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The Impact of US Drone Strikes on Terrorism in Pakistan

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This study analyzes the effects of US drone strikes on terrorism in Pakistan. 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. This matters for key ongoing debates. Some 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 US drone strikes and terrorism in Pakistan from 2007–2011 to test each theory's implications. The available data do not enable us to evaluate if drone strikes resulted in increased recruitment, but the data do allow us to examine if these strikes resulted in changes in terrorist activities. While our findings do not suggest long-term effects, the results still lend some credence to the argument that drone strikes, while unpopular, bolster US counterterrorism efforts in Pakistan.

Do drone strikes against terrorists reduce the threat posed by their organizations, or do they unintentionally increase support for anti-United States militants and fuel terrorism?[1]

Existing research examines 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 we lack compelling social-scientific analysis of the effects of drone strikes.[2] As the debate over the use of drones for counterterrorism efforts intensifies,[3] participants resort to anecdotal evidence to support their positions. This is unfortunate, as unmanned aerial vehicles (UAVs) and their lethal targeting capabilities will likely remain a critical aspect of current and future counterterrorism efforts.

Drone strikes' consequences present a critical policy concern. Detractors consistently call on the United States to cease drone strikes in Pakistan in order to protect noncombatants. Instead, the United States has expanded its use of drones to other countries in which it believes al-Qaida-affiliated militants operate, such as Somalia and Yemen.[4] 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 combatants that they believe are affiliated with terrorist organizations against which the United States has declared war (Gray 2000, 1). Liberal democratic states face substantial pressures to protect civilians in war, but substantial uncertainty still exists about how to abide by legal principles such as "discrimination"—the obligation of military forces to select means of attack that minimize the prospect of civilian casualties (Crawford 2003, 6; Walzer 2006, 5–14). The deaths of two al-Qaida-held hostages, an American and an Italian, in a January 2015 drone strike, in which an Amercian-born al-Qaida spokesman Adam Gadahn also died, sparked further controversy over the drone program.

The United States need not rely upon drone strikes to counter terrorists. US Special Operations forces have conducted hundreds of raids in permissive political environments, such as Afghanistan (2001–2014) and Iraq (2003–2011). However, the United States enjoys fewer counterterrorism instruments in the context of semipermissive environments such as Pakistan, Somalia, Yemen, and

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[1]Examples of arguments that drone strikes are ineffective or counterproductive include NYU/Stanford (2012) and Cronin (2009). Examples of arguments that drone strikes are effective include Fair (2010, 2012) and Byman (2013). Statistical 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) and Smith and Walsh (2013).

[3]See, for example, Mayer (2009); Fair (2010); Fair, Kaltenthaler, and Miller (2013); Davis et al. (2014); and Fair (2014).

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

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Iraq (2014–). The effectiveness of drone strikes at countering terrorism lies at the core of US policymakers' arguments for their continued use in these environments. Yet because, in no small part, neither US officials nor human-rights advocates present compelling, systematic evidence in support of their claims, debate about the effectiveness of drone strikes continues unabated. We therefore need a rigorous, evidence-based assessment of drone strikes' effect on terrorist activities. Such an assessment should sharpen the debate on drone strikes; it should also help counterterrorism officials and critics alike to better evaluate the trade-offs associated with drone warfare.

This study moves in that direction. Based on the available detailed data on both drone strikes and terrorism in Pakistan, the study examines how drone strikes, by triggering changes in terrorist behavior, have affected terrorist violence in northwest Pakistan bordering Afghanistan. Specifically, this study investigates the relationship between drone strikes and several measures of terrorist violence, such as terrorist attack patterns and lethality and attacks on tribal elders, whom some militants view as actual or potential rivals. The available data prevent us from examining whether drone strikes have resulted in increased terrorist-organization recruitment—a key argument advanced by drone-program opponents. However, the data do allow us to investigate the effect of drone strikes on terrorism measured in terms of the terrorist activities mentioned here, which, unlike recruitment, are more widely recorded and reported.[5]

A systematic data analysis reveals that drone strikes have successfully curbed deadly terrorist attacks within the targeted territory in Pakistan. Specifically, our study finds 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 linked to decreases in selective targeting of tribal elders, who terrorist groups frequently see as colluding with the enemy and impeding 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, we find evidence that there is a small *violence-reducing* effect in areas near those that drones strike. This article, however, only studies short-term changes 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; we should not summarily dismiss claims that drones aid US counterterrorism efforts in Pakistan.

The remainder of this article proceeds as follows. First, we provide background information on the militant organizations that the United States has targeted in Pakistan and their objectives. Second, we outline a range of relevant hypotheses on the effects of drone strikes and briefly discuss the theoretical logics that undergird them. Third, we describe our dataset and the methodology. Fourth, we discuss the results of our empirical analysis and our interpretation of the findings. We conclude with a discussion of our findings' implications for policy and for the future of counterterrorism.

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. This region, which covers more than 27,000 square kilometers—roughly the size of New Jersey—and has a population of more than 3 million, is predominantly inhabited by ethnic Pashtun tribes. These tribes are further divided into numerous subtribes and clans, but each of the region's seven agencies has a dominant tribe (Nawaz 2009). Much of the region's territory is highly rugged and mountainous, especially in 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 that the postindependence Pakistani state more or less retained.[6] Sir William Barton once described the region as an "Imperial problem of the first magnitude" (Barton 1939, 23). The British carried out several major military operations in the region, the last of which they conducted in 1937 and 1938, but the British were never able subjugate the population or gain its allegiance.

A multitude of militant groups resides in the FATA. This reflects not only local ethno-sectarian, ideological, and personal divisions, but also these militants' varying strategic and operational goals, as well as their 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. Their survival and effectiveness hinges on control over civilians. Here, they face challenges not only from the state and its allies but also from both armed and civilian opponents.[7]

All of these groups share an anti-Americanism and an adherence to radical Islam. But, in the context of the struggle for control and survival, intergroup differences still breed internecine feuds that engulf militants and civilians alike. Some of these differences run deep; they stem from centuries of distrust and hostilities between tribes and clans, such as those between the Mehsuds and Wazirs. The prevalent animosity and distrust breed suspicion and hostility between local rivals. The victims of such hostilities include not only members of rival groups but also local civilian collaborators.

US drone strikes have targeted several militant groups in the Pakistani tribal areas believed to be affiliated with al-Qaida and its associated groups, Tehrik-i-Taliban

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

[6]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.

[7]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).

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Pakistan (TTP) and the Haqqani Network. These groups have differing objectives and do not always behave as unitary organizations, but they all share an adherence to a jihadi ideology and the pressures of conducting asymmetric warfare in contested territory. Al-Qaida, 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 US invasion and occupation of Afghanistan. Most of al-Qaida'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 (Rashid 2010, 237–39). Al-Qaida's core personnel in Pakistan consist primarily of foreign jihadists from across the Muslim world who serve as the central hub of al-Qaida's campaign of global jihad. The primary goals of al-Qaida's core in Pakistan are twofold. The first is to establish an Islamic caliphate across the Muslim world, hence al-Qaida's alliance with affiliate al-Qaida jihadist insurgencies in countries such as Algeria, Somalia, Syria, and Yemen, and the Indian subcontinent. The second is to plan or support attacks against Western countries. The number of al-Qaida operating in Pakistan is unknown, but numerous estimates place it in the low hundreds (Sanger and Mazzetti 2010; Bergen and Schneider 2014).

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 FATA and other parts of Khyber Pakhtunkhwa, under the governance of a single organization commanded by Baitullah Mehsud of South Waziristan (Abbas 2014, 152). Mehsud was killed in a US drone strike in August 2009. Unlike al-Qaida, the TTP recruits most of its members locally, and it is not an official affiliate of al-Qaida. However, the TTP's primary objectives—overthrowing the Pakistani government and replacing it with an Islamic emirate similar to the one the Afghan Taliban established in Afghanistan in the late 1990s—are consistent with al-Qaida's. Further, the TTP is known as one of al-Qaida's associated movements.[8]

The third main group targeted by US 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 aligns ideologically with both al-Qaida and the TTP, and the three groups engage in tactical cooperation in pursuit of shared objectives. The Haqqani Network's founding leader, Jalaluddin Haqqani, who led the group until his death in 2014, was a *mujahideen* commander in the anti-Soviet war in Afghanistan and held important positions in the Taliban regime in the 1990s. Haqqani was 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, 4–6). 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.

[8]This is evident in correspondence captured during the raid of Osama bin Laden's Abbottabad, Pakistan, compound in May 2011, which indicated that al-Qaida leadership was sending tactical and operational information to then-TTP leader Hakimullah Mehsud as of December 2010. See "Letters from Abbottabad" (Lahoud et al. 2012).

Hypotheses on Drone Strikes and Terrorism

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

We analyze the relationship between US 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 US drone strikes, all are engaged in asymmetric warfare against the Pakistani government and local tribal elements organized along clan lines. Each group relies 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, 173–209).

The first argument we examine holds that US 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) attempts to kill militant leaders may trigger internecine fighting that results in civilian targeting.

First, terrorist leaders may seek to punish and deter informers whose information can help the US and Pakistani governments locate and target them and their senior lieutenants. Drone strikes against specific individuals reportedly rely on robust informant networks that provide human intelligence on the activities and locations of militant targets (Cronin 2013, 54). 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-Qaida, 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 United States' 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), *imams* 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 US 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, many claim that drone strikes radicalize alienated civilians and therefore increase overall terrorist violence. The logic of this argument holds that the radicalization of segments of the civilian population renders it ripe for recruitment by fellow Muslims with whom they share common enemies—the US or Pakistani government. Militants could thus recruit more manpower and mobilize more resources. This could, in turn, 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

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its targeting of moderate Muslims under the "*takfir*" principle of strict sharia law.[9]

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. A bitter rivalry ensued between Hakimullah Mehsud and Waliur Rehman, both killed in drone strikes in 2013, for the top leadership position in the TTP following the death of Baitullah Mehsud (Rehman 2013). In 2013, the differences within the TTP over the choice of a successor to replace Waliur Rehman, the 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).

Hypothesis 1: All else equal, drone strikes increase terrorist violence.

Drone Strikes, Militant Capabilities, and Reductions in Terrorist Violence

The second argument, which US counterterrorism officials often advance, contends that drone strikes reduce the terrorist threat posed by targeted groups. Proponents of this view frequently cite two mechanisms at work: disruption and degradation.

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, because 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 US 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 United States to collect information in areas where they have no ground presence—as is currently the case for the United States in Pakistan—but they can also credibly threaten to punish militants from afar, with lethal and selective use of 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:

Hypothesis 2: 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, 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 multisource intelligence difficult. This is not what we see; there have been 400 drone strikes conducted in Pakistan's tribal areas since 2004, which is consistent with the disruption mechanism described above.[10] The disruption mechanism's implication is that semifrequent drone strikes are used to pursue persistent disruption of terrorist operations. This is in line with the empirical record. Second, 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.

Degradation

The second mechanism by which drones could reduce terrorism is through degradation. This mechanism suggests that drone strikes remove terrorist leaders and other "high-value individuals" (HVIs) from the battlefield, which reduces terrorism. 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 key HVIs. Killing core and affiliated al-Qaida leaders is the stated objective of drone strikes.[11]

Drone strikes have resulted in the deaths of many top terrorist leaders. In late 2012, the US administration claimed to have eliminated at least two-thirds of the top 30 al-Qaida leaders in Pakistan and Afghanistan during the first three years of President Obama's first term in office.[12] The estimates compiled by the New America Foundation suggest that by August 2014, drone strikes in

[9]As a religious concept, *takfir* is the act of declaring a Muslim an infidel. In classic Islamic law, *takfir* is an extremely serious measure that only qualified religious authorities can pronounce under specific circumstances. Many contemporary Islamic scholars question the legitimacy and legality of groups like the Taliban and the Islamic State of Iraq and al-Sham invoking the concept of *takfir* in their governance authorities (e.g., Hegghammer 2009, 247–48).

[10]This count is based on data gathered by New America Foundation researchers, accessed August 12, 2015, http://securitydata.newamerica.net/drones/pakistan-analysis.html.

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

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

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Pakistan accounted for the killing of 64 militant leaders. The list includes 38 high-level al-Qaida functionaries and several al-Qaida-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 comprehensive datasets and sophisticated 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.[13] Scholars of leadership decapitation have come to different conclusions. On the one hand, using large-N approaches, Johnston (2012) 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 their collapse. Jordan further argues that decapitation may have counterproductive effects when used against terrorist organizations whose goals involve religion—as do al-Qaida's, the TTP's, and the Haqqani Network's—particularly when these organizations are large and old (relative to an "average" terrorist organization in her dataset).[14]

We expect drone strikes that kill terrorist leaders to be associated with reductions in terrorist attacks. Previous research 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 the threat of drone strikes limits militants' freedom of movement, 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 is 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:

> *Hypothesis 3: 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 counterproductive effect. We thus elaborate Hypothesis 4:

> *Hypothesis 4: All else equal, drone strikes that kill one or more terrorist leader(s) will lead to an increase in terrorist violence.*

Spatial and Temporal Effects

Spillover Effects: Do Drone Strikes Divert Terrorist Violence?

Drone strikes may disrupt terrorist activities in their FATA strongholds by diverting militants to other areas. There, terrorists might continue their activities. 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 ability of the United States 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 Laden's compound in Abbottabad, Pakistan (itself an urban area outside of Islamabad, where the al-Qaida leader hid for years), bin Laden advised al-Qaida members there to move to Afghanistan's Kunar province for protection from US 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.[15] Dozens of al-Qaida and Afghan Taliban have been arrested in Balochistan since 2009, when the drone war in FATA escalated.[16] Importantly, the terrorist groups targeted have networks and an 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:

[13]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 methodologies used in scholarship on leadership decapitation, see Johnston (2012).

[14]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).

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

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

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Hypothesis 5: 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 of the objectives of the drone program is to protect the US forces across the border in Afghanistan (Shah 2014). This motivates the following hypothesis:

Hypothesis 6: All else equal, drone strikes decrease militant violence in neighboring areas.

How Long Does the Effect of a Drone Strike Last?

Finally, do drone strikes' short-term effects differ from their long-term ones?

These contrasting possibilities generate two additional hypotheses:

Hypothesis 6: Drone strikes have an extended violence-reducing effect.

Hypothesis 7: Drone strikes have an extended violence-increasing effect.[17]

Statistical 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 (see Table 1). Conducting analysis at the agency level enables us to estimate the average effect of drone strikes, conditional on unobserved time-invariant agency-specific effects.[18] FATA's seven agencies did indeed suffer varying levels of violence in the years studied.[19]

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.[20]

Our 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 areas 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 to 150 km in increments of 25 km.[21] This approach enables us to avoid arbitrary assumptions about the specific distance from struck agencies on any "spillover" effect on terrorist violence and, instead, to evaluate a broad range of possibilities and test whether there is any evidence of such a trend at any plausible distance.[22]

Identifying Assumptions

A range of quasi-random factors shape the week-to-week timing of drone strikes in FATA's agencies. This, in turn, motivates our empirical strategy.

It appears that, in practice, the ability of the United States 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 the occurrence of any given drone strike in a given FATA agency in a given week has a quasi-random character. Panel-data regression analysis is able to account for fixed effects and thus interpret the statistical estimates of the effects of the quasi-random treatment 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

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

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

[19]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 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.

[20]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 toward the region and provided the basis for the current agency boundaries (see, for example, 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), and Fishman (2010).

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

[22]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 statistically. On the other hand, however, an advantage of our nonassumption-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.

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in documents that were captured from senior al-Qaida leadership in multiple theaters of operation that they were aware of these factors (Lahoud et al. 2012; Associated Press 2013).[23]

This is consistent with information from US sources that "cloudy days" obscure satellites and make it more difficult to view objects on the ground and hinder operations (Tilford 2012).[24] Second, drones are a scarce commodity and are in high demand. The availability of drones in FATA (whether for intelligence, surveillance, and reconnaissance (ISR) missions or for lethal targeting itself) varies with changing ISR requirements in other theaters in which the United States conducts counterterrorism missions.[25] Third, not all drones are weaponized. A nonweaponized drone covering an area where a high-value target is found must request fire support from other aircraft or ground elements, increasing the chances that the target will "lose the tail" before a strike can be deployed.[26] Fourth, mundane bureaucratic and logistical factors such as the work schedules of key policy and legal officials who must authorize certain drone strikes can affect the timing of a strike (Radsan and Murphy 2009). Fifth, the window of opportunity for a clean shot at an HVI can vary and is likely to be largely 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 violence in specific agencies and weeks a credible means of causal identification.[27] The key to identification is that the unit-of-analysis is relatively small. As the temporal unit of aggregation increases, the validity of the identifying assumption goes down. The larger the window, the harder it is to detect relationships where most conflict occurs—at the micro level. Drawing on incident-level data aggregated to a fairly micro level of conflict, our approach offers an opportunity to analyze such relationships.

Estimation

In the analysis presented below, we estimate two-level fixed-effects (2FE) models with both agency and temporal (week) fixed effects and a spatial lag of drone strikes (2FESL).[28] Fixed-effects regression is a standard econometric approach to panel data analysis.[29] Letting i denote the cross sectional index (FATA agencies) and t the time index (weeks), a two-level fixed effect equation is given by:

$$y_{it} = \alpha_i + \beta x_{it} + h_t + \varepsilon_{it}, \quad (1)$$

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 shown that cross-sectional dependence may cause panel ordinary least squares (OLS) estimates to be biased and inconsistent. Including a spatial lag enables us to directly model cross-sectional dependence in the regression.[30] A spatial-lag model with two-level fixed effects (2FESL) assumes the following form:

$$y_{it} = \alpha_i + \varrho \sum_{j \neq i} w_{ij} y_{jt} + \beta x_{it} + h_t + \varepsilon_{it}, \quad (2)$$

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, a_i are unobserved agency-specific effects, and h_t are weekly time effects.

Data and Variables

To examine the effect of drone strikes, we combined detailed data on US drone strikes in FATA from the New America Foundation (NAF) (Bergen and Tiedemann 2011) with incident-level data on terrorist activities from the National Counterterrorism Center's (NCTC) Worldwide Incidents Tracking System (WITS) over the same time period. We also use data on militant violence against tribal elders from the South Asia Terrorism Portal (SATP).[31]

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 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 account for every single drone strike in

[23]Recently declassified al-Qaida 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.

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

[25]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 US counterterrorism officials than a higher-value individual, such as a known al-Qaida cell leader. For examples, see Miller (2010) and Entous (2010).

[26]Author interview with a US Air Force drone pilot, December 2013.

[27]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).

[28]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.

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

[30]See, for example, Franzese and Hays (2007).

[31]The SATP data, accessed June 15, 2013, http://www.satp.org/satporgtp/countries/pakistan/database/Tribalelders.htm.

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Table 1. FATA: population, size, and 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) and Gesch, Verdin, and Greenlee (1999).

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.[32] Moreover, increased public scrutiny and the operational necessity of naming successors by terrorist groups should mitigate some concerns about the data, despite the lack of government transparency on the subject.

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 nonstate militants. Spontaneous violence, hate crimes, and genocides are excluded from the database. The data are gathered using both English and foreign-language open sources and rely 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 WITS.

We focus on terrorist incidents (violence against civilian rather than military targets) both for 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 that informants provide the targets for drone strikes and thus target those suspected of informing (Bennett 2011). Along these lines, tribal elders (local elites who possess political authority and are the interlocutors between the political agent and locals) are often the prime target (Fishman 2010, 6). We use data on militant attacks on tribal elders in Pakistan from 2005 through 2011 compiled by SATP.[33]

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.

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 the fall of 2011. Drone strikes (left axis) were relatively rare until the fall of 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.[34]

In the statistical analysis presented in the next section, we normalize all measures of terrorist violence based on agency and district population statistics to capture the number of violent incidents per 1,000 residents. Normalizing the data in this way reduces variance that might spuriously influence our statistical results for reasons unrelated to drone strikes. 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.

Statistical Results

Have drone strikes increased or decreased terrorist violence? A cursory look at the data suggests the former: Figure 1 shows that violence rose from 2007–2009; by September 2011, when our time-series ends, violence was as high as it had been since 2007. Yet, Figure 1 also shows that the increase in drone strikes came after terrorist violence had already begun to increase dramatically. In other words, the trends suggest the drone war's escalation came

[32]The drone program attracted relatively little public attention until 2007, and Pakistani and US government officials did not acknowledge the existence of the program during this period. Even in response to a January 2006 strike that allegedly targeted 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.

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

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

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Table 2. Summary statistics: FATA and 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		

Note: S.D., Standard Deviation.

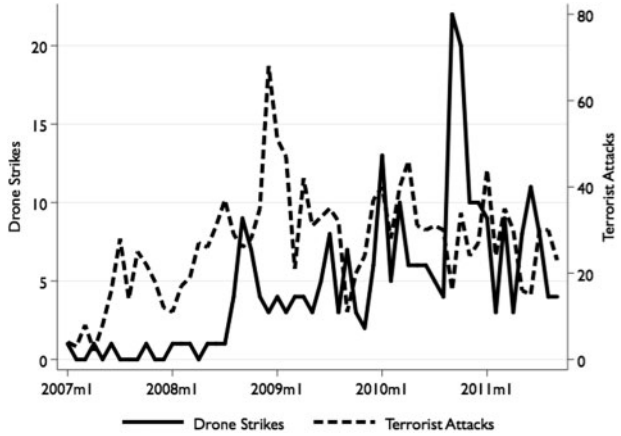

Figure 1. Time trends in drone strikes and terrorist attacks.

in response to real and anticipated increases in terrorism. Given the increasing levels of violence prior to the escalation of the drone campaign and the variation in terrorism across agencies, we adjust for these secular trends in the data by including week- and agency-fixed effects. We use these regressions to estimate the average effect of drone strikes within agencies across time.

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.[35] We thus use 2FESL estimates to calculate the substantive effects of drone strikes.

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, which proposes that drone strikes are associated with increases in terrorism. We find no statistically significant evidence of a positive relationship between drone strikes and terrorism. The results instead support the alternative thesis as elaborated in Hypothesis 2: drone strikes are associated with decreases in militant violence. The substantive effects of drone strikes on terrorist violence are presented in Figure 4.

The 2FESL result in column 4 of Table 3 estimates that drone strikes are associated with about a five-percentage-point decrease in terrorist attacks. This result is statistically significant at conventional levels. From 2007 through 2011, the agencies suffered roughly 0.88 militant attacks per week on average. During weeks in which a drone strike occurred, agencies experienced 0.68 attacks on average.

These findings differ from results in Lyall (2014), which finds a statistically significant and positive relationship between airstrikes conducted by the United States-led International Security Assistance Force (ISAF) coalition in Afghanistan and insurgent attacks. However, the dependent and independent variables used in the present study differ from Lyall (2014). His primary independent variable is all air strikes, not just drone strikes.[36] His dependent variable is "insurgent-initiated" attacks against ISAF. Insurgent-initiated attacks do not include attacks on civilians, which is our primary dependent variable. The dynamics between warring parties also differs across the two contexts. In FATA, Pakistani military operations are limited and the US military has no overt battlefield presence. Consequently, opportunities to target counterinsurgent forces are limited. Compared with Afghanistan, the option of attacking counterinsurgents for reputation's sake is limited in FATA. Due to these contextual differences, we would not expect Lyall's argument to have as much explanatory power in the context studied here.

Our findings also run counter to some implications of recent survey results. These results suggest that the unpopularity of drone strikes is associated with relatively high levels of civilian support for militancy (Lyall, Blair, and Imai 2013) and increased anti-Americanism (Kaltenthaler, Miller, and Fair 2012). These findings are consistent with the radicalization mechanism underlying Hypothesis 1. Our statistical analysis provides an indirect test of this argument by examining patterns of violence, which presumably trends with levels of militant mobilization and support. However, we did not find any evidence in support of this observable implication. At the least, our findings suggest that any link between increased support for counterinsurgent or increased anti-Americanism, on the one hand, and terrorist attacks (or recruitment), on the other, is more complicated than the argument that motivated Hypothesis 1. The relationship between civilian support and terrorist violence often tends to be contingent on a variety of confounding factors, including a militant group's ability to maintain operational security. Sympathy for a cause or public anger at counterterrorist actions may not necessarily

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

[36]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.

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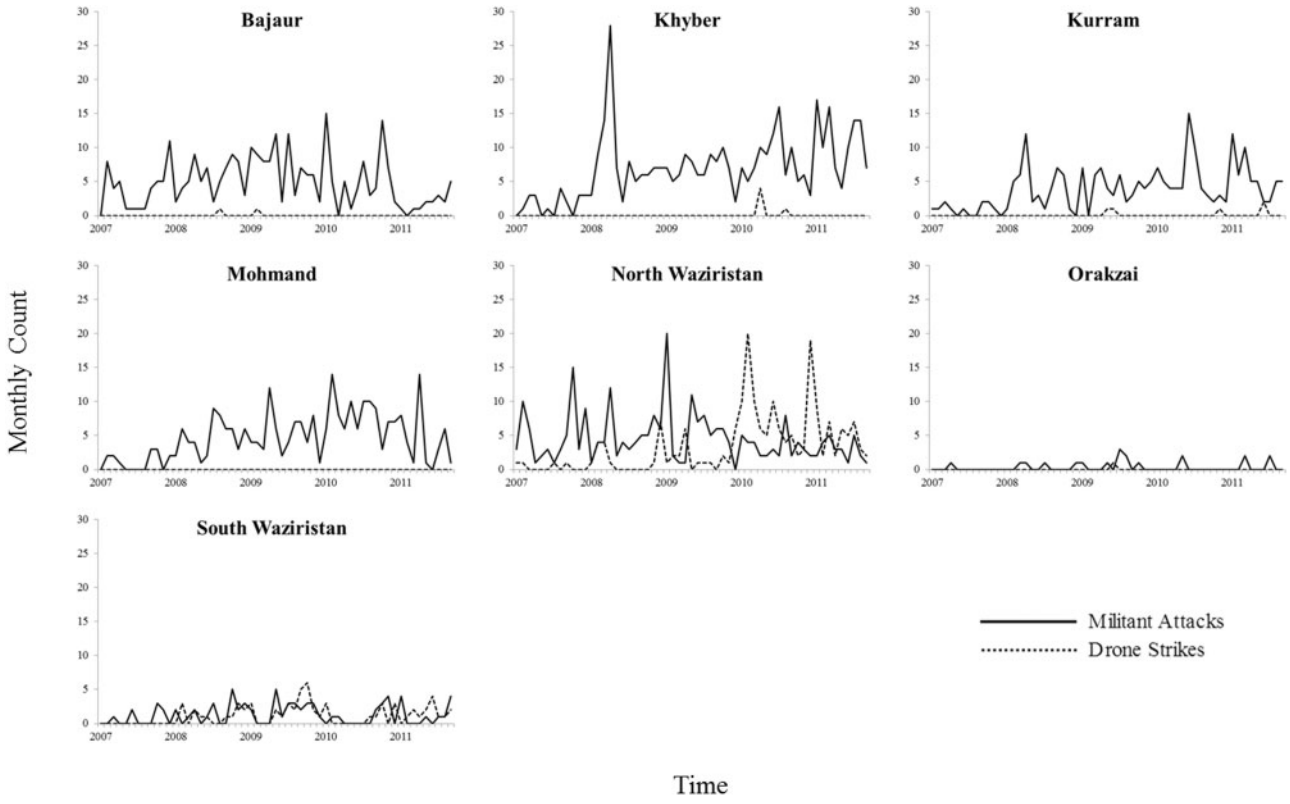

Figure 2. Time trends in drone strikes and militant attacks by agency.

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.[37] 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.[38]

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

Degradation

Killing HVIs in terrorist organizations is the purpose of drone strikes, but does it work?

We address this question by evaluating whether patterns of militant attacks differ following drone 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.[39] The results are largely consistent with Hypothesis 3, which proposed that killing militant leaders should be associated with decreases in violence.[40] Conversely, the results do not support Hypothesis 4, which suggests that killing militant leaders is counterproductive and increases violence. Controlling for the number of drone strikes, the point estimate displayed in column 1 of Table 4 indicates that the death of a HVI is statistically associated with a decrease in terrorist attacks. 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.[41]

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

[38]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.

[39]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.

[40]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.

[41]These estimates may be more imprecise than the statistical results suggest, as a result of heterogeneity in the measurement of the HVI variable. Although US government officials consider terrorists targeted by drone strikes as "senior leaders" or "high-value individuals," the US 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.

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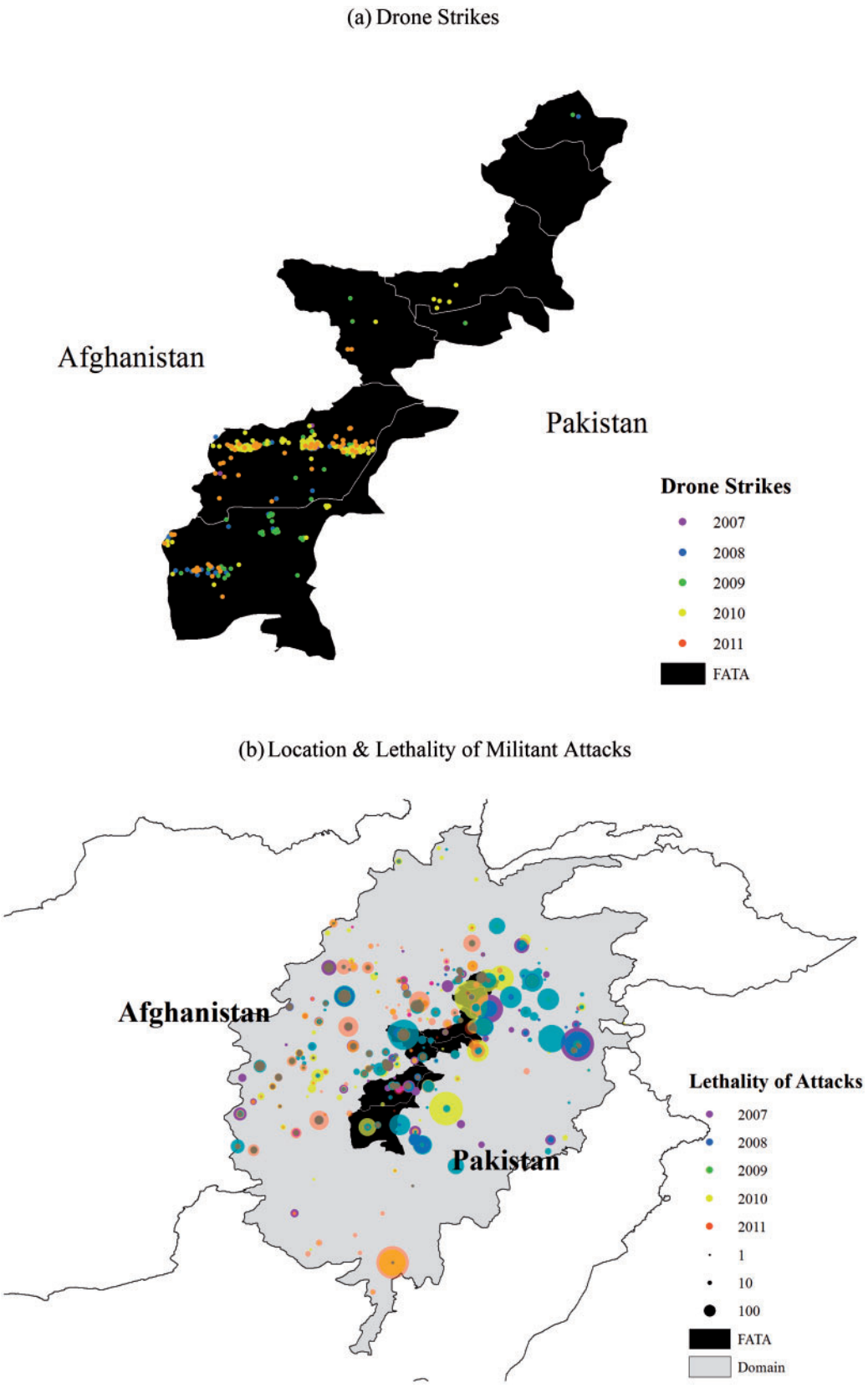

Figure 3. Drone strikes and militant attacks in FATA and its neighborhood. (a) Drone Strikes. (b) Location and lethality of militant attacks.

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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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .01.

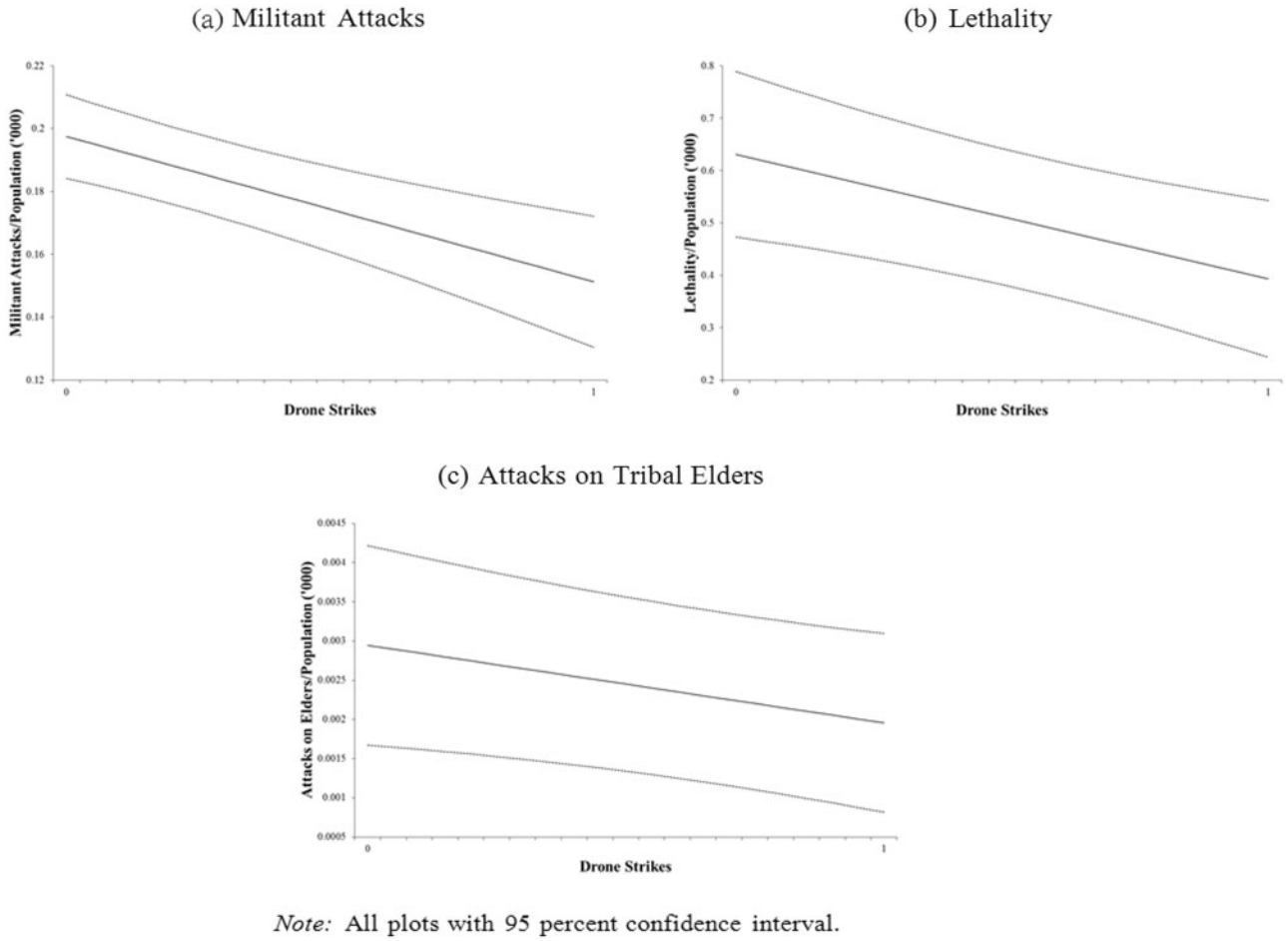

Figure 4. Substantive effect of drone strikes.

Overall, there is some evidence that key militant leaders do matter for a terrorist organization's ability to conduct kinetic attacks. The evidence that removing HVIs reduces the lethality of militant violence is less conclusive. 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).

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).

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

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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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .01.

varying distances, we assess how drone strikes affect militancy beyond specific FATA agencies.

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-km radius from struck agencies.

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).

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 display evidence of a statistically significant, negative relationship between drone strikes that occurred five weeks prior (t–5) to attacks in the present week (t) (column 2). Moreover, the sign on the coefficients of the drone strikes variable at t–5 is negative for the average number of weekly incidents. The coefficients are negative, but 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. This suggests some evidence, albeit weak statistically, 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.[42] 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.

Table 5. Drone strikes and neighborhood militant violence

Dependent variable	Neighborhood radius					
	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		

Note: Robust standard errors in parentheses. Coefficient estimates for drone strike (UAV) variable. Intercept estimates not presented. *p < .1, **p < .05, ***p < .01

Conclusion

This article offers a systematic analysis of the relationship between US drone strikes and militant violence in northwestern Pakistan and eastern Afghanistan. Our analysis suggests that drone strikes negatively correlate with various measures of militant violence. This negative association holds both within individual FATA agencies and their immediate neighborhoods. Perhaps unsurprisingly, our

[42]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. These inconsistencies also obtain when we extend the tests 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, we find some evidence that the lethality of militant attacks in agencies contiguous to those that were struck declined following a drone strike. This effect might last as long as five weeks (see Column 2 in Table 6). 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.

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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
UAVt-1	−0.013	−0.089	−0.0004
	(0.014)	(0.115)	0.001
UAVt-2	0.0003	−0.088	−0.0001
	(0.015)	(0.123)	0.0009
UAVt-3	0.019	0.047	−0.001
	(0.013)	(0.089)	(0.001)
UAVt-4	−0.017	0.022	0.001
	(0.014)	(0.136)	(0.001)
UAVt-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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .01.

findings suggest that the effects of drone strikes on militant violence occur primarily at the tactical level, not the strategic level. This may explain the persistent use of drone strikes against militants operating in Pakistan, Somalia, and Yemen: Given drone strikes' disruptive short-term efficacy, using drones to counter terrorism effectively may require counterterrorists to apply continual pressure against terrorist networks.

The plausible exogeneity of the week-to-week timing and location of drone strikes suggests a causal interpretation. Despite the econometric techniques used to mitigate selection bias in our analysis, we urge caution in inferring causality due to the possibility of selection bias that inheres in any observational study.

Still, our findings provide key support for the hypothesis that new technologies—specifically, remote means of surveillance, reconnaissance, and targeting—prove capable of disrupting and degrading militant organizations. In doing so, such technologies limit both the frequency and the lethality of militant attacks. They thus compensate for an incumbent government's lack of physical presence in these areas. This suggests, in turn, 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 coheres with widespread claims that, as technology continues to become increasingly sophisticated, warfare will become increasingly virtual, if not bloodless. Adversaries—not only governments, but also nonstate actors such as insurgents, terrorists, and criminal organizations—will adapt their strategies in order to reduce vulnerability to state countermeasures. Some militant groups are leveraging technology—including drones—against state interests. Islamic State militants in Iraq and Syria are now flying small UAVs, which offer advantages not only for aerial surveillance and reconnaissance, but also for propaganda efforts.

Nonetheless, powerful states retain vast technological advantages over insurgent and terrorist groups. As long as drones remain effective for countering terrorists, they are here to stay.

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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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .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 $\chi 2$ (254)	26765.590	31531.500
AIC	4089.155	5088.752
BIC	5484.673	6484.270

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .01.

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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			

Note: S.D., standard deviation.

Table B-2. Drone strikes and terrorist violence: North and 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

Note: Robust standard errors in parentheses. *p < .1, **p < .05, ***p < .01

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