The Impact of U.S. Drone Strikes on Terrorism in Pakistan*

Patrick B. Johnston
RAND Corporation

Anoop K. Sarbahi
University of Minnesota

April 21, 2015

Abstract

This study analyzes the effects of US drone strikes on terrorism in Pakistan. Some theories suggest that drone strikes anger Muslim populations, and that consequent blowback facilitates recruitment and incites Islamist terrorism. Others argue that drone strikes disrupt and degrade terrorist organizations, reducing their ability to conduct attacks. We use detailed data on U.S. drone strikes and terrorism in Pakistan from 2007-2011 to test each theory's implications. The available data does not enable us to test whether drone strikes have resulted in increased recruitment, but it does allow us to examine whether these strikes have resulted in changes in terrorist activities. We find that drone strikes are associated with decreases in the incidence and lethality of terrorist attacks, as well as decreases in selective targeting of tribal elders. While our findings do not suggest that these effects are long-term, the results do lend some credence to the argument that drone strikes, while unpopular, have bolstered U.S. counterterrorism efforts in Pakistan.

*Earlier versions of this article were presented at the 2011 Annual Meetings of the American Political Science Association, the Belfer Center for Science and International Affairs at Harvard University's Kennedy School of Government, and the New America Foundation. For helpful feedback on earlier versions, we thank Peter Bergen, James Dobbins, Daniel Egel, C. Christine Fair, Brian Fishman, Melissa Willard-Foster, Joshua Foust, Seth G. Jones, Jennifer Keister, Akbar Khan, Peter Krause, Sean Lynn-Jones, Steven E. Miller, Jacob N. Shapiro, Arthur Stein, Katherine Tiedemann and Jeremy Weinstein. Johnston acknowledges financial support from AFOSR Award #FA9550-09-1-0314.

1 Introduction

Do drone strikes against terrorists reduce the threat posed by terrorist organizations, or do they unintentionally increase support for anti-U.S. militants and thus fuel terrorism? [1]

Existing research has studied the effects of coercive airpower,(Pape 1996; Horowitz and Reiter 2001), targeted killings (Jaeger 2009; Jordan 2009; Johnston 2012; Price 2012) and civilian victimization (Kalyvas 2006; Lyall 2009; Condra and Shapiro 2012), but social scientists have conducted little empirical analysis of the effects of drone strikes.[2] While the debate over the use of drones for counterterrorism efforts has intensified, the arguments, both for and against their usage, although informed by plausible logics, are supported primarily by anecdotal evidence, not systematic empirical investigation. This lack of attention is unfortunate: unmanned aerial vehicles, and their lethal targeting capabilities, are likely to represent a critical aspect of current and future counterterrorism efforts.

The consequences of drone strikes are a critical policy concern. The United States has frequently been called upon to cease drone strikes in Pakistan in order to protect noncombatants, but instead it has expanded its use of drones to other countries in which al-Qa'ida-affiliated militants are believed to operate, such as Somalia and Yemen.[3] The laws governing international armed conflict codify and strengthen norms against targeted killings, yet other interpretations of the laws of war leave civilian officials and military commanders with substantial latitude to target enemy

[1] Examples of arguments that drone strikes are ineffective or counterproductive include NYU/Stanford (2012); Cronin (2009). Examples of arguments that drone strikes are effective include Fair (2010, 2012) and Byman (2013). Empirical studies of targeted killings and civilian casualties in counterinsurgency and counterterrorism show that both outcomes are possible (Valentino, Huth and Balch-Lindsay 2004; Downes 2007; Stanton 2009; Jordan 2009). Strikes conducted by remotely piloted aircraft may undermine counterterrorism efforts or enhance them depending on the nature of the violence, the intentionality attributed to it, or the precision with which it is applied (Kalyvas 2006; Downes 2007; Kocher, Pepinsky and Kalyvas 2011).

[2] Exceptions include Jaeger and Siddique (2011); Smith and Walsh (2013).

[3] For excellent descriptions of the drone war's expansion, see Mazzetti (2013) and Scahill (2013).

combatants believed to be affiliated with terrorist organizations against which the U.S. has declared war (Gray 2000). Liberal democratic states face substantial pressures to protect civilians in war, but at the same time are often confronted with substantial uncertainty as to what abiding by legal principles such as "discrimination"—the obligation of military forces to select means of attack that minimize the prospect of civilian casualties—actually entails (Crawford 2003; Walzer 2006).

Drone strikes are not the only instrument the U.S. can use to counter terrorists. U.S. Special Operations forces have conducted hundreds of raids in permissive political environments, such as Afghanistan (2001–2014) and Iraq (2003–2011). However, the U.S. has fewer counterterrorism instruments at its disposal in semi-permissive environments such as Pakistan, Somalia, Yemen, and Iraq (2014-). The effectiveness of drone strikes at countering terrorism lies at the core of U.S. policymakers' arguments for their continued use in semi-permissive environments. Yet because neither U.S. officials nor human rights advocates have presented compelling, systematic evidence in support of their claims, disagreement about the effectiveness of drone strikes remains rife. What is needed is a rigorous, evidence-based assessment of drone strikes' impact on terrorist activities. Such an assessment should sharpen the debate on drone strikes and help counterterrorism officials and critics alike to evaluate the tradeoffs associated with drone warfare.

The present study is a step in that direction. Based on the available detailed data on both drone strikes and terrorism in Pakistan, the study examines how drone strikes, triggering changes in the behavior of terrorists, have affected terrorist violence in northwest Pakistan bordering Afghanistan. Specifically, this study investigates the relationship between drone strikes and a range of measures of terrorist violence including terrorist attack patterns, terrorist attack lethality, and attacks on tribal elders, whom some militants view as actual or potential rivals. The available data do not allow us to examine whether drone strikes have resulted in increased recruitment in terrorist organizations—a key argument advanced by the opponents of the drone program. However, the data do allow us to investigate the impact of drone strikes on terrorism measured in terms of the terrorist activities mentioned here, which, unlike recruitment, are more widely recorded and reported.[4]

A systematic analysis of the data reveals that drone strikes have succeeded in curbing deadly terrorist attacks within the targeted territory in Pakistan. Specifically, the key findings of our study show that drone strikes are associated with substantial short-term reductions in terrorist violence along four key dimensions. First, drone strikes are generally associated with a reduction in the rate of terrorist attacks. Second, drone strikes are also associated with a reduction in the number of people killed as a result of terrorist attacks, i.e., the lethality of attacks. Third, drone strikes are also linked to decreases in selective targeting of tribal elders, who are frequently seen by terrorist groups as conniving with the enemy and acting as an impediment to the pursuit of their agenda. Fourth, we find that this reduction in terrorism is not the result of militants leaving unsafe areas and conducting attacks elsewhere in the region. On the contrary, there is some evidence that drone strikes have a small *violence-reducing* effect in areas near those struck by drones. However, this work only studies short-term changes, extending over a few weeks, in terrorist violence and our findings do not provide a basis to conclude that the effects of drone strikes on these measures of terrorist violence extend beyond the week during which they take place. Taken together, these findings suggest that despite their unpopularity, drone strikes do affect terrorist activities and claims that drones have aided U.S. counterterrorism efforts in Pakistan should not be summarily dismissed.

[4] Arguably, an increased anger with the drone program may not necessarily translate into an increased enlistment in terrorist groups as potential recruits weigh their options including the possibility of being killed in a drone strike. Much of the debate on this topic is based on anecdotal evidence and individual cases such as Faisal Shahzad, the failed Time Square bomber, who had claimed to have planned the attack in response to the US drone strikes in Pakistan. It is almost impossible to get systematic and reliable data on insurgent recruitment. For an exception, see Sarbahi (2014).

The remainder of this article proceeds as follows. In Section 2, we provide background information on the militant organizations that the U.S. has targeted in Pakistan and their objectives. In Section 3, we outline a range of relevant hypotheses on the effects of drone strikes, and briefly discuss the theoretical logics that undergird them. In Section 4, we describe our dataset and the methodology. In Section 5, we discuss the results of our empirical analysis and our interpretation of the findings. Finally, Section 6 concludes with a discussion of our findings' implications for policy and for the future of counterterrorism.

2 Militancy in Northwest Pakistan

Often described as Pakistan's "lawless frontier," the Federally Administered Tribal Areas (FATA) is located in the northwestern corner of the country bordering Afghanistan (see Figure 3). This region, which covers over 27,000 square kilometers---roughly the size of New Jersey---and has a population of over 3 million, is predominantly inhabited by ethnic Pashtun tribes. These tribes are further divided into numerous sub-tribes and clans, but each of the seven agencies of the region has a dominant tribe (Nawaz 2009). Much of the territory of the region is highly rugged and mountainous, especially the south where the two Waziristans—North and South—are located. The British governed this territory indirectly through local *maliks* and political agents with minimal direct involvement—a system more-or-less retained by the post-independence Pakistan state. [5] Sir William Barton once described the region as the "Achilles heel" of the British Empire (Barton 1939). The British carried out several major military operations in the region, the last of which was conducted during 1937 and 1938, but the British were never able subjugate the population or gain its allegiance.

[5] It was not until 1997 that the population of the region was able to vote in national elections. In recent years, the government of Pakistan has proposed the introduction of elected local institutions, including a draft legislation in 2012, but the proposal has not been enacted into a law.

Table 1: FATA: Population, Size & Elevation

Agency	Area (km^2)	Population (total)	Population Density (persons/km^2)	Mean Elevation (meters)
Bajaur	1,290	595,227	461	1198
Khyber	2,576	546,730	212	1413
Kurram	3,380	448,310	133	1746
Mohmand	2,296	334,453	146	902
North Waziristan	4,707	361,246	77	1438
Orakzai	1,538	225,441	147	1540
South Waziristan	6,620	429,841	65	1390
FATA	27,220	3,176,331	117	1375

Source: Population Census Organisation (2001) & Gesch, Verdin and Greenlee (1999)

The FATA is home to a multitude of militant groups, which reflect not only local ethno-sectarian, ideological, and personal divisions, but also the militants' varying strategic and operational goals and foreign and domestic affiliations. Most of the militant organizations in the FATA trace their origins to the anti-Soviet *mujahideen* mobilization of the late 1970s and 1980s. In recent years, militants in the FATA have engaged in asymmetric war against the Pakistani forces, in which the control of civilians is critical to both their survival and effectiveness. Here they face challenges not only from the state, and those allied with the state, but multiple other armed and civilian actors opposed to them.[6]

What all of these groups have in common is anti-Americanism and a Salafi-jihadi ideology. But, in the context of the struggle for control and survival, intergroup differences are powerful enough to breed internecine feud and bloodshed that engulfs militants and civilians alike. Some of these differences run deep, and are rooted in centuries of distrust and hostilities between tribes and clans such as those between the Mehsuds and Wazirs. The prevalent animosity and distrust breeds suspicion of

[6]Multiple anti-Taliban *lashkars*, usually constituted by local tribal *jirgas* operate across FATA. The formation of some of these *lashkars* was actively encouraged by the Pakistani government, and the *jirgas* that constituted such *lashkars* are often referred to in the official parlance as "peace committees." See, for example, Taj (2011).

local rivals' connivance with U.S. and Pakistani forces, and the resulting bloodshed when government forces target militants in the region. Those targeted are not just the members of rival groups, but also include their actual and presumed supporters, which include civilians and tribal elders.

U.S. drone strikes have targeted several militant groups in the Pakistani tribal areas believed to be affiliated with al-Qa'ida and its associated groups, Tehrik-i-Taliban Pakistan (TTP), and the Haqqani Network. These groups have differing objectives, and do not always behave as unitary organizations, but they all share in common an adherence to a jihadi ideology and the pressures of conducting asymmetric warfare in contested territory. Al-Qa'ida, which was based in Afghanistan from 1996–2001 after Afghan Taliban leader Mullah Omar gave Osama bin Laden's group sanctuary there, took refuge in northwest Pakistan after the 9/11 attacks on the United States and the subsequent U.S. invasion and occupation of Afghanistan. Most of al-Qa'ida's senior leaders and core members are now in Pakistan's FATA region, where local jihadists who control the area gave them sanctuary beginning in late 2001 and 2002. Al-Qa'ida's core personnel in Pakistan are made up primarily of foreign jihadists from across the Muslim world who serve as the central hub of al-Qa'ida's campaign of global jihad. The primary goals of al-Qa'ida's core in Pakistan are (1) to establish an Islamic caliphate across the Muslim world, hence al-Qa'ida's alliance with affiliate al-Qa'ida jihadist insurgencies in countries such as Algeria, Somalia, Syria, and Yemen, and the Indian subcontinent; and (2) to plan or support attacks against Western countries. The number of al-Qa'ida operating in Pakistan is unknown, but numerous estimates place it between 150–300.

The TTP was formally established in 2007 as an umbrella organization that brought together some 40 Islamist militant leaders, and their groups, from across the Federally Administered Tribal Areas (FATA) and other parts of Khyber Pakhtunkhwa under the governance of a single organization commanded by the TTP's founding emir, Baitullah

Mehsud, who was killed in a U.S. drone strike in August 2009 (Abbas 2014). Unlike al-Qa'ida, the TTP recruits most of its members locally, and it is not an official affiliate of al-Qa'ida. However, the TTP's primary objectives—overthrowing the Pakistani government and replacing it with an Islamic emirate similar to the one established in Afghanistan by the Afghan Taliban in the late 1990s—are consistent with al-Qa'ida's, and the TTP is known as one of al-Qa'ida's associated movements. [7]

The third main group targeted by U.S. drone strikes is the Haqqani Network. The Haqqani Network cooperates with, but is autonomous from, the Afghan Taliban. It operates on both sides of the Durand line. The Haqqani Network is aligned ideologically with both al-Qa'ida and the TTP, and the three groups engage in tactical cooperation in pursuit of shared objectives. The Haqqani Network's founding leader, Jalaluddin Haqqani, was a mujahideen commander in the anti-Soviet war in Afghanistan and held important positions in the Taliban regime in the 1990s. Haqqani is a *Zadran*, a Pushtun tribe that inhabits the Paktia and Khost provinces of Afghanistan, and has been based in North Waziristan since the 1970s. He is credited as having recruited the first batch of Arab volunteers against the Soviets in Afghanistan (Brown and Rassler 2013). The Haqqanis have operated numerous madrassas and training camps in the two Waziristans and have had close ties with key Salafi-jihadi ideologues, including Abdullah Azzam and Osama bin Laden.

[7] This is evident in correspondence captured during the raid of Osama bin Laden's Abbottabad, Pakistan, compound in May 2011, which indicated that al-Qa'ida leadership was sending tactical and operational to then-TTP leader Hakimullah Mehsud as of December 2010. See "Letters from Abbottabad."

3 Hypotheses on Drone Strikes and Terrorism

3.1 Drone Strikes, the Civilian Population, and Incentives for Terrorist Violence

We analyze the relationship between U.S. drone strikes and terrorism in Pakistan—that is, militant violence that targets civilians. Although there are distinct differences in the aims of the three main groups targeted by U.S. drone strikes, all are engaged in asymmetric warfare against the Pakistani government and local incumbents, which organize primarily around local tribes and clans. Each group relies mainly on unconventional tactics to establish or maintain its sanctuary in FATA. Within this environment, each group has an incentive to use violence against civilians deemed disloyal or perceived as jeopardizing the advancement of its cause (Kalyvas 2006).

The first argument we examine is that U.S. drone strikes increase terrorist violence. We examine terrorist targeting of civilians for four reasons: (1) terrorists attempt to deter civilian disloyalty, specifically civilians' cooperation with local authorities and provision of human intelligence; (2) civilians are "softer" targets and are more plentiful in these groups' areas of operation due to the relative lack of government and military presence in the region; (3) radicalization among the population, possibly caused by drone strikes, could enable militants greater capabilities to engage in more attacks against perceived enemies; and (4) because attempts to kill militant leaders may trigger internecine fighting that results in civilian targeting. We discuss each in turn.

First, terrorist leaders may seek to punish and deter informers whose information can help the U.S. and Pakistani governments locate and target them and their senior lieutenants. Drone strikes against specific individuals reportedly rely on robust informant networks which provide human intelligence on the activities and locations of militant targets (Cronin 2013). As a result, all militant groups targeted by drone strikes have an incentive to target civilians they believe to have sided with their enemies, even though the global strategic goals of, say, al-Qa'ida, differ from the TTP's local and national objectives. Second, focusing on militant violence against civilians makes sense because Pakistan maintains only a minimal state presence in FATA—which is a key factor in the U.S.' escalation of UAV counterterrorism strikes in the region. The Pakistani government has essentially maintained the colonial administration that emphasized minimum involvement and relies heavily on formal or informal arrangements with the local actors such as *maliks* (chiefs), *imam* and *mullahs* (religious leaders), *jirgas* (council of elders) and *lashkars* (armed bands). Given the relative sparseness of Pakistani government presence with a heavy reliance on local, usually civilian, actors and the absence of U.S. boots on the ground, the civilian population is by far the largest and most important "target set" for FATA militants seeking to establish, maintain, and consolidate a territorial sanctuary in Pakistan.

Third, a common argument holds that drone strikes increase terrorist violence overall by radicalizing alienated civilians. The logic of this argument is that by radicalizing segments of the civilian population, the population is ripe for recruitment by fellow Muslims with whom they share common enemies—the U.S. or Pakistani government. Militants could thus recruit more manpower and mobilize more resources. This could lead to higher levels of observed terrorism because a militant group's enhanced capabilities enable it to develop sophisticated counterintelligence networks for identifying and rooting out informants or by enabling a group to increase its targeting of moderate Muslims under the "*takfir*" principle of strict sharia law .

Fourth, the death of a militant leader from a drone strike might trigger rivalry among potential successors and result in civilian killing as the rival claimants seek to establish an upper hand. The bitter rivalry between Hakimullah Mehsud and Waliur Rehman, both killed in drone strikes in 2013, to become the chief of the TTP following the death of Baitullah Mehsud has been widely reported. In 2013, the differences within the TTP over the choice of a successor to replace Waliur Rehman, group's deputy emir, spilled over to Karachi (Rehman 2014). A similar factional fight was triggered by the death of Hakimullah Mehsud in November, 2013, which is believed to have resulted in the killing of Asmatullah Shaheen (Rehman 2013).

H1: All else equal, drone strikes increase terrorist violence.

3.2 Drone Strikes, Militant Capabilities, and Reductions in Terrorist Violence

The second argument, which is common among U.S. counterterrorism officials, contends that drone strikes are effective at reducing the terrorist threat posed by targeted groups. Two mechanisms are frequently cited: (1) disruption and (2) degradation.

3.2.1 Disruption

The first mechanism involves the "disruption" of militant operations. This disruption mechanism suggests drone strikes reduce militants' ability to operate in a cohesive, efficient, manner and limit their ability to control local areas. Even if an insurgent or terrorist organization is the only armed actor in an area, as is often the case in FATA localities, the greater the threat drones pose, the harder it is for the militants to exercise direct control in that area.

This runs counter to Kalyvas (2006), whose "logic of violence" predicts that when insurgents are the sovereign in an area, insurgent violence will be absent, since betraying an area's sovereign carries prohibitive risks for civilians. This equilibrium makes violence against civilians unnecessary for the sovereign. In this case, government or U.S. forces seeking to root out militants from an area they control lack the necessary information to target militants selectively. Kalyvas' logic of violence suggests counterterrorist operations would thus be likely to rely on indiscriminate force. Drones' novel intelligence, surveillance, and reconnaissance capabilities change these dynamics in contemporary Pakistan vis-a-vis the earlier conflicts that Kalyvas seeks to explain. Not only do drones enable the U.S. to collect information in denied areas where they have no ground presence—as is currently the case for the U.S. in Pakistan—but they can also credibly threaten to punish militants from afar, with lethal and discriminate force.

Our argument is that, in this scenario, militant violence should decrease, both in terms of its frequency and its lethality. The reason is that drone strikes in an area represent a meaningful indication of an increased security risk to militants operating in that area. The increased risk associated with continuing to operate in the targeted areas should apply to any type of militant activity that is vulnerable to drone capabilities, including conducting terror attacks, regardless of whether militants would otherwise conduct operations at their "average" rate and level of lethality (the null hypothesis), or if they would otherwise escalate the frequency and lethality of their operations to deter potential defectors (the alternative) "logic of violence" hypothesis.

We thus advance the following hypothesis:

H2: All else equal, drone strikes decrease terrorist violence.

We should note that there are a couple of other mechanisms that would be consistent with this observable implication. First, there is a possibility that drone strikes make the population more reticent to inform, and therefore reduce the need for terrorist violence in retribution. If this were the case, we would expect to see a relatively small number of drone strikes drying up the pool of available informers and making additional drone strikes based on multi-source intelligence difficult. This is not what we see—there have been over 350 drone strikes conducted in Pakistan's tribal areas since 2004–which is consistent with the disruption mechanism described above. The disruption mechanism's implication is that semi-frequent drone strikes are used to pursue persistent disruption of terrorist operations. This is consistent with the empirical record. Second, it can be argued that recent technological advancement, including the use of drones and tracking of cellular and satellite phones, has enabled counterinsurgents to reduce their reliance on human intelligence. This not only implies that there are fewer potential targets for insurgents, and that civilians have more credible basis for 'deniability', but it also implies that if insurgents kill more civilians, they are more likely to make mistakes, which would be counterproductive.

3.2.2 Degradation

The second mechanism by which drones could reduce terrorism is through "degradation." This mechanism would suggest that drone strikes reduce terrorism by taking terrorist leaders, and other "high-value individuals" (HVIs), off the battlefield. The loss of individuals with valuable skills, resources, or connections hinders a terrorist organization's effectiveness, including its ability to continue producing violence at the same rate it had before losing it lost key HVIs. Killing core and affiliated al-Qaida leaders is the stated objective of drone strikes.[8]

Drone strikes have resulted in the deaths of many top terrorist leaders. In late 2012, the U.S. administration claimed to have eliminated at least two-thirds of the top 30 al-Qa'ida leaders in Pakistan and Afghanistan during the first three years of President Obama's first term in office.[9]. The estimates compiled by New America Foundation suggest that by August 2014 drone strikes in Pakistan accounted for the killing of 64 militant leaders. The list includes 38 high-level al-Qai'da functionaries and several al-Qai'da-affiliated and Taliban group leaders.(New America Foundation 2015).

An emerging political science literature has begun to assess the effects of "leadership decapitation"—the killing or capture of militant leaders or other HVIs–using more

[8] "Remarks of President Barack Obama," speech delivered at National Defense University, May 23, 2013. Accessed online at `https://www.whitehouse.gov/the-press-office/2013/05/23/remarks-president-barack-obama`. Last accessed on July 5, 2013.

[9] "Two-Thirds of Top Qaeda Leaders 'Removed' Since 2009: Obama Aide," *Reuters*, December 18, 2012. Quoted in International Crisis Group (2013: p. 22)

comprehensive datasets and sophisticated statistical methodologies and research designs. The literature on leadership decapitation has largely focused on evaluating the effect of killing or capturing top insurgent or terrorist leaders on outcomes like the probability of group collapse, mortality, and attack rates. [10] Scholars of leadership decapitation have come to different conclusions. On the one hand, using large-N approaches, Johnston (2010) and Price (2012) both find evidence that removing the top leaders of insurgent and terrorist groups helps degrade these organizations, rendering them less lethal, more vulnerable to defeat, and more likely to end quickly than groups that did not suffer leadership decapitation. Using a different dataset and dependent variable, Jordan (2009, 2014) argues that decapitating terrorist organizations is ineffective because it rarely results in the their collapse. Jordan further argues that decapitation may have counterproductive effects when used against terrorist organizations whose goals involve religion—as do al-Qa'ida's, the TTP's, and the Haqqani Network's– particularly when these organizations are large and old (relative to the average terrorist organization in her dataset). [11]

We expect drone strikes that kill terrorist leaders will be associated with reductions in terrorist attacks. Previous research has demonstrated that conducting effective terrorist activities requires skilled individuals, many of whom are well-educated and come from upper middle-class backgrounds (Krueger 2007; Bueno de Mesquita 2005; Berrebi and Klor 2008). Indeed, scholars have found that a disproportionate number of jihadi militants were trained as engineers (Gambetta and Hertog 2009).

In the context of northwest Pakistan, where militant freedom of movement is

[10] Scholars disagree about the conceptualization and measurement of these variables. On leadership decapitation and terrorist group collapse, see Jordan (2009, 2014). On decapitation and group mortality, see Price (2012). For a critique of the empirical strategies used in scholarship on leadership decapitation, see Johnston (2012).

[11] These claims are difficult to assess because Jordan's methodology is unsuited to enable the evaluation of such hypotheses. Jordan only selected cases in which leadership decapitation occurred. Consequently, it is impossible to know if terrorist groups that suffer leadership decapitation are more or less likely to collapse than those that do not. For a general description of this methodological problem, see Ashworth (2008).

limited by the threat of drone strikes, we expect that militant groups will find it difficult to replace senior leaders killed in drone strikes because recruiting and deploying their replacements, perhaps from a foreign country with an active Salafi-jihadi militant base, will be costly and difficult. This is not to say that leaders killed in drone strikes are irreplaceable. On the contrary, other militants are likely to be elevated within their organization to replace them. But we anticipate that on average, these replacements will be lower-quality than their predecessors. We thus predict that the loss of leaders will be associated with the degradation of terrorist organizations; specifically, in their ability to organize and produce violent attacks in the short term. This logic implies Hypothesis 3:

H3: All else equal, drone strikes that kill one or more terrorist leader(s) will lead to a decrease in terrorist violence.

Based on the contradictory arguments and findings in the literature, however, we cannot dismiss the possibility that killing terrorist leadership might have a counter-productive effect. We thus elaborate Hypothesis 4:

H4: All else equal, drone strikes that kill one or more terrorist leader(s) will lead to an increase in terrorist violence.

3.3 Spatial and Temporal Effects

3.3.1 Spillover Effects: Do Drone Strikes Divert Terrorist Violence?

Another possibility is that drone strikes disrupt terrorist activities in their FATA strongholds by diverting militants to other areas where these activities can be continued.

As a counterintelligence strategy, terrorists may move into rural or urban areas with terrain favorable to avoiding drone surveillance or targeting.

Rural areas—especially ones with rugged, mountainous terrain or heavy tree cover—have long offered favorable geography for insurgencies (Fearon and Laitin 2003: 76, 85). They may also provide a measure of protection from drones. Urban areas might offer terrorists human camouflage, enabling them to blend into the population and limiting the U.S.' ability to conduct lethal targeting due to concerns about civilian casualties (NYU/Stanford 2012).

This theory implies that drone strikes in FATA might increase militant violence in rural or urban areas. In documents captured from Osama bin Ladens compound in Abbottabad, Pakistan—itself an urban area outside of Islamabad, where the al-Qaida leader had been hiding for years—bin Laden advised al-Qaida members there to move to Afghanistan's Kunar province for protection from U.S. drones: "Kunar is more fortified due to its rougher terrain and many mountains, rivers and trees, and it can accommodate hundreds of the brothers without being spotted by the enemy," wrote bin Laden. "This will defend the brothers from the aircraft" (Bin Laden 2010). Other militants have taken refuge in urban areas to elude drone targeting. [12] Dozens of al-Qa'ida and Afghan Taliban have been arrested in Balochistan since 2009, when the drone war in FATA escalated.[13] Importantly, the terrorist groups being targeted have networks and area of operation that straddle the Durand line, and many in the region do not even recognize the British-drawn border (Perlez and Shah 2009). Thus, we should not expect the effect of the drone strikes to be confined to the targeted area.

If drone strikes systematically divert militants to other locations, spatial patterns of observed violence in areas around FATA should increase. This argument implies the following hypothesis:

H5: All else equal, drone strikes increase militant violence in neighboring areas.

However, it is also possible that drone strikes reduce the capacity of targeted terrorist groups to operate in nearby areas of Pakistan and Afghanistan. In fact, one

[12] See, for instance, a report in *The Times*, dated August 8, 2009 (Hussain 2009).

[13] These statistics came from an assessment by the Institute for Conflict Management, a South Asian think tank, based primarily on reporting from Pakistani newspapers. It was accessed online at `http://www.satp.org/satporgtp/countries/pakistan/Balochistan/index.html`. Last accessed on June 10, 2013.

of the objectives of the drone program is to protect the U.S. forces across the border in Afghanistan (Shah 2014). This motivates the following hypothesis:

H6: All else equal, drone strikes decrease militant violence in neighboring areas.

3.3.2 How Long Does the Effect of a Drone Strike Last?

Finally, there is a question about drone strikes' short-term versus long-term effects. The effect of drone strikes on terrorist behavior may be short-lived or long-lasting. This is an empirical question.

These contrasting possibilities generate two additional hypotheses:

H6: Drone strikes have an extended violence-reducing effect.

H7: Drone strikes have an extended violence-increasing effect.[14]

4 Empirical Strategy

In this section, we describe our methodology for evaluating the effects of drones. Our study spans from January 2007 through September 2011. We analyze how drone strikes in the FATA region of Pakistan affect militant violence both in FATA and in other parts of Pakistan and neighboring areas of Afghanistan.

We use the agency-week as our unit of analysis. Agencies in FATA are akin to districts in many other countries. There are seven FATA agencies: Bajaur, Khyber, Kurram, Mohmand, North Waziristan, Orakzai and South Waziristan. Conducting analysis at the agency level enables us to estimate the average effect of drone strikes, conditional on unobserved time-invariant agency-specific effects.[15] FATA's seven agencies did indeed suffer varying levels of violence in the years studied.[16]

[14]For both hypotheses, "extended" is defined as longer than one week.

[15]Time-invariant cross-agency variation in FATA includes factors such as physical terrain, location relative to key logistics hubs, and tribal demographics.

[16]Although the first documented drone strike in FATA occurred in June 2004, our analysis focuses primarily on events between early 2007 through late 2011. Through the end of 2006, only six drone strikes were reported. The number of strikes in 2007—five—nearly equaled the number that had

By controlling for these agency-specific trends and secular time trends in violence, our results offer plausibly unbiased estimates of drone strikes' causal effect on terrorism in FATA.[17]

Our empirical approach also includes spatial panel data analysis. Analysts have posited that drone strikes may lead terrorists to relocate their bases and activities away from the areas where drone strikes are common. A positive relationship between drone strikes and increases in terrorist attacks outside the locations of the drone strikes would be consistent with this argument. We provide a systematic test of this hypothesis by analyzing whether drone strikes are associated with militant violence in areas neighboring struck agencies. These area include territory not only in Pakistan but also in eastern Afghanistan, as drone strikes occur in Pakistani territory near the Afghanistan-Pakistan border, across which militants associated with jihadi movements in both countries move. To operationalize this test, we increase the radius of "neighborhoods" in our spatial analysis from 25 km to 150 km in increments of 25 km. [18] This approach enables us to avoid arbitrary assumptions about the specific distance from struck agencies on any "spillover" effect on terrorist violence, and instead

been conducted in the entire previous history of the war. This number would increase dramatically in the following years, peaking in 2010 at 122 and declining to 73 and 48 in 2011 and 2012, respectively. Temporal variation in drone targeting at the local level during the period under study is an important part of our identification strategy. Likewise, 2007 is also an ideal starting point because, unlike in previous years when levels of violence in the region were fairly flat, there was significant variation in militant violence starting in 2007—both across agencies and in FATA overall—due to conflict escalation largely unrelated to drone strikes. Our data allow us to trace this violence to particular locations and times, giving us some ability to assess possible endogeneity in the statistical results.

[17]We chose the agency-level for substantive reasons: more than any other administrative or tribal boundaries, agencies are the administrative units that correspond with the geographic distribution of militant groups across FATA. Historically, the territory corresponding to each of these agencies has constituted a relatively small yet distinct geo-political and socio-cultural unit. This was reflected in the British approach towards the region and provided the basis for the current agency boundaries (see, for instance, An old Punjaubee (1878), published presumably by a British officer under a pseudonym). Today, shared ethnic and clan ties, which vary across agencies but display relative homogeneity within them, influence the likelihood of a given militant group operating primarily within a given agency. Thus, *Lashkar-e-Islami* led by Mangal Bagh is primarily influential among the *Afridi*-dominated Khyber agency and the *Tehrik-i-Taliban Pakistan* leader Hafiz Gul Bahadur's dominance has remained confined to the *Utmanzai Wazir*-dominated North Waziristan. On variation in militant organizations across FATA agencies, see, for example, Nawaz (2009); Gul (2010); Fishman (2010).

[18]The average radius of a FATA agency is 32 kilometers. See Table B-2 in Appendix B.

to evaluate a broad range of possibilities and test whether there is any evidence of such a trend at any plausible distance. [19]

4.1 Identifying Assumptions

Our empirical strategy is motivated by the fact that the week-to-week timing of drone strikes in FATA's agencies is subject to a range of quasi-random factors.

This is because, in practice, it appears that the ability of the U.S. to conduct drone strikes depends on several plausibly exogenous weather, bureaucratic, and technological factors discussed below. Each factor can delay a drone strike from happening when a drone's pilot has a clean shot at a designated target. When combined, these factors suggest that it is highly likely that the occurrence of any given drone strike in a given FATA agency in a given week is quasi-random.

This quasi-random treatment assignment gives us a high level of confidence in interpreting the estimates of relationship between drone strikes and terrorist attacks, using time-series cross-sectional regression analysis with agency and week fixed effects, as causal.

First, weather patterns play a significant role in drone operators' ability to identify and strike targets, for example, introducing a random component into the timing of a given drone strike. Importantly, there is direct evidence in documents that were captured from senior al-Qa'ida leadership in multiple theaters of operation that they were aware of these factors (Lahoud 2012; Associated Press 2013). [20]

This is consistent with information from the U.S. sources that "cloudy days"

[19] To be sure, any single observed statistically significant effects from this approach could themselves be statistically "insignificant," (Gelman and Stern 2006) due to the relatively large number "neighborhood" sizes analyzed empirically. On the other hand, however, an advantage of our non assumption-based approach is that if we see a common trend through a series of distance measures, it would increase the credibility of the hypothesis that drone strikes do, on average, lead to spillover violence in Pakistan and Afghanistan.

[20] Recently declassified al-Qa'ida documents show, for example, that Osama bin Laden once advised operatives not to move from their safe houses on clear days. See "Letter dated 7 August 2010 from 'Zamarai' (Osama bin Ladin) to Mukhtar Abu al-Zubayr," SOCOM–2012–0000015-HT," May 2012, pp. 2–3.

obscure satellites and make it more difficult to view objects on the ground and hinder operations

(Tilford 2012). [21] Second, drones are a scarce commodity and are in high demand. The availability of drones in FATA—whether for intelligence, surveillance, and reconnaissance missions or for lethal targeting itself—varies with changing ISR requirements in other theaters in which the U.S. conducts counterterrorism missions. [22] Third, it is important to know that not all drones are weaponized. A non-weaponized drone covering an area where a high-value target is found will have to request for fire support from manned or unmanned aircraft or a ground element, increasing the chances that the target will "lose the tail" before a strike element can be deployed against the target.[23] Fourth, bureaucratic and logistical factors as mundane as the work schedules of key lawyers and decision-makers in the United States, who are required to provide legal counsel and authorization before a strike can occur, might affect the timing of strike (Radsan and Murphy 2009). Fifth, the timing of when a known terrorist presents drone operators with a clean shot is likely to be random on a week-to-week basis. As such, the treatment could plausibly occur in the preceding or following agency-week as in the current one, making weekly comparisons of differences in militant violence across agencies and weeks using panel-data econometric estimation a credible means of causal identification. [24]

Finally, a key to identification based on any of these factors is to make the unit-of-analysis temporally small. As the temporal unit of aggregation increases, the validity of the identifying assumption goes down because the longer the window, the less that

[21]For a detailed analysis of the bin Laden documents, see Lahoud (2012: 32, 46-47).

[22]This could depend on one's definition of a terrorist. For example, ISR coverage might be more likely to be withdrawn from an individual who is less well-known and thus is a lower priority for U.S. counterterrorism officials than a higher-value individual, such as a known al-Qa'ida cell leader. For examples, see Miller (2010); Entous (2010).

[23]Author interview with a United States Air Force drone pilot, December 2013.

[24]It is likely that an identified militant is purposefully surveilled over an extended period of time in the belief that the militant's "pattern of life" might lead him to reveal the locations of other militants in his network, which lends a high degree of certainty to the timing of the strike. See Flynn, Juergens and Cantrell (2008).

factors like the ones described above will matter, consequently reducing confidence that the relationship identified is causal. We exploit incident-level data by aggregating it into relatively narrow windows in which plausibly random variation can be observed in order to better identify the causal effect of drone strikes on terrorism.

4.2 Estimation

In the analysis presented below, we estimate two-level fixed-effect (2FE) models with both agency and temporal (week) fixed effects and a spatial lag of drone strikes (2FESL).[25] Fixed-effects regression is a standard econometric approach to panel data analysis. [26] Letting i denote the cross sectional index (FATA agencies) and t the time index (weeks), a two-level fixed effect equation is given by

$$y_{it} = \alpha_i + \beta x_{it} + h_t + \epsilon_{it} \tag{1}$$

where y measures the incidence of terrorism, x is the number of drone strikes, α_i are unobserved agency fixed effects, and h_t are time (week) fixed effects.

Agency fixed effects account for all the time-invariant differences between agencies, such as terrain and elevation, which could otherwise confound cross-sectional analysis. In practice, the fixed effects are included to control for unobserved factors that might vary by agency, as well as secular quarterly trends in levels of conflict violence. Week fixed effects allow us to control for time-specific differences such as heavy snow, flooded terrain, natural disasters, and religious festivals, which could potentially determine combatant activity. In addition to the fixed-effects regressions described above, we also estimate models that include a spatial lag. Phillips and Sul (2003, 2007) have

[25]The spatial lag in spatial econometrics is equivalent of the temporal lag in time-series analysis. It is the value of the dependent variable for the unit(s) that constitute(s) the space of the observation under consideration, which in this article is formed by all agencies or districts in Afghanistan and Pakistan falling within a certain distance from the centroid of the agency under consideration.

[26]See especially Wooldridge (2002); Angrist and Pischke (2009).

shown that cross-sectional dependence may cause panel OLS estimates to be biased and inconsistent. Including a spatial lag enables us to directly model cross-sectional dependence in the regression.[27] A spatial lag model with two-level fixed effects (2FESL) assumes the following form

$$y_{it} = \alpha_i + \rho \sum_{j \neq i} w_{ij} y_{jt} + \beta x_{it} + h_t + \epsilon_{it}. \quad (2)$$

where ρ is the spatial autoregressive coefficient, which measures the general strength of spatial dependence, w_{ij} is an element of the spatial weight matrix reflecting the degree of connection between two units i and j, y_{jt} is the measure of militant violence for unit j during time period t, x_{it} is the number of drone strikes in unit i at time t, α_i are unobserved agency-specific effects, and h_t are weekly time effects.

4.3 Data and Variables

To examine the effect of drone strikes, we combined detailed data on US drone strikes in FATA originally compiled by researchers at the New America Foundation (NAF) (Bergen and Tiedemann 2011) with incident-level data on terrorist activities in FATA during the same time period compiled in the National Counterterrorism Center's (NCTC) Worldwide Incidents Tracking System (WITS) National Counterterrorism Center (2012) and incidents of militant violence against tribal elders compiled by the South Asia Terrorism Portal (SATP).[28] Incidents from each data source were georeferenced according to the reported locations of the incidents in the media accounts used to track and cross-reference each drone strike and militant attack.

The NAF data on drone strikes include information on the incidence, date, and

[27]See, for instance,Franzese and Hays (2007). We also performed the Pesaran cross-sectional dependence (CD) test on the residuals of the estimated models. See Pesaran (2007). The results of the CD test are available upon request.

[28]The SATP data were accessed online at `http://www.satp.org/satporgtp/countries/pakistan/database/Tribalelders.htm`. Last accessed June 15, 2013.

location of each strike, the high and low estimates of fatalities that have occurred in each strike, deaths of militant leaders in drone strikes, and the sources of information that were used to compile each summary. The data were compiled from reports in reputed international and Pakistani news media sources. While we cannot be certain that the NAF data accounts for every single drone strike in FATA, we do believe that the likelihood of Pakistani news media underreporting these strikes during the period covered by this analysis (2007–2011) has declined drastically since late 2006 when the program began eliciting increased public scrutiny in Pakistan. [29] Moreover, increased public scrutiny and the operational necessity of naming successors by terrorist groups should help dispel some of our concerns about the reported counts of senior leaders killed in drone strikes.

The WITS database uses fairly standard criteria in coding incidents as terrorist attacks. To be included as a terrorist attack in the WITS database, activities were required to be "incidents in which sub-national or clandestine groups or individuals deliberately or recklessly attacked civilians or non-combatants, including military personnel and assets outside war zones" (National Counterterrorism Center 2012). Moreover, attacks have to be initiated and executed by non-state militants. Spontaneous violence, hate crimes, and genocides are excluded from the database. The data is gathered using both English and foreign language open sources and relies on both humans and computers in the process of coding incidents of terrorist attacks. The WITS data provide the most comprehensive available coverage of terrorist attacks worldwide from 2005, when filters restricting the coverage to "international" and "significant" events were removed, through 2011, when NCTC stopped publishing

[29] The drone program attracted relatively little public attention until 2007, and Pakistani and U.S. government officials did not acknowledge the existence of the program during this period. Even in response to a January 2006 strike that allegedly targeted at Osama bin Laden's deputy, Ayman al-Zawahiri, a Pakistani foreign ministry official contended that "in all probability the strike was launched from across the border, in Afghanistan" (BBC News 2006). It was not until November 2006 that the then Pakistani Prime Minister Shaukat Aziz cautiously acknowledged a "fare element of truth" to the allegations surrounding the source of the January 2006 strike. The transcript of Aziz's interview with CNN is available at `http://transcripts.cnn.com/TRANSCRIPTS/0611/12/le.01.html`.

WITS.

Using data that focuses on terrorist incidents—violence against civilian rather than military targets—is justifiable for both theoretical and empirical reasons. Theoretically, Kalyvas (2006) argues that the combatants are likely to target civilians selectively in their zones of control as a result of real or perceived spying by civilians. A similar narrative is often used to describe militant responses to drone strikes in FATA: militants believe drone strikes are the result of informant betrayal, and thus target suspected informants (Bennett 2011). Along these lines, tribal elders—-typically associated with a local incumbency—have been cited as particularly common targets (Fishman 2010). We use data on militant attacks on tribal elders in Pakistan from 2005 through 2011 compiled by SATP. [30] The inclusion of this variable is warranted by the suggestion that drone strikes increase attacks on tribal elders whom militants suspect of collaborating with U.S. or Pakistani military or intelligence services.

Table 2 summarizes the variables and data sources used in our analysis. We focus on drone strikes and four key measures of terrorist activity. Our data set contains information on the following variables at the agency-week level:

- UAV: The number of drone strikes in a given agency and week.
- HVI: The number of "senior leaders" killed by drone strikes in a given agency and week.
- Incidents: The number of militant incidents or attacks in a given agency and week.
- Lethality: The number of dead and wounded in terrorist incidents or attacks in a given agency and week.
- Attack on Tribal Elder(s): The number of militant attacks against tribal elders in a given agency and week.

[30] The SATP data were compiled from open-source media reports, primarily from south Asian sources, by the Institute of Conflict Management, New Delhi.

Table 2: Summary Statistics: FATA & Neighborhood

Variable	FATA				Neighborhood				Afghanistan				Pakistan			
	Mean	S.D.*	Min.	Max.	Mean	S.D.*	Min.	Max.	Mean	S.D.*	Min.	Max.	Mean	S.D.*	Min.	Max.
UAV	0.153	0.605	0	8	–	–	–	–	–	–	–	–	–	–	–	–
HVI	.0231	0.181	0	3	–	–	–	–	–	–	–	–	–	–	–	–
Incidents	0.880	1.333	0	13	0.183	0.732	0	17	0.681	3.044	0	77	1.824	5.500	0	91
Lethality	2.777	14.019	0	285	0.689	6.759	0	361	2.148	21.982	0	1305	7.696	61.135	0	2219
Attacks on Tribal Elders	0.013	0.112	0	1	–	–	–	–	–	–	–	–	–	–	–	–
Number of Observations	1729				50822				37791				13091			

* Standard Deviation

4.4 Descriptive Statistics and Graphs

For this study, we constructed an agency-week dataset. The time-series spans the period from January 1, 2007 through September 30, 2011. Descriptive statistics of key variables over this time period are shown in Table 2.

Figures 1–3 illustrate the variation in terrorist attacks and drone strikes over time and space for all of FATA and for its constituent agencies. Figure 1 shows the monthly time trend of drone strikes and terrorist attacks for all of FATA from 2007 through September 2011. Militant attacks began trending upward in mid–2007, peaking in early 2009 before declining back to roughly mid–2007 levels by Fall 2011. Drone strikes (left axis) were relatively rare until Fall 2008—before August 2008, when four strikes were conducted, there had never been more than one strike in a month. At the agency level, Figure 2 shows that North Waziristan closely mirrors the macro trend, with trends fluctuating more in South Waziristan and Khyber while being relatively rare elsewhere in FATA.[31].

[31] Separate summary statistics for North and South Waziristan are presented in Table B–1 in Appendix B

Figure 1: Time Trends in Drone Strikes and Terrorist Attacks

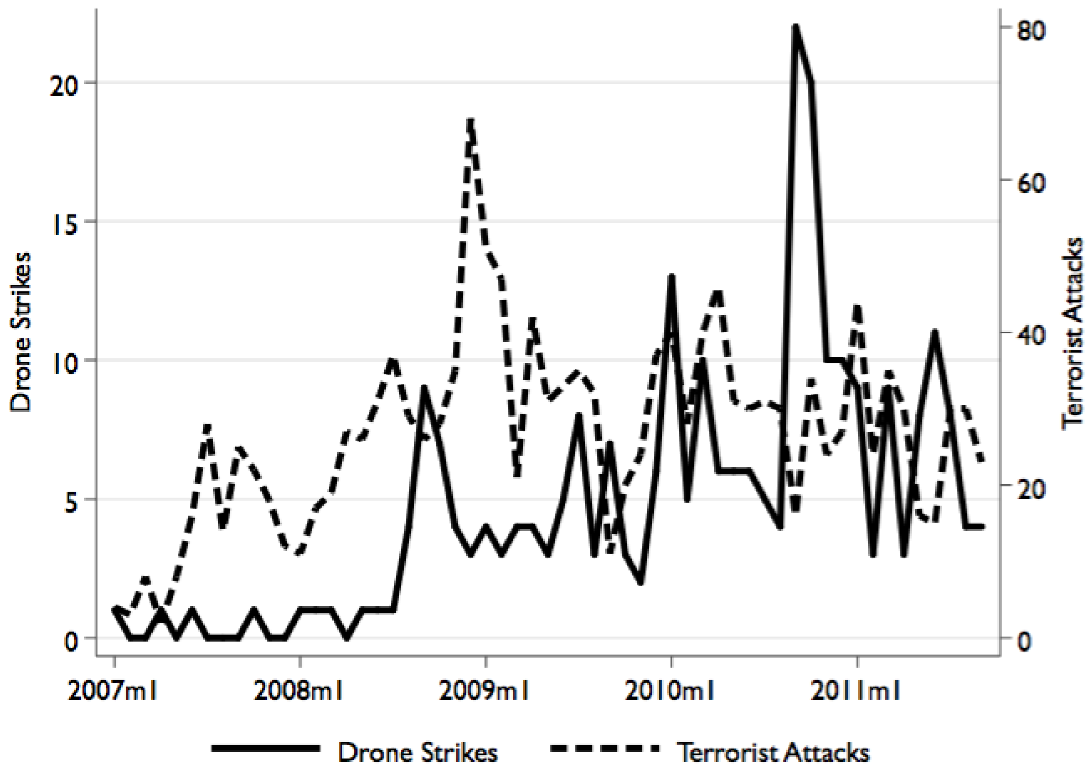


Figure 2: Time Trends in Drone Strikes and Militant Attacks by Agency

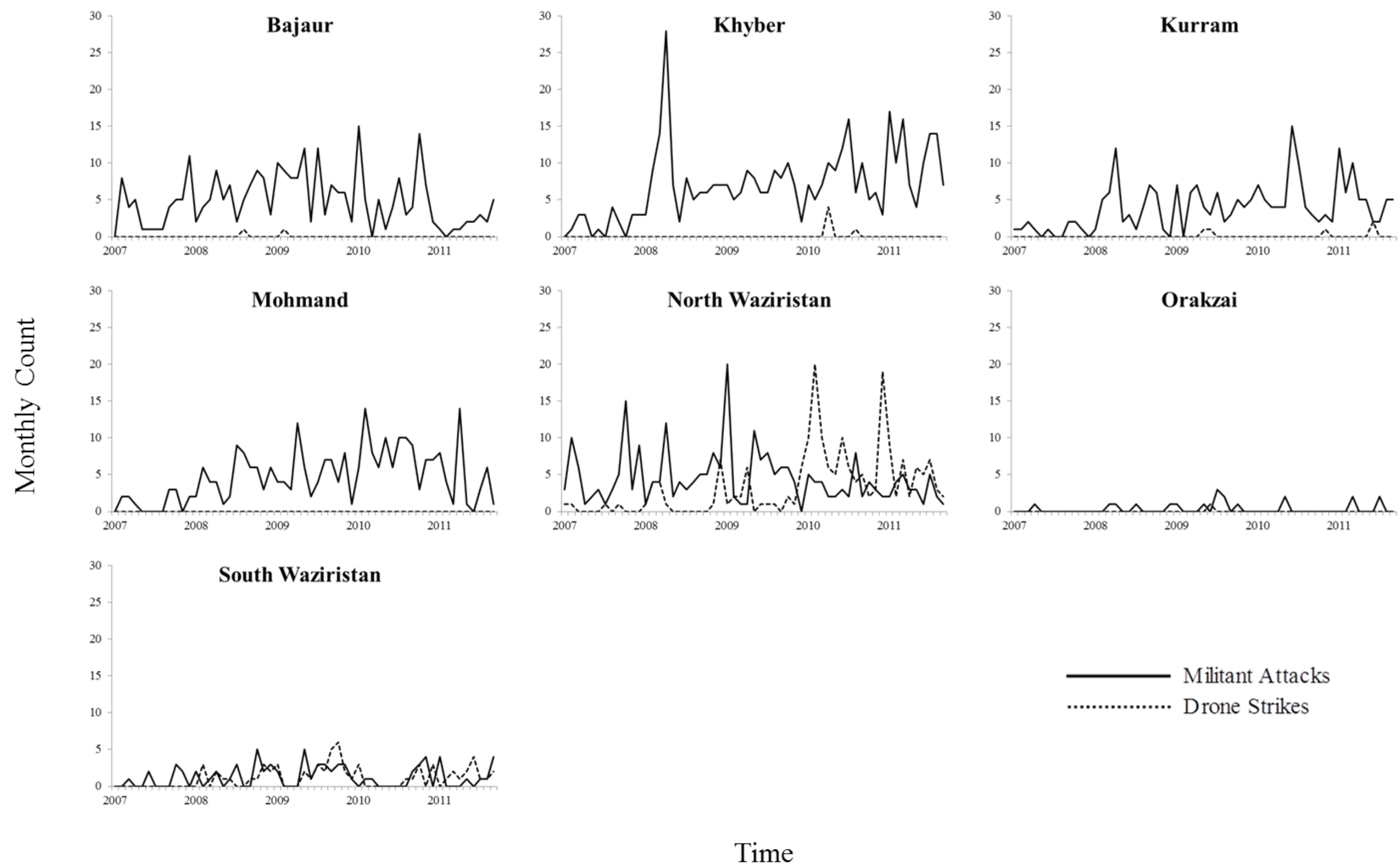
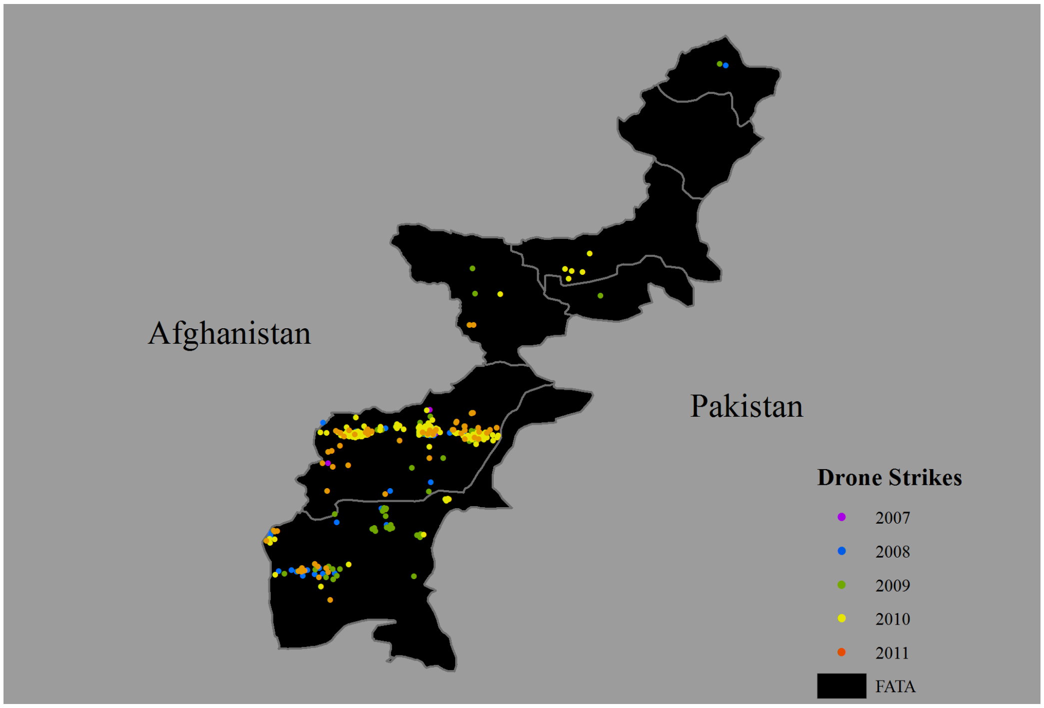
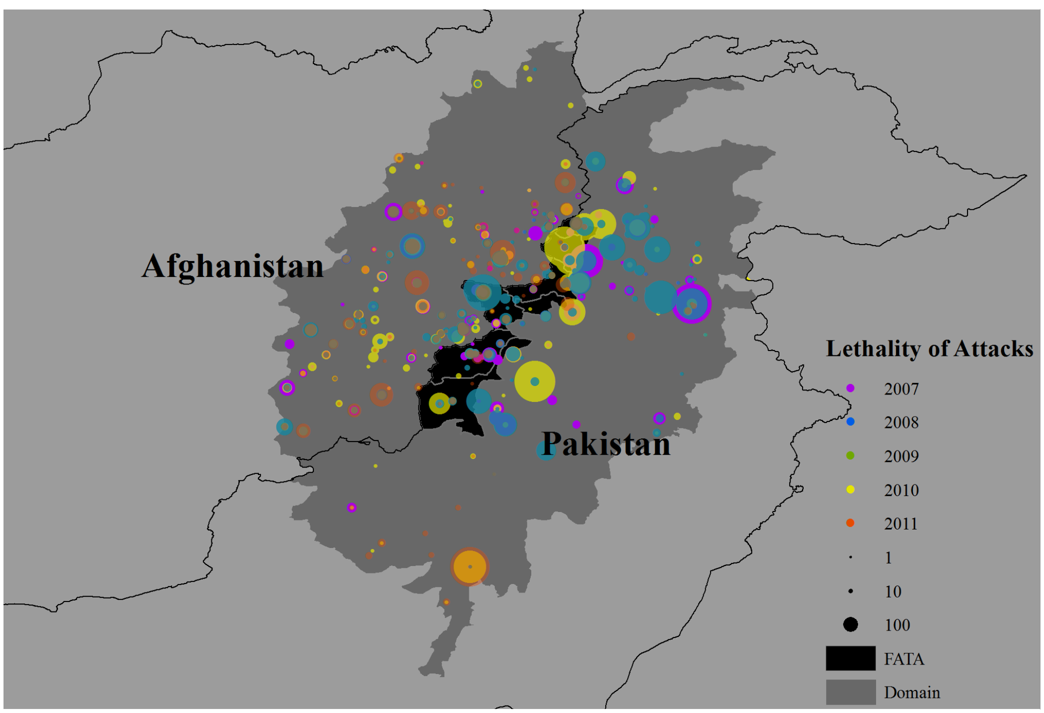


Figure 3: Drone Strikes & Militant Attacks in FATA & its Neighborhood

(a) Drone Strikes



(b) Location & Lethality of Militant Attacks



In the statistical analysis presented in the next section, all measures of terrorist violence have been normalized using agency and district population to create a series representing the number of violent incidents per 1000 residents. Our rationale for normalizing the data by population is that the cross-agency population variance likely influences levels of terrorist activity for reasons unrelated to drone strikes. Eliminating this variance should thus enhance our ability to draw inferences from our statistical results. The population figures for Pakistan are from the 1998 census and the figures for Afghanistan are from the estimates for 2006 published by the Central Statistics Office.

5 Empirical Results

Have drone strikes increased or decreased terrorist violence? A cursory look at the data might suggest the former: As Figure 1 shows, violence rose from 2007 until 2009 and was as high in September 2011, when our time-series ends, as in any year since 2007. Yet Figure 1 also shows that the rise of drone strikes appears to have been a response to a deteriorating environment in which terrorist violence was increasing dramatically. It is thus plausible that the drone wars escalation occurred as a result of real and anticipated increases in terrorist violence. Given the upward trend in terrorist violence prior to the escalation of the drone campaign, and the observed variation in terrorist attacks across agencies, the use of both week- and agency-fixed effects mitigates the confounding impact of both secular time trends in terrorist violence and agency-specific differences. We use these within regressions to estimate the average effect of drone strikes within agencies over time. [32]

[32] As a robustness test, we also ran regressions using a series of model specifications including ordinary least square (OLS) and involving temporal lags, spatial lags, and first-differences, both with and without fixed effects. We also conducted two panel unit-root tests, the Breitung and Pesaran tests, which both allow for cross-sectional dependence (Breitung and Pesaran 2008; Pesaran 2007). Results of these tests are available on request.

5.1 Disruption

Table 3 presents both the 2FE and the 2FESL estimates of drone strikes on three measures of militant violence. The spatial lag included in the 2FESL models measures the value of our dependent variables in the districts falling within 75 km of the centroid of the agency in which strikes occurred. The 2FE and 2FESL estimates are similar. However, overall, the model fitness statistics suggest the use of 2FESL specification. [33] We thus use 2FESL estimates to calculate the substantive effects of drone strikes.

Table 3: Drone Strikes and Terrorist Violence: 2FE & 2FESL Estimates

	Without Spatial Lag (2FE)			With Spatial Lag (2FESL)		
	Incidents	Lethality	Attacks on Elders	Incidents	Lethality	Attacks on Elders
UAV	-0.049***	-0.237***	-0.001*	-0.049***	-0.241***	-0.001*
	(0.012)	(0.099)	(0.001)	(0.012)	(0.099)	(0.001)
Constant	-0.016	-0.019	0.004**	-0.017	-0.073	0.004**
	(0.046)	(0.201)	(0.002)	(0.046)	(0.203)	(0.002)
Observations	1729	1729	1729	1729	1729	1729
R-squared	0.316	0.143	0.165	0.317	0.152	0.181
AIC	635.860	9231.835	-7410.452	636.854	9216.791	-7442.537
BIC	2021.506	10617.480	-6024.806	2027.955	10607.890	-6051.436

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

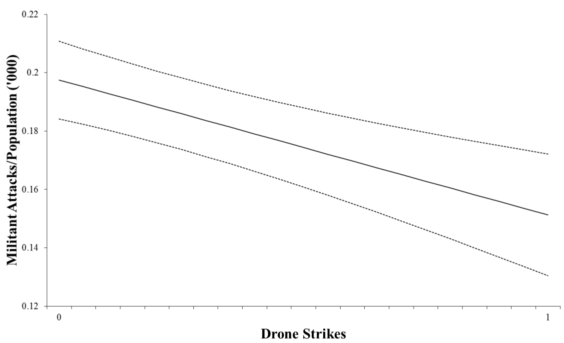
To test Hypotheses 1 and 2, we examine three different measures of militant violence: the frequency of attacks, the lethality of attacks, and the number of attacks on tribal elders. The results, which are presented in Table 3, do not support Hypothesis 1—that drone strikes are associated with increased terrorism. On the contrary, they support our thesis, Hypothesis 2: Drone strikes are associated with a decrease in militant violence. We find no evidence in support of the competing hypothesis (Hypothesis 1)—that drone strikes increase violence. These substantive effects of drone strikes on these measures of militant violence are presented in Figure 4.

The 2FESL estimate in column 4 of Table 3 show that drone strikes are associated

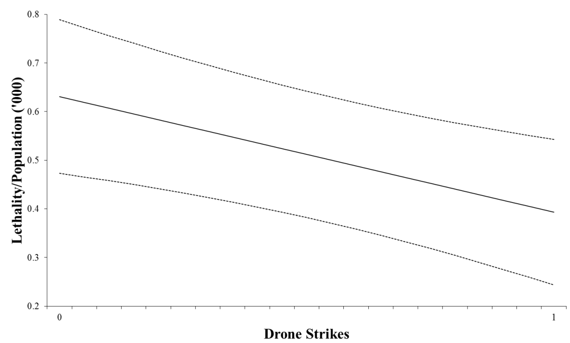
[33] The model fitness statistics used are the Akaike information criterion (AIC) and the Bayesian information criterion (BIC).

Figure 4: Substantive Effect of Drone Strikes

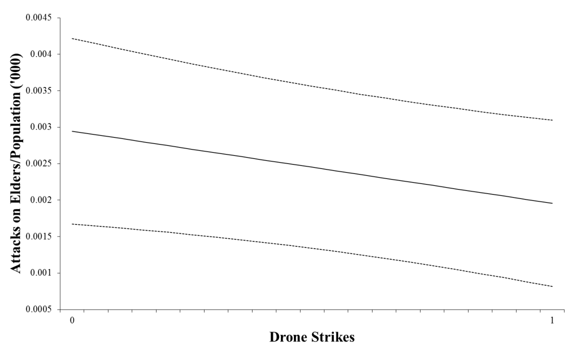
(a) Militant Attacks



(b) Lethality



(c) Attacks on Tribal Elders



Note: All plots with 95 percent confidence interval.

with an average decrease in militant attacks of almost 5 percentage points. This result is statistically significant at the one percent level. From 2007 through 2011, the average agency suffered roughly 0.88 militant attacks per week. During weeks in which a drone strike occurred, agencies suffered an average of about 0.68 attacks.

These findings differ from results in Lyall (2014), who finds a statistically significant and positive relationship between air strikes and insurgent attacks in Afghanistan. However, both our dependent and independent variables are different from those used in Lyall (2014). In Lyall's study, the independent variable is air strikes—not just drone strikes.[34] His dependent variable is "insurgent-initiated" attacks against the International Security Assistance Force. Insurgent-initiated attacks do not include attacks on civilians—the focus of the present analysis. The dynamics of interaction between the warring parties is different in the two contexts. In FATA, where during the period under consideration Pakistani military operations were limited and the US military presence all but absent, opportunities to target the counterinsurgent forces were comparatively few. The option of maintaining reputation, the key mechanism put forward by Lyall (2014), is largely unavailable to the FATA militant groups. It is possible that they try to salvage their reputation by targeting counterinsurgent forces in their proximate "neighborhoods"—a question we examine below.

Our findings also run counter to the implications of recent survey-based findings, which suggest that the harm inflicted by drone strikes on the civilian population has led to increased support for insurgents (Lyall, Blair and Imai 2013) or led to increased anti-Americanism (Kaltenthaler, Miller and Fair 2012). This is consistent with the radicalization mechanism underlying our hypothesis 1 discussed in Section 3.1. However, we did not find any observable evidence that supports this implication. Our findings suggest that the linkage between increased support for counterinsurgent

[34]When he runs his analysis with drone strikes as the explanatory variable, (Lyall 2014) finds the relationship between drone strikes and insurgent attacks to be statistically insignificant in five of six models. The coefficient, however, remains positive.

or increased anti-Americanism, on the one hand, and terrorist attacks (or recruitment), on the other, is likely more complicated than usually hypothesized. The relationship is likely contingent on other factors such as the ability to operate without constant surveillance, likelihood of being killed (calculus of survival), presence of alternative modes of opposition, or other locally-specific factors. Sympathy for a cause or public anger at counterterrorist actions may not necessarily translate into the collective action necessary to observe an increase in active participation in militant activities that results in an escalation of terrorist attacks.

Given that drone strikes are associated with reductions in militant attacks in the areas where they occur, we also expect drone strikes to be negatively associated with the lethality, or "quality," of militant attacks in these same areas. [35] This is indeed the case. Consistent with Hypothesis 2, the estimate presented in column 5 of Table 3 suggests that the lethality of militant attacks declined by an average of nearly 25 percentage points in a given week in which a drone strike occurred. On average, 2.77 people were killed or injured in militant attacks in FATA between 2007 and the end of the third quarter of 2011. This figure would decline substantially to 1.73 per week as a result of a single drone strike if the number of drone strikes would increase by one per agency-week. [36]

On balance, the results shown in Table 3 provide strong support for Hypothesis 2: Drone strikes were associated with a decline in local militant violence in FATA from 2007–2011. The evidence is consistent with observable implications of a "disruption" mechanism, suggesting that the threat to militants posed by drone strikes inhibits insurgent and terrorist groups from conducting operational activities at the same rate

[35] On the quality of terrorism, see Bueno de Mesquita (2005); Benmelech, Berrebi and Klor (2012).

[36] It is important to note that the estimate of decline in lethality of militant attacks is based on an assumption of a constant linear relationship–an assumption that may or may not be correct. The predicted decline is probably an overstatement of the impact drones could realistically have, simply because even at the peak of the drone campaign in 2010, when the number of drone strikes was two and a half times larger than the previous year (119 in 2010, versus 53 in 2009), the number of drones per campaign-week in 2010 was 0.33, while it was 0.14 in 2009.

at which they are able to perpetrate such activities in the absence of drone strikes.

5.2 Degradation

Given that killing terrorist leaders or HVIs in terrorist organizations is the purpose of drone strikes, we evaluate whether patterns of militant attacks differ following strikes in which a militant leader was killed. Table 4 displays the results of tests of Hypotheses 3 and 4, based on four of the outcomes assessed in Table 4. The results shown in Table 4 are based on the same 2FESL estimation technique used in Table 3. [37] The results are largely consistent with Hypothesis 3—that drone strikes that result in the death of a militant leader are associated with a decrease in militant violence. [38]

Table 4: Militant Leaders Killed and Militant Violence: 2FE & 2FESL Estimates

	Without Spatial Lag (2FE)			With Spatial Lag (2FESL)		
	Incidents	Lethality	Attacks on Elders	Incidents	Lethality	Attacks on Elders
UAV	-0.043***	-0.232***	-0.001*	-0.043***	-0.234***	-0.001
	(0.012)	(0.104)	(0.001)	(0.012)	(0.103)	(0.001)
HVI	-0.070***	-0.062	-0.001	-0.068***	-0.071	-0.001
	(0.026)	(0.002)	(0.131)	(0.026)	(0.134)	(0.002)
Constant	-0.016	-0.019	0.004**	-0.017	-0.074	0.004**
	(0.046)	(0.201)	(0.045)	(0.002)	(0.202)	(0.002)
Observations	1729	1729	1729	1729	1729	1729
R-squared	0.318	0.143	0.181	0.318	0.151	0.165
AIC	633.825	9233.814	-7440.687	634.992	9218.761	-7408.524
BIC	2024.926	10624.910	-6044.131	2031.548	10615.320	-6017.423

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

There is little support for Hypothesis 4, which suggested that killing militant leaders has a counterproductive, violence-increasing, effect. Controlling for the number

[37] Like the estimates presented in Table 3, 2FESL estimates in Table 4 are also consistent with the 2FE estimates, which are not included in the table.

[38] We also estimated models with interaction terms between terrorist leaders killed and drone strikes, but the interactions terms were consistently statistically insignificant and model fitness statistics suggested their exclusion from estimation. The coefficient of drone strikes variable retains its sign and statistical significance. These results are available upon request.

of drone strikes per agency-week, the point estimate displayed in column 1 of Table 4 indicates that the death of a senior militant leader in a drone strike was associated with a reduction in the number of militant incidents that occur. This result is statistically significant at the one-percent level. The negative coefficients of the "HVI" variable in columns 2–3 of Table 4 suggest the possibility that removing senior militant leaders was also associated with a decline in militant lethality. However, the results are not statistically significant at conventional levels.[39]

Overall, there is some evidence that key militant leaders do matter for a terrorist organizations ability to conduct operational activities—namely, to conduct terrorist attacks. However, there is only inconclusive evidence that removing key leaders through drone strikes reduced the lethality of the attacks that militants managed to conduct or reduced militant organizations' ability to conduct sophisticated attacks. Nonetheless, along with other evidence from macro-level studies of leadership decapitation, the present results suggest that critics who argue against the efficacy of removing key figures may be overemphasizing the extent to which key individuals can be easily replaced without compromising operational efficiency (Jordan 2009, 2014).

5.3 Diversion

A potential concern with the previous findings is that drone strikes may not actually reduce terrorist violence, but instead displace it. While drone strikes might cause militant activities to decline in the targeted agencies, they may cause an escalation in militant violence in proximate areas if militants move their operations in response to UAV targeting. The concern with spillover effects is not just academic; media reporting points to it as a key policy concern (Rodriguez 2010).

[39] These estimates may be more imprecise than the statistical results suggest, as a result of heterogeneity in the measurement of the HVI variable. Although U.S. government officials consider terrorists targeted by drone strikes target as "senior leaders" or "high-value individuals," the U.S. government has not publicly stated the criteria it uses to identify individual terrorists as senior leaders or HVIs. Available information on individuals identified as leaders killed in drone attacks suggests a degree of heterogeneity.

To assess these claims, we extend the above analysis by estimating the effect of drone strikes beyond the seven FATA agencies in neighboring areas within various distances of agencies where strikes have occurred. To do this, we vary the radius of struck agency's "neighborhood," from 25 kilometers to 150 kilometers, by increments of 25 kilometers. By testing the effect of drone strikes on militant violence in geographic units that expand outward to varying distances, we assess how drone strikes affect militancy beyond specific FATA agencies.

Table 5: Drone Strikes and Neighborhood Militant Violence

	Neighborhood Radius					
Dependent Variable	25 km	50 km	75 km	100 km	125 km	150 km
Incidents	-0.042***	-0.022	-0.009	-0.007*	-0.004	0.002
	(0.010)	(0.010)	(0.006)	(0.004)	(0.004)	(0.003)
Lethality	-0.252***	-0.152*	-0.037	0.081	0.055	0.038
	(0.090)	(0.080)	(0.040)	(0.050)	(0.040)	(0.030)
Observations				1722		

Robust standard errors in parentheses. Coefficient estimates for drone strike (UAV) variable. Intercept estimates not presented.
* p<0.10, ** p<0.05, *** p<0.01

Table 5 presents the results of a test of the spillover hypothesis. Each column in these tables presents estimates of the effect of drone strikes on militant violence in a neighborhood of a particular radius, beginning with a radius of 25 kilometers in column 1 and ending with a radius of 150 kilometers in column 6. In the first two rows of Table 5, we present estimates of the effect of drone strikes on the number of militant attacks in the proximate "neighborhood" of the agency in which drone strikes occurred. The sign of the drone strike estimate is negative up to 125 km and is statistically significant at 25 kilometers and 100 kilometers at the five-percent and ten-percent levels, respectively. The coefficient becomes positive at a radius of 150 km, but the positive coefficients are small and are not statistically significant. The estimates of the effect of drone strikes on militant lethality in similarly-defined "neighborhoods" display a pattern similar to the militant attack estimates, suggesting that militant lethality decreased within a 50-kilometer radius from struck agencies.

Table 6: The Duration of the Effect of Drone Strikes

	Incidents	Lethality	Attacks on Elders
UAV	-0.033***	-0.140	-0.001
	(0.013)	(0.112)	0.001
$UAV_{t\text{-}1}$	-0.013	-0.089	-0.0004
	(0.014)	(0.115)	0.001
$UAV_{t\text{-}2}$	0.0003	-0.088	-0.0001
	(0.015)	(0.123)	0.0009
$UAV_{t\text{-}3}$	0.019	0.047	-0.001
	(0.013)	(0.089)	(0.001)
$UAV_{t\text{-}4}$	-0.017	0.022	0.001
	(0.014)	(0.136)	(0.001)
$UAV_{t\text{-}5}$	-0.021	-0.250*	-0.001
	(0.014)	(0.132)	(0.001)
Constant	0.045	0.954	0.005
	(0.084)	(0.582)	(0.002)
Observations	1694	1694	1694
R-squared	0.332	0.153	0.182
AIC	596.198	9074.26	-7246.743
BIC	1992.954	10471.02	-5855.421

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Overall, the evidence suggests that drone strikes not only reduce militant violence in the local agencies in which they are conducted, but also in proximate areas, to varying degrees depending on the outcome of interest. There is no conclusive evidence that drone strikes cause violence to spill over into neighboring areas. As such, there is no evidence that drone strikes have a "whack-a-mole" effect in which militant violence is pushed to other areas (Long 2014).

5.4 Duration

If the evidence indicates that drone strikes help disrupt and degrade terrorist group operations in Pakistan, a final question is how long drone strikes' violence-reducing effects last.

Using a model that includes five one-week lags of drone strikes, the results in column 2 of Table 6 show a statistically significant and negative relationship between drone strikes that occurred five weeks prior (t–5) and attack lethality (column 2). Moreover, the sign of the coefficients of the drone strikes variable at t–5 are negative for the average number of weekly incidents but are not statistically significant at conventional levels. However, both the sign and significance of the coefficient estimates for each of the dependent variables shown in Table 6 are inconsistent, suggesting that the violence-reducing effects of drone strikes on certain types of militant activities might last as long as five weeks, but that noise and additional unobservable variation associated with the lagged variables makes it difficult to make definitive claims about the duration of drones' violence-reducing effects. [40] As opposed to the results presented in Table 3, which were both more conclusive and also consistent with theoretical predictions, these results indicate a greater possibility that the statistically-significant negative relationships observed in Table 6 resulted from chance. Thus, the results shown in Table 6 provide only limited support for Hypothesis 6. Additional study of the duration of drone strike effects on militant behavior is needed for a clearer understanding of these dynamics.

6 Conclusion

This article offers a systematic analysis of the relationship between U.S. drone strikes and militant violence in northwestern Pakistan and eastern Afghanistan. Our analysis

[40]These inconsistencies are also observed when the tests are extended to areas neighboring targeted agencies. This is not surprising, given the additional unobservables introduced by attempting to evaluate drone strikes' more indirect effects spatially. However, there is some evidence to suggest that the lethality of militant attacks in agencies contiguous to those that were struck declined following a drone strike, and that the effect might have lasted as long as five weeks (Column 2). Still, it remains unclear why a statistically-significant negative effect should obtain in some weeks but not others, particularly for longer lags, such as the five weeks included in our models. These results are available upon request.

suggests that drone strikes are negatively associated with various measures of militant violence, both within individual FATA agencies and their immediate neighborhoods. As should be expected, our findings show that the results presented in this study of the effects of drone strikes on militant behavior, albeit strong, are primarily contemporaneous, and there is only limited evidence of their persistence over longer periods of time. Such a temporal dynamic may explain the U.S.' persistent use of drone strikes in militant strongholds in the Tribal Areas of northwestern Pakistan and southern Yemen, suggesting the possibility that persistent counterterrorism pressure needs to be applied against militant organizations to counter their cycles of violence effectively.

Nonetheless, the plausible exogeneity of the week-to-week timing and location of drone strikes, as discussed earlier, suggests that these findings can be plausibly interpreted as causal. Despite the econometric techniques used to mitigate selection bias in our analysis, caution in inferring causality is necessary due to the possibility of selection bias, which is inherent in any observational study.

Still, our findings provide key support for the hypothesis that new technologies—specifically, remote means of surveillance, reconnaissance and targeting—are able, at least in certain key areas of northwest Pakistan, to disrupt and degrade militants in ways that compensate for an incumbent governments lack of physical presence in these areas, and can consequently limit both the frequency and the lethality of militant attacks. This suggests that new technologies that provide information previously available only to actors with a strong physical presence in a geographic area might be altering conventionally accepted "logics of violence" in civil war (Kalyvas 2006).

The implication of these findings, of course, is that as technology continues to become increasingly sophisticated, warfare is likely to become increasingly "virtual," if not bloodless. Adversaries—not only governments, but also non-state actors such as insurgents, terrorists, and criminal organizations—will adapt their organizational strategies and behavior in an attempt to reduce their vulnerability to state countermeasures, and some are likely to try to leverage new technologies—possibly including drones, whether armed or unarmed—for their own use. Indeed, Islamic State militants in Iraq and Syria have already begun flying small UAVs, both for aerial surveillance and as propaganda that demonstrates the Islamic State's sophisticated capabilities. In the near term, however, powerful states are likely to continue to exploit the technological advantages they currently enjoy. As long as they remain an effective counterterrorism tool, drones are here to stay.

References

Abbas, Hassan. 2014. *The Taliban Revival: Violence and Extremism on the Pakistan-Afghanistan Frontier*. New Haven, CT: Yale University Press.

An old Punjaubee. 1878. *The Punjaub and North-West frontier of India*. London, Kegan Paul.

Angrist, Joshua D. and Jorn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press.

Ashworth, Peter. 2008. "Conceptual Foundations of Qualitative Psychology." In Jonathan A. Smith (Ed.) *Qualitative Psychology: A Practical Guide to Research Methods*. London: Sage Publications, 4–25.

Barton, Sir William. 1939. *India's North-West Frontier*. London: John Murray.

BBC News. 2006, January 6. "'Zawahiri' Strike Sparks Protest." *BBC News*. <http://news.bbc.co.uk/2/hi/south_asia/4613108.stm>. (2012, August 14).

Associated Press. February 21, 2013. "The Al-Qaida Papers – Drones." *Associated Press*. <http://hosted.ap.org/specials/interactives/_international/_pdfs/al-qaida-papers-drones.pdf>.(2013, July 5).

Benmelech, Efraim, Claude Berrebi and Esteban F. Klor. 2012. "Economic Conditions and the Quality of Suicide Terrorism." *The Journal of Politics* 74:113–128.

Bennett, Dashiell. December 29, 2011. "Pakistani Death Squads Target Informants Who Help Drone Attacks." *The Atlantic Wires* . <http://news.yahoo.com/pakistani-death-squads-target-informants-help-drone-attacks html>(2013, June 15).

Bergen, Peter and Katherine Tiedemann. 2011. "New America Foundation Drones Database". <http://counterterrorism.newamerica.net/drones>.(2011, January 02).

Berman, Eli, Jacob N Shapiro and Joseph Felter. 2008. "J. Felter (2008):"Can hearts and minds be bought? The economics of counterinsurgency in Iraq"." *NBER Working Paper* (14606).

Berrebi, Claude and Esteban F. Klor. 2008. "Are Voters Sensitive to Terrorism? Direct Evidence from the Israeli Electorate." *American Political Science Review* 102:279–301.

bib Laden, Osama. August 7, 2010. "Letter from "Zamarai" (Usama bin Ladin) to Mukhtar Abu al-Zubayr." <http://www.ctc.usma.edu/posts/socom-2012-0000005-english>. (April 10, 2013).

Breitung, Jorg and M. Hashem. Pesaran. 2008. "Unit Roots and Cointegration in Panels." *The Econometrics of Panel Data* 45:279–322.

Brown, Vahid and Don Rassler. 2013. *Fountainhead of Jihad: The Haqqani Nexus, 1973-2012*. Oxford, New York: Oxford University Press.

Bueno de Mesquita, Ethan. 2005. "The Quality of Terror." *American Journal of Political Science* 49:515–530.

Byman, Daniel. 2013. "Why Drones Work: The Case for Washington's Weapon of Choice." *Foreign Affairs*. 92:32–43.

Condra, Luke and Jacob N. Shapiro. 2012. "Who Takes the Blame? The Strategic Effects of Collateral Damage." *American Journal of Political Science* 56:167–187.

Crawford, Neta C. 2003. "Just War Theory and the U.S. Counterterror War." *Perspectives on Politics* 1:5–25.

Cronin, Audrey Kurth. 2009. *How Terrorism Ends: Understanding the Decline and Demise of Terrorist Campaigns.* Princeton, NJ: Princeton University Press.

Byman, Audrey Kurth. 2013. "Why Drones Fail: When Tactics Drive Strategy." *Foreign Affairs.* 92:44–54.

Downes, Alexander B. 2007. "Draining the Sea by Filling the Graves: Investigating the Effectiveness of Indiscriminate Violence as a Counterinsurgency Strategy." *Civil Wars* 9:420–444.

Adam Entous, Julian E. Barnes, and Siobhan Gorman. October 2, 2010. "CIA Escalates in Pakistan: Pentagon Diverts Drones From Afghanistan to Bolster U.S. Campaign Next Door." *Wall Street Journal.*

Fair, C Christine. 2005. *Urban Battle Fields of South Asia: Lessons Learned from Sri Lanka, India, and Pakistan.* Santa Monica, CA: Rand Corporation.

Fair, C. Christine. 2010. "Clear, Hold, Build, Transfer: Can Obama's Afghan Strategy Work?". *Asian Affairs: An American Review.* 37:113–131.

Fair, C. Christine. 2012. "For Now, Drones Are the Best Option.". *New York Times.* <`http://www.nytimes.com/roomfordebate/2012/09/25/do-drone-attacks-do-more-harm-than-good/for-now-drones-are-the-best-option`>(2012, December 29).

Fearon, James and David Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *American Journal of Political Science* 97:75–90.

Fishman, Brian. 2010. "The Battle for Pakistan: Militancy and Conflict across the FATA and NWFP." *Counterterrorism Strategy Initiative Policy Paper.* The

New America Foundation. April. <`http://counterterrorism.newamerica.net/sites/newamerica.net/files/policydocs/fishman.pdf`>.(2013, June 15).

Flynn, Michael T., Rich Juergens and Thomas L. Cantrell. 2008. "Employing ISR SOF Best Practices." *Joint Force Quarterly*. 50:51. <`http://stinet.dtic.mil/oai/oai?&verb=getRecord&metadataPrefix=html&identifier=ADA516799`>.

Franzese Jr, Robert J. and Jude C. Hays. 2007. "Spatial Econometric Models of Cross-sectional Interdependence in Political Science Panel and Time-Series-Cross-Section data." *Political Analysis* 15:140–164.

Gambetta, Diego and Steffan Hertog. 2009. "Why are there so many Engineers among Islamic Radicals?." *European Journal of Sociology*. 50:201–230.

Gelman, Andrew and Hal Stern. 2006. "The Difference Between "Significant" and "Not significant" is Not Itself Statistically Significant." *The American Statistician* 60:328–331.

Gesch, Dean B., Verdin, Kristine L. and Greenlee, Susan K. 1999. "New Land Surface Digital Elevation Model Covers the Earth."*Eos, Transactions, American Geophysical Union*. 80: 69-70.

Gray, Christine D. 2000. *International Law and the Use of Force.* New York, NY: Oxford University Press.

Gul, Imtiaz. 2010. *The Most Dangerous Place : Pakistan's Lawless Frontier /*. New York, NY: Viking.

Horowitz, Michael and Dan Reiter. 2001. "When Does Aerial Bombing Work? Quantitative Empirical Tests, 1917-1999." *Journal of Conflict Resolution*. 45:147–173.

Hussain, Zahid and Michael Evans. August 8, 2009. “Drone Attacks in Tribal Pakistan Force al-Qaeda into Urban Areas.” em The Times. <http://www.thetimes.co.uk/tto/news/world/asia/article2611093.ece>. (2013, June 11).

International Crisis Group. 2013. “Drones: myths and reality in Pakistan.” May 21. <http://www.crisisgroup.org/~/media/Files/asia/south-asia/pakistan/247-drones-myths-and-reality-in-pakistan.pdf>

Jaeger, David A. 2009. “The Shape of Things to Come? On the Dynamics of Suicide Attacks and Targeted Killings.” *Quarterly Journal of Political Science*. 4(4):315–342.

Jaeger, David A. and Zahra Siddique. 2011. “Are Drone Strikes Effective in Afghanistan and Pakistan? On the Dynamics of Violence between the United States and the Taliban.” *IZA Discussion Paper No. 6262* .

Jenkins, Brian Michael. 1971. *The Five Stages of Urban Guerrilla Warfare: Challenge of the 1970's*. Santa Monica, CA: Rand Corp.

Johnston, Patrick B. 2012. “Does Decapitation Work? Assessing the effectiveness of Leadership Targeting in Counterinsurgency Campaigns.” *International Security*. 36:47–79.

Jordan, Jenna. 2009. “When Heads Roll: Assessing the Effectiveness of Leadership Decapitation.” *Security Studies*. 18:719–755.

Jordan, Jenna. 2014. “Attacking the Leader, Missing the Mark: Why Terrorist Groups Survive Decapitation Strikes.” *International Security*. 38:7–38.

Kaltenthaler, Karl, William Miller and Christine Fair. 2012. “The Drone War: Pakistani Public Attitudes toward American Drone Strikes in Pakistan.” Presented at the Annual Meeting of the Midwest Political Science Association, Chicago.

Kalyvas, Stathis N. 2006. *The Logic of Violence in Civil War.* New York, NY: Cambridge University Press.

Kilcullen, David. 2013. *Out of the Mountains: The Coming Age of the Urban Guerrilla.* New York, NY: Oxford University Press.

Kocher, Matthew A., Thomas B. Pepinsky and Stathis N. Kalyvas. 2011. "Aerial Bombing and Counterinsurgency in the Vietnam War." *American Journal of Political Science*. 55:201–218.

Krueger, Alan B. 2007. *What Makes a Terrorist: Economics and the Roots of Terrorism.* Princeton, NJ: Princeton University Press.

Nelly Lahoud, Stuart Caudill, Liam Collins, Gabriel Koehler-Derrick, Don Rassler, and Muhammad al Ubaydi. 2012. *Letters from Abbottabad: Bin Ladin Sidelined?* (West Point, NY: Combating Terrorism Center, 2012); Associated Press, "The Al-Qaida Papers – Drones," February 21, 2013. Westpoint, NY:

New America Foundation. 2015. "Drone Wars Pakistan: Leaders Killed." <`http://securitydata.newamerica.net/drones/pakistan/leaders-killed.html`>. (2015, April 24).

King, Gary, Michael Tomz, and Jason Wittenberg. 1998. Making the Most of Statistical Analyses: Improving Interpretation and Presentation. September 7. http://gking.harvard.edu/ preprints.shtml (October 22, 1998).

Long, Austin. 2014. "Whack-a-Mole or Coup de Grace? Institutionalization and Leadership Targeting in Iraq and Afghanistan." *Security Studies* 23:471–512.

Lyall, Jason. 2009. "Does Indiscriminate Violence Incite Insurgent Attacks?: Evidence from Chechnya." *Journal of Conflict Resolution*. 53:331–362.

Lyall, Jason, Graeme Blair and Kasuke Imai. 2013. "Explaining Support for Combatants during Wartime: A Survey Experiment in Afghanistan." *American Political Science Review* 107:679–705.

Lyall, Jason. 2014. "Bombing to Lose? Airpower and the Dynamics of Violence in Counterinsurgency Wars." *Working Paper*. Yale University, New Haven, CT.

Mazzetti, Mark. 2013. *The Way of the Knife: The CIA, a Secret Army, and a War at the Ends of the Earth*. New York, NY: Penguin.

Miller, Greg. October 3, 2010. "Military Drones Aid CIA's Mission." *Washington Post*.
<http://www.washingtonpost.com/wp-dyn/content/article/2010/10/02/AR2010100203965_pf.html>. (2013, April 11).

National Counterterrorism Center. 2012. "Worldwide Incidents Tracking System.". <https://wits.nctc.gov/>. (2011, January 02).

Nawaz, Shuja. 2009. *FATA–a Most Dangerous Place: Meeting the Challenge of Militancy and Terror in the Federally Administered Tribal Areas of Pakistan*. Washington, DC: Center for Strategic and International Studies.<http://csis.org/files/media/csis/pubs/081218_nawaz_fata_web.pdf>.(2011, November 29).

NYU/Stanford. 2012. "Living Under Drones: Death, Injury, and Trauma to Civilians From US Drone Practices in Pakistan." *Technical Report*. International Human Rights and Conflict Resolution Clinic, Stanford Law School and Global Justice Clinic, NYU School of Law.

Pape, Robert A. 1996. *Bombing to Win: Air Power and Coercion in War*. Ithaca, NY: Cornell University Press.

Perlez, Jane and Pir Zubair Shah. May 4, 2009. "Porous Pakistani Border Could Hinder U.S." em The New York Times. <http://www.nytimes.com/2009/05/05/world/asia/05fighter.html>. (2014, November 5).

Pesaran, M. Hashem. 2007. "A Simple Panel Unit Root Test in the Presence of Cross-section Dependence." *Journal of Applied Econometrics*. 22:265–312.

Phillips, Peter C. B. and Donggyu Sul. 2003. "Dynamic Panel Estimation and Homogeneity Testing under Cross Section Dependence*." *The Econometrics Journal*. 6:217–259.

Phillips, Peter C. B. and Donggyu Sul. 2007. "Bias in Dynamic Panel Estimation with Fixed Effects, Incidental Trends and Cross Section dependence." *Journal of Econometrics*. 137:162–188.

Population Census Organisation. 2001. 1998 Census Report of F.A.T.A. Islamabad: Population Census Organization, Statistics Division, Government of Pakistan.

Price, Bryan. 2012. "Targeting Top Terrorists: How Leadership Decapitation Contributes to Counterterrorism." *International Security*. 36:9–46.

Radsan, Afsheen and Richard Murphy. 2009. "Due Process and Targeted Killing of Terrorists." *Cardozo Law Review*. 31:405–450.

Rehman, Zia ur. November 8, 2013. "Leaderless Taliban Bicker Over New Chief." *The Friday Times*. <http://www.thefridaytimes.com/tft/leaderless-taliban-bicker-over-new-chief>. (2014, June 12).

Rehman, Zia ur. February 28, 2014. "Who Killed Asmatullah Bhittani?". *The Friday Times*.

<http://www.thefridaytimes.com/tft/who-killed-asmatullah-bhittani>. (2014, June 12).

Rodriguez, Alex. 2010. "U.S. Concerns Grow as Militants Move Bases Along Pakistan Border." *Los Angeles Times.* <http://articles.latimes.com/2010/nov/07/world/la-fg-pakistan-haqqani-20101108>. (2012, December 29).

Sarbahi, Anoop. 2013. "Determinants of Rebel Recruitment: What Does the Universe of Recruits in an Ethnic Insurgency Tell Us?" *Working Paper*, University of Minnesota, Twin Cities.

Scahill, Jeremy. 2013. *Dirty Wars: The World is a Battlefield.* New York: Nation Books.

Saeed, Shah. 2014. "U.S. Resumes Drone Attacks In Pakistan." *The Wall Street Journal.* <http://www.wsj.com/articles/u-s-resumes-drone-attacks-in-pakistan-1402506903>. (2014, November 5).

Smith, Megan and James Igoe Walsh. 2013. "Do Drone Strikes Degrade al Qaeda? Evidence from Propaganda Output." *Terrorism and Political Violence* 25(2):311–327.

Staniland, Paul. 2010. "Cities on Fire: Social Mobilization, State Policy, and Urban Insurgency." *Comparative Political Studies* 43:1623–1649.

Stanton, Jessica. 2009. "Strategies of Violence and Restraint in Civil War." Ph.D. dissertation. Columbia University, New York.

Taj, Farhat. 2011. *Taliban and Anti-Taliban.* Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Tilford, Robert. March 3, 2012. "Al-Qaedas 'Anti Drone' Tactics Discussed In Bin Laden Letter." *The Examiner*. <http://www.examiner.com/article/al-qaeda-s-anti-drone-tactics-discussed-bin-laden (2013, April 10).

Valentino, Benjamin, Paul Huth and Dylan Balch-Lindsay. 2004. ""Draining the Sea": Mass Killing and Guerrilla Warfare." *International Organization*. 58:375–407.

Walzer, Michael. 2006. *Just and Unjust wars: A Moral Argument With Historical Illustrations*. New York, NY: Basic Books.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

Appendix A: Robustness Tests

Here we evaluate whether the results are sensitive to certain time periods. We also test whether our findings are altered by the use of a count model.

The drone war escalated significantly in 2008 relative to previous years; drone strikes increased again in both 2009 and 2010, and remained higher in 2011 than in 2008. Given that we cannot rule out that unobserved changes in FATA, starting approximately in 2008, drive this change, we restrict the sample to 2008 and later to test whether the patterns that we observed in the previously discussed results hold during this later period. Table A-1 shows that the main findings do hold when we estimate the 2FESL specification for each of the measures of violence with the sample restricted to observations after 2007. In Table A-2, we extend our analysis to an additional three years by starting from the beginning of 2004, the year of the first-known drone strike in FATA. In Table A-3, we present negative binomial estimates. The results are remarkably similar to the main findings.

Table A-1: Drone Strikes and Terrorist Militant Violence: 2008-2011

	Incidents	Lethality	Attacks on Elders
UAV	-0.034***	-0.194***	-0.001*
	(0.142)	(0.089)	(0.001)
Constant	0.079***	1.137***	0.005***
	(0.025)	(0.534)	(0.002)
Observations	1456	1456	1456
AIC	480.277	7792.078	-6176.432
BIC	607.080	7918.881	-6049.629

Robus standard errors in parentheses

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A-2: Drone Strikes and Militant Violence: 2004-2011

	Incidents	Lethality	Attacks on Elders
UAV	-0.051***	-0.227***	-0.002***
	(0.010)	(0.076)	(0.001)
Constant	0.120	0.035	0.002**
	(0.012)	(0.086)	(0.001)
Observations	2912	2912	2912
AIC	-273.484	13654.120	-13228.340
BIC	-34.42016	13893.180	-12989.270

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table A-3: Negative Binomial Estimates of Drone Strikes and Militant Violence: 2007-2011

	Incidents	Lethality
UAV	-0.197***	-0.380***
	(0.064)	(0.106)
Constant	-0.685***	-0.033
	(0.317)	(0.367)
Observations	1722	1722
Log Psuedolikelihood	-1788.577	-2288.376
Wald χ^2 (254)	26765.590	31531.500
AIC	4089.155	5088.752
BIC	5484.673	6484.270

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Appendix B: Additional Tables

Table B-1: Summary Statistics: FATA

Variable	Entire FATA				North Waziristan				South Waziristan			
	Mean	**S.D.***	**Min.**	**Max.**	**Mean**	**S.D.***	**Min.**	**Max.**	**Mean**	**S.D.***	**Min.**	**Max.**
UAV	0.153	0.605	0	8	0.761	1.277	0	8	0.259	0.610	0	4
Incidents	0.201	0.304	0	2.691	0.288	0.327	0	1.661	0.068	0.145	0	0.931
Lethality	0.627	3.259	0	63.572	0.874	2.706	0	34.049	0.260	1.330	0	17.681
Attacks on Tribal Elders	0.013	0.112	0	1	0.004	0.064	0	1	0.008	0.090	0	1
Number of Observations	1729				247				247			

* Standard Deviation

Table B-2: Drone Strikes and Terrorist Violence: North & South Waziristan

	North Waziristan			South Waziristan		
	Incidents	Lethality	Attacks on Elders	Incidents	Lethality	Attacks on Elders
UAV	-0.040***	-0.189***	-0.001	-0.009	-0.076	-0.001
	(0.014)	(0.095)	(0.001)	(0.013)	(0.071)	(0.001)
Constant	0.261	1.053***	0.001	0.048***	0.295**	0.002
	(0.046)	(0.290)	(0.002)	(0.013)	(0.116)	(0.002)
Observations	247	247	247	247	247	247
AIC	142.731	1195.711	-1291.727	-256.329	846.430	-1205.416
BIC	153.259	1206.239	-1284.708	-245.801	856.958	-1194.888

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01