

The Unintended Consequences of the War on Drugs: Eradication and Armed Conflict Violence in Colombia

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December 10, 2023

Abstract

Illicit economies, such as coca crops, provide an unparalleled source of wealth for insurgencies, paramilitaries, and criminal organizations. While state interventions such as forced aerial spraying eradication seek to weaken illicit economies and ultimately build political order, peace, and stability, outcomes on the ground typically diverge from these intentions. How do attempts at curtailing illicit markets at the origin of the production and trafficking chain shape dynamics of armed conflict violence? And once the state has intervene, how does its withdrawal affect subsequent levels of violence? By focusing on the case of Colombia, we study the effects of these type of interventions on armed conflict violence. First, we analyse municipal data of coca crops eradication by aerial spraying between 1994 and 2015, and find that it increased violent events associated to non-state armed actors. We then look at the sudden suspension of this policy and find that the state's withdrawal increased, rather than decreased, subsequent levels of violence. Our work suggests that state coercive interventions that affect actors expectations regarding the availability and profitability of illicit resources are likely to backfire in the short term, provoking more violence.

Prepared for presentation at the seminar of the Conflict & Change cluster, Department of
Political Science, University College London.

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1 Introduction

In countries affected by the presence of non-state armed groups crops with compounds that can be used for the production of drugs pose a major challenge for security and stability (Dávalos and Dávalos, 2019). While governments have adopted a variety of anti-drug policies—ranging from voluntary crop substitution and alternative development to interdiction and forced eradication—to deal with this issue, the dominant approach has consisted in the use of coercive strategies for eradicating illicit crops at the point source. By relying on forced eradication, governments expect to rapidly and efficiently contain non-state armed groups’ economic and political power. Indeed illicit economies can bolster the financial strength of non-state violent groups, facilitate their territorial expansion, and contribute to the creation of social orders (Buhaug et al., 2009; Ross, 2012). Conventional wisdom suggests that only by eradicating violent groups’ main sources of financing can the state presumably transform ungoverned spaces into areas of greater state control (Clunan and Trinkunas, 2010) and attacking production at source is an effective way of doing so.

Yet after decades of waging a costly and long-lasting war on drugs, the effectiveness and success of crop eradication have been called into question. Some literature has found that the benefits of forced eradication policies are rather small relative to their costs. Moreover, growing empirical evidence suggests that forced drug eradication policies can have harmful consequences on the ground, as policies that disrupt armed equilibria are likely to backfire and lead to greater levels of violence (Calderón et al., 2015; Flores-Macías, 2018).

To try to isolate the effect of coercive anti-narcotic policies targeting production at source point, in this paper we look at the effects of aerial spraying, a type of eradication policy that seeks to solely target illicit crops in areas that are beyond the control of the state. Unlike manual eradication and interdiction, whose enforcement requires the presence of state agents on the ground, aerial spraying is a form of policy that allows us to explore the effects of a coercive policy aimed at eradicating the crop but does not introduce other confounding factors that could lead to violence, such as and increased presence of the police or the military.

We argue that coercive eradication policies, rather than consolidate security in growing regions, can lead to greater incentives and opportunities for the use of violence. In particular,

we propose that aerial spraying disrupts armed groups' long-term horizons, leading to a shift towards short-term extraction and undermining social contracts between these groups and local populations. Simultaneously, because aerial spraying displaces an important source of financing, non-state violent groups have the incentives to fight each other for territorial control and push back against state intervention. Both processes—the erosion of social contracts and exacerbation of uncertainty, coupled with the incentives to conquer and fend off territory—are likely to lead to greater levels of violence.

If aerial spraying leads to greater levels of violence, does the suspension of the policy reduce its occurrence? We argue that once the state has already intervened the state's withdrawal from growing regions leaves swathes of territory available to be recaptured, thus leading to armed competition and higher levels of violence as well. Overall, our argument illuminates the limitations of the war on drugs and suggests that the use of drug eradication policies, such as aerial spraying, creates harmful consequences for peace which are likely to persist even after its suspension.

We empirically evaluate this argument by focusing on the case of Colombia, a country with a long-lasting civil conflict, the participation of multiple armed organizations, the presence of extensive swathes of coca crops, and the use of aerial spraying for drug eradication. We leverage both temporal and municipal-level variation on armed violence and aerial spraying to uncover the dual effect of forced eradication: its implementation and subsequent suspension.

First, we explore the impact of aerial spraying on armed conflict violence in municipalities with coca production. Perhaps counter-intuitively, eradication—*aerial and also manual*—is also associated with higher levels of non-state armed actor violence in a municipality, which we attribute to the shock that this signifies for a stable territorial equilibrium, since it forces the relocation of producers and associated non-state armed groups, leading to more inter-group competition and civilian victimization to gain control over the new territories. As our theory predicts, these type of violence seems to be specifically related to insurgents with high stakes in the preservation of their territorial positions.

Second, we leverage a natural experiment to understand the effects of the policy suspension, whereby, in the context of the peace talks between the Colombian government and the FARC, the Colombian National Drug Council (Consejo Nacional de Estupefacientes or

CNE) suspended aerial spraying. Using a difference-in-differences approach we find that the suspension of aerial spraying—a reduction of state presence—had a positive effect on violence as well. In line with our predictions, we find that those increases in violence affect actors with loser strategic considerations who can quickly move into the generated vacuum, such as the paramilitary and criminal organizations.

Our paper hopes to contribute to a number of related literatures. First, this paper studies the logic of state interventions against drugs during civil conflict. To date, most of the literature has studied how the exogenous rise of coca prices increases levels of conflict and violence ([Angrist and Kugler, 2008](#); [Mejia and Restrepo, 2013](#)), or focused on other types of state intervention ([Dell, 2015](#); [Phillips, 2015](#); [Trejo and Ley, 2018](#)). Acknowledging the ample menu of drug eradication policies, we focus instead on the consequences of aerial spraying.

In doing so, our paper establishes a dialogue with research on counterinsurgency ([Mason and Company, 2007](#); [Weintraub, 2016](#); [Delgado, 2015](#)). In implementing a coercive policy, such as aerial spraying, governments are forced to consider the trade-off between disturbing illicit economies, and a key source of strength for armed groups, and the consequences of alienating the civilian population living in coca-growing areas. Indeed, the forced eradication of coca crops, rather than deterministically weakening violent actors, can increase their legitimacy and political support among locals ([Felbab-Brown, 2010](#)).

The paper is organized as follows. In Section 2, we take stock of the literature on civil war noting that state weakness and plunderable resources figure prominently as explanations for civil war onset. In Section 3 we come up with a theory of the use of violence in the context of a civil war where control over lootable resources plays a prominent role, deriving from it some testable implications. Section 4 provides a brief overview of the Colombian armed conflict and discusses the role of coca as a key resource financing its multiple non-state armed actors. It also highlights aerial spraying as the primary policy response implemented by the Colombian government to address this issue. This context sets the stage for Section 5, where we describe our data. Then Section 6 contains our three empirical studies and a brief discussion of each. Some concluding remarks are presented in Section 7.

2 Taking Stock: Illicit resources during conflict

Illicit economies provide an unparalleled source of wealth for insurgencies, paramilitaries, and criminal organizations alike. In addition to appropriating public funds, control over illegal markets, such as drugs, allows organizations to expand geographically, strengthen the recruitment of new combatants, and improve their military capability vis-a-vis the state and other armed competitors (Buhaug et al., 2009). More generally, the political economy literature has found that natural resources, both licit and illicit, provide an opportunity for rebellion (Collier and Hoeffler, 2004), attract a contingent of recruits willing to fight (Weinstein, 2006), and generate conflict among existing armed organizations (Metelits, 2010).

The mere presence of natural resources, however, does not automatically lead to greater levels of violence. Indeed, as suggested by evidence from Colombia, the effect of commodities on violence depends on their relative use of capital vs. labor: capital-intensive commodities, such as oil, are associated with rising levels of violence, but labor-intensive commodities, such as coffee, are associated with a reduction of violence (Dube and Vargas, 2013; Dal Bó and Dal Bó, 2011). Moreover, others have argued that an increase in the price and availability of resources does not necessarily lead to more armed violence. Instead, revenue from natural resources has a ‘state capacity effect’, allowing governments to further build their military capacity and deter challengers (Bueno de Mesquita and Smith, 2010; Ross, 2012).

Illicit economies, however, are different. While coca is, like coffee, an essentially agricultural commodity with a high demand for labor, an increase of its price is not associated with less violence. Because the coca economy is intrinsically related to violent actors, an increase in coca prices —and therefore a higher demand for labor— may incentivize individuals to move towards a ‘criminal labor sector’ prone to violence. In other words, coca does not carry the beneficial effects of other licit agricultural goods. On the other hand, the ‘state capacity effect’ is less likely to apply to illicit economies. Since states cannot overtly and formally accumulate revenue from illicit economies, in the same way as commodities from legal markets, coca is less likely to have direct positive effects on their capacity.

The rise of illicit economies, such as coca crops, leads to higher levels of violence. As the resource becomes more valuable, armed actors are likely to intensify their surveillance and coercion of civilians living in areas involved or suitable for its production. This is to

ensure compliance in territories they already control and to gain control over new ones. The higher the resource's value, the greater their incentives to perform coercive actions against civilians in order to maximize profits (Berman et al., 2017; Nieto-Matiz, 2023). Moreover, the availability of the resource will attract other groups to that geography in the case of multi-party civil wars (Cunningham, 2006). This intensified competition for the control of resources (and workers) will create incentives on non-state armed groups to apply coercion in order to increase the costs for civilians that might want to defect to other groups.

The empirical literature examining the role of coca crops corroborates this relationship. In Colombia, the exogenous upsurge in the global price of coca led to more violence in the rural areas where coca was produced, while urban areas were minimally affected (Angrist and Kugler, 2008). Additional evidence from Colombia suggests that as the value of coca cultivation goes up, municipalities with the presence of coca crops experience a growth in homicide rates, forced displacement, and explosion of land mines (Mejia and Restrepo, 2013). Also in Colombia, Estancona (2021) finds that increases in violence, derived from positive shocks in coca production, apply to both insurgent groups and right-wing paramilitaries.

More crucially, illicit resources, like coca, can help armed organizations consolidate their political power in the countryside. Extensive qualitative and quantitative evidence corroborates this assertion. The coca economy in some regions of Colombia prompted the insurgency to develop a social basis of peasants and coca farmers to actively oppose aerial fumigations and make certain claims to the state (Ramírez, 2001; Ferro and Uribe Ramón, 2002). Evidence from Central America also suggests that illicit economies have been pivotal to the creation of armed governance: communities in marginalized areas, where the state is very much absent, form collaborative relationships with traffickers (Blume, 2021). To be sure, the relationship between labor and armed organizations is not always voluntary and is often times mediated by threats and coercion. Yet the illicit economy of coca crops in Colombia stimulated population growth and the construction of *rebel roads*, which ultimately allowed insurgents to enhance their political authority and military strategies (Peñaranda Currie et al., 2021; Torres Bustamante, 2011).

If illicit economies provide not only a means to become wealthier, but also the vehicle for armed organizations to consolidate local social orders and accumulate political power, it is reasonable to expect states to perceive illicit economies, such as coca crops, as threatening

to their own governance. Not surprisingly, the war on drugs has been an important part of counterinsurgency policies, where the state is interested in winning the population's 'hearts and minds'.

Different strategies have been implemented by the state. First, the state can attempt to intervene the markets in which the resource is traded. In the case of drugs trafficking, states can go on the offensive with the executive and/or judicial powers instructing the police to more raids and seizures. These policies are unlikely to affect the availability of the resource but will impact their profitability by increasing transaction costs. Second, states can try to more directly affect the productivity of the resource by attacking or otherwise reducing the output at the source. In the case of the Colombian conflict, aerial spraying is intended to reduce the availability of the resource tout court. Lastly, the state can decide not to intervene or redress a previous attempt to influence these markets, in the understanding that these interventions are unfeasible, ineffective, or counterproductive. Since state withdrawal is a policy option as well, it is therefore worth exploring what its effect might be on the violence that non-state armed actors perpetrate against civilians and against competing actors. In this paper, we explore the effects on violence of the last two: aerial spraying and its sudden suspension.

3 Theory: Coca, state intervention, and violence

While governments rely on aerial fumigation with the aim of reducing non-state armed actors' sources of financing and eventually reduce levels of violence, coercion-based interventions, such as aerial spraying, may backfire. Our central argument is that aerial spraying of coca crops has unintended consequences: rather than consolidate security, fumigation can lead to greater incentives and opportunities for the use of violence.

3.1 Aerial spraying: a case of coercive state intervention

In their effort to combat illicit crops, governments have traditionally employed forced eradication, alternating between manual and aerial methods. *Manual* eradication involves teams of rural workers who, accompanied and protected by law enforcement, manually uproot coca plants. This approach entails a larger group of eradicators, requiring stricter security

clearance and proceeding at a slower pace. On the other hand, *aerial* eradication involves the use of aircrafts flying as close as possible to the ground and spraying herbicide on illicit crops. With aircrafts, authorities expect to access more remote locations, minimize injuries to eradicating teams, and rapidly hindering the cultivation of illicit crops at the point source (Felbab-Brown, 2010; Rozo, 2013; Díaz and Sánchez, 2004).

We leverage existing literature on state interventions to better understand the implications of aerial spraying for violence. In doing so, we characterize aerial spraying as a fleeting form of state intervention characterized by its coercive, unilateral, and often unconditional nature. First, aerial spraying, like other types of intervention, is based on the use of coercion. Through state security agencies, interventions may have goals as ambitious as regaining territorial control (Magaloni et al., 2020), decapitating the leadership of drug cartels (?), and interdicting the transport and production of processed drugs (Castillo and Kronick, 2020). In the context of drug eradication, aerial spraying is supported by the tacit use of force, with the deployment of police and army troops to clear the area from potential threats and safeguard the aircraft against armed attacks.

Moreover, aerial spraying can be considered as a type of unconditional crackdown. As an influential literature has shown, the degree and type of repression used by the government has important consequences for subsequent levels of violence (Davenport, 1995; Moore, 1998). However, this is likely to vary depending on the level of conditionality used by the state: instances of high conditionality are those where the state represses only in response to violence, while in situations of low conditionality, authorities crack down regardless of whether non-state violent actors have engaged in violence. As Lessing (2020) has persuasively argued, unconditional repression is associated with greater levels of violence. Building on this key distinction, aerial spraying can be seen as a type of unconditional crackdown: authorities seek to target areas with high density of illicit crops, regardless of the type of armed actor involved and its past levels of violence.

Lastly, aerial spraying is characterized by its unilateral approach and absence of consent from local communities. Some state interventions, specially those with a more civilian component are defined by a stage of engagement with the local community to communicate the state's actions, understand the community's demands, and influence locals' behavior. Examples include community policing and some counterinsurgency programs utilizing both

security agencies and civilian institutions for infrastructure and land reform, among others (Arias and Ungar, 2009; Delgado, 2015; Strauss, 2017). In the case of aerial spraying, however, even when it targets the most vulnerable link in the drug-trafficking chain, the state may engage in forced eradication without seeking prior approval or agreement from local communities. It is no surprise, then, that communities dependent on illicit crops resist against aerial spraying, a strategy which can lead to social tensions and exacerbate mistrust towards the state (Felbab-Brown, 2010).

In sum, aerial spraying is aimed at rapidly reducing the cultivation of illicit agricultural crops at the point source. It is a form of state intervention, marked by its coercive, unilateral, and often unconditional nature. Despite it being one of the most commonly used approaches, aerial spraying remains a controversial strategy due to its environmental and social consequences and cost-benefit relation (Mejía et al., 2017). In the following subsection, we identify three mechanisms linking the use of aerial spraying to the occurrence of non-state armed violence.

3.2 How aerial spraying affects armed violence

While there is an important literature exploring the effects of aerial spraying on health and environmental outcomes, surprisingly very little attention has been devoted to its effects on violence. What explains this relationship? Coca crops—very much like other licit agricultural products—presuppose the involvement of government authorities, non-state violent actors in control of crops, and civilians responsible for growing and maintaining the crops. If aerial spraying of illicit crops constitutes a type of crackdown, then it is plausible to expect such a strategy to generate an increase in armed violence through its effect on all three actors and their interactions. In concrete, we posit that aerial spraying generates violence via three mechanisms: *armed group backlash* against the state, the *erosion of social contracts* with the population, and *turf wars* between armed groups.

One of the most important mechanisms linking aerial spraying to violence concerns the *armed backlash* against government authorities by non-state armed actors. The literatures on political repression and organized crime are particularly instructive in this regard: crackdowns on specialists of violence, especially when they are unconditional and threaten a major source of income, are likely to backfire and generate cycles of violence (Lessing, 2017;

Heath et al., 2000; Flores-Macías, 2018). Related literature has also found that greater state penetration can lead to more intense civil conflict as local actors resist the reach of state authority (Ying, 2021; Koss and Sato, 2016). Although aerial spraying will normally take place in spaces that are otherwise inaccessible to the state, armed actors have incentives to retaliate aerial spraying by attacking state controlled areas, eradication teams, and state security forces, relying on landmines, ambushes, and other forms of attrition typically used as a means of wearing down the enemy. Indeed, since aerial spraying displaces an important source of financing, non-state armed actors will be tempted to push back against state intervention to protect their economic activities. Backlash can also be used by violent actors as a way to signal their resolve to fight push back against the possibility of future eradication attempts.

In addition to violent retaliation, aerial spraying generates the conditions for *turf wars* between competing non-state violent actors. For one, if a non-state violent actor is affected by aerial spraying—especially when eradication is accompanied by the deployment of state authorities—other rival armed groups may perceive it as a good opportunity to attack the affected armed group and try to conquer their territory. By disrupting a crucial link in the drug trafficking chain, aerial spraying can increase uncertainty for the affected armed actor and motivate the entry of rival actors. Indeed, evidence from Mexico has suggested how the government’s resolve to fight drug cartels motivated them to exploit rivals’ weaknesses and conquer their territory (Duran-Martinez, 2015; Trejo and Ley, 2018). Eradication disrupts the criminal drug market and leads armed actors to seek control over strategic territories unaffected by aerial spraying (Muñiz-Sánchez et al., 2022). Of course, this general ‘turf war’ mechanism can also account for the ‘balloon effect’ and the subsequent spatial displacement of violence to neighboring municipalities, as affected violent actors seek new territory for re-establishing the cultivation of coca crops.

Evidence for the balloon effect is abundant: applying pressure on one geography often has the effect of displacing production (the air in the balloon) to another place, without affecting the global output (Bagley, 2013; Reyes, 2014). Melissa Dell (2015) identifies a similar effect in Mexico, even when state intervention intends the control of routes for commercialization rather than production at the source. In such scenarios, we can anticipate an escalation of violence due to the geographic displacement of non-state armed actors. If we picture a

situation where a mine or a field controlled by one non-state armed actor and this source of revenue is taken from the rebel group, it is easy to imagine that the first reaction will be to try to replace it by wresting control to a competing actor in a nearby location or by ensuring the compliance of the civilians in this new location.

Lastly, the third mechanism we posit is the *erosion of social contracts* forged between armed groups and the local population. Social contracts are a crucial dimension of armed actor-civilian interaction: as violent actors enter a particular territory, they must establish a framework of rules and institutions for guaranteeing a predictable order, regulating civilian affairs, and negotiating the scope of armed intervention (Arjona, 2016b; Lessing, 2020; Mampilly, 2011). With respect to illicit economies, the arrival of coca crops in a particular region may produce some initial economic prosperity and rapid population growth, but it may also create social disorder. In this context, social contracts between civilians and armed actors, which result from negotiation, conflict, and push-back from both sides, are fundamental. In the Colombian case, the insurgency became a central actor in local communities¹. Armed actors' expansion into these areas grant them the opportunity to regulate the illicit economy, shape social relationships, and become the main enforcer of social contracts among locals (Jaramillo, 1988; Ferro and Uribe Ramón, 2002). Aerial spraying is likely to generate displacement of crops, disruptions to production and taxation at source, damage other crops and generate health issues. These dynamics are likely to suddenly increase uncertainty about and undermine the sustainability of social contracts, thus leading to greater levels of violence (Arjona, 2016b; Kalyvas, 2006).

H1: Aerial spraying is likely to lead to more armed violence in intervened municipalities

H1a: Aerial spraying is likely to lead to more armed violence in neighboring municipalities

An account of the effects of drug eradication on violence would be incomplete if we failed to uncover the effects of aerial spraying on *different* types of violent actors. This is particularly important for multi-party civil conflicts, situations marked by the participation of several armed groups with different ideologies, backgrounds, and relationships with the

¹Of course, this example does not mean that other armed actors, like paramilitaries and criminals, have not built arrangements with local populations or that insurgencies' relationships with communities are free from violence. The importance of guerrilla organizations in the social regulation of coca stems from their early insertion into coca-growing areas since the 1980s.

state (Christia, 2012). A key distinction to be made is between armed actors interested in overtly challenging the state, such as insurgent groups, and armed actors interested in shaping government policy, such as criminal actors and paramilitary organizations. Although this is a rather simple distinction, it is general enough to account for potential differences in violence².

Insurgent groups are interested in overthrowing government authorities. Relying on attrition and guerrilla warfare, these groups seek to harass and disrupt the state's military operations. Electorally speaking, insurgent groups are associated with lower turnout, as rather than promoting the election of particular politicians, they tend to target all types of politicians (Berman and Matanock, 2015; Galula, 2006). Most insurgencies embrace a left-wing ideology and their relationship with wealthy and influential actors, such as businesses and landowners, tends to be mediated by conflict and the use of kidnapping and extortion. Other types of groups hold a different relationship with the state. Paramilitary and criminal groups are less interested in transforming the political regime and instead seek to shape the government's behavior around crackdowns and enforcement (Bailey and Taylor, 2009; Lessing, 2017). Therefore, a key difference with respect to insurgents is their tendency to establish collusive relationships with some state officials and to hold cooperative relationships with economically influential actors.

While these differences have been associated with differential impacts on local state capacity (Ch et al., 2018; Nieto-Matiz, 2023), electoral behavior (Gallego, 2018), violence during economic booms (Dube and Vargas, 2013), we do not anticipate any substantive differences between insurgents and paramilitaries as it pertains to violence in the context of aerial spraying of illicit crops. For one, both actors benefit equally from the growing of coca: in the case of Colombia, while some actors have diversified their economic activities more than others, coca illicit crops remain one of the main sources of revenue. In addition, the logic of aerial spraying is mostly dictated by the density of illicit crops and not by the type of violent actor present in coca-growing areas. If aerial spraying was predominantly biased against areas controlled by insurgents, for instance, backlash violence perpetrated by them would likely be higher than that by other groups. Lastly, both insurgents and paramilitary/criminal groups engage in social contracts with coca growing communities. Of course, while the shape

²Indeed, most of the empirical literature on Colombia has studied the differential effect on violence of insurgents versus paramilitary and criminal actors.

and scope of such agreements could vary across armed actors' ideologies (Gutiérrez Sanín and Wood, 2014), how and whether armed groups engage civilians depends, to a larger extent, on the quality of pre-existing local institutions and armed groups' time horizons, typically shaped by internal discipline and competition with other groups (Arjona, 2016b; Hoover Green, 2016).

Therefore, we expect aerial spraying to have a positive effect on the violence perpetrated by all types of actors.

H1b: Aerial spraying will not produce any significant differences in violence by insurgents and paramilitaries (and criminal groups)

3.3 State withdrawal: consequences for violence

An important corollary from the previous discussion is that if the state does not intervene, no significant increase in violence should be observed. This might be so since armed groups do not see the need to violently react to the state, are not forced to displace production to other geographies seek new sources of income, and their relationships with local communities are likely to be unaffected.

However, once the state has intervened a particular territory, the suspension of aerial spraying may alter the local equilibria and lead to violence. Since the withdrawal of the state leaves swaths of territory available to be recaptured, it is possible that this policy change may generate armed actor competition for the control of newly available territories where the growing of crops is now possible. In addition to direct competition with other groups, the suspension of aerial spraying may lead armed groups to engage, once again, with local communities and negotiate the terms of their relationship. For instance, an armed group attempting to re-establish its control over the crops might prohibit local communities from selling the processed drug to rival armed groups, which can lead to potentially violent conflicts.

Here, too, we might expect a differential effect on violence by the type of actor. In particular, it is to be expected that the suspension of aerial spraying will increase the violence perpetrated by insurgents, while decreasing that by paramilitary organizations. While

both insurgents and paramilitaries must, in the event of the policy suspension, deal with local communities and re-negotiate the terms of their mutual relationship, how the state engages both armed actors might make an important difference. Since insurgencies—as a quintessential anti-state group—are more likely to constitute a threat to state officials, these will have incentives to devote greater resources and manpower in clearing the insurgency from the territory (Slater, 2010). On the other hand, in a situation where they must allocate resources to confronting multiple armed actors, state authorities may have fewer incentives to target paramilitary actors, might have strategic reasons to turn a blind eye on their presence, and even establish temporary military alliances with them to fight their common enemy—insurgencies (Jentzsch et al., 2015; Koivu, 2018).

H2: Intervened municipalities are likely to see an increase of armed violence when the state withdraws

H2a: State withdrawal from intervened municipalities will produce an increase of armed violence by insurgents (and not criminal groups and paramilitaries)

4 Context: Civil war and drug markets in Colombia

The civil war in Colombia can be traced back to the mid-20th century when several insurgent and left-wing revolutionary groups, including the Revolutionary Armed Forces of Colombia (FARC), the National Liberation Army (ELN), and the Popular Liberation Army (EPL), emerged as a response to the socioeconomic inequalities, government repression and lack of political representation. In response to the threat posed by these insurgent groups and their impact on Colombian society, the government implemented a range of social, political, economic, and military policies.

Notably, the Colombian government adopted measures influenced by the counterinsurgency doctrine developed by the United States during the Cold War. One crucial policy involved encouraging civilian involvement in the armed conflict to support the government's efforts in preventing and limiting the growth of insurgent groups. This approach gained legitimacy in 1969 through the counterinsurgency regulation issued by the central command of the Colombian armed forces. The regulation outlined the military organization of civilians, enabling them to protect themselves from guerrilla actions and assist the military in combat

operations. However, the policy inadvertently created a problem as it granted civilians a broad scope of action. This was leveraged by various actors such as landowners, corrupt political leaders, and drug lords, to safeguard their own political and economic interests. Consequently, strong paramilitary groups and criminal organizations emerged, extending their actions beyond merely confronting insurgent groups ([Comisión de la Verdad, 2022](#)).

The situation described above alone created an ideal environment for the escalation of violence in Colombia's rural regions. However, it worsened significantly due to the expansion of drug trafficking in the country between the 1970s and 1990s. This was a result of a variety of geographical, political and social factors, including the strategic geographical position of the country, the availability of vast wastelands suitable for growing coca crops, and the lack of strong government presence and control in many rural areas. Additionally, the social and economic crisis faced in the 1970s led to a rise in rural poverty and limited economic opportunities for many rural families. These local factors converged with the increased efforts in neighboring countries like Bolivia and Peru to target coca crops, which moved to Colombia. Overall, farmers found an important comparative advantage in growing coca crops in rural territories, as it had a higher external demand and offered higher profits with lower transaction and transport costs. This situation made it easier for drug cartels to convince many farmer families to cultivate coca and transform it into cocaine base paste (CBP), which they would later sell for cocaine production.

As drug production primarily took place in rural territories, insurgent groups operating in these areas eventually became entangled. Initially, these groups acted as intermediaries, purchasing CBP from farmers and selling it directly to drug cartels. This approach aimed to avoid conflicts between the parties and profit from the transactions. However, these groups soon realized the high financial potential of the cocaine market and became more deeply involved in the entire production process of coca crops and CBP. A clear proof of is the Seventh Guerrilla Conference of the FARC in 1982 when the group formally decided to participate in these illicit markets ([Bruce-Jones and Smith, 2021](#)).

The expansion of cocaine production also significantly impacted paramilitary groups and criminal organizations. In various regions, these groups were paid by drug cartels to perform several tasks, such as protecting the cartels and their drug production and trafficking sites from insurgent groups and state security forces, expanding the scope of their activities by

gaining territorial and civilian control. They also confronted competing non-state armed actors and forcibly displaced farmers from their lands to expand the cultivation of coca crops and gain control over strategic areas for the illegal operations of the cartels ([Comisión de la Verdad, 2022](#)). Overall, the lucrative nature of drug production fueled the armed conflict in Colombia as it became a crucial source of financing for non-state armed actors on all sides.

To face this pressing issue and after several years of unsuccessful efforts, the Colombian government, in cooperation with United States authorities, launched a joint strategy in 1999 called Plan Colombia. This plan aimed to contribute to the solution of the armed conflict by supporting the implementation of two types of drug policies: those focused on reducing production and those focused on combating trafficking ([Camacho and Mejia, 2017](#)). The primary strategy under this plan was the use of aerial spraying of glyphosate for eradication purposes. According to the Colombian government this method was designed to swiftly and safely confront and reduce coca crops. Although the National Drug Council (CNE) had regulated this program since 1994, Plan Colombia marked a turning point as the United States government provided additional resources and equipment, leading to its reinforcement and expansion ([Moreno, 2016](#)).

Despite being a central pillar of Colombia's anti-drug efforts, aerial spraying was largely criticized for its low cost-effectiveness and potential negative externalities in various areas. Regarding its effectiveness, several studies have concluded that this policy, in addition to being significantly more costly compared to others that do not rely on eradication ([Mejía and Restrepo, 2016](#)), is ineffective in terms of reducing the area of illicit crops ([Moreno-Sanchez et al., 2003](#); [Reyes, 2014](#); [Rozo, 2014](#); [Vargas Manrique, 2004](#)). Regarding externalities, the literature has primarily focused on health—the use of glyphosate has been associated with increased medical consultations for dermatological and respiratory diseases ([Camacho and Mejia, 2017](#)), diseases in newborn children ([Dias et al., 2019](#)), cellular mutations ([Solomon et al., 2009](#)), and non-Hodgkin lymphoma (LNH) cancer ([Eriksson et al., 2008](#))—and environmental consequences—including deforestation ([Rincón-Ruiz and Kallis, 2013](#)), water resource contamination, and disruption of ecosystems by affecting species development and survival rates ([Huber, 2012](#); [WWF, 2021](#)).

Consequently, after several years of discussion, on May 14 of 2015 the CNE announced

the suspension of this policy starting from October of 2015. This order was later upheld in 2017 by the Colombian Constitutional Court, who directed the CNE not to resume this policy until there was conclusive evidence regarding the complete absence of risks associated with its application. It is in the spirit of contributing to this debate that we explore here the effect of sprayings on the violent presence of non-state armed actors, an important aspect which remains so far unexplored.

5 Data

Non-state armed actors violence. Non-state armed actors are motivated to gain control over territories and routes used for illicit activities in order to reap profits from them and attain economic goals. To achieve this objective, they often employ violent tactics as a means to confront competing actors and influence the population and other relevant actors, ensuring territorial control and civilian compliance (Nieto-Matiz, 2023). Therefore, while violence is not the sole indicator of the presence of armed actors as they may also use non-violent means (Arjona, 2016a), it serves as a crucial strategy for establishing territorial control. Consequently, we use violent actions conducted by armed actors as our main outcome of interest. Specifically, we look at the number of violent events, including both lethal and non-lethal, perpetrated by armed actors in each municipality of Colombia from 1994 and 2018. These events are categorized based on the type of armed actor involved (insurgent organizations, paramilitary groups, criminal organizations, and FARC dissidents) and corresponds to all three types of violence (group-population; group-group; and group-state) that we are interested in. Figure B.1 displays the geographical distribution of these violent events, depicting the respective areas impacted by each category of armed actor during the specified time frame.

The information used to calculate these measures comes from the Violent Presence of Armed Actors in Colombia database (ViPAA) (Osorio et al., 2019), which encompasses information on the violent presence of armed actors in specific municipalities. This dataset specifically includes records of violent incidents in which any of the non-state actors mentioned earlier were participants. The data within this database is generated through computerized identification of actors and locations from a systematic set of narratives of human rights violations provided by the Centro de Investigación y Educación Popular (CINEP),

a research institution and human rights think tank in Colombia. To compile these narratives, CINEP collects daily reports from numerous national and local newspapers, as well as testimonies of human rights violations from victims, community leaders, and civil society organizations across a wide geographical network. This comprehensive approach allows for access to information even from remote areas of the country.

Coca crops presence. To identify the territories affected by coca and cocaine production dynamics, it is crucial to pinpoint the municipalities where coca crops were present. Available data on the presence of coca crops per municipality and year from 1994 to 2018 enables us to identify the territories where there non-state armed actors had opportunities to reap profits from drug production. Specifically, we created a dichotomous variable that is assigned a value of 1 if coca crops were confirmed in a given municipality for a particular year, and 0 otherwise. Figure B.2 shows the municipal distribution of coca crops presence for three periods of interest. Data for this variable comes from the Drug Observatory of Colombia (ODC) and the Sistema Integrado de Monitoreo de Cultivos Ilícitos (SIMCI), a system that utilizes satellite imagery to identify the presence and extent of coca crops which is administered by the United Nations Office on Drug and Crime (UNODC). This information is systematized and organized by Centro de Estudios sobre Desarrollo Económico (CEDE).

Aerial spraying eradication. As mentioned in Section 4, aerial spraying played a crucial role in Colombia’s drug control policy until 2015 when it was suspended by the National Drug Council (CNE), the governing body responsible for defining national drug policies. Notably, aerial spraying eradication accounted for 79.8% of the total hectares of coca crops eradicated in Colombia between 1994 and 2015, highlighting its significant role in the national drug control policy. This importance is visually illustrated in Figure B.3, which presents the evolution of coca eradication in Colombia.

We have access to data on the hectares of coca crops eradicated through aerial spraying in each municipality of Colombia from 1994 to 2015. Based on this data, we created a dichotomous variable that takes the value of 1 if aerial eradication occurred in a specific municipality and year, and 0 otherwise. Additionally, we obtained information on the total hectares eradicated by any eradication method during the same period. Figure B.4 displays the spatial distribution of eradication efforts across Colombian municipalities throughout this designated period. Furthermore, we possess monthly data on the number of coca crop

hectares eradicated specifically through aerial spraying between 2005 and 2015. This monthly data allows us to examine the variations in eradication efforts in a more detailed manner during this specific time-frame.

The data utilized to construct these variables is sourced from the Anti-Narcotics Colombian Police Directorate (DIRAN) and the Drug Observatory of Colombia (ODC), with organization and systematization carried out by the Centro de Estudios sobre Desarrollo Económico (CEDE).

6 Empirical Analyses

We turn now to our empirical analyses. In this section, we present two different approaches to explore the impact of both the implementation and subsequent suspension of the aerial spraying eradication policy on the violence linked to non-state armed actors during the Colombian civil war. For each of these approaches, we will begin by explaining our methodology for identification and then proceed to present the initial results as our baseline findings.

6.1 Eradication efforts and non-state armed actors violence

6.1.1 Estimation

To examine how the occurrence of drug policies influences the levels of armed conflict violence, in this subsection we look at variation in aerial spraying eradication of coca crops and its impact on the violent presence of non-state armed actors. To explore this, we estimate the following equation only using data from municipalities involved in coca crop production, covering the period from 1994 to 2015:

$$violent_events_{it}^j = \beta_0 + \beta_1 D.aerial_erad_{it} + \alpha_i + \rho_t + \varepsilon_{it} \quad (1)$$

where $violent_events_{it}^j$ is the outcome variable representing the number of violent events associated with armed actor j in municipality i and year t ; $D.aerial_erad_{it}$ is a dichotomous variable that takes the value of 1 if aerial spraying eradication was carried out in municipality m during year t , 0 otherwise; and α_i and ρ_t correspond to municipality and year fixed effects,

respectively.

In this analysis, we focus exclusively on municipalities involved in coca crop production. Particularly, we limit the estimation of Equation 1 to the municipalities where coca crop production was identified between 1994 and 2015. This deliberate selection allows us to avoid potential biases that may arise from including municipalities unaffected by the dynamics of cocaine production. By narrowing our scope to these specific municipalities, we can examine the impact of eradication policies on the violent presence of non-state armed actors with greater precision.

It is important to note that the dependent variable in this model varies depending on the specific type of non-state armed actor being analyzed. This disaggregation is necessary because each type of actor operates with distinct strategies and motivations. By isolating the effect for each type, we can better understand the unique dynamics at play for each group, resulting in a more accurate assessment of the impact of the cocaine commodity valuation on their violent presence. In our analysis, we have data on violent events involving insurgent groups, paramilitary groups, and criminal organizations. In addition, we also include the total number of violent events associated with non-state armed actors as a general measure of civil war incidence in each municipality. This broader measure provides a comprehensive view of the overall levels of violence and conflict in a given area, considering all types of non-state armed actors collectively. By considering the disaggregated effects for each armed actor type and including a general measure of violent events, our analysis provides a comprehensive understanding.

The parameter of interest in Equation 1 is β_1 , which represents the average difference in the violent presence of non-state armed actors between coca producer municipalities that were affected by aerial spraying eradication and those that were not. This parameter allows us to quantify the specific influence of aerial eradication on the levels of violence in these targeted areas. To ensure the validity of our findings, the main identification assumption for β_1 is that the occurrence of aerial spraying eradication is not correlated with unobservable factors that influence the presence of violent non-state armed actors. This assumption is supported by three primary reasons.

First, by including municipality fixed effects in our model, we account for unobservable variables at the municipality level that are related to both the occurrence of violent events

perpetrated non-state actors and the implementation of aerial spraying eradication. This helps control for potential biases and endogeneity issues that could affect the estimation of the parameter. Second, the occurrence of aerial spraying is significantly determined by the proximity of an area to airfields due to fuel constraints of the aircraft used for the spraying operations (Reyes, 2014). This factor is unrelated to the dynamics of the Colombian civil war, suggesting that the occurrence of aerial spraying is exogenous and independent of the geographical location of violent events involving non-state armed actors. Third, the possibility of aerial spraying is also highly determined by specific characteristics of an area and the suitability of its geographic conditions. For instance, certain areas such as natural national parks, forest reserves, indigenous reservations, and Afro-descendant communities are designated as special management zones and are protected from aerial spraying due to environmental considerations. Additionally, complex terrains like mountainous regions pose challenges for low-altitude spraying operations to avoid potential drift. These characteristics are independent of the violent presence of non-state armed actors, further supporting the exogeneity of aerial spraying occurrence in this context.

By considering these factors, we strengthen the credibility of our identification assumption, enabling us to attribute any disparities in violence to the occurrence of aerial spraying eradication. By taking these considerations into account, we aim to provide a robust examination on how the opportunities that arise from the state’s response to drug production shape the location of violent presence of non-state armed actors.

6.1.2 Baseline Results

Table 1 presents the baseline results of estimating Equation 1, which capture the effect of the occurrence of aerial spraying eradication on the violent presence of non-state armed actors in coca crop producer municipalities. Columns 1 to 3 show the estimation results using the violent events associated to insurgent groups as dependent variable; 4 to 6 the violent events associated to paramilitary groups; 7 to 9 criminal organizations; and 10 to 12 total violent events.

Columns 1, 4, 7, and 10 show the baseline estimations of coefficient β_1 in Equation 1 (Model 1). For robustness purposes, we also estimated two additional variations of the mentioned Equation. In the first variation (Model 1.1), we replaced the independent variable,

the dichotomous one that indicates the occurrence of aerial spraying eradication, with a continuous variable that indicates the number of coca crop hectares eradicated by the aforementioned policy. This modification allows us to differentiate the effect of aerial eradication depending on its intensity in each municipality. The results of this model can be found in columns 2, 5, 8, and 11. In the second variation, we use the total coca crop hectares eradicated by any mean as independent variable (Model 1.2). By using this alternative variable, we aim to capture the total effect of eradication policies. The results of this model are presented in columns 3, 6, 9, and 12.

In summary, the results provide strong statistical evidence supporting a positive effect of eradication policies on the violent presence of non-state armed actors. Specifically, when analyzing different subsets of armed actors, in the cases of insurgent groups and all non-state armed actors together we consistently observe a strong and statistically significant positive effect of eradication on violent events across the baseline model and its variations (Models 1.1 and 1.2). For paramilitary groups, the evidence also suggests a positive and statistically significant effect of eradication on violent events, although not all models associated with these groups demonstrate robust results.

Also as expected by our Hypothesis 1b, outlined in Section 3, in the case of criminal organizations, the results do not show statistically significant effects. Excluding the lack of significance for criminal organizations, it is worth noting that all the estimated coefficients of the rest of the models have a positive direction, indicating a notable relationship between eradication policies and the violent presence of non-state armed actors. This relationship is particularly strong for insurgent groups and the overall presence of non-state armed actors.

These findings provide support for Hypothesis 1. It is evident that state interventions aimed at curtailing production, aerial spraying in this case, lead to an increase in violence perpetrated by non-state armed actors in the municipalities involved in producing illicit crops. Specifically, the eradication policies disrupt the production of coca crops, which in turn affects the expectations of armed groups and raises uncertainty. To counteract these adverse impacts, armed groups have incentives to gain control over nearby territories to maintain their profits from drug production, for which they resort to violence to enforce compliance among civilians and contend competing actors in the region. These actions serve as a means of ensuring their continued control over the drug markets and protecting their

economic interests in the face of state interventions.

Table 1: Aerial spraying eradication effects on armed conflict violence

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Insurgent events (1-3)		Paramilitary events (4-6)		Criminal organizations events (7-9)		Total events (10-12)					
D.Aerial spraying eradication	0.301** (0.144)			0.247 (0.154)			0.0591 (0.0508)			0.607** (0.266)		
Aerial spraying eradication (ha)		8.06e-05* (4.42e-05)			0.000202*** (4.72e-05)			-2.60e-05* (1.56e-05)			0.000256*** (8.15e-05)	
Total eradication (ha)			8.49e-05** (3.92e-05)			0.000193*** (4.19e-05)			-1.59e-06 (1.38e-05)			0.000277*** (7.23e-05)
Observations	11,924	11,924	11,924	11,924	11,924	11,924	11,924	11,924	11,924	11,924	11,924	11,924
R-squared	0.101	0.100	0.101	0.031	0.033	0.033	0.019	0.019	0.019	0.068	0.069	0.069
Number of codimpio	542	542	542	542	542	542	542	542	542	542	542	542

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. All regressions include municipal and year fixed effects.

6.2 Suspension of spraying as a sudden shock

6.2.1 Estimation

To further study how state withdrawal affects the levels of armed conflict violence, in this subsection, we leverage the sudden suspension of the aerial spraying eradication policy in October 2015. To explore this, we estimate the following difference-in-difference equation using monthly data from municipalities involved in coca crop production from January 2014 to June 2016:

$$\begin{aligned} violent_events_{im}^j &= \beta_0 + \beta_1 Aerial_erad_i + \beta_2 Suspension_m \\ &+ \beta_3 Aerial_erad_i \times Suspension_m + \rho_m + \varepsilon_{im} \end{aligned} \tag{2}$$

where $violent_events_{im}^j$ represents the outcome variable, which measures the number of violent events associated with armed actor j in municipality i and month m ; $Aerial_erad_i$ serves as our treatment group variable, being a dichotomous variable that takes the value of 1 if the municipality m had the presence of aerial spraying eradication at any time between 2014 and 2015; $Suspension_m$ is a dichotomous variable that captures the occurrence of the natural experiment (suspension of aerial spraying eradication policy); and ρ_m correspond to month fixed effects.

Given the availability of daily data on the violent presence of non-state armed actors, we can look at the impact of the administrative decision to lift the aerial spraying as an exogenous shock that affected the expectations of future state intervention and future earnings in municipalities in which aerial spraying was formerly carried out. These expectations may shape the incentives of the mentioned actors to gain control over newly unaffected territories, as well as the surrounding ones, in order to maximize their profit.

Because the suspension was prompted by concerns about potential negative impacts on the health of local communities and the environment, and therefore unrelated to conflict dynamics, we are confident the shock is exogenous. Yet, to ensure the robustness of our analysis, we explore two different dates for constructing the variable $Suspension_m$. The first one is October of 2015, month in which the aerial spraying policy was suspended by the CNE. Although, as explained in Section 4, this suspension was announced on May 14 of 2015, which may have caused a shift in the expectation of non-state armed actors related to

coca and cocaine markets. To account for this potential effect, we also consider June 2015 as a second date for constructing the variable, which is the first month after the announcement.

It is also relevant to consider that to minimize potential biases, this analysis is limited until June 2016. In that month, a ceasefire agreement was reached between the Colombian government and the FARC group. After this agreement, the dynamics of the Colombian civil war underwent significant changes, leading to alterations in the levels of violence in the territories previously controlled by the FARC. While time fixed effects are included in the analysis, the post-June 2016 period might introduce confounding effects that could impact the validity of the results. By limiting the analysis to this date, we can more accurately assess the impact of the aerial spraying suspension on the violent presence of non-state armed actors.

In this analysis, we also focus exclusively on municipalities involved in coca crop production. Particularly, we limit the estimation of Equation 2 to the municipalities where coca crop production was identified between 2014 and 2016. As explained in Section 6.1, this allows us to avoid potential biases that may arise from including municipalities unaffected by the dynamics of cocaine production. Moreover, as with Equation 1, we look at the specific type of non-state armed actor that perpetrates the violent act to have a better understanding on the unique dynamics at play for each group.

The parameter of interest in Equation 2 is β_3 , which corresponds to the Average Treatment Effect on the Treated (ATT) estimated using a difference-in-differences model. This parameter allows us to quantify the average difference in violent events associated with non-state armed actors following the suspension of the aerial spraying policy in October of 2015. Specifically, it measures a (first) difference in violent events between municipalities with coca crop presence but no aerial spraying occurrence from 2014 to September 2015, and those where aerial spraying did occur during that period, and a (second) additional difference between the two groups that results from the policy suspension.

This analysis helps us understand the causal relationship between the policy change and the observed differences in violence, providing insights into how this shock may be seen as an opportunity by armed actors. In addition, by controlling for pre-existing differences between the two groups of interest, the difference-in-difference approach enables us to attribute any disparities in violence to the suspension of the aerial spraying policy by excluding any

confounders that may bias our findings.

To ensure the validity of our findings, the main identification assumption for β_3 is the parallel trends one. This assumption implies that between 2014 and September 2015 (suspension of aerial spraying), the violence levels in coca-producing municipalities where this policy was implemented followed a similar trend to the violence levels in coca-producing municipalities where the policy was not carried out. In simpler terms, the assumption entails that both groups of municipalities exhibited comparable trends of violence in the mentioned time period prior to the suspension of aerial spraying, although not similar levels, helping to mitigate the risk of confounding factors influencing the results. Figure B.5 visually represents this assumption and demonstrates its plausibility. While both groups differ in their violence levels, it can be observed an overall similar trend during the pre-treatment period.

6.2.2 Baseline Results

Table 2 presents the baseline results of estimating Equation 2, capturing the effect of the suspension of aerial spraying eradication in October of 2015 on the violent presence of non-state armed actors in coca crop producer municipalities. Columns 1 and 2 show the estimation results using the violent events associated to insurgent groups as dependent variable; 3 and 4 the violent events associated to insurgent and dissident groups; 5 and 6 paramilitary groups; 7 and 8 criminal organizations; and 9 and 10 total violent events.

Columns 1, 3, 5, 7, and 9 display the baseline estimates of coefficient β_3 in Equation 2 (Model 2). To ensure the robustness of our findings, we also estimated an additional variation of the same equation (Model 2.1). In this alternative model, we consider the announcement of the aerial spraying suspension as the treatment period, which occurred on May 14, 2015. This choice is motivated by the possibility that non-state armed actors involved in the cocaine production process may have adjusted their expectations upon learning about the impending suspension. This could have potentially increased their incentives to gain control over new territories through violent means. The results of Model 2.1 can be found in columns 2, 4, 6, 8, and 10.

In summary, the results suggest a positive effect of the aerial spraying eradication policy suspension on the presence of the predicted non-state armed actors engaging in violence. As we expected, the suspension does not have a significant effect on violent events associated

with insurgent groups, which can be attributed to the specific type military-strategic considerations that affect these particular type of actors and their decision to move into new territories. In contrast, for paramilitary groups, there is a positive and statistically significant effect of the suspension on the incidence of violent events associated with these groups. This finding remains robust even when considering the announcement of the suspension as the treatment shock. Regarding criminal organizations and the overall presence of non-state armed actors, the effect of the suspension itself is not statistically significant. However, it is worth noting that there is a positive and significant effect of the suspension announcement on the levels of violence associated with these groups.

The findings from this analysis provide suggestive evidence that support the Hypothesis 2 presented in Section 3. Particularly, a withdrawal of the state, in this case the suspension of aerial spraying, alters the equilibrium of areas involved in coca crop production that were formerly affected by aerial spraying. This increase in violence could be attributed to the availability of swaths of territory that were previously under state intervention, which are now open to be captured by non-state armed actors. This situation may lead to intensified competition among armed groups for the control of these newly available territories, where cocaine production can now take place without state intervention.

Furthermore, it is important to consider that changes in expectations due to the suspension of the drug policy materialized rather rapidly, as can be evidenced in B.5. This supports our intuition that state intervention and withdrawal have immediate effects on actors expectations, even if these expectations fail to materialize in terms of actual increase in production and market prices. The fact the materialization of this effect is immediate and levels of violence in intervened municipalities stabilizes thereafter, also means that the effects found in Model 1 do not undermine the parallel trends assumption behind Model 2.

Table 2: Aerial spraying suspension effects on armed conflict violence

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Insurgent events	Paramilitary events	Criminal organizations events	Total events				
ATT - Suspension	-0.0261 (0.0248)	0.0679*** (0.0257)	0.00740 (0.0101)				0.0526 (0.0468)	
ATT - Suspension announcement		-0.00641 (0.0241)		0.0638** (0.0249)		0.0218** (0.00977)		0.0818* (0.0455)
Observations	11,356	11,356	11,356	11,356	11,356	11,356	11,356	11,356
R-squared	0.018	0.018	0.022	0.022	0.018	0.019	0.025	0.025

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. All regressions include month fixed effects.

7 Conclusion

This article analyzed how state interventions, aimed at targeting the availability of illicit resources, affect non-state armed groups' propensity to resort to violence. Our argument suggests that such interventions, rather than improving security in intervened areas, can lead to greater levels of violence. State interventions disrupt armed groups' long-term horizons, undermine their social contracts with local populations, and force them to push back against the state. Moreover, once the state has intervened, state's withdrawal will leave swathes of territory available to be recaptured, thus leading to violence as well.

We tested several implications of previous theory, in particular, the idea that higher profitability of resources and competition between these actors for the control of available resources will lead to more armed violence. Furthermore, we integrated those insights into a coherent theory of non-state armed actor violence in the context of state interventions trying to reduce the profitability or availability of such resources. Our empirical focus is on cocaine production in the context of the Colombian civil conflict. We focused on the behavior of insurgents, paramilitaries, and criminal organizations, and explored the variation of violence over time and across municipalities.

In our first study, we explored the impact of aerial spraying, a form of more direct state intervention targeted at specific municipalities. We find evidence suggesting that state intervention produces an increase in violence. We then explored how the withdrawal of aerial spraying, due to a resolution of the National Drug Council in October of 2015, impacted violence against civilians. Although suggestive evidence is found of a positive relation, the effect of this treatment is less consistent, in line with the expectation. The withdrawal of the state, however, seems to lead to an increase of paramilitary violence.

This work has important implications for the study of the policies that states can implement to limit the availability and profitability of resources financing rebellion in the most likely scenarios for civil war: those with weak states and the presence of prominent plunderable resources outside the direct control of the state. The main takeaway is that any form of state intervention affecting these markets is likely to increase violence against civilians in geographies where the resource is produced.

References

- Angrist, J. D. and Kugler, A. D. (2008). Rural Windfall or a New Resource Curse? Coca, Income, and Civil Conflict in Colombia. *Review of Economics and Statistics*, 90(2):191–215.
- Arias, E. D. and Ungar, M. (2009). Community policing and Latin America’s citizen security crisis. *Comparative Politics*, 41(4).
- Arjona, A. (2016a). *Rebelocracy*. Cambridge University Press.
- Arjona, A. (2016b). *Rebelocracy: Social Order in the Colombian Civil War*. Cambridge University Press, New York, NY.
- Bagley, B. (2013). The evolution of drug trafficking and organized crime in Latin America. *Sociologia (Lisbon, Portugal)*, 71(71):99–123.
- Bailey, J. and Taylor, M. M. (2009). Evade, Corrupt, or Confront? Organized Crime and the State in Brazil and Mexico. *Journal of Politics in Latin America*, 1(2):3–29.
- Berman, E. and Matanock, A. M. (2015). The Empiricists’ Insurgency. *Annual Review of Political Science*, 18:443–464.
- Berman, N., Couttenier, M., Rohner, D., and Thoenig, M. (2017). This mine is mine! how minerals fuel conflicts in Africa. *American Economic Review*, 107(6):1564–1610.
- Blume, L. R. (2021). Narco Robin Hoods: Community support for illicit economies and violence in rural Central America. *World Development*, 143:105464.
- Bruce-Jones, T. and Smith, M. (2021). Coca, Clausewitz, and Colombia: The inadequacy of micro-level studies in explaining FARC violence against civilians during the Colombian civil war. *Studies in Conflict & Terrorism*, 44(12):994–1021.
- Bueno de Mesquita, B. and Smith, A. (2010). Leader Survival, Revolutions, and the Nature of Government Finance. *American Journal of Political Science*, 54(4):936–950.
- Buhaug, H., Gates, S., and Lujala, P. (2009). Geography, rebel capability, and the duration of civil conflict. *Journal of Conflict Resolution*, 53(4):544–569.

- Calderón, G., Robles, G., Díaz-Cayeros, A., and Magaloni, B. (2015). The Beheading of Criminal Organizations and the Dynamics of Violence in Mexico. *Journal of Conflict Resolution*, 59(8):1455–1485.
- Camacho, A. and Mejia, D. (2017). The health consequences of aerial spraying illicit crops: The case of colombia. *Journal of health economics*, 54:147–160.
- Castillo, J. C. and Kronick, D. (2020). The Logic of Violence in Drug War. *American Political Science Review*, 114(3):874–887.
- Ch, R., Shapiro, J., Steele, A., and Vargas, J. F. (2018). Endogenous Taxation in Ongoing Internal Conflict: The Case of Colombia. *American Political Science Review*, 112(4):996–1015.
- Christia, F. (2012). *Alliance Formation in Civil Wars*. Cambridge University Press, Cambridge.
- Clunan, A. and Trinkunas, H. A. (2010). *Ungoverned Spaces: Alternatives to State Authority in an Era of Softened Sovereignty*. Stanford University Press, Stanford, CA.
- Collier, P. and Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford economic papers*, 56(4):563–595.
- Comisión de la Verdad (2022). *No matarás. Relato histórico del conflicto armado en Colombia*. New York University Press, Bogota.
- Cunningham, D. E. (2006). Veto players and civil war duration. *American Journal of Political Science*, 50(4):875–892.
- Dal Bó, E. and Dal Bó, P. (2011). Workers, warriors, and criminals: Social conflict in general equilibrium. *Journal of the European Economic Association*, 9(4).
- Dávalos, E. and Dávalos, L. M. (2019). Social Investment and Smallholder Coca Cultivation in Colombia. <https://doi.org/10.1080/00220388.2019.1650167>, 56(6):1118–1140.
- Davenport, C. (1995). Multi-Dimensional Threat Perception and State Repression: An Inquiry into Why States Apply Negative Sanctions. *American Journal of Political Science*, 39(3):683.

- Delgado, J. E. (2015). Counterinsurgency and the limits of state-building: An analysis of Colombia's policy of territorial consolidation, 2006–2012. *Small Wars and Insurgencies*, 26(3):408–428.
- Dell, M. (2015). Trafficking networks and the mexican drug war. *American Economic Review*, 105(6):1738–1779. .
- Dias, M., Rocha, R., and Soares, R. R. (2019). Glyphosate use in agriculture and birth outcomes of surrounding populations.
- Díaz, A. M. and Sánchez, F. (2004). A geography of illicit crops (coca leaf) and armed conflict in Colombia.
- Dube, O. and Vargas, J. F. (2013). Commodity price shocks and civil conflict: Evidence from Colombia. *Review of Economic Studies*, 80(4):1384–1421.
- Duran-Martinez, A. (2015). To Kill and Tell? State Power, Criminal Competition, and Drug Violence. *Journal of Conflict Resolution*.
- Eriksson, M., Hardell, L., Carlberg, M., and Åkerman, M. (2008). Pesticide exposure as risk factor for non-hodgkin lymphoma including histopathological subgroup analysis. *International journal of cancer*, 123(7):1657–1663.
- Estancona, C. L. (2021). Rebel Primary Commodity Markets, Price Shocks, and Supplier Victimization. *International Studies Quarterly*, 65(4):1111–1123.
- Felbab-Brown, V. (2010). *Shooting Up: Counterinsurgency and the War on Drugs*. Brookings Institution Press, Washington, DC.
- Ferro, J. G. and Uribe Ramón, G. (2002). *El orden de la guerra: las FARC-EP, entre la organización y la política*. Centro Editorial Javeriano, Bogotá.
- Flores-Macías, G. (2018). The Consequences of Militarizing Anti-Drug Efforts for State Capacity in Latin America: Evidence from Mexico. *Comparative Politics*, 51(1):1–20.
- Gallego, J. (2018). Civil conflict and voting behavior: Evidence from Colombia. *Conflict Management and Peace Science*, 35(6):601–621.

- Galula, D. (2006). *Counterinsurgency warfare: theory and practice*. Greenwood Publishing Group.
- Gutiérrez Sanín, F. and Wood, E. J. (2014). Ideology in civil war: Instrumental adoption and beyond. *Journal of Peace Research*, 51(2):213–226.
- Heath, J. A., Mason, T. D., Smith, W. T., and Weingarten, J. P. (2000). The Calculus of Fear: Revolution, Repression, and the Rational Peasant. *Social Science Quarterly*, 81(2):622–633.
- Hoover Green, A. (2016). The commander’s dilemma: Creating and controlling armed group violence. *Journal of Peace Research*, 53(5):619–632.
- Huber, D. (2012). Glyphosate hazards to crops, soils, animals and consumers. Article.
- Jaramillo, J. (1988). *Estado, sociedad y campesinos*. Tercer Mundo Editores, Bogotá.
- Jentzsch, C., Kalyvas, S. N., Schubiger, L. I., Carey, S. C., Colaresi, M. P., and Mitchell, N. J. (2015). Governments, Informal Links to Militias, and Accountability. *Journal of Conflict Resolution*, 59(5):850–876.
- Kalyvas, S. N. (2006). *The Logic of Violence in Civil War*. Cambridge Studies in Comparative Politics. Cambridge University Press, Cambridge.
- Koivu, K. L. (2018). Illicit Partners and Political Development: How Organized Crime Made the State. *Studies in Comparative International Development*, 53(1).
- Koss, D. and Sato, H. (2016). A Micro-Geography of State Extractive Power: the Case of Rural China. *Studies in Comparative International Development*, 51(4):389–410.
- Lessing, B. (2017). *Making peace in drug wars: Crackdowns and cartels in Latin America*. Cambridge University Press.
- Lessing, B. (2020). Conceptualizing Criminal Governance. *Perspectives on Politics*.
- Magaloni, B., Franco-Vivanco, E., and Melo, V. (2020). Killing in the Slums: Social Order, Criminal Governance, and Police Violence in Rio de Janeiro. *American Political Science Review*, 114(2).

- Mampilly, Z. C. (2011). *Rebel Rulers: Insurgent Governance and Civilian Life during War*. Cornell University Press, Ithaca, N.Y, 1 edition edition.
- Mason, T. D. and Company, C. (2007). Guerrillas, drugs and peasants: The rational peasant and the war on drugs in Peru. <http://dx.doi.org/10.1080/09546559508427322>, 7(4):140–170.
- Mejia, D. and Restrepo, P. (2013). Bushes and Bullets: Illegal Cocaine Markets and Violence in Colombia. *SSRN Electronic Journal*.
- Mejía, D. and Restrepo, P. (2016). The economics of the war on illegal drug production and trafficking. *Journal of Economic Behavior & Organization*, 126:255–275.
- Mejía, D., Rico, D. M., et al. (2010). La microeconomía de la producción y tráfico de cocaína en colombia.
- Mejía, D., Restrepo, P., Rozo, S. V., Camacho, A., Ferguson, L., Guiliano, P., and Boustan, L. (2017). On the Effects of Enforcement on Illegal Markets: Evidence from a Quasi-Experiment in Colombia*. *The World Bank Economic Review*, 31(2):570–594.
- Metelits, C. (2010). *Inside insurgency : violence, civilians, and revolutionary group behavior*. New York University Press, New York.
- Moore, W. H. (1998). Repression and Dissent: Substitution, Context, and Timing. *American Journal of Political Science*, 42(3):851.
- Moreno, M. M. (2016). Memoria histórica de las fumigaciones 1978-2015. Retrieved from: <https://www.indepaz.org.co>.
- Moreno-Sanchez, R., Kraybill, D. S., and Thompson, S. R. (2003). An econometric analysis of coca eradication policy in colombia. *World Development*, 31(2):375–383.
- Muñiz-Sánchez, V., Fuerte-Celis, P., and Méndez-Ramírez, K. (2022). The killing fields. A Bayesian analysis of crop eradication and organized crime violence in Mexico. *Spatial Statistics*, 47:100553.
- Nieto-Matiz, C. (2023). Land and state capacity during civil wars: How land-based coalitions undermine property taxation in colombia. *Journal of Conflict Resolution*, 67(4):701–727.

- Osorio, J., Mohamed, M., Pavon, V., and Brewer-Osorio, S. (2019). Mapping Violent Presence of Armed Actors in Colombia. *Advances of Cartography and GIScience of the International Cartographic Association*, 16(1):1–9.
- Peñaranda Currie, I., Otero-Bahamon, S., and Uribe, S. (2021). What is the state made of? Coca, roads, and the materiality of state formation in the frontier. *World Development*, 141:105395.
- Phillips, B. J. (2015). How does leadership decapitation affect violence? the case of drug trafficking organizations in Mexico. *Journal of Politics*, 77(2).
- Ramírez, M. C. (2001). *Entre el estado y la guerrilla: identidad y ciudadanía en el movimiento de los campesinos cocaleros del Putumayo*. Instituto Colombiano de Antropología e Historia: Colciencias, Bogotá.
- Reyes, L. C. (2014). Estimating the causal effect of forced eradication on coca cultivation in colombian municipalities. *World Development*, 61:70–84.
- Rincón-Ruiz, A. and Kallis, G. (2013). Caught in the middle, colombia’s war on drugs and its effects on forest and people. *Geoforum*, 46:60–78.
- Ross, M. L. (2012). *The oil curse: How petroleum wealth shapes the development of nations*. Princeton University Press, Princeton, N.J.
- Rozo, S. V. (2013). On the Unintended Consequences of Anti-drug Eradication Programs in Producing Countries.
- Rozo, S. V. (2014). On the unintended consequences of enforcement on illegal drug producing countries. *UCLA CCPR Population Working Papers*.
- Slater, D. (2010). *Ordering power: Contentious politics and authoritarian leviathans in Southeast Asia*. Cambridge University Press, Cambridge.
- Solomon, K. R., Marshall, E., and Carrasquilla, G. (2009). Human health and environmental risks from the use of glyphosate formulations to control the production of coca in colombia: overview and conclusions. *Journal of Toxicology and Environmental Health, Part A*, 72(15-16):914–920.

- Strauss, J. C. (2017). Campaigns of redistribution: Land reform and state building in China and Taiwan, 1950–1953. In *States in the Developing World*.
- Torres Bustamante, M. C. (2011). *Estado y coca en la frontera colombiana: el caso de Putumayo*. CINEP - ODECOFI, Bogotá.
- Trejo, G. and Ley, S. (2018). Why did drug cartels go to war in Mexico? subnational party alternation, the breakdown of criminal protection, and the onset of large-scale violence. *Comparative Political Studies*, 51(7):900–937.
- Vargas Manrique, C. E. (2004). Cultivos ilícitos y erradicación forzosa en Colombia. *Cuadernos de economía*, 23(41):109–141.
- Weinstein, J. M. (2006). *Inside rebellion : the politics of insurgent violence / Jeremy M. Weinstein*. Cambridge studies in comparative politics. Cambridge University Press, Cambridge.
- Weintraub, M. (2016). Do all good things go together? Development assistance and insurgent violence in civil war. *Journal of Politics*, 78(4):989–1002.
- WWF (2021). ¿qué tan riesgoso para la salud y la naturaleza es volver a la aspersión aérea con glifosato? Retrieved from: <https://www.wwf.org.co>.
- Ying, L. (2021). How State Presence Leads to Civil Conflict. *Journal of Conflict Resolution*, 65(2-3):506–533.

Appendices

A Cocaine prices and armed conflict violence

This appendix explores the relationship between cocaine prices and the levels of violence associated to armed conflict. In particular, we aim to provide an empirical corroboration of one of our main assumptions, which has already been proved in academic literature: the rise of illicit economies, such as coca crops, leads to higher levels of violence. For this purpose, we first present the data used for this exercise, then we explain our methodology for identification and last we present the results.

A.1 Data: Cocaine prices

Cocaine production is a complex process that involves multiple actors, such as farmer families, non-state armed actors, and suppliers, among others. This process can be divided into four main phases (Mejía et al., 2010): (i) cultivation and harvesting phase of coca leaves; (ii) primary transformation of coca leaves into cocaine base paste (CBP); (iii) transformation of CBP into cocaine hydrochloride (cocaine); (iv) packaging and trafficking of the final product. The first two phases primarily occur within farmer economies, where nearly two-thirds of coca leaf producers directly engage in producing and selling CBP to cocaine producers, rather than selling the coca leaves directly.

The price associated with CBP serves as a suitable proxy for the value of the cocaine commodity in local economies. While international cocaine prices are influenced by factors such as production costs and global demand, they are also affected by idiosyncratic dynamics within international markets. These dynamics include transportation costs to the final destination and local distribution, as well as various local factors like seizures, confrontations between cartels and gangs, and weather conditions. In contrast, CBP price is primarily determined by expectations of cocaine prices in international markets, alongside other local determinants such as production costs. Given that non-state armed groups in Colombia are primarily involved in the production phases of cocaine rather than distribution and trafficking, they may have limited awareness of these idiosyncratic factors within international markets. In addition, as explained in Section 4, often non-state armed actors act

as intermediaries between farmers and drug cartels to sell CBP rather than being involved in the later production and trafficking of cocaine. Therefore, the price of CBP can be seen as a reasonable approximation of the value of the cocaine commodity for non-state armed actors and within local economies. It is then plausible to assume that this price significantly influences the incentives for these groups to gain control over territories and routes used for cocaine production, as higher commodity value can lead to increased profits.

Consequently, we use the price of cocaine paste base (CBP) as a proxy for the overall valuation that non-state armed actors make of the cocaine commodity. Our dataset includes information on the average in-site CBP price in Colombia, measured in Colombian pesos (COP), spanning from 2004 to 2018. From this data, we calculate the yearly percentage change in the CBP price, which is illustrated graphically in Figure B.6. The data is obtained from the Yearly Colombia Coca Survey reports, which are compiled by the United Nations Office on Drugs and Crime (UNODC). These reports provide insights into the in-site prices associated with the cocaine production process within coca cultivation zones and commercialization influence zones. The information is gathered through information networks involving various key entities, such as the National Police, the Anti-Narcotics Colombian Police Directorate (DIRAN), and other governmental organizations. For robustness purposes in our analysis, we have also obtained average wholesale prices of cocaine in Colombia, the United States, and Europe from the UNODC. These additional price data points allow for a more comprehensive examination of the cocaine market dynamics.

A.2 Estimation

To explore the effect of cocaine prices on the levels of armed conflict violence, we exploit the exogenous variation in the CBP prices to instrument the effect of the valuation of the cocaine commodity on the presence of non-state violent armed actors in Colombia. To achieve this, we estimate the following equation using data from all Colombian municipalities for the period between 2005 and 2018:

$$\begin{aligned}
 violent_events_{it}^j &= \beta_0 + \beta_1 \Delta CBPprice_t + \beta_2 D.coca_{it} \\
 &+ \beta_3 \Delta CBPprice_t \times D.coca_{it} + \alpha_i + \rho_t + \varepsilon_{it}
 \end{aligned}
 \tag{3}$$

where $violent_events_{it}^j$ is the outcome variable representing the number of violent events

associated with armed actor j in municipality i and year t ; $\Delta CBPprice_t$ is the yearly variation of the in-site cocaine paste base (CBP) price; $D.coca_{it}$ is a dichotomous variable that takes the value of 1 if municipality m had the presence of coca crops during year t , 0 otherwise; and α_i and ρ_t correspond to municipality and year fixed effects, respectively.

It is important to note that the dependent variable in this model varies depending on the specific type of non-state armed actor being analyzed. This disaggregation is necessary because each type of actor operates with distinct strategies and motivations. By isolating the effect for each type, we can better understand the unique dynamics at play for each group, resulting in a more accurate assessment of the impact of the cocaine commodity valuation on their violent presence. In our analysis, we have data on violent events involving insurgent groups, FARC dissident groups, paramilitary groups, and criminal organizations. However, it is worth mentioning that the occurrence of FARC dissident violence is relatively limited across the Colombian territory, as depicted in Figure B.1. To address this, we have created a category that combines the events involving insurgent groups and FARC dissidents. This aggregated category allows us to capture the dynamics of groups motivated by insurgency. In addition to the disaggregated analysis, we also include the total number of violent events associated with non-state armed actors as a general measure of civil war incidence in each municipality. This broader measure provides a comprehensive view of the overall level of violence and conflict in a given area, considering all types of non-state armed actors collectively. By considering the disaggregated effects for each armed actor type and including a general measure of violent events, our analysis provides a comprehensive understanding.

To address the lack of municipality-specific cocaine prices, our model incorporates an interaction term between the yearly variation of the average in-site CBP price in Colombia and a dichotomous variable indicating the presence of coca crops in each municipality for each year. This interaction term serves as our variable of interest as it allows the model to capture the municipal and yearly variation of the impact of the value of the cocaine commodity. While the price variable itself does not vary at the municipal level, the interaction remains meaningful for one reason: the CBP price, being an intermediate product in the cocaine production process, is primarily determined by expectations of future prices for the final product, cocaine, in international markets rather than local factors. As a result, the price of

CBP is unlikely to exhibit significant variation across municipalities. This means that any variation in the interaction term can be attributed to changes in the presence of coca crops within municipalities, rather than local price fluctuations.

By incorporating this interaction term, we are able to assess the combined effects of the yearly CBP price variation and the presence of coca crops on our outcome of interest, which is captured by the coefficient β_3 . It is important to consider the main identification assumption associated with this parameter, which posits that the $\Delta CBPprice_t \times D.coca_{it}$ interaction is not correlated with unobservable factors that influence the presence of violent non-state armed actors. This assumption appears plausible for two key reasons. First, by including municipality fixed effects in our model, we are able to control for unobservable time-invariant characteristics of each municipality that are related to both the occurrence of violent events involving non-state actors and the aforementioned interaction term. This helps mitigate potential biases stemming from unobserved heterogeneity across municipalities. Second, given that the CBP price is primarily influenced by expectations linked to external factors, such as international market dynamics, the interaction has an important source of exogeneity and independence on the specific local contexts of individual municipalities. This further supports the plausibility of our identification assumption, allowing us to attribute any observed differences in violence to the impact of changes in the valuation of the cocaine commodity.

A.3 Results

Table A.1 presents the baseline results of estimating Equation 3, which capture the effect of the variation on the cocaine commodity valuation on the violent presence of non-state armed actors. Columns 1 to 4 show the estimation results using the violent events associated to insurgent and FARC dissident groups as dependent variable; 5 to 8 the violent events associated to paramilitary groups; 9 to 12 criminal organizations; and 13 to 16 total violent events.

Columns 1, 5, 9 and 13 show the baseline estimations of coefficient β_3 in Equation 3 (Model A). For robustness purposes, we also estimated three additional variations of the mentioned Equation. In the first variation (Model A.1), we replaced the dichotomous variable indicating the presence of coca crops with a continuous variable representing the number of

coca crop hectares identified in each municipality. This modification allows us to differentiate the effect of price shifts based on the size of the cocaine production market. The results of this model can be found in columns 2, 6, 10, and 14. In the second variation, we substitute the CBP price variation variable with the yearly variation of the average wholesale price of cocaine in Colombia (Model A.2). By using this alternative variable, we aim to capture the specific dynamics associated with cocaine as a final product. The results of this model are presented in columns 3, 7, 11, and 15. Lastly, in the third variation, we introduce an interaction term between the number of coca crop hectares and the yearly variation of the average wholesale price of cocaine in Colombia (Model A.3). This allows us to capture both the effects aforementioned related to the size of the coca crop market and the specific dynamics of cocaine as a final product. The results of this model can be found in columns 4, 8, 12, and 16.

Overall, the results provide strong statistical evidence supporting the existence of a positive effect of the price variation related to the cocaine commodity on the violent presence of non-state armed actors. These results support our assumption and the academic literature findings in this matter, as it is found that higher prices associated with an illegal commodity, cocaine in this case, leads to more violence perpetrated by non-state armed actors. Specifically, when examining insurgent groups and FARC dissidents, as well as the aggregated total events involving all the non-state armed actors, we observe a consistently strong and statistically significant positive effect of the price variation of cocaine production process on violent events across the baseline model and its variations (Models A.1, A.2, and A.3). For paramilitary groups, and criminal organizations, there is strong suggestive evidence of a positive and statistically significant effect of cocaine prices on violent events. However, it is important to note that while most of the models associated with these groups demonstrate robust results, not all of them do. Despite this, all the estimated coefficients of all the models have a positive direction, indicating a compelling relationship between cocaine commodity prices and the occurrence of violent events, which is particularly strong for insurgent and dissidents groups, as well as for the overall presence of non-state armed actors.

Table A.1: Effects of cocaine commodity prices on armed conflict violence

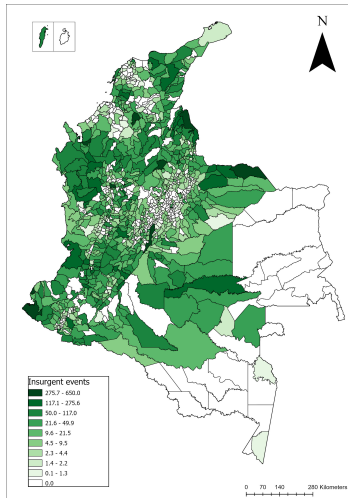
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Insurgent and dissident events (1-4)											
	Paramilitary events (5-8)											
	Criminal organizations events (9-12)											
D.coca x CBP price	2.630*** (0.619)				0.305 (0.787)				0.0833 (0.393)			
H.coca x CBP price		0.00922*** (0.000422)				0.00189*** (0.000548)				0.00192*** (0.000273)		
D.coca x Cocaine price			2.179*** (0.551)				1.596** (0.701)				1.101*** (0.350)	
H.coca x Cocaine price				0.00257*** (0.000323)				-0.000303 (0.000414)				0.000880*** (0.000206)
Observations	15,708	15,708	15,708	15,708	15,708	15,708	15,708	15,708	15,708	15,708	15,708	15,708
R-squared	0.016	0.057	0.016	0.030	0.009	0.009	0.009	0.008	0.006	0.013	0.007	0.011
Number of codmpio	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122

VARIABLES	(13)	(14)	(15)	(16)
	Total events (13-16)			
D.coca x CBP price	3.018** (1.343)			
H.coca x CBP price		0.0130*** (0.000929)		
D.coca x Cocaine price			4.876*** (1.195)	
H.coca x Cocaine price				0.00315*** (0.000706)
Observations	15,708	15,708	15,708	15,708
R-squared	0.010	0.024	0.011	0.012
Number of codmpio	1,122	1,122	1,122	1,122

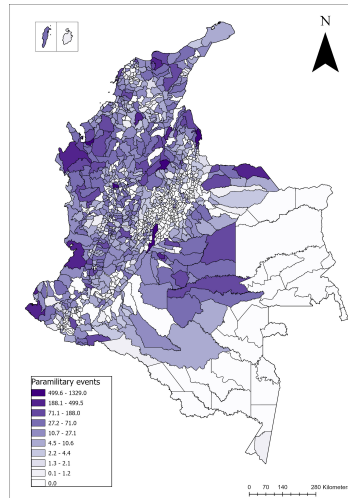
*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. All regressions include municipal and year fixed effects.

B Descriptive statistics

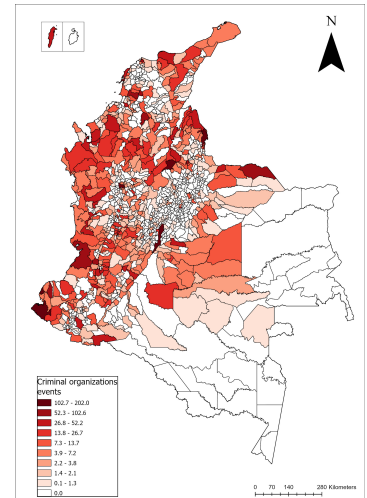
Figure B.1: Violent events between 1994 and 2015 (geometric scale)



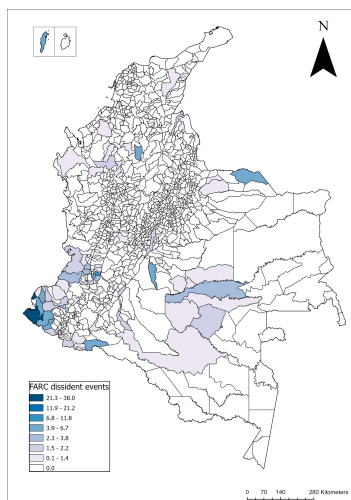
(a) Insurgent events



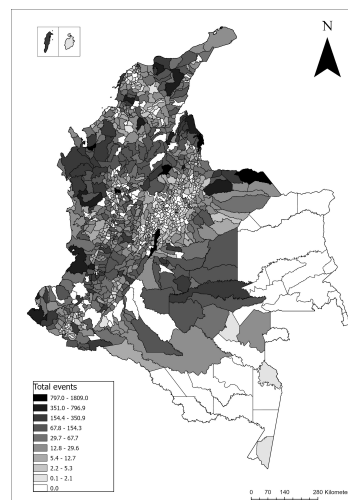
(b) Paramilitary events



(c) Criminal organizations events



(d) FARC dissidents events



(e) Total events

Figure B.2: Coca crops presence between 1994 and 2018

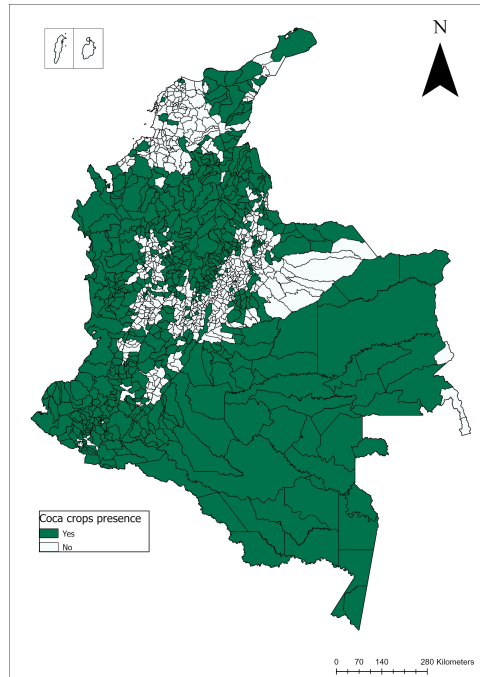


Figure B.3: Eradication evolution in Colombia

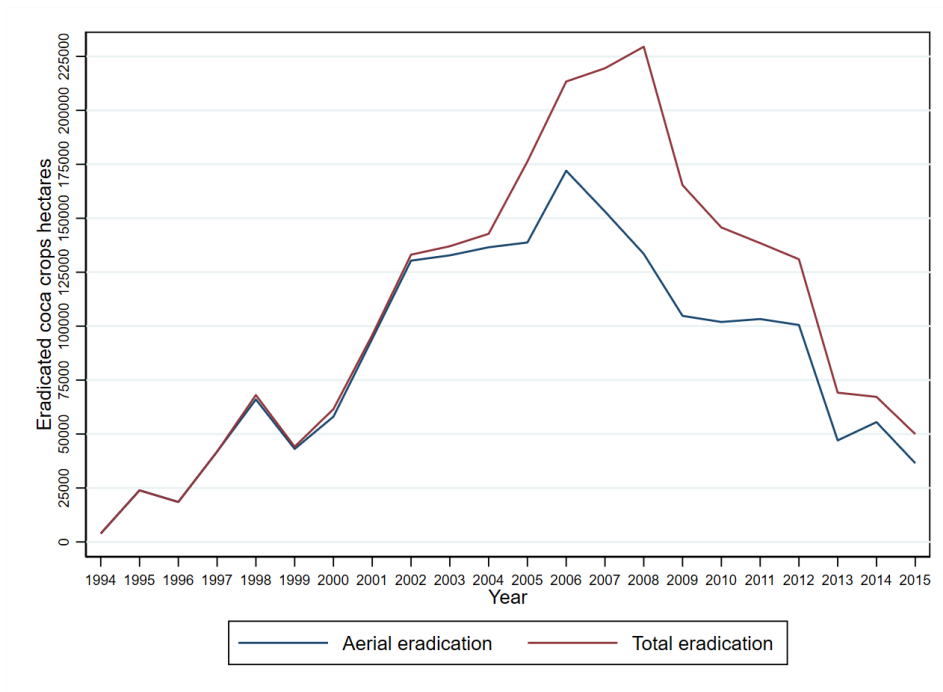


Figure B.4: Coca crops eradication between 1994 and 2015

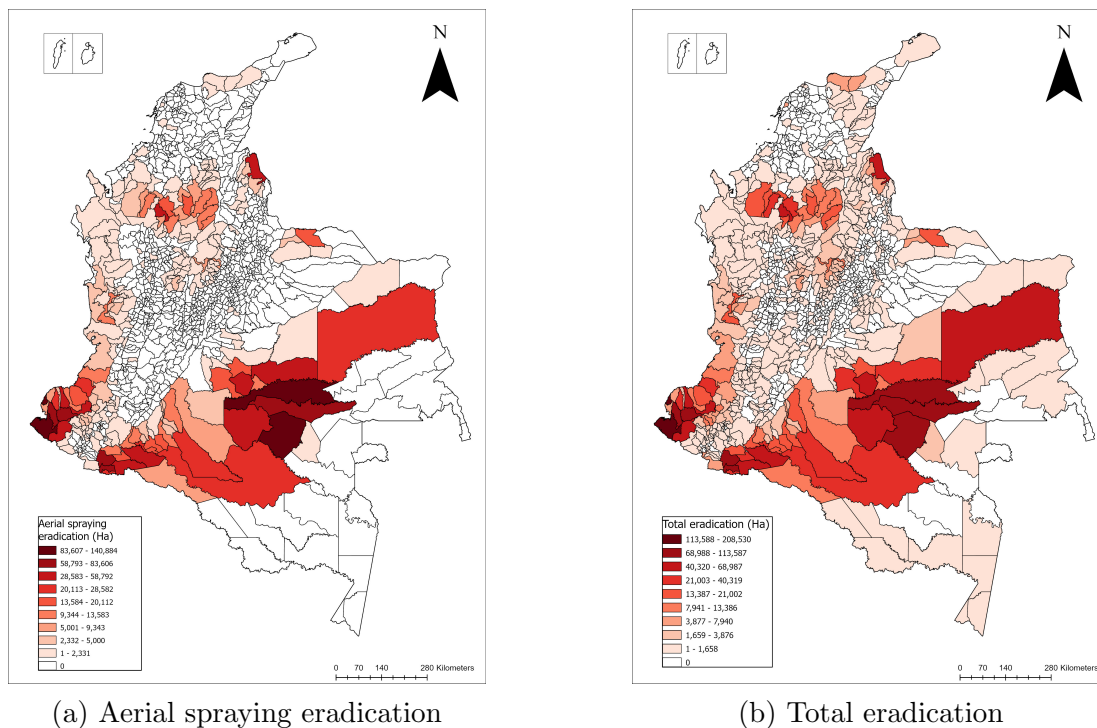
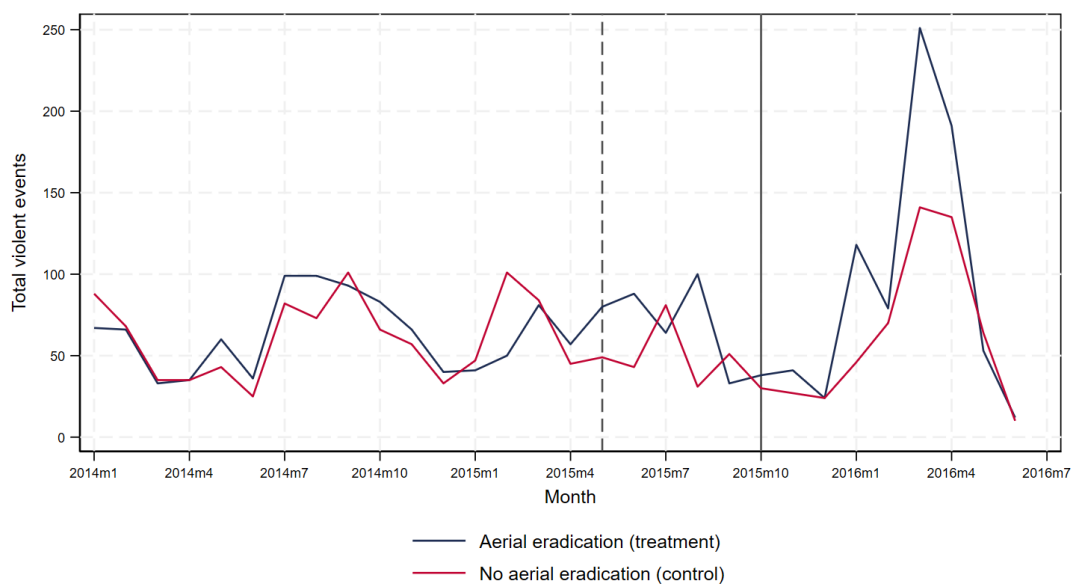


Figure B.5: Parallel trends assumption analysis for Equation 2



Note on vertical lines → Dashed line: Announcement of suspension; Solid line: Suspension of aerial spraying.

Figure B.6: CBP and cocaine wholesale yearly price variation in Colombia

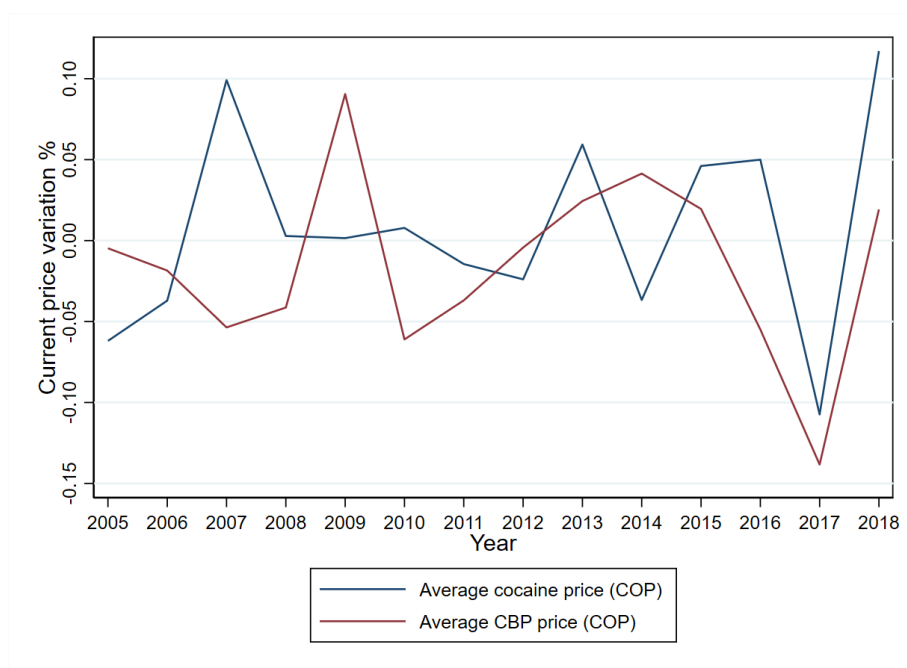


Table B.1: Yearly descriptive statistics for all municipalities - 2005 to 2018

Variable	Obs	Municipalities	Mean	Sd	Min	Max	Percentile			Year covered	
							25	50	75		90
<i>Conflict - Violent events</i>											
Insurgent events	15,708	1,122	0.57	2.42	0	70	0	0	0	1	2005-2018
Insurgent and dissident events	15,708	1,122	0.61	3.56	0	123	0	0	0	1	2005-2018
Paramilitary events	15,708	1,122	0.23	1.32	0	86	0	0	0	0	2005-2018
Criminal organizations events	15,708	1,122	0.58	2.48	0	70	0	0	0	2	2005-2018
Total events	15,708	1,122	1.42	6.01	0	182	0	0	0	3	2005-2018

Table B.2: Yearly descriptive statistics for municipalities with coca crops - 1994 to 2015

Variable	Obs.	Municipalities	Mean	Sd	Min	Max	Percentile				Year covered
							25	50	75	90	
<i>Coca crops eradication</i>											
Aerial spraying (ha)	11,924	542	159.04	967.37	0	33,813.97	0	0	0	77.39	1994-2015
D.Aerial spraying	11,924	542	0.12	0.33	0	1	0	0	0	1	1994-2015
Total (ha)	11,924	542	199.30	1,119.59	0	34,432.53	0	0	2.15	188.67	1994-2015
D.Total	11,924	542	0.28	0.45	0	1	0	0	1	1	1994-2015
<i>Conflict - Violent events</i>											
Insurgent events	11,924	542	1.45	4.68	0	123	0	0	1	4	1994-2015
Insurgent and dissident events	11,924	542	1.45	4.68	0	123	0	0	1	4	1994-2015
Paramilitary events	11,924	542	1.19	5.24	0	125	0	0	0	3	1994-2015
Criminal organizations events	11,924	542	0.26	1.46	0	86	0	0	0	1	1994-2015
Total events	11,924	542	2.90	9.46	0	182	0	0	2	7	1994-2015

Table B.3: Monthly descriptive statistics for municipalities with coca crops - 2005 to 2015

Variable	Obs	Municipalities	Mean	Sd	Min	Max	Percentile				Year covered	
							25	50	75	90		
<i>Coca eradication</i>												
Aerial spraying eradication (ha)	63,597	493	15.21	137.39	0	13,890.35	0	0	0	0	0	2005-2015
D.Aerial spraying eradication	63,597	493	0.05	0.22	0	1.00	0	0	0	0	0	2005-2015
<i>Conflict - Violent events</i>												
Insurgent events	63,597	493	0.09	0.58	0	36	0	0	0	0	0	2005-2015
Insurgent and dissident events	63,597	493	0.10	0.63	0	27	0	0	0	0	0	2005-2015
Paramilitary events	63,597	493	0.03	0.30	0	19	0	0	0	0	0	2005-2015
Criminal organizations events	63,597	493	0.09	0.58	0	36	0	0	0	0	0	2005-2015
Total events	63,597	493	0.23	1.16	0	50	0	0	0	0	0	2005-2015