille, 2022).

[16] As we are interested in immediate response patterns, we will consider the period in which the G5-Sahel mission was incapacitated by a suicide attack on its headquarters as a period in which the G5 is not active, between June 2018 and January 2019.

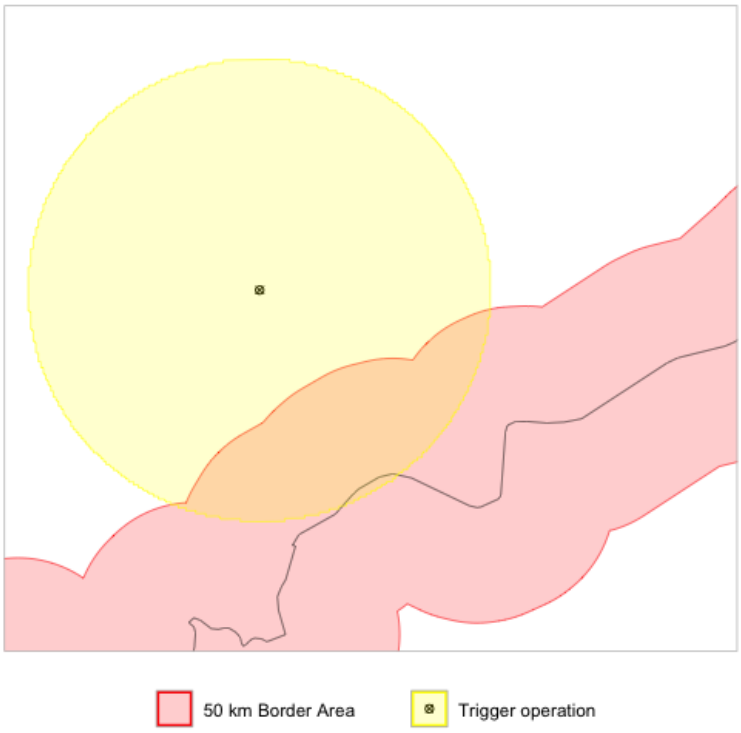


Figure 2: Definition of trigger response areas and border areas

gridcell-level. While our main interest is in the triple difference specification above, we will also show results where we estimate time-to-operation effects in event study graphs.

For both empirical exercises, we consider the period of activity of the G5 Sahel between September 2017 and January 2020 within 50 km of border areas, at the zone of operation of the Joint Mission after January 2020 and the exact date of the end if its activities cannot be defined clearly. For the response analysis, as we are interested in immediate military response to initial trigger events, we consider the period between June 2018 and January 2019 in which the G5-Sahel mission was incapacitated by a suicide attack on its headquarters as a period in which the G5 is not active, but check that the results are robust to considering this period as active.

6 Results

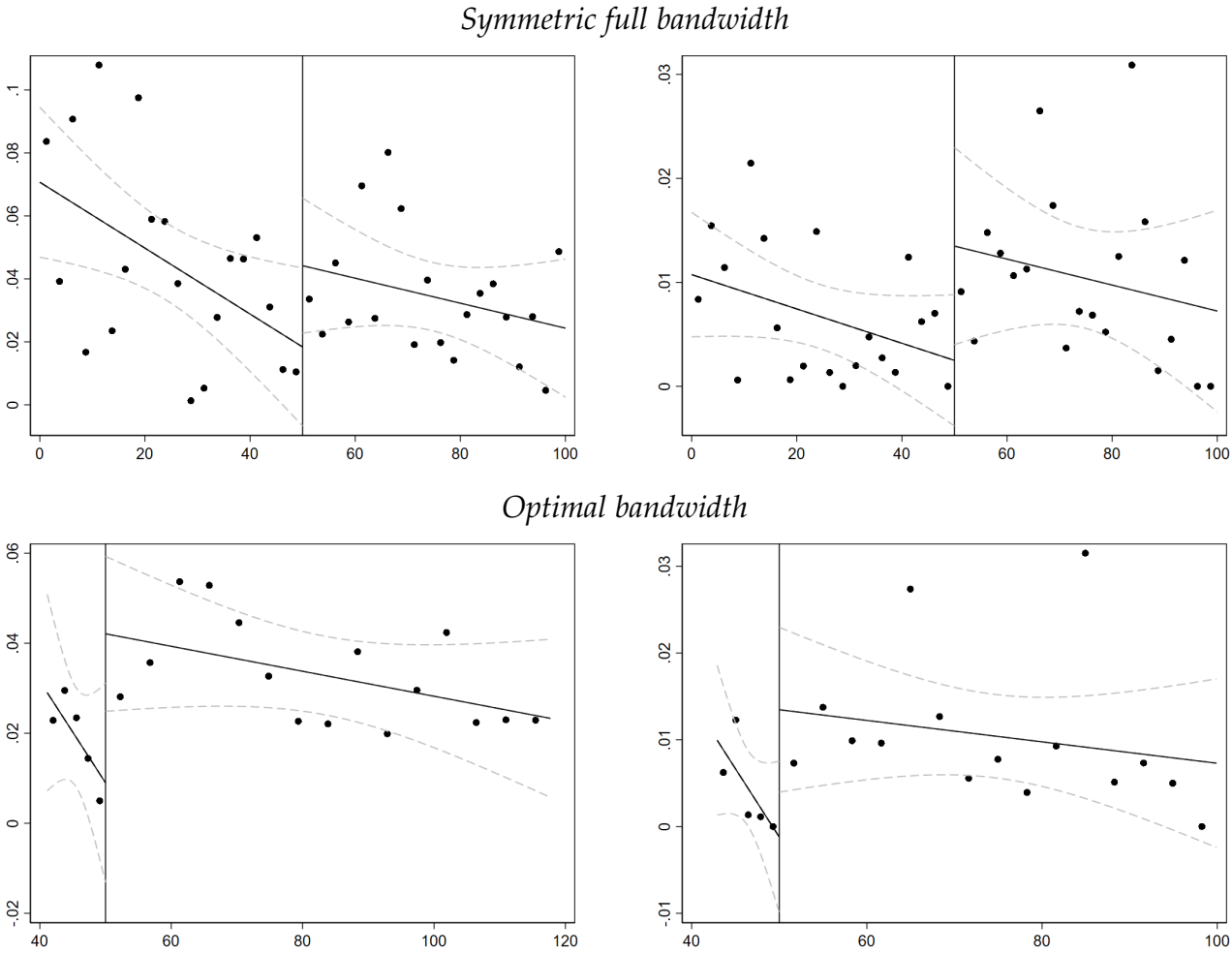
RD results Figure 3 compares fatalities in gridcells within the G5-Sahel central operation zone to those in gridcells just outside the operation zone during the period of activity of the G5 mission within 50km of international borders. The local linear regressions in Panel A and B shows a clear discontinuity in the number of total conflict fatalities and civilians fatalities caused by Islamist groups at the border of the operation. There are less fatalities where the G5 mission is active, especially for events involving Islamist groups whose containment was the objective of the G5 mission. The discontinuity appears stronger with the data-driven optimal bandwidth (Calonico-Cattaneo-Titiunik procedure to minimise bias and variance of the RD estimator) which mostly excludes cells closer to the international border.

The graphical patterns show a gradual increase in conflict as one moves closer to the international border. This effect can be due to the strategic importance of the border for the security forces, as well as the net benefits of operating in these areas from the perspective of armed groups. However, the RD results show a discontinuous jump in this pattern within the operation zone of the G5. The graphical patterns also suggest that the results are not driven by symmetrical displacement, where the reduction within the operation zone is offset by increased violence just outside the operation zone. Of course, it is impossible to rule out more gradual displacement. However, interpretationally, this would still provide evidence of the local effectiveness of the G5-Sahel mission. As we set out in the theoretical framework, it is far from obvious ex ante that the mission should have reduced violence - even locally.

Figure A 2 in Appendix shows the comparison for the total number of fatalities during the G5 mission period and before September 2017, when the G5 mission was not active. There is no discontinuity in the pre-treatment period, which supports the validity of the RD approach.

Figure 3: Regression Discontinuity for G5 central operation zone

Panel A: All events fatalities *Panel B:* Attacks on civilians by Islamist groups



Notes: Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 200km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. The sample comprises the central Zone (Mali-Niger-Burkina Faso three borders regions). Included events are coded with geo-precision level 1.

Table 1: Discontinuity in conflict intensity for G5 Sahel Central operation zone by actors 2017-2020.

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count) (1)	Events (2)	Fatalities (count) (3)	Events (4)	Fatalities (count) (5)	Events (6)	Fatalities (count) (7)	Events (8)
Panel A: All events								
Robust	-0.0449***	-0.0108	-0.0050**	-0.0022***	-0.0359**	-0.0073	-0.0319***	-0.0033
	(0.0165)	(0.0073)	(0.0025)	(0.0007)	(0.0151)	(0.0069)	(0.0113)	(0.0051)
Mean DV	0.027	0.011	0.003	0.001	0.024	0.010	0.016	0.007
Standard Deviation	1.115	0.220	0.211	0.033	1.073	0.198	0.646	0.123
Observations within buffer	3726	5881	7285	4865	3609	6378	3285	7668
Observations untreated	38392	25505	27652	42229	32315	22713	34083	22389
Bandwidth untreated (km)	71.101	46.514	50.720	78.387	59.485	41.264	62.884	40.734
Bandwidth treated (km)	6.499	10.214	12.582	8.413	6.280	11.000	5.684	13.220
Panel B: Events involving Islamist groups								
Robust	-0.0244**	-0.0094***	-0.0015	-0.0008	-0.0244**	-0.0094***	-0.0132***	-0.0041*
	(0.0115)	(0.0035)	(0.0017)	(0.0005)	(0.0115)	(0.0035)	(0.0047)	(0.0021)
Mean DV	0.015	0.006	0.000	0.000	0.015	0.006	0.005	0.003
Standard Deviation	0.875	0.123	0.067	0.011	0.875	0.123	0.273	0.076
Observations within buffer	6957	5243	8599	6298	6957	5243	4079	8771
Observations untreated	37374	39015	30246	28692	37374	39015	25485	45587
Bandwidth untreated (km)	69.241	72.389	55.643	52.692	69.241	72.389	46.456	84.874
Bandwidth treated (km)	12.079	9.105	14.864	10.868	12.079	9.105	7.090	15.092
Panel C: Events involving Communal militia								
Robust	-0.0084	0.0019	-0.0025	-0.0017***	-0.0084	0.0019	-0.0081	0.0035
	(0.0085)	(0.0033)	(0.0018)	(0.0006)	(0.0085)	(0.0033)	(0.0076)	(0.0029)
Mean DV	0.008	0.002	0.002	0.001	0.008	0.002	0.006	0.001
Standard Deviation	0.573	0.058	0.195	0.028	0.573	0.058	0.516	0.042
Observations within buffer	3270	11604	6942	4750	3270	11604	3114	12034
Observations untreated	39963	24751	29184	34175	39963	24751	35309	20710
Bandwidth untreated (km)	74.163	45.224	53.602	63.075	74.163	45.224	65.131	37.586
Bandwidth treated (km)	5.664	19.825	12.034	8.208	5.664	19.825	5.421	20.548
Panel D: Events involving civilians								
Robust	-0.0319***	-0.0033	-0.0020*	-0.0011***	-0.0249**	-0.0004	-0.0319***	-0.0033
	(0.0113)	(0.0051)	(0.0012)	(0.0004)	(0.0104)	(0.0046)	(0.0113)	(0.0051)
Mean DV	0.016	0.007	0.002	0.000	0.013	0.006	0.016	0.007
Standard Deviation	0.646	0.123	0.191	0.024	0.600	0.112	0.646	0.123
Observations within buffer	3285	7668	7553	5101	3190	9994	3285	7668
Observations untreated	34083	22389	16038	33412	27594	21360	34083	22389
Bandwidth untreated (km)	62.884	40.734	28.872	61.633	50.602	38.746	62.884	40.734
Bandwidth treated (km)	5.684	13.220	13.036	8.807	5.544	17.149	5.684	13.220

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of borders between Burkina Faso, Mali and Niger are included for the period between January 2011 and September 2017. Include events coded with geo-precision level 1 only. Empty cells means the discontinuity could not be estimated due to lack of variability in the dependent variable. Military operations involving islamist groups record fatalities from islamist groups only, whereas attacks by armed group and attacks on civilians involving islamist goups record fatalities caused by islamist groups. Idem for communal militia and unidentified armed groups. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Continuity in conflict intensity and geographical variables for G5 Sahel Central operation zone before G5 Sahel first operation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Conflict variables before Sept 2017		Geographical variables							
Variables:	Events	Fatalities(#)	GHS pop	Nightlight 2017	Nightlight 2014	NDVI	Road	Rivers	Cities	Ruggedness
Conventional	0.0005	-0.0004	-0.3384	-0.0034	-0.0024	0.2634	-0.3823	0.2758	0.1124	0.0909
	(0.0021)	(0.0020)	(4.1348)	(0.0027)	(0.0029)	(0.2451)	(0.4188)	(0.6033)	(0.6682)	(0.4954)
Bias-corrected	0.0007	-0.0006	-2.2285	-0.0044*	-0.0032	0.2521	-0.6176	0.2674	-0.0362	0.0989
	(0.0021)	(0.0020)	(4.1348)	(0.0027)	(0.0029)	(0.2451)	(0.4188)	(0.6033)	(0.6682)	(0.4954)
Robust	0.0007	-0.0006	-2.2285	-0.0044	-0.0032	0.2521	-0.6176	0.2674	-0.0362	0.0989
	(0.0024)	(0.0028)	(4.7529)	(0.0032)	(0.0035)	(0.2928)	(0.4756)	(0.7200)	(0.7954)	(0.5605)
Mean DV	0.004	0.010	36.676	0.195	0.009	131.669	21.677	36.819	116.643	13.787
Standard Deviation	0.357	0.920	214.323	0.262	0.260	16.791	36.265	33.116	101.818	20.645
Observations within buffer	5369	4476	7415	10155	6911	6319	8565	11255	12201	6700
Observations untreated	14332	6874	14654	11793	11971	15691	9974	17162	18665	8946
Bandwidth untreated (km)	25.662	12.131	26.330	21.065	21.399	28.188	17.742	30.911	33.761	15.923
Bandwidth treated (km)	9.389	7.804	12.804	17.466	11.981	10.904	14.798	19.211	20.821	11.560

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of borders between Burkina Faso, Mali and Niger are included for the period between January 2011 and September 2017. Include events coded with geo-precision level 1 only. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

Panel A in Table 1 shows RD estimates for different estimation approaches and outcomes. We see that the general pattern of lower fatalities in the G5 operation zone holds across estimation methods and outcomes. The magnitude of the effect is large: crossing into the operation zone of the G5 mission reduces the number of fatalities in a given gridcell by 0.04, whereas the mean number of fatalities per gridcell is around 0.03. The reduction in violence is observed for security operations, attacks by armed groups, and violence against civilians. The effects are a bit more marked for the number fatalities than for event counts, but they go in the same direction.

To shed more light on the mechanisms underlying the observed reduction in violence, the subsequent panels in Table 1 show RD results for a finer classification of violent events based on the actors involved. Panel B focuses on violence involving islamist groups. Interestingly, security operation against islamist groups do not decrease significantly in the operation zone of the G5 region. However, there are less attacks by armed jihadist groups and less attacks against civilians. Strikingly, there is a more pronounced reduction in security force violence against ethnic militia groups, while these ethnic militias do not reduce their violence significantly. As the official mandate of the G5-Sahel force is focused on combating Jihadist groups, these findings suggest the G5-Sahel mission reduces violence initiated by the actor it is supposed to target. In this sense, the mission appears to be effective.

Table 2 presents important validity checks for the RD approach. It confirms the absence of discontinuities in pre-G5 conflict measures as well as geographical characteristics. Hence, we are confident that the regression discontinuity estimates are picking up the causal effect of grid-cells belonging to the operation zone of the G5 mission.

Heterogeneity analysis

Table 3 presents heterogeneous results based on the characteristics of the border. The observed reduction in violence is particularly prominent in border segments aligned with rivers and where a shared ethnic group resides on both sides of the border. Rivers

serve as natural barriers, enhancing detection and interception capabilities, while the presence of a common ethnic group facilitates cross-border mobility and operations of armed groups. Consequently, these findings support the hypothesis that the effectiveness of the G5 is greatest in regions with porous borders. [17] Figure A 5 in appendix illustrates the definition of border segments characteristics used for this heterogeneity analysis. The patterns are a bit harder to interpret for the distance to MINUSMA forces. The reduction in violence is larger in the vicinity of MINUSMA forces, which could capture complementarities between the G5 Sahel mission and MINUSMA.

Table A1 in appendix further shows heterogeneity by border and country member, suggesting the G5 is most effective at the border between Mali and Burkina Faso, and to a lesser extent at the border between Mali and Niger, but does not seem to affect significantly conflict intensity at the border between Niger and Burkina Faso. At country level, the strongest effect is detected for Burkina Faso, and then for Mali. These results together suggest that the G5 may be most effect at containing conflict whithin Burkina Faso along the border with Mali. This in line with the characteristics of these borders describe in Table A6: the border between Mali and its two neighbors tend to be closer to MINUSMA bases, and have greater presence of transborder ethnic groups. These characteristics may, in turn, may drive a greater "Mali effect". We cannot test formally however, to which extent these factors drive the observed heterogenous effects across borders. The second part of Table A6 in turn, show that among G5 operations observed in the ACLED data (represented in Figure 1), there were relatively more operations conducted within Mali, and especially at the border between Mali and Burkina-Faso. While reporting issues may affect the reliability of the ACLED data on foreign interventions, these patterns are consistent with a general objective of the G5 to prevent the spread of insecurity from Mali to its neighbors.

[17] Modern RD methods are not set up to estimate heterogeneous effects, so we do not formally test the difference between coefficients. Another caveat to this interpretation is that that some of difference between these regions already appears in the mean of the dependent variable.

Table 3: Discontinuity in conflict intensity for central G5-Sahel operation zones 2017-2020, heterogeneity by border segment characteristics.

	Low rugged		High rugged		River		No river		Close MINUSMA		Far MINUSMA		No common group		Transborder group	
	Fatalities (1)	Events (2)	Fatalities (3)	Events (4)	Fatalities (5)	Events (6)	Fatalities (7)	Events (8)	Fatalities (9)	Events (10)	Fatalities (11)	Events (13)	Fatalities (11)	Events (14)	Fatalities (15)	Events (16)
Conventional	-0.0306	0.0064	-0.0489***	-0.0242***	-0.0561	0.0016	-0.0409***	-0.0166**	-0.0956**	-0.0096	-0.0089*	-0.0100**	-0.0332**	-0.0059	-0.0647**	-0.0193**
	(0.0194)	(0.0089)	(0.0186)	(0.0072)	(0.0484)	(0.0151)	(0.0119)	(0.0066)	(0.0402)	(0.0143)	(0.0048)	(0.0041)	(0.0155)	(0.0087)	(0.0287)	(0.0084)
Bias-corrected	-0.0403**	0.0079	-0.0442**	-0.0256***	-0.0687	0.0022	-0.0411***	-0.0182***	-0.1084***	-0.0105	-0.0085*	-0.0107***	-0.0382**	-0.0076	-0.0639**	-0.0208**
	(0.0194)	(0.0089)	(0.0186)	(0.0072)	(0.0484)	(0.0151)	(0.0119)	(0.0066)	(0.0402)	(0.0143)	(0.0048)	(0.0041)	(0.0155)	(0.0087)	(0.0287)	(0.0084)
Robust	-0.0403*	0.0079	-0.0442**	-0.0256***	-0.0687	0.0022	-0.0411***	-0.0182**	-0.1084**	-0.0105	-0.0085	-0.0107**	-0.0382**	-0.0076	-0.0639**	-0.0208**
	(0.0228)	(0.0108)	(0.0195)	(0.0084)	(0.0550)	(0.0181)	(0.0139)	(0.0076)	(0.0458)	(0.0161)	(0.0063)	(0.0048)	(0.0178)	(0.0100)	(0.0322)	(0.0094)
Mean DV	0.027	0.011	0.028	0.011	0.034	0.015	0.025	0.010	0.054	0.019	0.016	0.008	0.031	0.015	0.022	0.005
Standard Deviation	1.156	0.208	1.079	0.229	1.437	0.268	0.985	0.202	1.869	0.325	0.496	0.151	0.954	0.231	1.313	0.202
Observations within buffer	1877	3857	2720	2553	1273	2210	3128	3683	1605	3325	2945	3046	2331	3810	1828	2098
Observations untreated	16102	7492	15009	20661	10716	5092	22476	27036	13580	9346	8385	20683	17560	13881	19543	15822
Bandwidth untreated (km)	67.118	30.000	49.788	68.818	83.155	37.708	54.495	66.045	79.221	51.911	22.665	56.679	53.362	41.634	90.312	73.044
Bandwidth treated (km)	7.074	14.561	8.660	8.134	8.829	15.297	7.261	8.442	7.887	16.044	7.915	8.148	6.446	10.470	8.465	9.790

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only. Cells that intersect with the limit of the 50km buffer of intervention are dropped from the sample. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

Robustness of the RD results In the appendix, we present RD plots for a wider range of outcomes in figures A 3 and A 4.[18] Table A5 offers a detailed comparison of alternative coding approaches for the main violence outcomes. It includes results where the fatality numbers are subject to an inverse hyperbolic sine transformation. It also considers measures that include violence events that are coded less precisely (level 2 in ACLED). Including these less precisely coded violence events tends to makes the RD estimates less precise too. However, the broad patterns we found in our main results are generally robust to these alternative measurement approaches. Table A2 replicates the main RD results over the Western and Easter operations zones and finds no discontinuity in any outcome, which is consistent with the lower treatment intensity in these areas.

Table A3 further shows that the results are also robust to dropping cells crossed by the 50km buffer line, top-coding the 1% top fatalities and transforming the fatalities variable to a dummy indicating any fatality. Table reproduces the RDD results with manually set banwdith and a standard linear estimation of the G5 area effect while controlling for several transformation of the distance to the border and flexible controls for longitude and latitude, with stable coefficients across specifications.

Strategic relocation of armed groups outside the G5 intervention zone. Despite the limitations of the RD setting preventing a direct assessment of gradual displacement beyond border areas, the observed patterns in the RDD plots do not support a symmetrical shift of conflict intensity just beyond the 50km operational zone of the G5 Joint Force. The concentration of violence in border regions, as evidenced by a significant linear increase in conflict intensity with proximity to borders, suggests that borders inherently escalate conflict intensity. Thus, relocating armed groups away from border areas should yield a positive impact on overall security.

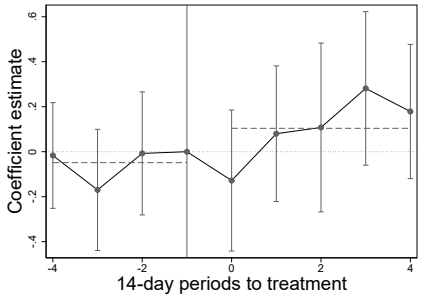
Furthermore, the heterogeneity analysis reveals that the G5 intervention is most ef-

[18]One issue "commongroup ==0" by the graphs in figure A 3 is the small number of security operations against Islamist groups in the optimal RD bandwidth. Figure A 4 shows this number increases when including less precisely coded events.Table A5 provides results for coarser geographical precision levels.

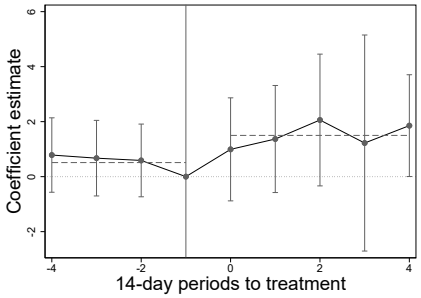
fective in regions with more porous borders. This indicates that the Joint Force has been successful in mitigating the border effect on conflict intensity. The second empirical exercise analysing response to French trigger operations in border areas highlights one mechanism through which this reduction operated.

Figure 4: Reaction to trigger events - border areas under G5

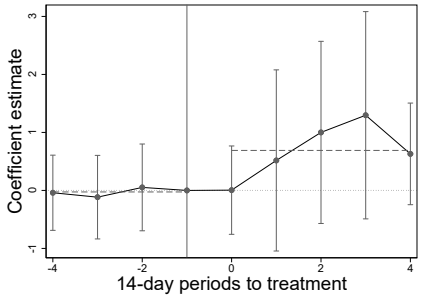
Panel A: All events - Fatalities



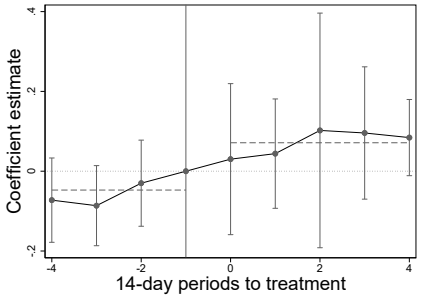
Panel B: All events



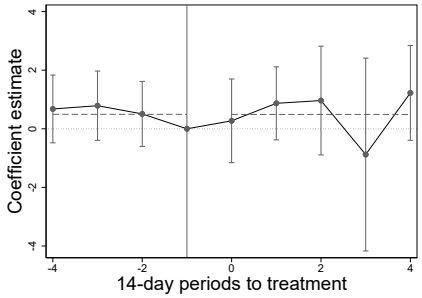
Panel C: Military Operations - Fatalities



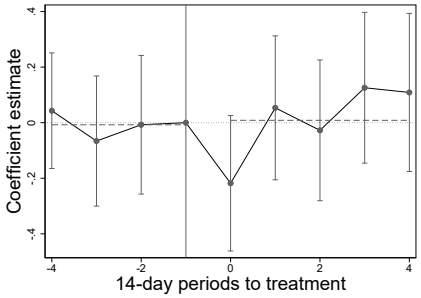
Panel D: Military Operations - Events



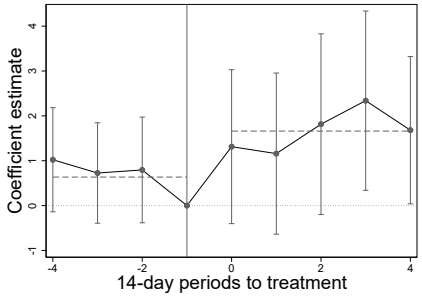
Panel E: Attacks by armed groups - Fatalities



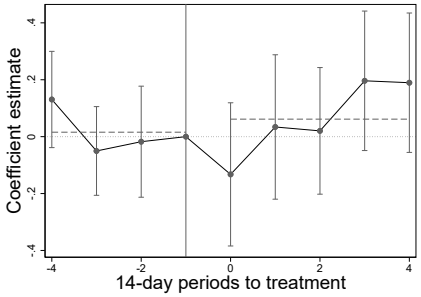
Panel F: Attacks by armed groups - Events



Panel G: Attacks on civilians - Fatalities



Panel H: Attacks on civilians - Events



Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020). Results are based on the estimating equation (2), in which we estimate time-to-treatment effects around the trigger operation for the interaction term $Border_i * G5_t$, and we include operation by time-to-treatment fixed effects. Standard errors are clustered at the grid-cell level, and grey bars represent 95% confidence intervals.

Table 4: Reaction to trigger events

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border x Post	-0.53	-0.15**	-0.51**	-0.10**	-0.02	-0.05	-0.68***	-0.07
	(0.40)	(0.07)	(0.21)	(0.04)	(0.36)	(0.06)	(0.21)	(0.04)
Border x Post x G5	0.99*	0.15*	0.99***	0.14***	-	0.02	1.03***	0.05
	(0.52)	(0.08)	(0.32)	(0.05)	(0.42)	(0.07)	(0.34)	(0.05)
Mean DV	0.693	0.178	0.313	0.054	0.380	0.125	0.360	0.099
Standard Deviation	4.676	0.576	3.373	0.372	2.635	0.387	2.432	0.332
Observations	3168	3168	3168	3168	3168	3168	3168	3168
Clusters	352	352	352	352	352	352	352	352

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020). Results are based on estimating equation (2). Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Response to trigger events We now turn to our second empirical exercise, which compares responses of violence events to trigger operations. Figure 4 shows the differential violence in border areas when the G5 mission is active, split up in 2-week time periods around each trigger event. Panel A shows that relatively more violence events occur in border areas (so, within the G5-Sahel operation zone) when the G5-Sahel force is active. The split-up by type of violence in Panels B to D suggests that it is mostly the violence initiated by security forces that is driving this intensification. Focusing on panel B alone, this intensification is visible relatively soon after the trigger event. Table 4 confirms these patterns. Interestingly, it also shows that when the G5 mission is not active, there are less security operations following a trigger event in border areas.[19] This finding supports the hypothesis that security forces are hampered in their operations when the G5-Sahel mission is not active. However, this relative reduction in the intensity of operations is entirely off-set when the G5 mission is active. This result suggests that the G5-Sahel mission did achieve its goal of facilitating operations in border areas. This pattern is mirrored by violence against civilians. Additional analysis in table A7 suggests that this effect is mostly coming from violence by security forces against the civilian population.[20] In the main results, based on the RD approach, we found reductions in violence by militant groups. The response analysis does not show such reductions, but it is important to keep in mind that the response estimates are not set up to capture the longer-term dynamic impacts of security operations in border areas. For such global effects, we think our earlier RD results are more insightful.

[19]Figure A 7 presents event studies around trigger events, comparing border and non-border areas, and showing these patterns separately for periods in which the G5-Sahel mission is active or not. Panel C shows the relative reduction in security operations in border areas after trigger events, and Panel D shows how this pattern reverses when the G5-Sahel mission is active.

[20]In this table, military operations against Islamist groups and communal militia respond in a similar way, which may appear at odds with the results of the RD analysis, where security force attacks against militia groups declined more than against Islamist groups. It should be kept in mind that the trigger events always involve Islamist groups, so that the nature of security force operations against communal militias may be different in trigger analysis. Indeed, it is impossible to disentangle the ethnic and religious dimensions of the conflict fully. In addition, it is also worth keeping in mind that there are limitations to the coding of actors (a substantial share of events involves unknown actors).

Robustness of the trigger event analysis In the appendix, we test the sensitivity of the results to an alternative criterion for the trigger event, where we focus on operations in which more than 10 (instead of at least 5) people died (Table A8). These results are noisier, as the more selective criterion reduces the sample, but the pattern on military operations is the same and significant (at 10%) for the event measures. In Table A9, we present results for an alternative coding of the G5 operation period, treating the entire period from September 2017 onwards as "active". In this coding, we ignore the incapacitation of the G5 mission after the 2018 suicide attack. Compared to table 4, we find similar patterns for military operations - they are lower in border areas before the G5 is active, and increase afterwards.[21] In table A10, we show a version of the response analysis where we include all grid cells in the sample, including those that were included in earlier event windows. The main results are robust to using this larger sample. Finally, table A11 shows the response analysis for binary violence outcomes. These findings confirm that the G5 mission changes response patterns on the extensive margin.

[21] In contrast to the main results, the coefficient on attacks against civilians is significantly positive before the G5 is active in the alternative coding. Low levels of violence before September 2017 hamper the comparability of violence patterns between the pre- and post-periods, so we do not want to emphasize this result. However, it is possible that the nature of violence against civilians changes over time. Before 2017, they could have suffered from poor security in border areas, whereas the intensification of the conflict might have them more vulnerable during military operations.

7 Conclusion

This paper examines how the establishment of an international armed force capable of crossing borders, known as the G5-Sahel, influenced the intensity and spatial distribution of conflict in the region's porous border areas. Our analysis indicates that the G5 mission reduced the intensity of conflict, at least locally, within its operation zone. By studying how the spatial distribution of violence responds to trigger events, we also find that the mission facilitated security operations in border areas. In this sense, our results offer a coherent narrative, whereby improved cooperation between national armies contributes to a reduction in equilibrium levels of violence. It should be kept in mind that the armies that are part of the G5-Sahel mission are regularly accused of human rights abuses, and we see that fatal violence against civilians mirrors their activities in our data. Hence, the welfare implications of our findings are far from clear in the context we study. In addition, the local effects that we estimate do not allow us to evaluate whether the G5 mission has helped to reduce levels of conflict at the aggregate level. The geographical spread of jihadist groups and the ongoing security challenges in the Sahel region put the local improvements we document in sharp perspective. In spite of these limitations, we think it is important to document that establishing zones in which national armies share security responsibilities can change conflict dynamics. These findings are particularly relevant for the many border regions in which armed groups exploit coordination frictions between national security forces.

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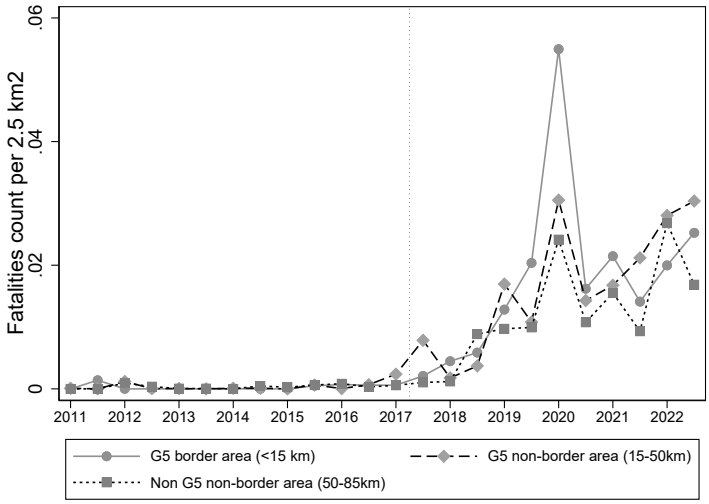
Appendix to **Cooperation between National Armies**

For Online Publication

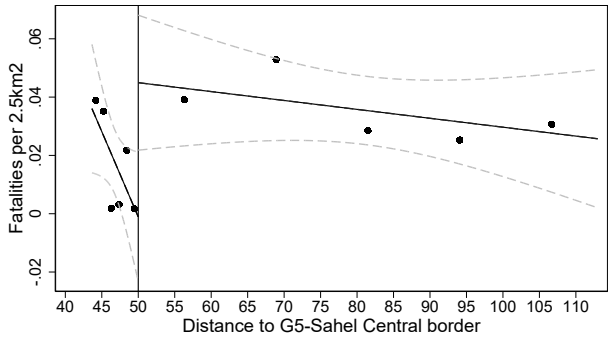
Figure A 1: Time trends in conflict intensity in G5 Sahel central operation zone



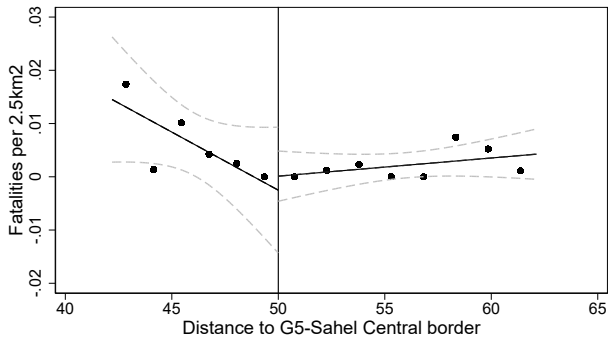
Notes: Observations at the grid-cell level, binned in six months periods (2011-2022). The sample comprises the central Zone (Mali-Niger-Burkina Faso three borders regions). Included events coded with geo-precision level 1 only.

Figure A 2: Regression Discontinuity for G5 operation zone

Panel A: All events (after Sept 2017)



Panel B: All events (before Sept 2017)

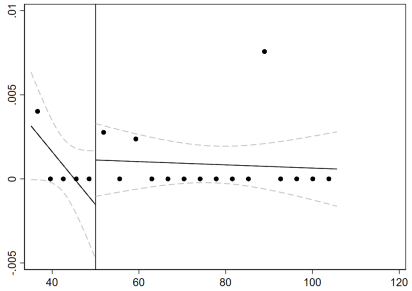


Notes: Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 200km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. The sample comprises the central Zone (Mali-Niger-Burkina Faso three borders regions). Included events are coded with geo-precision level 1.

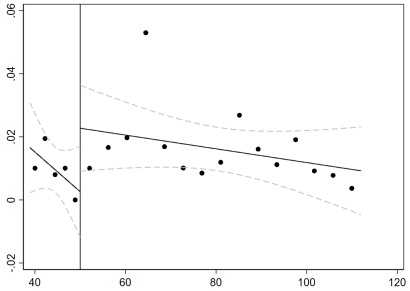
Figure A 3: RDD plots with optimal buffer for sub-groups, geo-precision level 1

Panel A: Events involving islamist groups

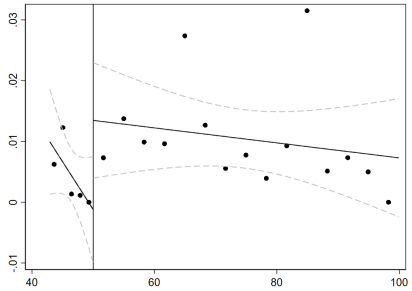
Panel A1: Military Operations



Panel A2: Attacks by armed groups

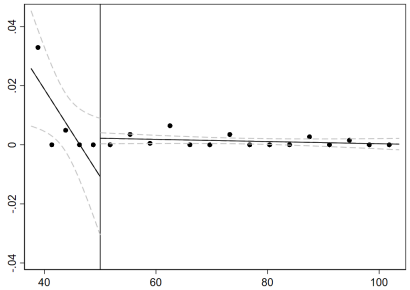


Panel A3: Civilians

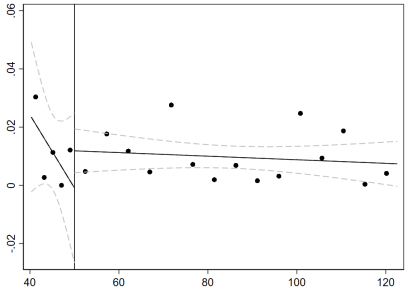


Panel B: Events involving communual militias

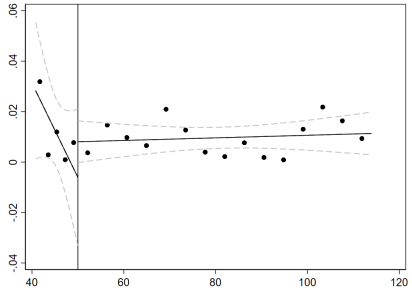
Panel B1: Military Operations



Panel B2: Attacks by armed groups

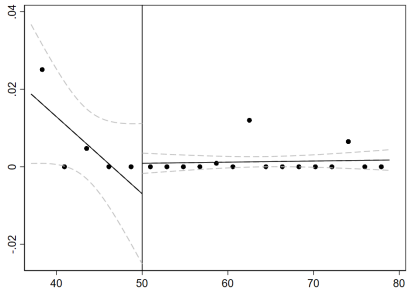


Panel B3: Civilians

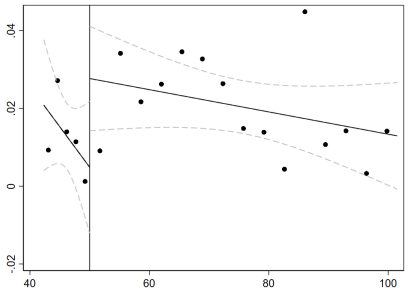


Panel C: Events involving civilians

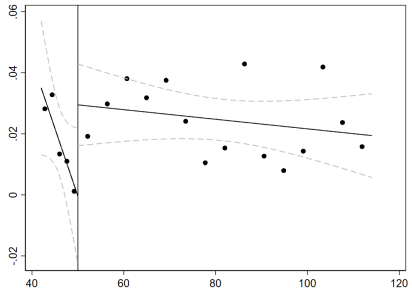
Panel C1: Military Operations



Panel C2: Attacks by armed groups



Panel C3: Civilians



Notes: Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. All conflict events occurring for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only.

Table A1: Discontinuity in conflict intensity for central G5-Sahel operation zones 2017-2020, by country/border.

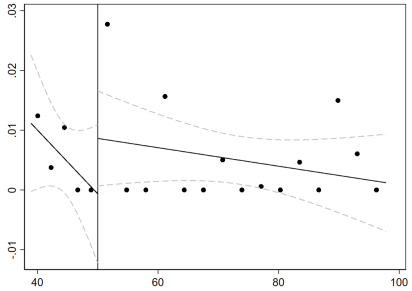
	Mali		Burkina Faso		Niger		MLI-BFA		MLI-NER		NER-BFA	
	Fatalities (1)	Events (2)	Fatalities (3)	Events (4)	Fatalities (5)	Events (6)	Fatalities (7)	Events (8)	Fatalities (9)	Events (10)	Fatalities (11)	Events (12)
Conventional	-0.0399*	-0.0088	-0.0842**	-0.0246**	-0.0042***	-0.0052***	-0.0813*	-0.0124	-0.0198***	-0.0056	-0.0073	-0.0064
	(0.0213)	(0.0109)	(0.0369)	(0.0114)	(0.0016)	(0.0017)	(0.0460)	(0.0119)	(0.0066)	(0.0053)	(0.0104)	(0.0077)
Bias-corrected	-0.0499**	-0.0081	-0.0802**	-0.0271**	-0.0042***	-0.0054***	-0.1031**	-0.0169	-0.0150**	-0.0063	-0.0029	-0.0066
	(0.0213)	(0.0109)	(0.0369)	(0.0114)	(0.0016)	(0.0017)	(0.0460)	(0.0119)	(0.0066)	(0.0053)	(0.0104)	(0.0077)
Robust	-0.0499**	-0.0081	-0.0802**	-0.0271*	-0.0042*	-0.0054**	-0.1031*	-0.0169	-0.0150**	-0.0063	-0.0029	-0.0066
	(0.0246)	(0.0125)	(0.0382)	(0.0139)	(0.0021)	(0.0022)	(0.0613)	(0.0141)	(0.0074)	(0.0065)	(0.0109)	(0.0083)
Mean DV	0.026	0.011	0.045	0.020	0.013	0.004	0.033	0.014	0.021	0.008	0.028	0.012
Standard Deviation	0.999	0.243	1.213	0.270	1.197	0.085	1.081	0.253	1.077	0.199	1.205	0.198
Observations within buffer	1592	4393	1736	1489	950	1475	2852	3114	7180	3559	3871	3364
Observations untreated	16791	14490	8179	7730	11640	9115	35848	27757	30602	38130	6194	14467
Bandwidth untreated (km)	72.991	63.214	52.278	49.213	73.416	57.273	130.390	102.342	126.416	154.848	49.630	115.350
Bandwidth treated (km)	6.800	18.233	9.986	8.625	5.728	8.952	10.506	11.491	31.853	15.773	30.229	26.307

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only. Cells that intersect with the limit of the 50km buffer of intervention are dropped from the sample. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

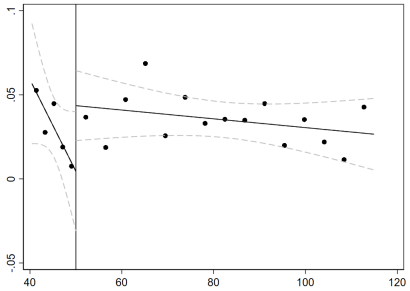
Figure A 4: RDD plots with optimal buffer for sub-groups, geo-precision level 1 and 2

Panel A: Events involving islamist groups

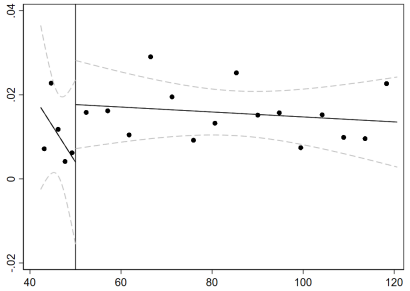
Panel A1: Military Operations



Panel A2: Attacks by armed groups

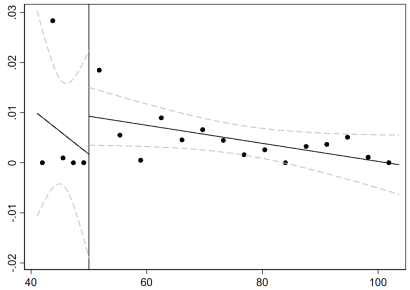


Panel A3: Civilians

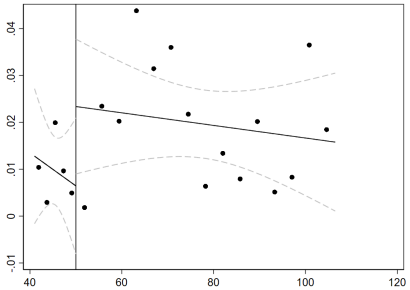


Panel B: Events involving communual militias

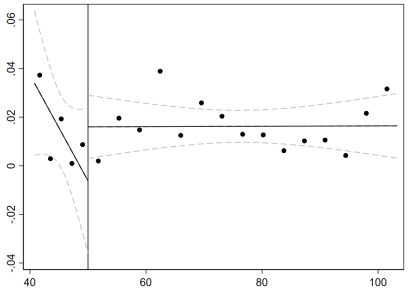
Panel B1: Military Operations



Panel B2: Attacks by armed groups

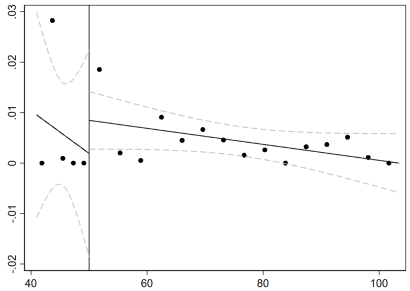


Panel B3: Civilians

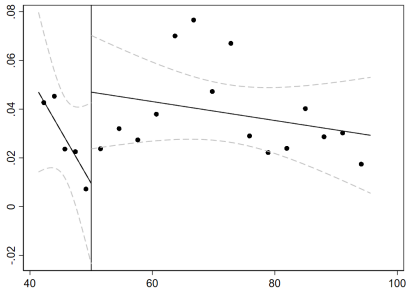


Panel C: Events involving civilians

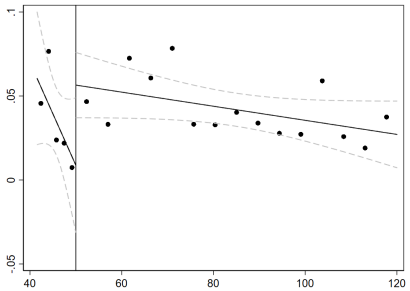
Panel C1: Military Operations



Panel C2: Attacks by armed groups



Panel C3: Civilians



Notes: Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. All conflict events occurring for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 and 2.

Table A2: Discontinuity in conflict intensity for all G5-Sahel operation zones 2017-2020, all regions.

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Central Zone (Mali-Niger-Burkina Faso three borders regions)								
Robust	-0.0452***	-0.0092	-0.0045*	-0.0022***	-0.0356**	-0.0056	-0.0321***	-0.0024
	(0.0161)	(0.0067)	(0.0024)	(0.0007)	(0.0143)	(0.0063)	(0.0114)	(0.0047)
Mean DV	0.026	0.010	0.003	0.001	0.022	0.009	0.015	0.007
Standard Deviation	1.071	0.200	0.211	0.032	1.030	0.178	0.640	0.119
Observations within buffer	3641	5821	7214	4863	3570	6358	3201	7491
Observations untreated	34378	21575	29292	44030	29242	19120	29838	18975
Bandwidth untreated (km)	63.484	39.229	53.794	81.883	53.718	34.596	54.787	34.321
Bandwidth treated (km)	6.347	10.099	12.443	8.409	6.189	10.973	5.569	12.931
Panel B: Eastern Zone (Niger-Chad border)								
Robust	-0.0138	-0.0003	-0.0018	-0.0003	-0.0108	-0.0005	-0.0035	0.0011
	(0.0148)	(0.0045)	(0.0016)	(0.0002)	(0.0120)	(0.0043)	(0.0044)	(0.0045)
Mean DV	0.004	0.002	0.001	0.000	0.003	0.002	0.002	0.002
Standard Deviation	0.332	0.098	0.142	0.015	0.256	0.085	0.137	0.080
Observations within buffer	3904	8375	3587	3587	3935	8259	3927	8598
Observations untreated	13977	24559	9555	8462	18746	22374	9858	17576
Bandwidth untreated (km)	45.304	78.924	30.996	27.498	60.539	72.039	32.022	56.787
Bandwidth treated (km)	12.819	27.554	11.753	11.753	12.904	27.168	12.884	28.231
Panel C: Western Zone (Mali-Mauritania border)								
Robust		-0.0002			-0.0003		-0.0002	
		(0.0003)			(0.0003)		(0.0002)	
Mean DV		0.002			0.001		0.001	
Standard Deviation		0.058			0.055		0.038	
Observations within buffer		2750			2750		2589	
Observations untreated		11367			13264		14096	
Bandwidth untreated (km)		20.655			24.049		25.824	
Bandwidth treated (km)		4.771			4.771		4.521	

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only. Empty cells means the discontinuity could not be estimated due to lack of variability in the dependent variable. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A3: Discontinuity in conflict intensity for central G5-Sahel operation zones 2017-2020, Robustness checks.

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count) (1)	Events (2)	Fatalities (count) (3)	Events (4)	Fatalities (count) (5)	Events (6)	Fatalities (count) (7)	Events (8)
Panel A: Splitted cells dropped								
Robust	-0.0525**	-0.0284***	-0.0023	-0.0031***	-0.0449**	-0.0232***	-0.0231	-0.0144***
	(0.0237)	(0.0090)	(0.0048)	(0.0009)	(0.0224)	(0.0082)	(0.0148)	(0.0047)
Mean DV	0.028	0.011	0.003	0.001	0.024	0.010	0.016	0.007
Standard Deviation	1.122	0.220	0.213	0.033	1.080	0.198	0.648	0.123
Observations within buffer	1930	3069	2646	4005	1833	3280	1463	4178
Observations untreated	42957	38014	41047	49234	37312	32178	34938	33698
Bandwidth untreated (km)	81.727	72.396	78.116	93.936	70.949	61.274	66.506	64.139
Bandwidth treated (km)	4.944	6.966	6.113	8.479	4.765	7.291	4.218	8.756
Panel B: Top-coded fatalities (0.01)								
Robust	-0.0394***	-0.0110	-0.0054**	-0.0022***	-0.0315**	-0.0074	-0.0320***	-0.0034
	(0.0144)	(0.0073)	(0.0025)	(0.0007)	(0.0130)	(0.0069)	(0.0117)	(0.0051)
Mean DV	0.024	0.011	0.003	0.001	0.020	0.010	0.014	0.007
Standard Deviation	0.748	0.220	0.203	0.033	0.687	0.198	0.474	0.123
Observations within buffer	5131	5878	7379	4865	5089	6358	4621	7606
Observations untreated	35693	25267	27394	43013	29074	22521	33368	21791
Bandwidth untreated (km)	65.999	46.142	50.227	80.011	53.424	40.894	61.575	39.637
Bandwidth treated (km)	8.874	10.204	12.752	8.414	8.789	10.976	7.997	13.119
Panel C: Any fatality								
Robust	-0.0049**	-0.0110	-0.0010***	-0.0022***	-0.0042*	-0.0074	-0.0042**	-0.0034
	(0.0023)	(0.0073)	(0.0004)	(0.0007)	(0.0023)	(0.0069)	(0.0020)	(0.0051)
Mean DV	0.004	0.011	0.000	0.001	0.003	0.010	0.003	0.007
Standard Deviation	0.060	0.220	0.020	0.033	0.058	0.198	0.051	0.123
Observations within buffer	5586	5878	6355	4865	5613	6358	5166	7606
Observations untreated	34557	25267	41484	43013	31794	22521	32913	21791
Bandwidth untreated (km)	63.862	46.142	77.063	80.011	58.605	40.894	60.730	39.637
Bandwidth treated (km)	9.714	10.204	10.965	8.414	9.737	10.976	8.955	13.119

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only. Cells that intersect with the limit of the 50km buffer of intervention are dropped from the sample. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Discontinuity in conflict intensity for central G5-Sahel operation zones 2017-2020, OLS estimations with flexible controls for coordinates.

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count) (1)	Events (2)	Fatalities (count) (3)	Events (4)	Fatalities (count) (5)	Events (6)	Fatalities (count) (7)	Events (8)
Panel A: 15-100 km buffer								
Linear distance ctrl	-0.0297**	-0.0053	0.0023	-0.0005	-0.0297**	-0.0049	-0.0162*	-0.0010
	(0.0137)	(0.0043)	(0.0034)	(0.0006)	(0.0128)	(0.0039)	(0.0090)	(0.0023)
Linear lat. lon. ctrl	-0.1247*	-0.0105	-0.0170	-0.0055*	-0.1078	-0.0035	-0.0616	-0.0029
	(0.0740)	(0.0233)	(0.0182)	(0.0030)	(0.0691)	(0.0211)	(0.0486)	(0.0127)
Linear dist. lat. lon. ctrl	-0.0301**	-0.0055	0.0022	-0.0005	-0.0301**	-0.0051	-0.0165*	-0.0011
	(0.0137)	(0.0043)	(0.0034)	(0.0006)	(0.0128)	(0.0039)	(0.0090)	(0.0023)
Linear dist. sq lat. lon. ctrl	-0.0295**	-0.0053	0.0023	-0.0005	-0.0296**	-0.0049	-0.0161*	-0.0010
	(0.0137)	(0.0043)	(0.0034)	(0.0006)	(0.0128)	(0.0039)	(0.0090)	(0.0023)
Linear dist. lat. lon. & flex. lat. lon. ctrl	-0.0296**	-0.0053	0.0023	-0.0005	-0.0297**	-0.0049	-0.0162*	-0.0010
	(0.0137)	(0.0043)	(0.0034)	(0.0006)	(0.0128)	(0.0039)	(0.0090)	(0.0023)
Linear, sq and cubic distance ctrl & flex. lat. lon. ctrl	-0.0278	-0.0081	-0.0077	-0.0018	-0.0134	-0.0052	-0.0176	0.0000
	(0.0274)	(0.0086)	(0.0068)	(0.0011)	(0.0256)	(0.0078)	(0.0180)	(0.0047)
Mean DV								
Standard Deviation								
Observations within buffer	74332	74332	74332	74332	74332	74332	74332	74332
Panel B: 50 km buffer								
Linear distance ctrl	-0.0266**	-0.0034	-0.0002	-0.0006	-0.0241**	-0.0027	-0.0227***	-0.0006
	(0.0129)	(0.0037)	(0.0035)	(0.0005)	(0.0119)	(0.0034)	(0.0082)	(0.0021)
Linear lat. lon. ctrl	-0.1259*	-0.0049	-0.0258	-0.0062**	-0.1010	0.0019	-0.0738*	-0.0011
	(0.0683)	(0.0198)	(0.0186)	(0.0029)	(0.0631)	(0.0178)	(0.0436)	(0.0110)
Linear dist. lat. lon. ctrl	-0.0274**	-0.0036	-0.0003	-0.0006	-0.0247**	-0.0029	-0.0232***	-0.0007
	(0.0129)	(0.0037)	(0.0035)	(0.0005)	(0.0119)	(0.0034)	(0.0082)	(0.0021)
Linear dist. sq lat. lon. ctrl	-0.0265**	-0.0033	-0.0002	-0.0005	-0.0240**	-0.0026	-0.0226***	-0.0005
	(0.0129)	(0.0037)	(0.0035)	(0.0005)	(0.0119)	(0.0034)	(0.0082)	(0.0021)
Linear dist. lat. lon. & flex. lat. lon. ctrl	-0.0268**	-0.0034	-0.0002	-0.0006	-0.0242**	-0.0027	-0.0229***	-0.0006
	(0.0129)	(0.0037)	(0.0035)	(0.0005)	(0.0119)	(0.0034)	(0.0082)	(0.0021)
Linear, sq and cubic distance ctrl & flex. lat. lon. ctrl	-0.0240	-0.0061	-0.0047	-0.0016	-0.0139	-0.0038	-0.0120	-0.0001
	(0.0258)	(0.0075)	(0.0070)	(0.0011)	(0.0239)	(0.0067)	(0.0165)	(0.0041)
Mean DV								
Standard Deviation								
Observations within buffer	84395	84395	84395	84395	84395	84395	84395	84395

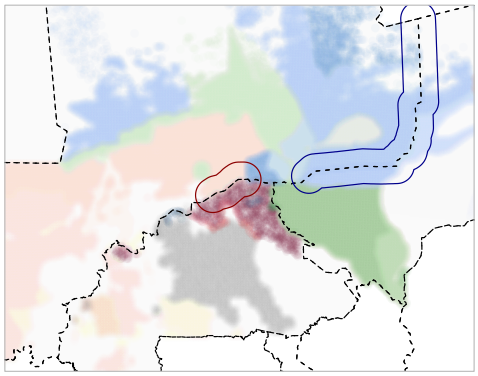
Notes : Manual choice of bandwidths. Additional country controls, no border segment controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Include events coded with geo-precision level 1 only. Only estimate of coefficient of interest "Cell within G5 operation zone" reported. Control variables include distance to the G5 central border, latitude, longitude, and squared and cubic transformations of latitude and longitude. Distance to the border and its transformation and are allowed a different slope within and outside of the operation zone while the effect of latitude and longitude is assumed to be the same within and outside of the G5 area to avoid overfitting. Robust standard errors in parentheses- *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5: Discontinuity in conflict intensity for G5 Sahel Central operation zone 2017-2020 , robustness checks.

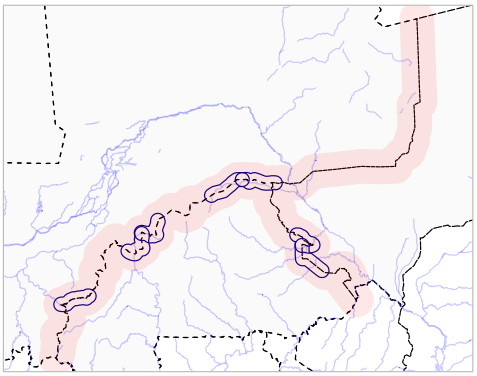
	Military operations						Attacks by armed groups						Attacks on Civilians					
	Geo1			Geo2			Geo1			Geo2			Geo1			Geo2		
	Events (1)	Fatalities(#) (2)	Fatalities(IHS) (3)	Events (4)	Fatalities(#) (5)	Fatalities(IHS) (6)	Events (7)	Fatalities(#) (8)	Fatalities(IHS) (9)	Events (10)	Fatalities(#) (11)	Fatalities(IHS) (12)	Events (13)	Fatalities(#) (14)	Fatalities(IHS) (15)	Events (16)	Fatalities(#) (17)	Fatalities(IHS) (18)
Panel 0: All Events																		
Conventional	-0.0020***	-0.0046**	-0.0018***	-0.0032**	-0.0280**	-0.0056***	-0.0054	-0.0349***	-0.0085**	-0.0013	-0.0194	-0.0025	-0.0019	-0.0299***	-0.0087***	0.0005	-0.0499***	-0.0081*
	(0.0006)	(0.0021)	(0.0007)	(0.0015)	(0.0119)	(0.0014)	(0.0055)	(0.0135)	(0.0034)	(0.0090)	(0.0174)	(0.0050)	(0.0041)	(0.0099)	(0.0030)	(0.0066)	(0.0180)	(0.0043)
Bias-corrected	-0.0022***	-0.0045**	-0.0021***	-0.0036**	-0.0355***	-0.0064***	-0.0056	-0.0356***	-0.0092***	-0.0015	-0.0187	-0.0023	-0.0024	-0.0321***	-0.0095***	-0.0002	-0.0530***	-0.0085**
	(0.0006)	(0.0021)	(0.0007)	(0.0015)	(0.0119)	(0.0014)	(0.0055)	(0.0135)	(0.0034)	(0.0090)	(0.0174)	(0.0050)	(0.0041)	(0.0099)	(0.0030)	(0.0066)	(0.0180)	(0.0043)
Robust	-0.0022***	-0.0045*	-0.0021**	-0.0036**	-0.0355**	-0.0064***	-0.0056	-0.0356**	-0.0092**	-0.0015	-0.0187	-0.0023	-0.0024	-0.0321***	-0.0095***	-0.0002	-0.0530***	-0.0085*
	(0.0007)	(0.0024)	(0.0008)	(0.0018)	(0.0151)	(0.0018)	(0.0063)	(0.0143)	(0.0040)	(0.0104)	(0.0192)	(0.0058)	(0.0047)	(0.0114)	(0.0036)	(0.0075)	(0.0206)	(0.0051)
Observations within buffer	4863	7214	5751	5789	5058	4798	6358	3570	5053	6298	4142	6011	7491	3201	4391	7558	3829	5759
Observations untreated	44030	29292	39076	33127	27298	42675	19120	29242	24499	14974	19095	17148	18975	29838	27214	15163	32646	24930
Bandwidth untreated (km)	81.883	53.794	72.495	61.152	50.043	79.308	34.596	53.718	44.758	26.884	34.538	30.886	34.321	54.787	49.873	27.252	60.108	45.535
Bandwidth treated (km)	8.409	12.443	9.997	10.051	8.738	8.282	10.973	6.189	8.726	10.868	7.238	10.403	12.931	5.569	7.665	13.044	6.734	10.013
Panel A: Events involving Islamist groups																		
Conventional	-0.0006	-0.0012	-0.0006	-0.0013	-0.0129	-0.0023**	-0.0083***	-0.0238**	-0.0077***	-0.0048	-0.0222*	-0.0040	-0.0035*	-0.0120***	-0.0058***	-0.0022	-0.0153*	-0.0035
	(0.0004)	(0.0012)	(0.0005)	(0.0010)	(0.0084)	(0.0010)	(0.0029)	(0.0104)	(0.0016)	(0.0063)	(0.0126)	(0.0035)	(0.0019)	(0.0040)	(0.0013)	(0.0035)	(0.0088)	(0.0025)
Bias-corrected	-0.0008*	-0.0014	-0.0007	-0.0015	-0.0162*	-0.0026***	-0.0086***	-0.0233**	-0.0082***	-0.0047	-0.0199	-0.0041	-0.0039**	-0.0127***	-0.0062***	-0.0024	-0.0165*	-0.0037
	(0.0004)	(0.0012)	(0.0005)	(0.0010)	(0.0084)	(0.0010)	(0.0029)	(0.0104)	(0.0016)	(0.0063)	(0.0126)	(0.0035)	(0.0019)	(0.0040)	(0.0013)	(0.0035)	(0.0088)	(0.0025)
Robust	-0.0008	-0.0014	-0.0007	-0.0015	-0.0162	-0.0026**	-0.0086**	-0.0233**	-0.0082***	-0.0047	-0.0199	-0.0041	-0.0039*	-0.0127***	-0.0062***	-0.0024	-0.0165*	-0.0037
	(0.0005)	(0.0016)	(0.0006)	(0.0013)	(0.0107)	(0.0013)	(0.0034)	(0.0110)	(0.0019)	(0.0074)	(0.0139)	(0.0041)	(0.0022)	(0.0045)	(0.0015)	(0.0041)	(0.0100)	(0.0030)
Observations within buffer	5862	8375	7966	8043	6400	5318	5216	6358	4362	6216	5476	6227	8805	4082	4305	10042	4433	7214
Observations untreated	29991	31396	33112	39346	26259	36853	31051	33063	31190	18758	24261	23732	31039	22979	34691	22650	33467	35520
Bandwidth untreated (km)	55.143	57.782	61.133	72.892	48.054	68.135	57.037	61.027	57.349	33.943	44.218	43.266	57.018	41.878	64.116	41.144	61.729	65.589
Bandwidth treated (km)	10.167	14.412	13.678	13.835	11.047	9.272	9.051	10.971	7.606	10.709	9.587	10.729	15.159	7.100	7.507	17.238	7.726	12.443
Panel B: Events involving Communal militia																		
Conventional	-0.0015***	-0.0024*	-0.0013**	-0.0022***	-0.0145*	-0.0029***	0.0018	-0.0071	-0.0007	0.0031	-0.0126	0.0012	0.0028	-0.0073	-0.0007	0.0042	-0.0096	0.0008
	(0.0005)	(0.0014)	(0.0005)	(0.0007)	(0.0080)	(0.0009)	(0.0028)	(0.0078)	(0.0022)	(0.0033)	(0.0091)	(0.0027)	(0.0024)	(0.0068)	(0.0021)	(0.0028)	(0.0079)	(0.0023)
Bias-corrected	-0.0017***	-0.0023*	-0.0016***	-0.0023***	-0.0191**	-0.0034***	0.0025	-0.0087	-0.0005	0.0036	-0.0134	0.0012	0.0036	-0.0086	-0.0010	0.0047	-0.0105	0.0007
	(0.0005)	(0.0014)	(0.0005)	(0.0007)	(0.0080)	(0.0009)	(0.0028)	(0.0078)	(0.0022)	(0.0033)	(0.0091)	(0.0027)	(0.0024)	(0.0068)	(0.0021)	(0.0028)	(0.0079)	(0.0023)
Robust	-0.0017***	-0.0023	-0.0016**	-0.0023***	-0.0191*	-0.0034***	0.0025	-0.0087	-0.0005	0.0036	-0.0134	0.0012	0.0036	-0.0086	-0.0010	0.0047	-0.0105	0.0007
	(0.0006)	(0.0018)	(0.0006)	(0.0008)	(0.0109)	(0.0012)	(0.0034)	(0.0088)	(0.0026)	(0.0039)	(0.0100)	(0.0031)	(0.0029)	(0.0078)	(0.0024)	(0.0034)	(0.0088)	(0.0026)
Observations within buffer	4755	6890	5476	5091	5229	5338	10870	3309	9967	10823	3303	8302	11883	3130	6965	10822	3246	6980
Observations untreated	34435	30027	38051	28846	28834	46875	20431	34722	27457	14629	25405	14983	19491	32549	23613	13150	24587	15319
Bandwidth untreated (km)	63.599	55.228	70.365	53.008	52.982	87.325	37.051	64.177	50.360	26.269	46.299	26.905	35.277	59.875	43.029	23.576	44.910	27.519
Bandwidth treated (km)	8.221	11.943	9.588	8.793	9.080	9.306	18.590	5.764	17.098	18.525	5.735	14.268	20.289	5.447	12.098	18.521	5.619	12.137
Panel C: Events involving civilians																		
Conventional	-0.0010***	-0.0023	-0.0007**	-0.0017***	-0.0133*	-0.0026***	0.0005	-0.0215**	-0.0065**	0.0032	-0.0226	-0.0035	-0.0019	-0.0299***	-0.0087***	0.0005	-0.0499***	-0.0081*
	(0.0003)	(0.0022)	(0.0004)	(0.0005)	(0.0080)	(0.0008)	(0.0037)	(0.0092)	(0.0029)	(0.0059)	(0.0151)	(0.0041)	(0.0041)	(0.0099)	(0.0030)	(0.0066)	(0.0180)	(0.0043)
Bias-corrected	-0.0011***	-0.0023	-0.0010***	-0.0018***	-0.0179**	-0.0031***	0.0005	-0.0232**	-0.0072**	0.0033	-0.0243	-0.0037	-0.0024	-0.0321***	-0.0095***	-0.0002	-0.0530***	-0.0085**
	(0.0003)	(0.0022)	(0.0004)	(0.0005)	(0.0080)	(0.0008)	(0.0037)	(0.0092)	(0.0029)	(0.0059)	(0.0151)	(0.0041)	(0.0041)	(0.0099)	(0.0030)	(0.0066)	(0.0180)	(0.0043)
Robust	-0.0011***	-0.0023	-0.0010**	-0.0018***	-0.0179	-0.0031***	0.0005	-0.0232**	-0.0072**	0.0033	-0.0243	-0.0037	-0.0024	-0.0321***	-0.0095***	-0.0002	-0.0530***	-0.0085*
	(0.0004)	(0.0015)	(0.0004)	(0.0007)	(0.0109)	(0.0011)	(0.0043)	(0.0102)	(0.0033)	(0.0068)	(0.0165)	(0.0047)	(0.0047)	(0.0114)	(0.0036)	(0.0075)	(0.0206)	(0.0051)
Observations within buffer	5133	7755	5965	5004	5258	5342	9893	3114	4497	9816	3758	6347	7491	3201	4391	7558	3829	5759
Observations untreated	35314	15956	25090	30217	28488	48181	17759	24679	23498	14268	20983	19806	18975	29838	27214	15163	32646	24930
Bandwidth untreated (km)	65.140	28.706	45.821	55.599	52.221	89.869	32.063	45.074	42.811	25.545	38.073	35.807	34.321	54.787	49.873	27.252	60.108	45.535
Bandwidth treated (km)	8.884	13.360	10.330	8.659	9.149	9.323	16.967	5.422	7.829	16.837	6.566	10.943	12.931	5.569	7.665	13.044	6.734	10.013

Notes : Discontinuity estimated at 50 km. Data-driven choice of two bandwidths for MSE-optimal point estimation. Local polynomial of order 1. Additional country and border controls. All conflict events occurring within 250km of each considered G5-Sahel borders are included for the period between September 2017 to January 2020. Military operations involving islamist groups record fatalities from islamist groups only, whereas attacks by armed group and attacks on civilians involving islamist goups record fatalities caused by islamist groups. Idem for communal militia and unidentified armed groups. Empty cells means the discontinuity could not be estimated due to lack of variability in the dependent variable. Robust Calonico-Cattaneo-Titiunik standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1.

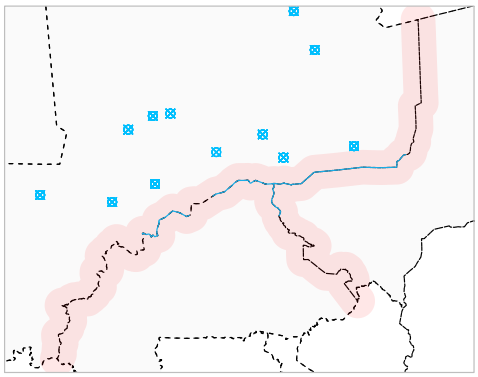
Figure A 5: Border segments characteristics



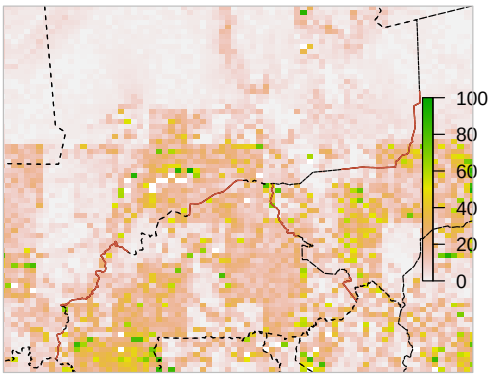
(a) Segments with transborder ethnic groups



(b) Segments following rivers



(c) Segments close to MINSUMA bases



(d) Segments in high rugged areas

Notes: Segments with transborder ethnic groups are those segments where the same ethnic group accounts for at least 10% of the population on both sides of the border. Such segments are represented in red for the Fulani group and in blue for the Tuareg. The other groups (Songhay in green, Mossi in gray, Bambara in yellow) never represents more than 10% of the population on both sides of the border. Segments aligned with rivers are defined as those segments within five kilometers of a river over 40% of their total length. Segments "close" to MINSUMA are segments for which the minimum distance between a MINUSMA base and the segment is lower than the median distance. Segments in "high rugged" areas are segments for which the average ruggedness of cells crossed by the segments is above the median ruggedness of cells crossed by the other segments.

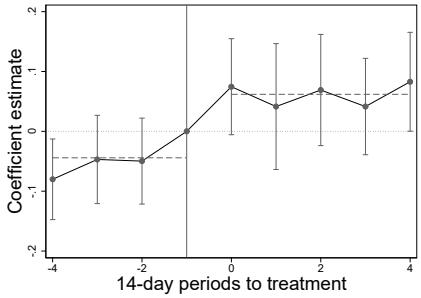
Table A6: Discontinuity in conflict intensity for central G5-Sahel operation zones 2017-2020, by country/border.

	Mali	Burkina Faso	Niger	MLI-BFA	MLI-NER	NER-BFA
	(1)	(2)	(3)	(4)	(5)	(6)
Share fulani	0.117	0.151	0.042	0.152	0.043	0.217
	(0.165)	(0.160)	(0.088)	(0.168)	(0.095)	(0.178)
Border segments with transborder fulani group	0.101	0.030	0.000	0.092	0.000	0.000
	(0.302)	(0.170)	(0.000)	(0.289)	(0.000)	(0.000)
Share tuareg	0.140	0.015	0.267	0.035	0.314	0.032
	(0.160)	(0.026)	(0.147)	(0.048)	(0.086)	(0.058)
Border segments with transborder tuareg group	0.322	0.000	0.763	0.000	0.835	0.000
	(0.467)	(0.000)	(0.425)	(0.000)	(0.371)	(0.000)
Border segments with any transborder ethnic group	0.424	0.030	0.763	0.092	0.835	0.000
	(0.494)	(0.170)	(0.425)	(0.289)	(0.371)	(0.000)
Distance to MINUSMA base	170.566	203.738	203.274	166.226	153.110	237.136
	(93.122)	(88.597)	(94.203)	(87.805)	(87.898)	(111.973)
Average rugdness around border segment	11.753	9.663	12.557	11.003	10.898	11.469
	(7.601)	(6.638)	(8.329)	(6.829)	(8.729)	(6.703)
Border segment aligns with river	0.270	0.439	0.057	0.384	0.039	0.328
	(0.444)	(0.496)	(0.231)	(0.486)	(0.192)	(0.470)
Observations	142898	71944	81068	29904	24034	15846
G5 interventions in acled	23	8	14	24	13	22

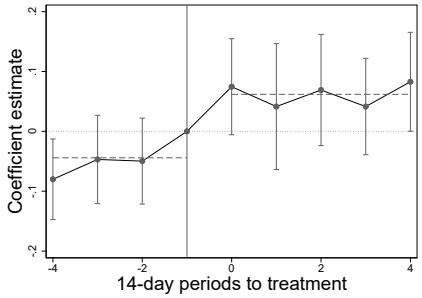
Notes: Observations at the grid-cell level in the first part of the table, and total count of interventions in the second part. Each grid-cell is defined by the closest border segment. Segments with transborder ethnic groups are those segments where the same ethnic group accounts for at least 10% of the population on both sides of the border. Segments aligned with rivers are defined as those segments within five km of a river over 40% of their total length. Segments in "high rugged" areas are segments for which the average ruggedness of cells crossed by the segments is above the median ruggedness of cells crossed by the other segments.

Figure A 6: Reaction to trigger events - time patterns (no differences)

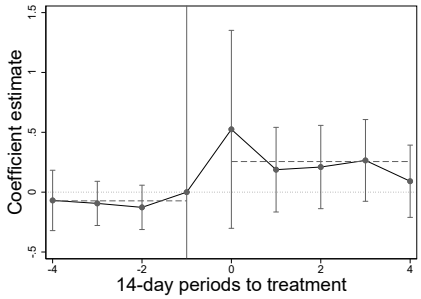
Panel A: All events - Fatalities



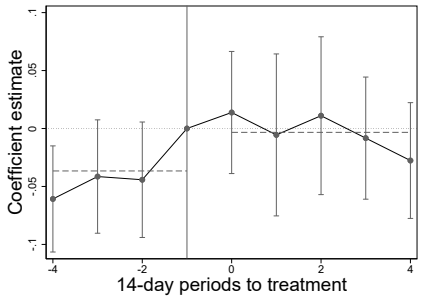
Panel B: All events



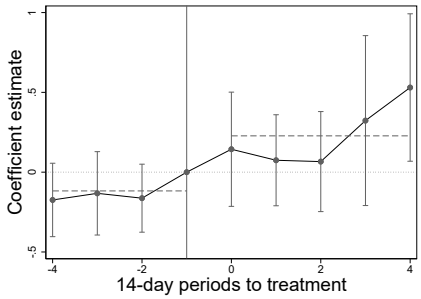
Panel C: Military Operations - Fatalities



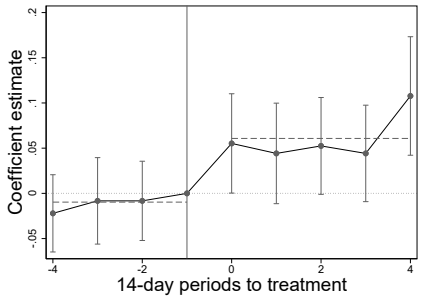
Panel D: Military Operations - Events



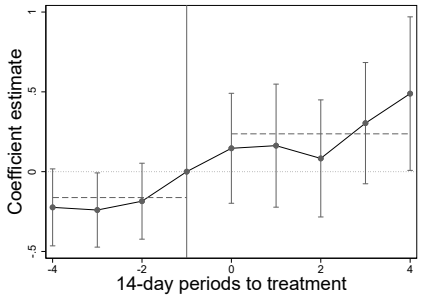
Panel E: Attacks by armed groups - Fatalities



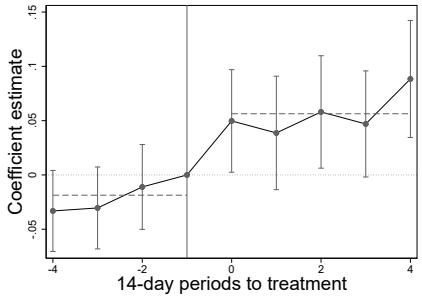
Panel F: Attacks by armed groups - Events



Panel G: Attacks by armed groups - Fatalities



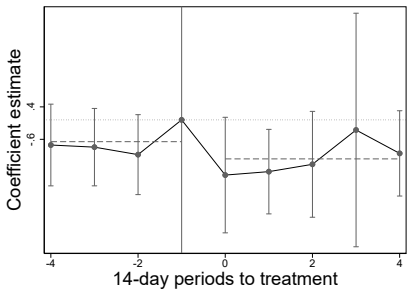
Panel H: Attacks by armed groups - Events



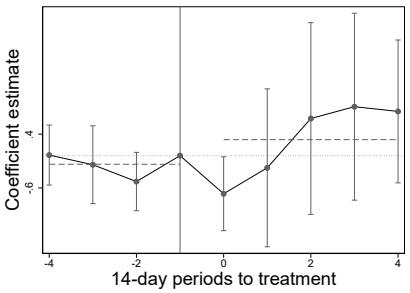
Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2021). The graph show coefficients on time-to-treatment dummies around the trigger operation. The model includes operation fixed effects. Standard errors are clustered at the grid-cell level, and grey bars represent 95% confidence intervals.

Figure A 7: Reaction to trigger events - comparison of border areas

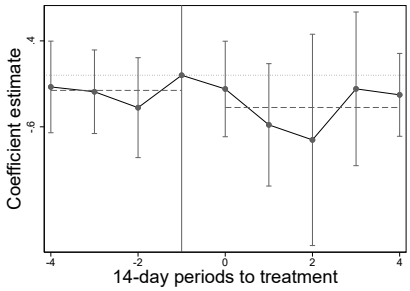
Panel A: All events -fatalities (no G5)



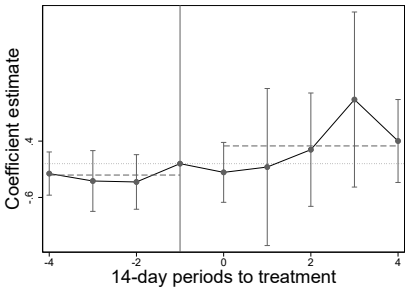
Panel B: All events - fatalities (G5 active)



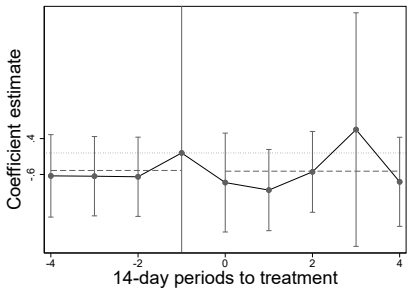
Panel C: Military Operations (no G5) fatalities



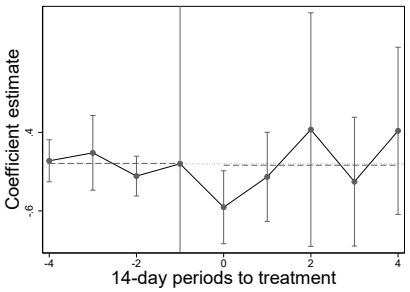
Panel D: Military Operations (G5 active) fatalities



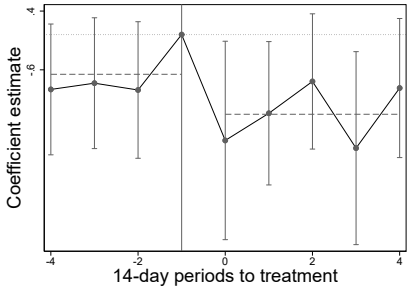
Panel E: Attacks by armed groups (no G5) fatalities



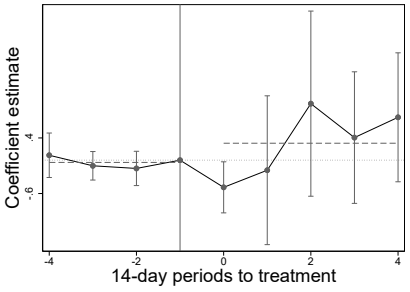
Panel F: Attacks by armed groups (G5 active) fatalities



Panel G: Civilian Casualty fatalities (no G5)



Panel H: Civilian Casualty fatalities (G5 active)



Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2021). The graph show coefficients on time-to-treatment dummies around the trigger operation. The model includes operation fixed effects. Standard errors are clustered at the grid-cell level, and grey bars represent 95% confidence intervals.

Table A7: Reaction to trigger events - by Actor

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Events involving Islamist groups								
Border x Post	-0.10	-0.05	-0.10	-0.05	-0.17	-0.05	-0.16	-0.01
	(0.16)	(0.04)	(0.16)	(0.04)	(0.15)	(0.04)	(0.13)	(0.03)
Border x Post x G5	0.40*	0.01	0.39*	0.08**	-0.01	0.01	0.15	-0.01
	(0.22)	(0.05)	(0.22)	(0.04)	(0.20)	(0.05)	(0.16)	(0.04)
Panel B: Events involving Communal militia								
Border x Post	-0.41	-0.01	-0.09	-0.03	0.15	-0.01	-0.11	-0.02
	(0.39)	(0.04)	(0.10)	(0.03)	(0.32)	(0.04)	(0.08)	(0.03)
Border x Post x G5	0.73	0.01	0.33	0.04	0.01	0.01	0.25	0.01
	(0.48)	(0.04)	(0.22)	(0.03)	(0.37)	(0.04)	(0.20)	(0.03)
Panel C: Events involving Security Forces and civilians								
Border x Post							-0.04	-0.41***
							(0.02)	(0.16)
Border x Post x G5							0.05*	0.62**
							(0.03)	(0.25)
Observations	3168	3168	3168	3168	3168	3168	3168	3168
Clusters	352	352	352	352	352	352	352	352

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2021). Results are based on the estimating equation presented above. Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A8: Reaction to trigger events - alternative criterion

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border x Post	-0.19	-0.09	-0.45	-0.18*	0.27	0.09	-0.28	0.02
	(0.99)	(0.14)	(0.37)	(0.10)	(0.92)	(0.10)	(0.38)	(0.07)
Border x Post x G5	1.08	0.13	0.74	0.19*	0.34	-0.06	0.78	-0.02
	(1.09)	(0.15)	(0.46)	(0.11)	(1.00)	(0.12)	(0.53)	(0.08)
Mean DV	0.836	0.211	0.350	0.071	0.486	0.140	0.344	0.104
Standard Deviation	5.674	0.686	3.964	0.464	3.209	0.420	2.211	0.338
Observations	1827	1827	1827	1827	1827	1827	1827	1827
Clusters	203	203	203	203	203	203	203	203

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020) claiming more than 10 lives. Results are based on estimating equation (2). Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A9: Reaction to trigger events - alternative "G5 treatment period"

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border x Post	0.76	-0.10	-0.57	-0.28	1.33	0.18	0.30**	0.06
	(1.52)	(0.23)	(0.65)	(0.18)	(1.40)	(0.16)	(0.14)	(0.09)
Border x Post x G5 (post Sep 2017)	-0.67	0.05	0.79	0.30*	-1.45	-0.24	-0.31	-0.11
	(1.54)	(0.24)	(0.67)	(0.18)	(1.41)	(0.16)	(0.26)	(0.09)
Mean DV	0.693	0.178	0.313	0.054	0.380	0.125	0.360	0.099
Standard Deviation	4.676	0.576	3.373	0.372	2.635	0.387	2.432	0.332
Observations	3168	3168	3168	3168	3168	3168	3168	3168
Clusters	352	352	352	352	352	352	352	352

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020) claiming at least 10 lives. Results are based on estimating equation (2). Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A10: Reaction to trigger events - allowing for repetition of grid cells

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events	Fatalities (count)	Events
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border x Post	-0.73*	-0.14**	-0.43**	-0.08**	-0.31	-0.06	-0.86***	-0.07*
	(0.38)	(0.06)	(0.18)	(0.03)	(0.34)	(0.05)	(0.26)	(0.04)
Border x Post x G5	1.46***	0.19***	0.59***	0.10***	0.86**	0.09*	1.05***	0.08*
	(0.49)	(0.06)	(0.21)	(0.03)	(0.44)	(0.05)	(0.29)	(0.04)
Mean DV	0.947	0.211	0.404	0.063	0.543	0.148	0.384	0.104
Standard Deviation	6.086	0.668	4.023	0.446	4.103	0.432	2.547	0.347
Observations	7155	7155	7155	7155	7155	7155	7155	7155
Clusters	359	359	359	359	359	359	359	359

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020) claiming at least 10 lives. Results are based on estimating equation (2). Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A11: Reaction to trigger events - Dummy outcomes

	All events		Military operations		Attacks by armed groups		Attacks on Civilians	
	Fatalities (any)	Events (any)	Fatalities (any)	Events (any)	Fatalities (any)	Events (any)	Fatalities (any)	Events (any)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border x Post	-0.09**	-0.11**	-0.05**	-0.07**	-0.05	-0.05	-0.07**	-0.07*
	(0.04)	(0.05)	(0.02)	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)
Border x Post x G5	0.07	0.11*	0.06**	0.10***	0.01	0.03	0.06	0.06
	(0.05)	(0.06)	(0.03)	(0.03)	(0.04)	(0.06)	(0.04)	(0.05)
Mean DV	0.097	0.141	0.027	0.037	0.074	0.110	0.063	0.090
Standard Deviation	0.296	0.349	0.161	0.189	0.262	0.313	0.244	0.287
Observations	3168	3168	3168	3168	3168	3168	3168	3168
Clusters	352	352	352	352	352	352	352	352

Notes: Observations at the grid-cell level, binned in two-week periods, in two-month windows around major French operations (2010-2020). Results are based on estimating equation (2). Standard errors are clustered at the grid-cell level and presented in parentheses; stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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ISSN 1379-244X D/2024/3082/05

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