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The Contribution of Geographical Factors to the Intensity and Duration[1] of Civil War: New Evidence from Colombia

By Santiago Montenegro[2] & Álvaro Pedraza[3]

Abstract

This paper examines and presents new empirical evidence on the impact of geographical sanctuaries, rough terrain, and external frontiers on the intensity and duration of armed political conflict. The paper a) analyzes political violence at the local level, in contrast to most studies that address this phenomenon at the national level; b) explores the determinants of political violence using explanatory variables that encompass both the "motives" and the "opportunities" approaches to political violence; and c) uses extensive geo-referenced data on illegal armed-group activities for Colombia between 1984 and 2012 to identify the variables that are correlated with the intensity and persistence of the conflict. We find that insurgency is most intense and prolonged in municipalities characterized by mountainous terrain, dense forests and jungles, fewer accessible rivers and roads, and proximity to neighboring countries. These results are consistent with the hypothesis that the cost of effectively providing public goods, such as security, increases with the roughness of the territory.

***Keywords*:** Violence, Conflict duration, Geography, Colombia.

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[1] This document is part of the authors' broader study on the causes of Colombia's historical State weakness.

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Resumen

Esta investigación proporciona nueva evidencia empírica sobre el papel de los refugios geográficos, el terreno montañoso y las fronteras externas en la intensidad y duración de los conflictos políticos armados. A diferencia de la literatura que estudia conflictos armados a nivel nacional, este documento analiza la violencia política a nivel local y examina sus determinantes utilizando variables explicativas que abarcan tanto el enfoque de *motivos* como el de *oportunidades*. Utilizando información geo-referenciada sobre la incidencia de grupos armados ilegales en Colombia entre 1984 y 2012, este documento tiene como objetivo identificar las variables que están correlacionadas con la intensidad y persistencia del conflicto. El documento muestra que la insurgencia es más intensa y de mayor duración en municipios con terreno montañoso, cubierto por bosques densos y selvas, con ríos y carreteras de difícil acceso, y en aquellos municipios que limitan con países vecinos. Estos resultados son consistentes con la hipótesis que sostiene que el costo de proporcionar eficientemente los bienes públicos, como la seguridad, crece en función de las barreras geográficas del territorio.

Palabras clave: violencia, duración del conflicto, geografía, Colombia.

Contents

1. Introduction

'*In Colombia, there is more geography than society; and more society than State*'

(Luis Carlos Galán)

This article examines and presents new evidence on the correlation between geographical sanctuaries, remote and inaccessible regions, jungles, neighboring regimes, and poor infrastructure with the dynamics of illegal armed political activity in Colombia. In doing so, the article contributes to a growing empirical literature investigating the relationship between these geographical factors and illegal armed political activity.[4] The specific objective is to determine the role of internal geography in the dynamics (i.e. intensity and duration) of civil conflict in Colombia by quantitatively analyzing a comprehensive dataset covering the activity of illegal armed groups across 1117 municipalities between 1984 and 2012.

While geography itself does not directly cause violence or instigate insurgency, it can restrict the reach of the state, thus facilitating guerrilla warfare and other forms of violent action. To complicate matters, in rugged terrain, these conditions may be exacerbated by a shifting internal frontier (where the territory is characterized by jungle and deep forests), neighboring countries that sympathize with local insurgency groups, and both old and new illegal revenue sources available to rebel groups.

Whether geographic factors contribute to the intensity and duration of conflict is a long-studied yet unresolved empirical question. For instance, a prevalent perspective in the study of civil war suggests that its onset and development are driven by political or cultural motivations that lead to grievances, hopes, and animosities, prompting certain groups to take

[4] See for example, Buhaug, Gates & Lujala (2009), Nemeth, Mauslein, Stapley (2014), and Tollefsen & Buhaug (2015).

up arms against an established authority – this is known as the "motives" approach to insurgency. An alternative hypothesis is that armed conflict is determined by the specific military and financial opportunities available to rebel organizations to sustain themselves over time – this is referred to as the "opportunities" approach to rebellion.

According to this perspective, rebellions cannot rely only on grievances, hopes, or animosities. A rebel organization must finance the insurgency and, in doing so, engage in some form of opportunistic behavior to extort goods, money, and resources from various sources, whether governmental or private. Equally significant, the success of a rebellion is determined by the military opportunities presented by the government's capacity, or rather its incapacity, to deter it. In this context, the specific characteristics of the terrain in which a rebel organization operates are expected to play a critical role (Fearon and Laitin, 2004; Collier and Hoeffler, 2003; Rustad et al., 2008; Peluso and Vandergeest, 2011; Shaver et al; 2016; Hammond, 2017). These considerations may have important implications for security policy. For a successful resolution of an insurgency problem that has affected a country for an extended period, it is crucial to accurately diagnose the root causes that led to the rebellion and, perhaps more importantly, the conditions that have sustained it over time.

While these considerations have long been acknowledged, early empirical analyses of armed conflict provide little insight into the specific location of conflicts, merely indicating whether a particular country has experienced rebellion over a certain period. Civil wars, however, rarely engulf entire countries; instead, they frequently occur in confined and specific areas, leaving much of the country relatively peaceful (Buhaug & Gates, 2002; Buhaug & Lujala, 2005). Furthermore, conditions conducive to the success and persistence of rebellions can vary significantly even within a country, so it is essential to consider the local context. Geographically disaggregated data are thus necessary to understand both the incidence and duration of insurgency. In recent efforts, researchers have begun to incorporate additional geographic information on conflict and correlate such data with other spatially varying and potentially conflict-confounding variables, including relative location, terrain ruggedness, population density, proximity to resource locations, and levels of infrastructure (e.g., Buhaug, Gates & Lujala, 2009; Beardsley, Gleditsch & Lo, 2015; Shaver, Carter & Shawa, 2016; Linke et al., 2017). A limitation of previous approaches is the lack of

socioeconomic information in the unit of observation, thus overlooking potentially relevant factors that may be correlated with violent actions (Buhaug & Gates 2002; Ballinger, 2011).[5]

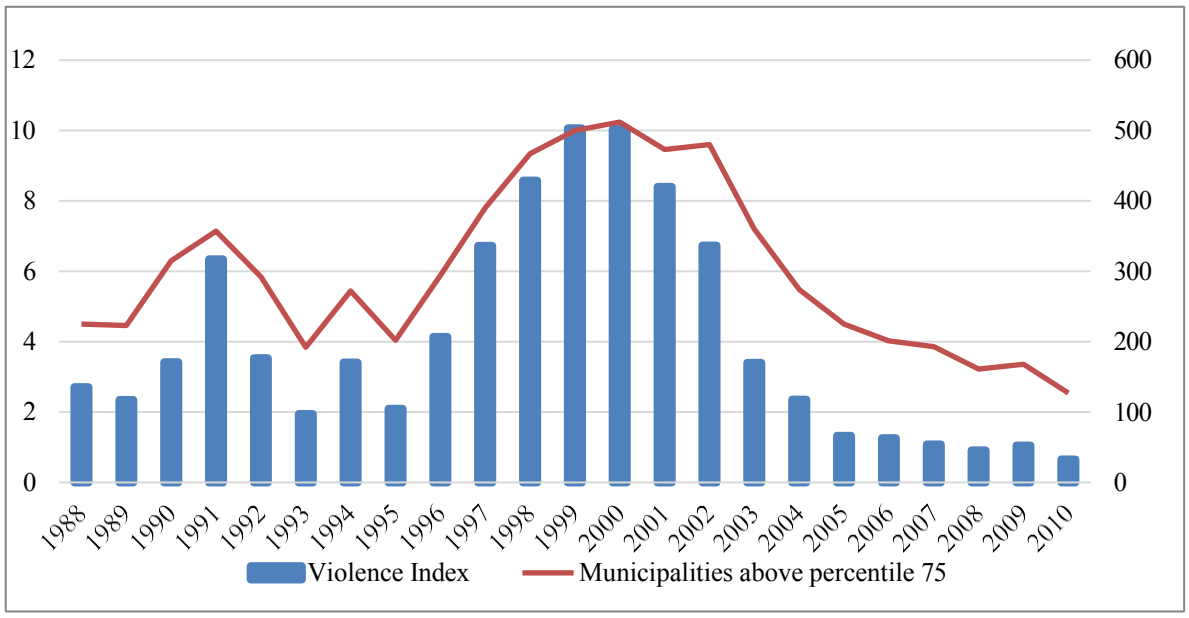
In contrast with several studies that, due to data limitations, have assessed rebellions and civil wars only at the national level, our study benefits from the fact that Colombia has very good subnational information on both violent activity and socioeconomic data. This offers at least three distinct advantages. Firstly, the data include detailed geo-referenced information on victims, perpetrators, and types of violence activity (e.g., kidnappings, massacres, attacks, and others). Overall, our study registers over 50 000 events of violence. This allows us to avoid the standard death thresholds commonly used in cross-national studies of conflict. Secondly, in addition to standard geographical information, there is extensive socioeconomic data at the municipality level (the country's smallest administrative body) on income, poverty, inequality, education, and natural resources, among other variables. With the available information, we can control for some of the most common factors used in the cross-national literature regarding the motives and opportunities that explain violent group activity. Thirdly, our period covers the surge of illegal armed group activity that began in the second half of the 1980s and abated in the first decade of the new millennium (see Figure 1). Within this general cycle, it is possible to disaggregate two clear sub-periods: (i) a short-lived and concentrated rise in violence in 1991, mostly associated with coca cartel wars, and (ii) a long-lived and widespread increase in violence across the territory between 1996 and 2002, related to the strengthening of Marxist guerrillas and the consolidation of paramilitary groups. The shift to high-intensity and widespread conflict, followed by its abatement in the later years of the sample period, provides substantial time and cross-sectional variation to study the dynamics of conflict and its relationship to the country's terrain and the limits of state reach.

Unlike the literature on the causes of war, which typically focuses on the origins of rebellion,[6] we inquire, within the context of an existing conflict, whether the intensity and persistence of insurgent violence are indeed greater in regions where the geographical "opportunities"

[5] Despite this issue, Buhaug finds that geography does indeed matter for territorial conflict. The risk of separatist conflict is highest in regions characterized by low population density, limited rough terrain, distance from the capital city, and proximity to the state border.
[6] See Daly, 2012 for such analysis in Colombia.

are most pronounced. For each municipality, we measure the rates of kidnapping, massacres, deaths, attacks, and property damages. We use these rates both separately and jointly in a "violence index" to gauge the intensity of violent activity across the territory. Since our interest lies in assessing how the persistence of violent action correlates with geographical conditions, we generate estimates of the serial correlation of violent activity at the municipal level by filtering the series from aggregate and regional trends. We then regress these cross-sectional estimates of persistence on measures of terrain conditions and other socioeconomic variables. This approach differs from most cross-national studies, where past conflict is primarily used to address issues of temporal dependence. Instead, we aim to identify the correlates of temporal dependence.

Figure 1. Violence Incidence in Colombia[7]
Violence Index (left axis) and number of municipalities with violent activity above the 75 percentile of the sample (right axis).



Notes: for each municipality-year pair, the violence index (left-axis) is the sum of the number of kidnappings, massacres, attacks, and property damages (each normalized by their sample mean). The solid line represents the number of municipalities with violent activity above the 75 percentile of the sample (right axis) from 1988 to 2010. *Source*: Conflict Analysis Resource Center. Authors' own calculations.

[7] We calculate the 75th percentile for the entire sample of the violence index, for the period 1988-2010. Then we count how many municipalities were above that percentile per year. We see that violence is high in intensity and this is a widespread effect.

Regarding conflict *intensity*, we find that insurgent action is most intense in municipalities with mountainous terrain, dense forests and jungles, fewer accessible rivers and roads, and those bordering neighboring countries. The results remain robust even after including several socioeconomic variables that proxy for state presence, access to potential recruits, and material and financial resources. Additionally, they remain robust when controlling for serial and spatial correlation.

Regarding conflict *persistence*, we find that outbursts of illegal armed group actions tend to last longer in municipalities characterized by mountainous terrain, underdeveloped transportation infrastructure, and proximity to neighboring countries. Specifically, we observe that violent actions by illegal armed groups in Colombia are more persistent in municipalities bordering Venezuela. While similar findings about the impact of rugged terrain on armed conflict have been documented in other contexts, particularly in recent studies disaggregating conflict at the local level,[8] we contribute to the literature by further affirming the significance of geographic factors even after controlling for a comprehensive set of socioeconomic variables at the local level.

Our results have important implications for security and peace-seeking policies. For example, well-intentioned policies aimed at redistributing land or income, or improving the coverage and quality of social services, may prove limited or even ineffective to deter rebel organizations and reducing violence if the critical determinants of rebellion and insurgency are the financial and military opportunities enjoyed by armed groups. In this paper, we find that the characteristics of Colombia's geography and territory largely account for the level and persistency of civil conflict and violence. In line with these results, government policy should focus on strengthening state capacity, improving the level and quality of governance, and significantly enhancing the provision of critical public goods, such as security and justice.

[8] For example, Buhaug, Gates & Lujala (2009), Shaver, Carter & Shawa (2016) and Linke et al. (2017) study the link between mountainous terrain and armed conflict. Also, Rustad et al., (2008) and Peluso & Vandergeest (2011) analyze the role of forest havens on conflict duration.

The rest of the paper is structured as follows. In Section 2, we provide a brief historical background of Colombia's insurgency. Section 3 reviews the main conceptual frameworks on the causes of rebellion and insurgency. Section 4 presents the main hypothesis, describes the data, and introduces the empirical strategy. Section 5 presents our main results, while Section 6 provides our conclusions.

2. Brief Historical Background of Colombia's Insurgency

The modern Colombian insurgency conflict traces its roots back to the emergence of communist insurgencies in the 1960s.[9] Throughout the period under analysis, three main sets of actors have been involved: left-winged guerrillas, right-wing paramilitaries, and the government. The guerrilla groups have consistently justified their existence and their struggle as a means to achieve political goals aimed at eliminating Colombia's historical social, economic, and political injustices. While these groups were initially founded on these principles, their reliance on drug money for funding led to exponential growth and a shift towards less political and more criminally oriented activities. The conflict remained of low intensity until the mid-1980s escalated sharply during the 1990s, and began to decline at the start of the new millennium.

The explosion of violence and subsequent cycles in the 1980s is a topic of debate. A necessary, albeit possibly insufficient, condition underlying the emergence of the crisis during the eighties was the consolidation of the illegal drug industry in Colombia. Initially, there was a marijuana boom in the 1970s, which lasted for about a decade until domestic production in the United States began to replace Colombian exports. This was followed by a more lethal and destructive boom related to cocaine production and drug trafficking to U.S. and European markets. This boom was spearheaded by the powerful drug cartels in Medellin and Cali, which either killed, threatened, or intimidated government officials, judges, police,

[9] We do not subscribe to the hypothesis that Colombia's conflict since the 1960s is the continuation of previous rebellions dating back to "La Violencia," a bloody confrontation between the Liberals and Conservatives, the country's main political parties; or the continuation of even older conflicts from the 19th century. For a comprehensive review of some of these theories, see the articles in Deas (2015).

and armed force members. During the 1989-90 presidential campaign, three presidential candidates were assassinated, including Luis Carlos Galán, who was leading in the opinion polls at the time.

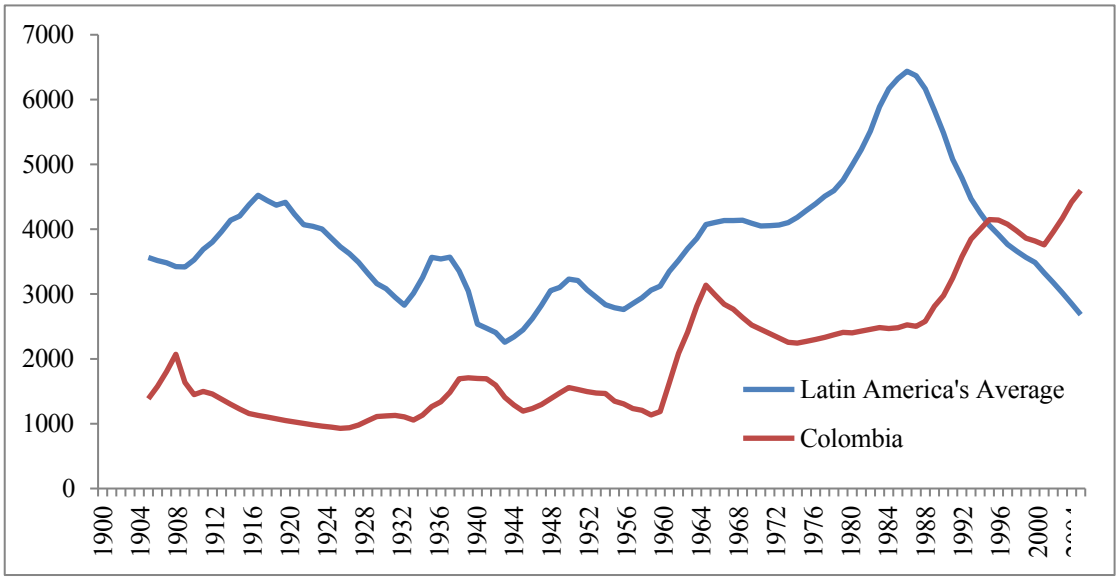
After a delay, the Colombian government reacted to this criminal onslaught, and, with the support of the United States and other governments, the Medellin and Cali drug cartels were dismantled, and their leaders either killed, imprisoned, or extradited to the United States within a few years. Unfortunately, even more dangerous actors—namely, Marxist guerrilla groups that have existed since1960, along with certain right-wing paramilitary organizations, soon replaced the cartels. Enormous sources of finance enabled the insurgent groups to expand exponentially. For example, until the early 1980s, the FARC group had a marginal existence with no more than 600 members scattered across Colombia. However, gaining access to illegal drug money allowed the group to expand into an organization of more than 15 000 members within a decade. Transforming itself into a drug cartel, the FARC gained national prominence, and its newfound power allowed it to reject, for example, the peace agreement that the Gaviria administration (1990-1994) offered them and indeed reached in the early 1990s with other insurgent groups such as the M-19, the EPL, and Quintin Lame.

Another decade passed before the FARC decided to enter a formal peace process with the government. By then, the FARC was so strong that even before the formal conversations began, the government was compelled to hand over a demilitarized area the size of Switzerland to this guerrilla group. Peace was not achieved, and violence rates increased again to the extent that some analysts, including those from the Council on Foreign Relations, labeled Colombia a "failed state." Within this environment, paramilitary groups proliferated across the country, exacerbating violence, anarchy, and human rights violations.

Exhausted by anarchy and alarmed by the government's lenient approach towards guerrilla groups, the subsequent presidential campaign saw Colombians overwhelmingly support a candidate who campaigned on a platform promising a tougher stance on terrorism and anarchy. As soon as the new administration took office (2002-2006), it began to implement the "democratic security policy," which quickly yielded impressive results. As a result of the policies introduced by the new administration, and thanks to the restructuring of the armed forces undertaken by the previous administration (1998-2002), as well as measures

and activities introduced under the U.S.-sponsored Plan Colombia, the situation began to change. Between 2002 and 2007, the number of individuals in the armed forces increased by 32%, rising from 307 000 to 405 000 members. Soon, all municipalities had a police presence, most paramilitary groups demobilized under a new law approved by Congress, while others were forced to retreat to jungles, inaccessible areas, or neighboring countries. Kidnapping, massacres, and attacks by all illegal actors in the conflict had decreased dramatically by the end of 2010 (see Figure 1).

Figure 2. Colombia's Armed Forces and Latin America's average measured in personnel per million inhabitants (5-year moving average).



Source: Correlates of War Project, COW. Authors' own calculations.

By the second half of the first decade of the century, the Colombian government had defeated, yet not eliminated, the country's strongest insurgency in history: the FARC. Several of the group's leaders had been killed, imprisoned, or found sanctuary in neighboring countries. The country had returned to normalcy as GDP growth accelerated, asset prices soared, investment as a percentage of GDP reached its highest level ever, construction boomed, and thousands of Colombians returned to their country. At the end of this insurgency cycle, the underlying causes of conflict, according to the motives approach to rebellion, had essentially remained unchanged. The political regime remained fundamentally the same, and

land and income remained as concentrated as before. However, what made the difference was undoubtedly a drastic reorganization of Colombia's armed forces and police, which not only grew dramatically in size but also modernized and became more efficient. For the first time in two hundred years, Colombia's armed forces, measured in personnel per million inhabitants, exceeded the Latin American average (see Figure 2). Policies aimed at eradicating coca plantations, destroying drug laboratories, and disrupting illegal drug trafficking also played a critical role in these results.

3. Conceptual Framework

In this paper, our conceptual framework is similar to the frameworks developed by Fearon and Laitin (2003), and Collier and Hoeffler (2004). Generally, these studies tend to emphasize the motives that may induce groups within societies to embark upon guerrilla warfare, insurgency, and other forms of domestic unrest, as well as the opportunities and catalysts that enable these violent forms of rebellion. The first account of the causes of conflict is usually referred to as the motives, preferences, or cultural approach to conflict and is emphasized in political science literature. It argues that societies differ in the severity of objective grievances faced, or injustices felt, by the population, such as inequality, political repression, or lack of freedom, which explain conflict. Some authors associate this approach with the notion that civil wars or rebellions are the outcome of cultural characteristics of societies such as ethnic, linguistic, national, and religious cleavages.

The opportunities approach to conflict argues that these objective grievances, such as perceived injustices and the lust for power, are found more or less in all societies and do not, by themselves, explain violence or rebellion. Otherwise, there would be violence everywhere. According to this approach, what makes rebellion possible are the opportunities or conditions that favor insurgency. Fearon and Laitin (2003) define insurgency as "a technology of military conflict characterized by small, lightly armed bands practicing guerrilla warfare from rural base areas." Within this approach to conflict, two different emphases are made to explain rebellions. First, there is the interpretation that Fearon and Laitin call the Hobbesian approach to insurgency, which is more institutional than economic, as they tend to look at state control capacity as the main determinant of violent conflict. That

is, they consider existing higher risks of conflict in countries where states are relatively weak. Financially, organizationally, and politically weak central governments render insurgency more feasible and attractive due to weak local policing or inept and corrupt counterinsurgency practices.

Quinn et al. (2003) confirm Fearon and Laitin's Hobbesian expectations that state control capacity is a crucial determinant of civil war onset. Critical factors explaining state control capacity, or incapacity, include several conditions that favor insurgency, such as the topographical terrain features, and the rebels' "better local knowledge than the governments". Guerrilla groups are assumed to have the possibility of choosing the area of operation. Hence, rural guerrilla warfare is supposed to be favored by the presence of sparsely populated areas, underdeveloped infrastructure, cross-border sanctuaries, and rough terrain. In choosing such landscapes, rebel groups tend to minimize the damage that can be inflicted by government forces. In particular, the rugged terrain hypothesis argues that inaccessible landscapes, like mountains, jungles, and swamps, are favorable to rebel groups as they provide shelter from government forces and are ideal for the so-called "hit and run" operations. These hypotheses also tend to support Mancur Olson's notion that in developing countries, the size and conditions of the territory may, after some point, create diseconomies of scale in the provision of critical public goods, such as security, and consequently, impair the state's capacity to deter rebel groups (Olson, 1987). Herbst (2000) also argues that one of the main problems facing governments in Africa has been to project authority over inhospitable territories that contain low densities of people. Collier and Hoeffler (2004) stress that low population density, low urbanization, and a dispersed population, inhibit government capability and thus facilitate rebellion. Quinn et al. (2003) find that their variables of state control—including per capita income, mountainous territory, and dependence on oil revenue—have a significant explanatory power for the risk of conflict.

Overall, Fearon and Laitin (2003) and Collier and Hoeffler (2004) find that grievances, ethnic differences, or cultural factors have no explanatory power for rebellions. Fearon and Laitin further argue that given the right environmental conditions, insurgencies can thrive based on small numbers of rebels without strong, widespread, popular support rooted in grievances and, hence, even in democracies. The literature shows that some

grievance variables, such as inequality, do seem to affect political and economic instability (Alesina and Perotti, 1996; Cramer, 2001; Gurr, 1970; Sen, 1973). In particular, Alesina and Perotti find that income inequality, by fueling social discontent, increases sociopolitical instability, which, in turn, negatively affects investment and growth. As proxies for political instability, these authors construct an index that includes variables such as the number of politically motivated assassinations, the number of people killed in domestic mass violence, and the number of successful military coups, among others. However, the analysis of political and economic instability is radically different from the determinants of rebellion and insurgency.

While most of the literature above focuses on countries as its unit of analysis, conducting studies at the national level, there is increasing attention to the spatial location and disaggregated analysis of conflict.[10] Our paper contributes to this emerging literature by analyzing subnational conflict data at the municipality level for the case of Colombia.

Our study is closely related to Daly (2012), who examines the legacies of violence in Colombia and finds a strong correlation between the onsets of illegal group activity from 1964 to 1984 and past mobilizations. Challenging the opportunities hypothesis, Daly finds that insurgency does not begin in municipalities with rough terrain and cross-border sanctuaries, but rather emerges in municipalities affording receptacles of collective action – organizational and social capital that can be appropriated for future mobilization. Additionally, Daly dismisses the opportunity cost hypothesis, as measures of per capita income and unsatisfied basic needs show no relationship with violence. Our study differs from Daly's in two main ways. First, we focus on a period characterized by high incidence and significant expansion throughout the Colombian territory, as opposed to the low-intensity and concentrated period of violence observed during her sample period. Second, we introduce a measure of violence persistence to empirically test whether the "motives" or "feasibility" hypotheses are related to the duration of the armed conflict in Colombia.[11] Contrary to Daly (2012), we find that sanctuaries provided by inaccessible mountains,

[10] Barron, Kaiser & Pradhan (2004); Buhaug & Gates (2002); Cunningham, Gleditsch & Salehyan (2009); and Oyefusi (2008).

[11] At the national level, Collier (2006) finds that immediately after the end of hostilities there is a 40% chance of further conflict, and this risk falls at around one percentage point for each year of peace.

jungles, and distance to international borders were significantly utilized by rebels and appear to have favored the incidence of violence for longer periods. While geography in Daly (2012) is not likely to predict which places were involved earlier in conflict (conflict onset), it does make conflict more severe and persistent after it has started.

Our findings are indirectly supported by the results of Angrist and Kugler (2008), who studied the effects of the disruption in the 1990s of the Andean air bridge that was used to transport coca paste from Peru and Bolivia into Colombia. The authors show that as a result of this disruption, coca leaf production in Colombia's rural areas increased, along with self-employment income, as well a positive effect on boys' labor supply. Because the gains appear to be fairly concentrated, increased coca production did not raise overall standards of living in growing areas due in part to extortion by insurgents and paramilitary forces, and the fact that coca finances a conflict that reduces economic activity outside the coca sector. Consistent with this, Angrist and Kugler show a sharply increased rate of violent deaths in growing areas, which aligns with the notion that coca supports rural insurgents and paramilitary forces, thereby sustaining Colombia's civil conflict. Remarkably, the increase in rural violence occurred against a backdrop of generally improving public health, as measured by death rates from disease. These results show that income increases did not lead to a reduction in civil conflict but rather fueled the fires of unrest, as the opportunities approach to rebellion would suggest.

Dube and Vargas (2013) also appear to confirm that important elements of the opportunities approach to insurgency play a significant role in the case of Colombia. These authors assess the effects of commodity price shocks on violent actions by guerrilla and paramilitary groups in coffee and oil regions. They find that a fall in the price of coffee, a labor-intensive commodity, increases violence disproportionately in the coffee regions. The channel through which this occurs is by reducing wages and hence the opportunity costs of recruiting workers into guerrilla and paramilitary groups. They also find that an increase in the price of oil, a capital-intensive commodity, increases violence in the oil areas vis-à-vis non-oil municipalities. Rather than operating through the opportunity cost mechanism, the authors find that, in the case of oil, a capital-intensive sector, violence occurred as a consequence of the rapacity effect or the predation of resources as the oil boom induced an

increase in local government expenditure. What these authors do not discuss is what makes it possible for a country's insurgency levels to become sensitive to the terms of trade of its main commodities. Of course, what underlies the existence of such elasticity is just the existence of an extremely weak government and more precisely, a fragile state that had not been able to exert the monopoly of legitimate force over the whole territory. We will return to this discussion in our final section.

4. The Incidence of Illegal Armed Group Actions

In this section, we introduce the measures of illegal armed group activity, establish our main hypothesis, describe the data, and present the empirical strategy.

4.1 Measuring Violent Activity

Standard measures of conflict and civil wars typically rely on battle-related death thresholds. In the Colombian case, rebellious activity has taken many forms since the onset of the internal conflict. Illegal armed group activity differs by the type of actor, the area of incidence, and how they finance their operations. Focusing solely on conflict-related deaths is likely to misrepresent the intensity and presence of such groups for at least two reasons. First, the absence of fatalities in a particular location does not imply the order given by state control; rather, it often signals the emergence of an alternative state, one fully controlled and administered by rebels in so-called liberated zones or ''base areas." Second, Marxist guerrillas and paramilitary groups often use strategies other than killings to impose their will over territories, such as destroying infrastructure, kidnappings, and extortions to landlords. To address these issues, we use several measures of violent activity—namely, kidnappings, massacres, attacks, and property damages—by guerrilla and paramilitary groups. These variables were obtained from the Conflict Analysis Resource Center (CERAC).

We define kidnappings as the criminal practice of taking away a person against their will, through the so-called miracle fishing or "pesca milagrosa," a massive kidnapping on the Colombian roads where people were selected as hostages if they were wealthy enough to handle extortion or if they were political notables. Kidnappings might also take place through an ambush and might target a specific person for economic or political purposes. We consider

the number of people kidnapped by guerrillas, paramilitary groups, and criminal organizations between 1970 and 2010. As for massacres, we consider the number of victims in each massacre committed by guerrillas or paramilitary groups for the period between 1980 and 2012. We also consider the number of attacks and total property damages that took place between 1988 and 2012[12], perpetrated by paramilitary groups, guerrillas (FARC or ELN), or both. For each variable, we employ annual rates normalized by each municipality's population and use 36 665 events of kidnappings, 11 382 massacre victims, 853 attacks, and 4 944 events of property damages.

We aggregate incidents at the municipality-year level. In addition to testing our hypothesis for each measure of criminal activity separately, we construct a violence index that combines the four variables to capture total criminal activity. To be precise, the index is the sum of each of the standardized variables.[13]

4.2 Geographic Sanctuaries

Our main interest is to determine which geographical factors have played a significant role in the dynamics of the long-lasting conflict in Colombia. Here, we elaborate on the main hypothesis.

To engage in rebellious activity, militants must be able to hide from counterinsurgent forces and avoid capture. Dense forests, jungles, and mountainous terrain provide insurgents camouflage against detection and aerial attack, thus facilitating the movement of combatants and arms. Superior knowledge of local terrain conveys a strategic advantage for insurgencies over state forces, enabling them to credibly threaten inhabitants with retaliation for denunciation (DeRouen and Sobek, 2004).

Governments are less capable of maintaining control of some areas of a country because of long distances from centers of state power, lack of road access, inferior knowledge of local conditions, and possibly lack of support from the local population. Related to this

[12] Our database considers up to 3 attacks per year in the same municipality for the period under study.
[13] As a robustness check, we also perform our entire set of empirical tests introducing a dummy variable coded as 1 if a municipality experienced violence activity in a given year above the full sample median, and zero otherwise.

argument is the notion of cross-border sanctuaries. If neighboring regimes, tacitly or explicitly, support rebel groups on the other side of the border, allowing them to operate from bases inside their countries, violent conflicts and rebellion are more likely to extend over time. In the case of Colombia, there is some circumstantial evidence that, at least during some periods, neighboring countries such as Venezuela and Ecuador facilitated and provided shelter to Colombian guerrilla organizations.

In line with the previous discussion, we test the following hypotheses, each one as it relates to the intensity of the conflict and its persistence:

H1: Areas farther away from the state's capital are likely to present more intense and longer-lasting conflict.

H2: Regions with mountainous terrain should prove more vulnerable to illegal armed group activity.

H3: Regions with low road density should exhibit more intense and longer incidences of violence.

H4: Insurgency should be more intense and persistent in areas with thick forests and dense jungles.

H5: The proximity to international borders should favor the presence of insurgency.

To evaluate H1 we use the natural logarithm of the distance between the municipality's center and the department's capital.[14] To capture each municipality's topography, we measure the roughness of terrain (H2) as the standard deviation of the contour lines, measured every 10 kilometers by the Agustín Codazzi Geographical Institute (IGAC for its acronym in Spanish). This ensures that high plateaus are not captured as mountainous if we were measuring exclusively altitude. For H3, we measure road and river density as the sum of paved roads and navigable rivers in kilometers, divided by the total kilometers of paved, unpaved roads and navigable rivers from IGAC. To measure and evaluate H4, we use

[14] A department is an administrative and political subdivision that groups municipalities. There are 32 departments grouping 1123 municipalities in Colombia.

the percentage of a municipality's area covered by forests and jungles taken from the Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM). Finally, we use a dummy variable for those municipalities bordering foreign countries and later distinguish the neighboring country.

4.3 Other Motives and Opportunities

In this section, we discuss several socioeconomic variables that, at the country level, are widely known to correlate with rebel activity and civil conflict. Our objective is to control for potential confounders of conflict intensity and test which national-level correlates of rebel action are also important at the within-country level.

For instance, the outbreak of internal wars is commonly attributed to poverty. The correlation between low per capita income and a higher propensity for internal war is one of the most robust empirical relationships in cross-country studies of civil wars. The financial dimension of the opportunities approach to insurgency also stresses that the viability of a rebel group may depend on the organization's ability to recruit members. Among other factors, such recruiting capacity is a function of the opportunity cost of hiring members, which, in turn, depends on the local level of salaries and the extent and quality of schooling. In other words, violence is considered a consequence of low opportunity costs and poverty (Hegre et al, 2001; Collier and Hoeffler, 2002; Collier, et al, 2003; Fearon and Laitin, 2003). While Fearon and Laitin (2003) and Collier and Hoeffler (2004) find that grievances, ethnic differences, or cultural factors have no explanatory power for rebellions, there is some evidence that shows that grievance-related variables, such as inequality, do seem to affect political and economic instability (Alesina and Perotti, 1996; Cramer, 2001; Gurr, 1970; Sen, 1973). In particular, Alesina and Perotti (1996) find that income inequality, by fueling social discontent, increases sociopolitical instability, which, in turn, negatively affects investment and growth.

H6: Low economic opportunities and inequality should favor more intense and longer-lasting civil conflict.

To test for H6, we introduce both per capita income and the Unsatisfied Basic Needs Index (NBI) at the municipal level. We also measure inequality as the Gini coefficient for income and land ownership. Per capita income is obtained from the National Planning Department, while NBI and the Gini coefficient for income are obtained from the National Administrative Department of Statistics (DANE). Lastly, the Gini coefficient for land tenure is taken from IGAC.

Successful rebellions require extensive financial revenues to prolong the fight. Common sources of financing can be derived from lootable natural resources and donations from the diaspora.

H7: Rebellious activity is likely to be more intense and persistent in regions with lucrative resources such as gems and oil.

H8: Illegal armed group activity is likely related to regions of coca cultivation, as they represent a source of lucrative resources.

For H7, we consider two dummy variables indicating whether the municipality has a gemstone location or if it has oil fields, pipelines, or refineries. These variables were taken from the replication files of Daly (2012). To evaluate H8 we use a continuous variable for the cultivated area of coca normalized by the municipality's area, obtained from the United Nations Office on Drugs and Crime (SIMCI). We also include in our model as a robustness check, a dummy variable for those municipalities that have coca plantings during the sample period. We have a limitation regarding H8 because there is very limited data available for the coca cultivation variables since there is only information for the period 2000 – 2009. However, we include a regression controlling for spatial correlation that contains the variable coca normalized (see Appendix A, Table A3).

Table 1. *Summary statistics*

Variable	Units	Years	Number of observations	Mean	St.Dev.	Min	Max
Kidnapping	Rate	1970-2010	36,861	3.910	20.501	0	1,888
Massacres	Rate	1980-2012	35,024	1.615	13.775	0	1,054
Attacks	Rate	1988-2012	35,024	0.224	2.129	0	121
Damages	Rate	1988-2012	35,024	0.700	4.043	0	175
Violence	Index	1988-2010	25,050	4.025	14.304	0	457
Discapital	Ln(Km)	1993-2012	36,861	0.813	0.603	0	4.93
Mount_Terrain	Km	1988-2012	36,861	0.408	0.299	0	1.459
Roads_Rivers	%	2014	36,663	0.208	0.217	0	1
Forest	%	2010	36,861	0.152	0.240	0	1.157
Frontier	Binary	2015	36,861	0.059	0.237	0	1
Gems	Binary	1964-2012	36,861	0.171	0.377	0	1
Oil	Binary	1964-2012	36,861	0.472	0.499	0	1
Rural_index	%	1993-2012	36,861	0.597	0.255	0	1
NBI	Index	1993, 1995, 2000 and 2005	36,861	46.335	23.100	0	105.29
GINI	Index	1993 and 2005	36,861	0.424	0.119	0	0.568
GINIL	Index	2000-2012	35,599	0.688	0.114	0	0.997
Percapita_GDP	COP	1993-2012	35,021	0.260	0.419	0	16.463
Popdensity	Rate	1993-2012	35,908	121.561	529.483	0	15,207
Coca	Binary	2000-2009	36,861	0.077	0.267	0	1

Notes: The table presents summary statistics of main variables used in the paper. Authors' own calculations. Variable definitions and sources are reported in Table A1.

Table 1 shows the summary statistics for the dataset. Some variables were either extrapolated or interpolated considering the period the data was available. The violence index was constructed conditionally based on the data availability for each of the measures of the incidence of violence, establishing a study period between 1988 and 2010. We consider that the geographical variables (distance to capital, contour lines, roads and rivers, forest, frontiers, gems, and oil) do not change over time, so we use the data for one year and replicate it for the entire period. Regarding the variables used as controls, specifically socioeconomic variables obtained from the 1993 and 2005 censuses, we consider that it is valid to use interpolations and extrapolations, taking into account that Colombia is a developing country

and variables such as income, inequality, poverty, and population, won't drastically change over a short period. More specifically, we carefully interpolated *NBI*, *Gini*, and *Ginit*, and extrapolated *Rural_index*, *Percapita_GDP*, and *Popdensity*.

4.4 Summary Statistics

Summary statistics for the sample, stratified into quartiles by distance to the capital, mountainous terrain, roads and rivers, and forest are presented in Table 2. According to panel A, and at least for the first three quartiles, rebel group activity is more intense in municipalities that are farther away from the state capital.

Panels B and D confirm the general intuition that mountainous terrain and municipalities with dense forests facilitate the actions of illegal armed groups, i.e. all four measures of rebel activity and the violence index increase in municipalities with more uneven terrain and with a larger share of land covered by forests and jungles. For example, while municipalities with flat terrain (Q1) experienced 4.25 yearly kidnappings per 100 000 residents on average during the sample period, those with the most complex terrain (Q4) had on average 2.8 more kidnappings per 100 000 residents. This difference is statistically significant at the 1% level. For the case of forests and jungles, municipalities in the fourth quartile experienced several times the intensity of violent actions than those in the first quartile group. These findings suggest that dense forests and jungles potentially provide camouflage against counterinsurgent forces, allowing rebels to successfully operate.

Panel C examines the subsamples of municipalities sorted by road and river density. Between the second and the fourth quartile, there is a decrease in the incidence of illegal group activity indicating that rebel activity is likely to be smaller in municipalities with easier access and better transportation infrastructure. Overall, the patterns discussed are indicative of the idea that rough terrain and weak state presence may correlate with conflict's intensity.

Table 2. Rebel activity sorted by geographic conditions and state presence

	Q1	Q2	Q3	Q4
Panel A. By Distance to capital				
Kidnapping	5.324	5.496	6.431	5.530
Massacres	1.415	1.922	2.604	2.184
Attacks	0.264	0.326	0.357	0.282
Damages	0.737	0.960	1.235	0.973
Violence	3.315	4.043	4.944	4.061
Panel B. By Mountainous Terrain				
Kidnapping	4.257	4.901	6.558	7.046
Massacres	1.661	2.017	2.104	2.301
Attacks	0.162	0.239	0.392	0.430
Damages	0.613	0.771	1.162	1.331
Violence	2.807	3.498	4.703	5.266
Panel C. By Roads and Rivers				
Kidnapping	5.004	6.513	5.841	5.379
Massacres	2.149	2.636	1.869	1.391
Attacks	0.490	0.311	0.218	0.202
Damages	1.039	1.163	0.864	0.831
Violence	4.678	4.741	3.626	3.231
Panel D. By Forest and Jungles				
Kidnapping	3.353	5.021	7.100	7.331
Massacres	0.642	2.082	2.810	2.601
Attacks	0.180	0.251	0.351	0.451
Damages	0.373	0.849	1.248	1.438
Violence	1.919	3.678	5.144	5.646

Notes: The table presents the average of different measure of violent activity sorted by municipalities based on their geographical characteristics. Authors' own calculations. Variable definitions and sources are reported in Table A1.

4.5 Methodology

To estimate the incidence of violent activity and its relationship with state presence, terrain ruggedness, and other socioeconomic variables, we estimate the following baseline model

$$y_{i,t} = \alpha + \gamma G_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where $y_{i,t}$ is the measure of illegal armed group activity in municipality *i* during period *t*. The vector $G_{i,t}$ includes variables of state presence and municipalities' terrain, and vector $X_{i,t}$ includes socio-economic variables introduced in Section 4.3. Since rebel group activity is likely to be serially and spatially autocorrelated, we control for the lagged violence incidence of each municipality and the lagged violence of its neighbors. Thus, we include $\varphi y_{i,t-1}$ and $\rho W y_{i,t-1}$ in equation (1), where φ is the serial correlation parameter, ρ is the spatial dependence parameter, and W is a NxN spatial weight matrix containing information on the inverse distances between each pair of municipalities. In an alternative specification, we estimate equation (1) as a probit model, where the dependent variable is a dummy variable equal to 1 if the municipality *i* in year *t* experiences violent activity above the sample median.

In addition to estimating the intensity of violence during the sample period, we are interested in the extent to which different municipality characteristics are correlated with the persistence of illegal armed group activity. For each municipality *i*, we estimate the time-series trend of the violence measure $\bar{y}_{i,t}$ and calculate the difference with the observed level of violence in the period, $\Delta y_{i,t} = y_{i,t} - \bar{y}_{i,t}$. These differences represent the innovations of violent activity during the period, i.e. how much of the observed illegal armed group activity is above or below the trend. Using these innovations, we estimate an AR(1) model $\Delta y_{i,t} = \phi_i \Delta y_{i,t-1} + \varepsilon_{i,t}$. The estimated parameter ϕ_i measures the persistence of "shocks" to the trend in violent activity. In other words, ϕ_i determines whether a rise in violent activity within a given municipality is likely to last over time.

Using the measure of persistence, we can estimate the following cross-sectional model

$$\phi_i = \alpha + W\phi_i + \gamma \bar{G}_i + \beta \bar{X}_i + \varepsilon_i \quad (2)$$

where the vectors $\bar{G}_i$ and $\bar{X}_i$ are averaged across the sample period for each municipality. We also introduce the persistence of neighboring municipalities to account for

spatial autocorrelation. Equation (2) is a key novelty in our analysis. Whereas most previous work has focused on the onset and intensity of violence, the extensive available information across municipalities for an extended period allows us to estimate the factors that contribute to the persistence of illegal armed group activity once they are present.

There are two important limitations to our analysis. First, we are not able to directly capture the government's capacity, or rather incapacity, to deter insurgency, and geographical variables may reflect both the rebel groups' offensive advantage and the state's weakness. Second, despite having extensive socio-economic and opportunities-related information in our unit of analysis, there is always the possibility that there may be some omitted variables, which are correlated both to the geographical location and to the conflict variables. For example, we should be using a variable capturing state strength or weakness at the municipality level, such as soldiers per hundred thousand inhabitants, but unfortunately, such data is not available. Similarly, there is no available data that captures the financial resources of rebel groups directly, such as cash receipts from laboratories that process coca paste into cocaine or from illegal mining. We have reasons to argue, however, that some of these omitted variables may be closely correlated with geographical information, such as distance to the capital or density of jungle or forestry. To give another example, we have no estimates of labor wages at the municipal level, but proxy the rebels' opportunity cost of joining the insurgent group with per capita income.

5. Results

Table 3 presents the estimates of equation (1) for kidnappings, massacres, attacks, and property damages during the sample period. For each dependent variable, we estimate three versions of the model: (i) baseline model, (ii) controlling for serial correlation, and (iii) controlling for serial and spatial correlation.

Kidnapping rates are higher in municipalities that are characterized by being far from the state capital as well as mountainous terrain, dense forests, and underdeveloped transportation infrastructure. However, the estimate of forest is the only significant one after

controlling for spatial correlation (column 3). According to the table, municipalities with a larger share of urban population and with higher GDP per capita tend to experience a higher incidence of kidnapping activity. The results can be explained as follows: kidnaping operations are more likely to be successful in locations far from the state forces or near less accessible areas since rebels can avoid capture and potential rescue efforts. At the same time, if ransoms are an important source of funds for the rebels, they are likely to target areas with potentially larger revenues, that is, urban areas with higher GDP per capita.

We find that average death rates by massacres were higher in municipalities with fewer accessible roads and rivers. The coefficients of distance to capital and forest have the expected positive sign but are only marginally significant in columns (4) and (5), and not statistically significant when controlling for spatial autocorrelation in column (6). We also find that the incidence of massacres was higher in regions with extended poverty, as measured with the unsatisfied basic needs index.

Attacks on populated areas were more prevalent in municipalities with mountainous terrain and lower density of navigable rivers and paved roads (columns 7-9). These estimates are highly statistically significant for all specifications. Attacks were more likely in rural areas, with a higher NBI index and lower GDP per capita. The positive relationship between poverty and both massacres and attack rates can result via a dual causality. A high incidence of illegal armed group activity, such as massacres and population attacks, is likely to discourage private investment and curb development. Alternatively, the government is less likely to devote resources to police areas without large industries and with low GDP per capita, thus facilitating rebel activity.

We find that attacks on infrastructure are also more prevalent in mountainous terrain as well as municipalities with a lower amount of roads and rivers, dense forests, and borders with neighboring countries. However, only the estimates for forest and frontier remain statistically significant (at the 10% confidence level) when controlling for spatial correlation. Also, property damage appears to be stronger in impoverished areas. Notice that the signs of NBI and GDP per capita are the same as those estimated for attacks and massacres.

Table 3. *Results for other measures of violent activity*

	Kidnappings			Massacres			Attacks			Property Damages		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Discapital	0.440	0.334	0.239	0.286	0.244	0.071	-0.006	-0.007	-0.005	0.122	0.089	0.019
	(0.400)	(0.307)	(0.275)	(0.203)	(0.173)	(0.171)	(0.039)	(0.037)	(0.036)	(0.121)	(0.088)	(0.081)
Mount_Terrain	2.075**	1.542**	0.851	0.022	0.018	0.216	0.291***	0.266***	0.183***	0.526*	0.370*	0.125
	(0.849)	(0.665)	(0.638)	(0.477)	(0.410)	(0.397)	(0.063)	(0.059)	(0.060)	(0.268)	(0.202)	(0.207)
Roads_Rivers	-2.150*	-1.612*	-0.464	-2.362***	-2.009***	-1.451***	-0.369**	-0.345**	-0.305**	-0.943***	-0.685***	-0.128
	(1.214)	(0.918)	(0.851)	(0.707)	(0.593)	(0.552)	(0.162)	(0.150)	(0.149)	(0.358)	(0.258)	(0.250)
Forest	3.457**	2.641**	1.805*	0.780	0.660	0.303	0.108	0.106	0.111	0.850**	0.611**	0.419
	(1.545)	(1.148)	(1.040)	(0.704)	(0.599)	(0.583)	(0.124)	(0.117)	(0.119)	(0.410)	(0.282)	(0.258)
Frontier	1.278	0.973	0.765	0.892	0.759	0.618	0.108	0.104	0.077	1.052**	0.786**	0.523*
	(0.908)	(0.688)	(0.661)	(0.717)	(0.608)	(0.595)	(0.118)	(0.110)	(0.104)	(0.424)	(0.306)	(0.293)
L.Dep_variable		0.244***	0.179***		0.155***	0.120***		0.064***	0.049***		0.272***	0.207***
		(0.031)	(0.029)		(0.042)	(0.040)		(0.020)	(0.019)		(0.041)	(0.040)
W Dep_variable			0.490***			0.421***			0.309***			0.580***
			(0.059)			(0.060)			(0.053)			(0.054)
Rural_index	-2.764***	-1.951***	-1.304**	-0.503	-0.407	0.295	0.400***	0.376***	0.333***	-0.312	-0.197	0.124
	(0.856)	(0.657)	(0.591)	(0.411)	(0.353)	(0.335)	(0.095)	(0.092)	(0.091)	(0.213)	(0.153)	(0.139)
Gems	2.998***	2.325***	1.027**	1.873***	1.597***	0.886***	-0.028	-0.025	-0.032	0.361**	0.267**	0.121
	(0.676)	(0.500)	(0.460)	(0.401)	(0.321)	(0.270)	(0.047)	(0.044)	(0.043)	(0.161)	(0.113)	(0.102)
Oil	2.222***	1.763***	0.754**	-0.290	-0.231	-0.059	-0.008	-0.008	-0.029	-0.289**	-0.212**	-0.141*
	(0.467)	(0.385)	(0.375)	(0.286)	(0.238)	(0.221)	(0.039)	(0.037)	(0.036)	(0.132)	(0.091)	(0.081)
NBI	-0.013	-0.011	-0.008	0.028***	0.023***	0.017***	0.003***	0.003***	0.002**	0.006**	0.004**	0.001
	(0.010)	(0.008)	(0.007)	(0.007)	(0.006)	(0.005)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
GINI	-3.790	-3.098	-1.575	1.027	0.699	0.533	-0.623*	-0.564*	-0.351	0.426	0.265	0.573
	(2.414)	(1.894)	(1.859)	(1.102)	(0.944)	(0.960)	(0.351)	(0.325)	(0.307)	(0.599)	(0.430)	(0.411)

GINIT	-1.140	-0.825	0.100	-1.326	-1.214	-1.145	0.123	0.122	0.054	-0.741	-0.499	-0.484
	(1.554)	(1.181)	(1.062)	(1.304)	(1.184)	(1.153)	(0.180)	(0.169)	(0.166)	(0.469)	(0.334)	(0.317)
Percapita_GDP	1.007*	0.395	0.247	-0.446	-0.520**	-0.250	-0.192***	-0.179***	-0.100**	-0.399***	-0.322***	-0.062
	(0.533)	(0.397)	(0.397)	(0.318)	(0.257)	(0.266)	(0.053)	(0.050)	(0.048)	(0.106)	(0.085)	(0.083)
Popdensity	-0.001**	-0.001**	-0.001**	-0.000	-0.000	-0.000	0.000	0.000	0.000**	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	6.558***	5.086***	2.211*	1.411	1.352	0.488	0.120	0.101	0.031	1.143***	0.827***	0.165
	(1.649)	(1.310)	(1.190)	(1.025)	(0.919)	(0.860)	(0.235)	(0.219)	(0.211)	(0.436)	(0.314)	(0.290)
Observations	27,362	27,362	27,284	27,362	27,202	27,126	23,317	23,249	23,183	23,317	23,249	23,183
Adjusted R-squared	0.060	0.105	0.149	0.025	0.045	0.077	0.020	0.023	0.037	0.039	0.107	0.176

Notes: Observations are at the municipality-year level. The table presents the coefficients of equation 1 using four different measures of violent activity. The dependent variables correspond to the total number of kidnappings, massacres, attacks, and property damages per 100 000 inhabitants. Standard errors are clustered at the municipality level. Author's own calculations. Variable definitions and sources are reported in Table A1. T-statistics are in parenthesis. ***, **, and * indicate significance levels at the 1, 5, and 10 percent.

The results for each measure of violence might be driven by the rebel strategies in the regions in which they operate. To account for all types of illegal armed group activity we estimate equation (1) using the violence index discussed earlier. Table 4 presents the estimation results for all three specifications. Overall, mountainous terrain, lack of transportation infrastructure, dense forests, and proximity to neighboring countries are related to a higher incidence of violent activity. To interpret the magnitude of the coefficients, we use specification (3) in the Table since estimates are less likely to be biased for this case. The magnitude of the coefficients can be interpreted as follows:

(i) Municipalities adjacent to neighboring countries experience a level of violent activity that is 1.30 times (measured in standard deviations) higher than the average incidence of violence in the country.

(ii) Municipalities with navigable rivers and paved roads one standard deviation above the mean experience 1.55 standard deviations less incidence of violence than the mean.

(iii) Municipalities with forests and jungles one standard deviation above the mean experience 1.34 standard deviations of incidence of violence above the mean.

Table 4. *Violence index results*

	(1)	(2)	(3)
Discapital	0.324	0.230	0.078
	(0.291)	(0.218)	(0.191)
Mountainous Terrain	1.900***	1.370***	0.639
	(0.623)	(0.483)	(0.463)
Roads_Rivers	-3.870***	-2.857***	-1.633**
	(1.060)	(0.758)	(0.712)
Forest	2.304**	1.726**	1.223*
	(0.990)	(0.719)	(0.645)
Frontier	2.374**	1.821**	1.271*
	(0.985)	(0.741)	(0.714)
L.Violence		0.253***	0.161***
		(0.030)	(0.024)
W Violence			0.557***
			(0.042)

Rural_index	0.207	0.279	1.063**
	(0.649)	(0.483)	(0.448)
Gems	1.709***	1.306***	0.451*
	(0.454)	(0.327)	(0.272)
Oil	-0.340	-0.213	-0.263
	(0.350)	(0.259)	(0.232)
NBI	0.027***	0.019***	0.010*
	(0.008)	(0.006)	(0.005)
GINI	-2.003	-1.581	0.181
	(1.834)	(1.387)	(1.366)
GINIT	-1.018	-0.628	-0.618
	(1.305)	(0.972)	(0.891)
Percapita_GDP	-1.276***	-1.152***	-0.154
	(0.352)	(0.295)	(0.278)
Popdensity	-0.000*	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)
Constant	3.876***	2.851***	0.294
	(1.413)	(1.050)	(0.982)
Observations	23,317	23,249	23,183
Adjusted R-squared	0.067	0.114	0.174

Notes: Observations are at the municipality-year level. The table presents the coefficients of equation 1. The dependent variable corresponds to a *Violence Index* that combines the four variables (kidnapping, massacres, attacks and damages), as the sum of each variable divided by its mean, per municipality. Standard errors are clustered at the municipality level. Author's own calculations. Independent variable definitions and sources are reported in Table A1. T-statistics are in parenthesis. ***, **, and * indicate significance levels at the 1, 5, and 10 percent.

The results are robust to estimating a Probit version of the model (1), where the dependent variable is coded as 1 if a municipality is above the sample median of violence in a given year, and 0 otherwise (see results in Appendix A, Table A2).

Finally, we turn to our empirical estimation of the correlates with persistence in violent activity. According to Table 5, outbursts of illegal armed group activity tend to last longer in municipalities characterized by mountainous terrain, underdeveloped transportation infrastructure, and proximity to neighboring countries. To further investigate the relationship between persistence and neighboring states, we use two separate dummy variables, one for those municipalities bordering Venezuela, and another for those adjacent to other countries. Interestingly, we find that the impact of the "frontier" variable is driven entirely by municipalities neighboring Venezuela. This finding strongly supports the view that outbreaks

of rebel group actions last longer in areas close to borders with sympathetic regimes. It is likely that, in line with circumstantial evidence and reports from the popular press, Venezuela provided a sanctuary where Marxist guerrillas, such as the FARC , could plan and execute actions more effectively.

We do not find any evidence linking poverty and inequality to the measure of persistence. Municipalities with higher GDP per capita tend to experience shorter durations of violent action outbreaks. We find that rural areas experience reversion to the mean. Periods of incidence of violent activity above the trend are likely to be followed by lower levels of violent actions. However, this does not imply a decrease in the average level of violent activity, since, as highlighted in Table 4, those municipalities experienced on average a higher level of violence.

Table 5. Persistence results

	(1)	(2)	(3)	(4)
Neighbor	0.183***	0.188***	0.175***	0.181***
	(0.0643)	(0.0643)	(0.0644)	(0.0644)
Discapital	-0.00420	-0.00650	-0.00405	-0.00565
	(0.0122)	(0.0124)	(0.0122)	(0.0124)
Mountainous Terrain	0.0482*	0.0492*	0.0434*	0.0446*
	(0.0252)	(0.0269)	(0.0253)	(0.0271)
Roads_Rivers	-0.0922**	-0.0800**	-0.0842**	-0.0762*
	(0.0387)	(0.0397)	(0.0389)	(0.0398)
Forest	0.0161	0.0293	0.0267	0.0334
	(0.0370)	(0.0416)	(0.0373)	(0.0416)
Frontier	0.0685**	0.0680**		
	(0.0304)	(0.0309)		
Venezuela			0.109***	0.102***
			(0.0365)	(0.0370)
Other_frontiers			-0.0147	-0.00390
			(0.0496)	(0.0507)
Coca	2.167	2.825	3.101	3.400
	(2.488)	(2.581)	(2.524)	(2.599)
NBI	-1.15	-5.62	-9.76	-1.50
	(0.394)	(0.447)	(0.393)	(0.448)
Percapita_GDP	-0.0867**	-0.117***	-0.0888**	-0.116***
	(0.0351)	(0.0377)	(0.0351)	(0.0376)
Rural_index	-0.135***	-0.120***	-0.130***	-0.120***

	(0.0323)	(0.0365)	(0.0324)	(0.0365)
Constant	0.113***	0.416*	0.109***	0.415*
	(0.0291)	(0.227)	(0.0291)	(0.227)
Observations	1,106	1,106	1,106	1,106
Adjusted R-squared	0.036	0.038	0.039	0.040
Region fixed effects	No	Yes	No	Yes

Notes: Observations are at the municipality-year level. The table presents the coefficients of equation 2. The dependent variable corresponds to the *Persistence* of violent activity in each municipality i, ϕ_i, calculated from an AR(1) model: $\Delta y_{i,t} = \phi_i \Delta y_{i,t-1} + \varepsilon_{i,t}$. $y_{i,t}$ is the *Violence Index* which combines kidnapping, massacres, attacks, and damages as the sum of each variable divided by its mean, per municipality. Independent variables definitions and sources are reported in Table A1. T-statistics are in parenthesis. ***, **, and * indicate significance levels at the 1, 5, and 10 percent.

6. Conclusions and Ideas for Future Research

In this paper, we provide new evidence about the role of geographical sanctuaries, remote regions, jungles, neighboring regimes, and poor infrastructure in shaping the dynamics of illegal armed political activity in Colombia.

One major challenge in the existing literature that examines how geographical factors contribute to the duration and intensity of war is the complexity of conflict, influenced by both "motives" and "opportunities" drivers, which are difficult to measure at the unit of observation where violent activity occurs. "Motives" encompass political, social, or cultural motivations that give rise to grievances, aspirations, and animosities prompting certain groups to take up arms against an established authority. "Opportunities" entail military and financial conditions enabling rebel organizations to sustain themselves over time. Using comprehensive data from Colombia at the subnational level for almost 30 years, we overcome many of the shortcomings of previous studies by measuring the intensity of rebel-group actions at the smallest administrative scale in the country, while controlling for a range of socioeconomic variables that capture the potential motives and opportunities which explain the conflict.

In this context, we explore both the intensity and the persistence of political violence. We find that Colombia's geography and territory significantly explain the level and

persistence of civil conflict and violence. Regarding conflict *intensity*, we find that insurgent action is most intense in municipalities with mountainous terrain, dense forests and jungles, fewer accessible rivers and roads, and proximity to neighboring countries. These results hold up even after the inclusion of several socioeconomic variables that proxy for state presence, access to potential recruits, and material and financial resources; the results also remain robust after controlling for serial and spatial correlation. Concerning conflict *persistence*, we find that outbursts of illegal armed group actions tend to last longer in municipalities with mountainous terrain, underdeveloped transportation infrastructure, and proximity to neighboring countries.

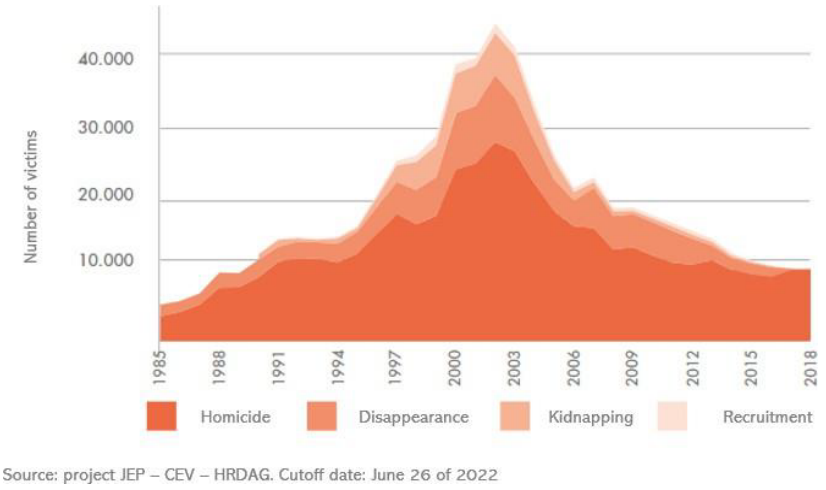
While similar findings about the impact of rough terrain on armed conflict have been documented elsewhere, especially in recent work disaggregating conflict at the local level, our results contribute to the literature by further confirming the importance of the role of geographic factors even after controlling for a comprehensive set of socioeconomic variables at the local level which are associated with the "motives" approach to political violence.

These results carry important implications for security and peace-seeking policies. Well-intentioned policies aimed at redistributing land or income or improving the coverage and quality of social services may prove insufficient or even ineffective in deterring rebel organizations and reducing violence if the critical determinants of rebellion and insurgency are the financial and military opportunities enjoyed by armed groups. Consequently, government policies should aim at strengthening state capacity, enhancing governance quality, and significantly refining the provision of critical public goods, such as security and justice.

This paper marks an initial step towards a more comprehensive approach to the determinants of political violence in countries like Colombia, with a particular emphasis on defining the pertinence of alternative public policies to combat political violence. Some avenues for further research include analyzing the success or failure of past spatial-oriented public policies in combination with security policies and interactions with local communities to reduce political violence. Additionally, assessing the effects of the La Habana peace agreement with the FARC in light of our findings is crucial, especially given indications that the anticipated peace outcomes may be significantly less extensive than initially expected. It

is well known that a fraction of the FARC group never joined the peace agreement, and shortly after its signing, another group led by Ivan Marquez, the FARC lead negotiator in La Habana, resumed the armed struggle. Understanding how the country's geographical conditions may have contributed to insurgent groups' military opportunities is crucial for grasping the shortcomings of the La Habana peace agreement and its implementation. Moreover, it is crucial to examine the relationship between security improvements and macroeconomic outcomes like GDP growth and employment. For example, during the Uribe administration (2002-2010), there was a significant economic recovery materialized in GDP growth and employment generation. Assassinations, kidnappings, and extortion, which were growing at an exponential rate before the start of that government, began to fall as soon as the new administration took office (Figure 3). This period also witnessed a marked improvement in Colombia's terms of trade, particularly due to a substantial increase in the price of oil. Establishing this causal link between macroeconomic policies and aggregate shocks with security outcomes in Colombia is essential. Furthermore, it is important to compare these effects with countries that have different geographical characteristics. As mentioned above, our study measures the intensity of rebel-group actions at the smallest administrative scale in the country, while considering various socioeconomic variables that capture potential motives and explanations for the conflict at the local level. Complementing these local variables with broader ones in Colombia and the region would provide valuable insights.

Figure 3. Number of victims per type of violent activity



Source: project JEP-CEV-HRDAG. Cutoff date: June 26 of 2022

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Appendix: Tables

Table A1
Variable definitions

Variable	Definition	Source
Kidnapping	Total number of kidnapping per 100,000 inhabitants	CERAC
Massacres	Total number of massacres victims per 100,000 inhabitants	CERAC
Attacks	Total number of attacks per 100,000 inhabitants	CERAC
Damages	Total number of property damages per 100,000 inhabitants	CERAC

Violence	Index that combines the four variables (*kidnapping, massacres, attacks* and *damages*), as the sum of each variable divided by its mean, per municipality	Author's calculations
Discapital	Natural logarithm of the linear distance to the state capital in kilometers	IGAC
Mountainous Terrain	Standard deviation of the contour lines for each municipality	IGAC
Roads_Rivers	Sum of paved roads and navigable rivers in kilometers, divided by total kilometers of paved, unpaved roads and navigable rivers	IGAC
Forest	Square kilometers of forest divided by the square kilometer area of the municipality	IDEAM
Frontier	Border dummy coded 1 if the municipality is a country borderline, 0 otherwise	Author's calculations
DisBogota	Linear distance to Bogota in kilometers	IGAC
Gems	Takes the value of 1 if the municipality has an emerald or sapphire location, 0 otherwise	Daly 2012 replication files, ANM
Oil	Coded 1 if the municipality has oil fields, pipelines, or refineries, 0 otherwise	Daly 2012 replication files, ANH
Rural_index	Population living in a rural area divided by total population, per municipality	DANE
NBI	Structural poverty measure that identifies the most critical shortages in a population. In Colombia, and according to the Economic Commission for Latin American and the Caribbean (ECLAC), the index takes into account five dimensions: an inadequate housing, absence of sanitary services (safe drinking water and a sewage service), critical overcrowding (more than 3 individuals living in the same room), non-attendance to school and a high economic dependence. An individual is considered poor if he	DANE

	or she has one of the shortages considered above, and it is called misery if there are more than two dimensions unattended.	
GINI	Gini coefficient as an inequality measure	DANE
GINIT	Gini coefficient as an inequality measure for land tenure	IGAC
Percapita_GDP	Municipality GDP per inhabitant	DNP
Popdensity	Total population divided by the square kilometer area of the municipality	Author's calculations
Coca	Hectares of coca cultivation divided by area in hectares of the municipality	SIMCI
Venezuela	Border dummy coded 1 if the municipality is a Venezuelan border, 0 otherwise	Author's calculations
Other_frontiers	Border dummy coded 1 if the municipality is a border of a country different than Venezuela, 0 otherwise	Author's calculations

Table A2. Probit results

	(1)	(2)	(3)
Discapital	-0.002	-0.002	-0.007
	(0.035)	(0.027)	(0.028)
Mountainous Terrain	0.458***	0.341***	0.326***
	(0.072)	(0.055)	(0.057)
Roads_Rivers	-0.356***	-0.244***	-0.200**
	(0.114)	(0.087)	(0.089)
Forest	0.246**	0.200***	0.176**
	(0.100)	(0.074)	(0.078)
Frontier	0.389***	0.286***	0.300***
	(0.084)	(0.062)	(0.067)
L.Violence		0.894***	0.845***
		(0.028)	(0.029)
W Violence			0.839***
			(0.052)
Rural_index	-0.527***	-0.347***	-0.353***
	(0.100)	(0.077)	(0.079)

Gems	0.270***	0.211***	0.192***
	(0.041)	(0.031)	(0.032)
Oil	0.091**	0.073**	0.001
	(0.037)	(0.029)	(0.030)
NBI	0.002**	0.001**	0.002**
	(0.001)	(0.001)	(0.001)
GINI	-0.401**	-0.357**	-0.386***
	(0.192)	(0.144)	(0.148)
GINIT	-0.056	-0.024	-0.108
	(0.177)	(0.134)	(0.141)
Percapita_GDP	-0.360***	-0.309***	-0.237***
	(0.059)	(0.052)	(0.046)
Popdensity	-0.000*	0.000	-0.000*
	0.000	0.000	0.000
Constant	-0.382**	-0.733***	-0.847***
	(0.169)	(0.130)	(0.134)
Observations	19,214	19,156	19,103
Pseudo R-squared	0.044	0.119	0.135

Notes: Observations are at the municipality-year level. The table presents the coefficients of equation 1 using a Probit model and four different measures of violent activity. The dependent variables are equal to one if the number of kidnappings, massacres, attacks, and property damages per 100,000 inhabitants are above the sample median and are zero otherwise. Standard errors are clustered at the municipality level. Author's own calculations. Variable definitions and sources are reported in Table A1. T-statistics are in parenthesis. ***, **, and * indicate significance levels at the 1, 5, and 10 percent.

Table A3. Results including coca cultivation and controlling for spatial correlation.

	(1) Kidnappings	(2) Massacres	(3) Attacks	(4) Damages	(5) Violence
Discapital	0.180	-0.239	-0.018	-0.007	-0.040
	(0.412)	(0.179)	(0.032)	(0.102)	(0.222)
Mountainous Terrain	0.928	0.312	0.140***	-0.047	0.262
	(1.073)	(0.432)	(0.054)	(0.184)	(0.492)
Roads_Rivers	0.518	-0.968	-0.166*	0.018	-0.586
	(1.675)	(0.671)	(0.090)	(0.197)	(0.705)
Forest	3.134*	-0.032	0.178	0.515**	1.486**
	(1.766)	(0.635)	(0.110)	(0.217)	(0.687)
Frontier	-0.779	0.903	0.013	0.302	0.514
	(1.053)	(0.869)	(0.056)	(0.201)	(0.647)
L.Violence	0.185***	0.137**	0.055**	0.251***	0.154***
	(0.039)	(0.061)	(0.026)	(0.049)	(0.036)
W Violence	0.575***	0.526***	0.256***	0.547***	0.689***
	(0.081)	(0.111)	(0.056)	(0.096)	(0.061)

Coca	-0.839	19.139	-1.554	-1.352	-0.764
	(17.344)	(22.533)	(1.118)	(4.136)	(13.087)
Rural_index	-1.281	0.218	0.149***	0.145	0.618
	(0.984)	(0.409)	(0.049)	(0.128)	(0.430)
Gems	-0.526	0.108	-0.067**	-0.015	-0.425
	(0.542)	(0.324)	(0.034)	(0.098)	(0.283)
Oil	-1.385*	-0.912**	-0.118**	-0.188*	-0.801**
	(0.764)	(0.379)	(0.057)	(0.111)	(0.378)
NBI	-0.015	0.016**	0.002**	0.000	0.005
	(0.013)	(0.007)	(0.001)	(0.002)	(0.006)
GINI	-4.651	0.084	-0.025	0.621*	0.269
	(4.477)	(1.584)	(0.210)	(0.341)	(1.479)
GINIT	0.070	-0.183	0.040	-0.335	-0.251
	(2.903)	(1.131)	(0.145)	(0.313)	(1.090)
Percapita_GDP	-0.105	-0.165	-0.106***	-0.036	0.048
	(0.537)	(0.331)	(0.030)	(0.097)	(0.237)
Popdensity	-0.001**	0.000	0.000*	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Constant	5.462*	0.865	0.043	0.153	0.504
	(3.156)	(1.007)	(0.159)	(0.324)	(1.118)
Observations	10,777	10,767	10,767	10,767	10,767
Adjusted R-squared	0.149	0.077	0.037	0.176	0.174

Notes: Observations are at the municipality-year level. The table presents the coefficients of equation 1 using five different measures of violent activity. The dependent variables correspond to the total number of kidnappings, massacres, attacks, property damages per 100,000 inhabitants, and a Violence index adding up the previous four measures. Standard errors are clustered at the municipality level. Author's own calculations. Variable definitions and sources are reported in Table A1. T-statistics are in parenthesis. ***, **, and * indicate significance levels at the 1, 5, and 10 percent.

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