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The Effect of U.S. Drone Strikes on Terrorism in Pakistan and Yemen

Abstract:
This paper examines the effect of U.S. Unmanned Aerial Vehicles, or drones, on terrorism in Pakistan and Yemen using the data from the Global Terrorism Database and the data on drone strikes from the Bureau of Investigative Journalism. I analyzed the Pakistan data from 2007-2015 for all terror acts in the Federally Administered Tribal Regions (FATA) of Pakistan, and I analyzed the Yemen data from 2011-2015 for terror acts committed by al-Qaeda in the Arabian Peninsula (AQAP) throughout Yemen's provinces. I found divergent effects for Pakistan and Yemen. In Pakistan, I observed a fade-out effect, where drone strikes decreased both the weekly rate of terror attacks and the probability of a terror attack but only within one week of the drone strike. After one week, the probability of a terror attack increased. In Yemen, I found evidence that within the first week of a drone strike, the probability of a terror attack increased. The increase in probability of terrorism was not persistent past the initial days of the strike. These results suggest U.S. drone use should be considered on a country-by-country basis and that the effects of drone strikes, whether they increase or decrease terrorism, do not seem to be long-term.

1 Introduction

There is not a consensus about the effectiveness of the United States' use of drones, formally known as Unmanned Aerial Vehicles (UAVs), against the enemy. More empirical analysis on this question is needed in the literature, as only three publications currently exist. The most recent research finds U.S. drone strikes in Pakistan to be associated with decreases in the incidence and lethality of terrorist attacks in Pakistan, as well as decreases in selective targeting of tribal elders (Johnston and Sarbahi 2015). This evidence suggests that U.S. counterterrorism efforts in Pakistan have been aided by drone strikes. Jaeger and Siddique also find drone strikes have a significant impact on Taliban/al-Qaeda violence in Pakistan. However, they also find drone strikes do not have any significant impact on terrorist violence in Afghanistan (Jager and Siddique 2011). Providing more evidence that the effect of drone strikes is ambiguous is research showing drone strikes in Pakistan have not impaired Al Qaeda's ability to generate propaganda. Smith and Walsh's 2013 study used propaganda output as a proxy to measure the degradation of the terrorist group. The existing body of research does not provide definitive conclusions about the effect of drone strikes on terrorism, and all prior research has focused exclusively on Pakistan and/or Afghanistan. No work has been done on Yemen, despite the large number of drones used there.

In this paper, I fill this gap in the literature by examining the effect of drone strikes on terrorism in Pakistan and Yemen using a two-level fixed-effect (2FE) model with both agency and temporal (week) fixed effects. I use both the weekly rate of terror and also the probability of a terror act as measures of terrorist activity. My analysis in Pakistan is from 2007-2015, and I will be the first to do any analysis on the period from 2012-2015. My analysis in Yemen is from 2011-2015 and focuses exclusively on al-Qaeda in the Arabian Peninsula, whose terror activity

in relation to drones has not yet been studied. I found divergent effects for Pakistan and Yemen. In Pakistan, I observed a fade-out effect, where drone strikes decreased both the weekly rate of terror attacks and the probability of a terror attack but only within one week of the drone strike. After one week, the probability of a terror attack increased. In Yemen, I found evidence that within the first week of a drone strike, the probability of a terror attack increased. The increase in probability of terrorism was not persistent past the initial days of the strike.

Determining the effects of drone strikes would be consequential for American foreign policy, as military drone use is extremely controversial and polarizing. Jimmy Carter vocalized his disbelief that drones are effective, stating, "drones create more additional terrorists, with the fervor of killing Americans, than we would be if we were not using drones to kill people" (Gentilviso 2014). Drone strikes have come under further scrutiny with statements by both the Times Square bomber in 2010 and also the Orlando night club shooter in 2016 that their attacks were motivated by U.S. drone operations in the Middle East (Gertz 2010). Drones have been in use by the U.S. for a relatively long period of time, with the first mission happening in Afghanistan on October 7, 2001. Since then, drones have been used in countries with whom the U.S. is at war, like Iraq and Afghanistan, as well as countries with whom the U.S. is not officially at war, like Yemen, Somalia, and Pakistan. This distinction is relevant because in countries with whom the U.S. is not at war, there are fewer counterterrorism instruments available at its disposal. For example, the U.S. must operate in Pakistan remotely because the Pakistani government does not allow for ground troops to be present (Williams 2010). The Pakistani government has secretly approved of the drone strikes in years past and even helped coordinate efforts with the U.S. government, despite making public announcements that they condemn the U.S.'s interference in the country's affairs (Kutsch 2014). Further complicating the

matter is the Pakistani public's view of the drone program. A 2013 Gallup poll showed 70% of respondents did not approve of the U.S. drone attacks on the Taliban and al-Qaeda.

At home, the issue remains contentious with the public from a moral and legal standpoint. President Obama did not publicly acknowledge the drone program in Yemen and Pakistan until June 2012, although this disclosure was regarded as unsurprising for the many who considered U.S. drone operations to be one of the nation's worst kept secrets (Entous 2012). Further disclosure that civilians are killed during drone strikes was not officially provided by the Obama administration until June 2016, where it also announced its estimation of civilian deaths from strikes between 2009-2015 to be between 64-116 civilians (DNI 2016). This disclosure prompted further outcry, as many believed the administration was underreporting civilian deaths in comparison to data from sources like the New America Foundation and the Bureau of Investigative Journalism. Legally, there have been concerns that the strikes violate international law because most of the strikes occur outside a defined theater of armed conflict. Amnesty International alleges U.S. drone strike policy allows for extrajudicial killings anywhere in the world, which can be tantamount to a war crime.

Thus, drones have not only a high monetary cost, as all military operations do, but also a high cost with the U.S. public. Determining the success of drone strikes would lessen criticism towards the government, as this new type of warfare would be more justifiable**.**

2 Background on Conflict

Pakistan

U.S. drone strikes in Pakistan have occurred almost exclusively in the Federally Administered Tribal Areas (FATA), a rugged and mountainous territory located in the northwest of Pakistan and bordering Afghanistan. The FATA is semi-autonomous and composed of seven tribal

agencies (North Waziristan, South Waziristan, Khyber, Kurram, Mohmand, Orakzai, and Bajaur). Because these tribal lands have never been fully incorporated into the Pakistani state, they often act under their own law. The region is inhabited almost exclusively by the Pashtuns. Within and between the tribes exist different militant groups and ethno-sectarian divisions, but they all share an anti-American and jihadist ideology. Traditionally, terror groups regarded FATA as a cross-border sanctuary away from American troops in Afghanistan, where they could train, rest, equip, and regroup for combat (Williams 2010). However, the idea of FATA as a sanctuary has changed since the drone campaign.

The U.S. has been carrying out drone strikes in Pakistan since 2004, but they did not occurred with regularity until 2008. There have been more strikes in Pakistan than in any other country besides Afghanistan. The transition from Bush to Obama was perhaps the biggest catalyst for the increase in strikes, as more strikes were launched during Obama's first year in office than during the entirety of Bush's presidency. The strikes in Pakistan are exclusively under the control of the CIA, unlike in Yemen where the military and CIA operate together. Initially, the strikes launched from airbases inside Pakistan. This was something the Pakistani government tried to conceal from its citizens, as it would publicly condemn the U.S. strikes. Then in 2011, U.S.-Pakistani relations were rated "disastrous," and U.S. drone strike launch bases subsequently moved out of Pakistan and into Afghanistan (Maqbool 2011). The strikes have targeted and killed several terrorist organizations, like al-Qaeda, the Tehrik-i-Taliban, and the Haqqani Network (Bureau of Investigative Journalism 2016).

Yemen

Yemen is divided into twenty-one governorates and one municipality. Drone strikes have occurred in ten of the governorates (Abyan, Al Bayda, Al Jawf, Dhamar, Hadramout, Lahij,

Marib, Saada, Saan'a, and Shabwah). Yemen is the poorest country in the Middle East and currently engaged in a brutal civil war. During the Arab Spring in 2011, Ali Abdullah Saleh, the authoritarian president of Yemen who had been in power for over thirty years, was ousted from office after large-scale protests. However, with the help of other Gulf states, Abdrabbuh Mansur Hadi was installed in his place. Then in 2013, Hadi's government began to disintegrate as Shia Houthis forced him from power and eventually seized Sana'a, the capital. Hadi and his cabinet officially resigned in January 2015. The Houthis are collaborating with northern tribesmen in Yemen and are backed by Iran, whose leaders are looking to increase its influence in the region. Hadi is aligned with Sunni southern tribesman and is backed by Saudi Arabia. They have waged a military campaign since March 2015. The Obama administration has supported the Saudi-led air campaign against the rebels by providing targeting intelligence and refueling Saudi warplanes.

U.S. involvement in Yemen predates Obama. The first known U.S. drone strike outside of Afghanistan hit Yemen in 2002, and the U.S. did not carry out a strike for another seven years. Strikes in Yemen began to spike in 2011, as the Obama administration began using drones to support the Yemeni government's battles against al-Qaeda linked militants. Both the CIA and the Pentagon are involved, using Camp Lemmonier in Djibouti and a base in Saudi Arabia to carry out the attacks. In 2007, al-Qaeda in Yemen and al-Qaeda in Saudi Arabia united to form al-Qaeda in the Arabian Peninsula (AQAP). Unlike in Pakistan, where drone strikes target multiple terrorist groups, the Yemen strikes have exclusively targeted AQAP. AQAP is considered the most dangerous of al-Qaeda's affiliates and franchises. Since bin Laden was killed in 2011 and Islamic State emerged a year later, al-Qaeda has struggled. The AQAP branch is an exception; it has been able to gain territory and control, as the war between the Houthi

rebels and the government destabilizes the country. The AQAP has been active in 16 of Yemen's 21 governorates (Bureau of Investigative Journalism 2016).

3 Hypotheses, Data-Set, and Variables

3.1 Hypotheses

I tested two opposite hypotheses in this paper, both of which seemed plausible given the current conflicting evidence on drone strikes.

H1: All else equal, drone strikes decrease incidents of terrorism.

H1 comes from the mission of the drone campaign, which is to take out high value targets in terrorist groups like AQAP (Obama 2013). This theoretically works to limit terror activity in three ways. First, taking out dozens or even hundreds of senior leadership seriously hinders the efficacy of terrorist operations, as mid-level operatives who are inexperienced must replace the individuals who were the most connected and best trained. Second, the fringes of the terrorist networks, like local tribesmen, are less willing to associate with militants who have become magnets for drone strikes. Local people are used for recruitment and other tasks within the terror network. Third, attacks limit large gatherings or open training because of the constant threat of surveillance and the target such a large gathering creates. Communication and skill dissemination become more difficult (Williams 2010). Beyond the theoretical, there is empirical evidence that terrorist groups with decapitated leadership have a significantly higher mortality rate than non-decapitated terrorist groups (Price 2012).

H2: All else equal, drone strikes increase incidents of terrorism.

H2 posits that drone strikes will be counterproductive to their intention if they radicalize individuals in the target country who would not otherwise join the terrorist network. The radicalization would be a result of the civilian deaths from drone strikes. Civilian deaths make

excellent propaganda, and newspapers in Pakistan and Yemen can and do exaggerate the civilian deaths from drone strikes without fearing a fact-check. Terrorist groups can utilize civilian deaths as a recruitment tool to encourage individuals to seek revenge against the U.S. and the weak national government (Williams 2010). As for the effect that decapitated leadership has on a terrorist organization, the research is not conclusive. Contradicting Price's 2012 study is research showing that decapitating terrorist organizations is not an effective tool because it rarely results in their collapse, rendering decapitation action ineffective and even counterproductive (Jordan 2009).

3.2 Data and Variables

I used the same data for my analysis in both Pakistan and Yemen. To examine the effect of drone strikes, I combined detailed data on U.S. drone strikes originally collected by researchers from the Bureau of Investigative Journalism (BIJ) with incident-level data on terrorist activities during the same time period compiled in the Global Terrorism Database (GTD) from the National Consortium for the Study of Terrorism and Responses to Terrorism at the University of Maryland. In Pakistan, I restrict the time period from January 2007 through October 2015. In Yemen, I restrict the time period from April 2011 through December 2015. I went to Harvard's Center for Geographic Analysis to merge the two datasets, where I was able to match the latitude and longitude coordinates given in the terrorism dataset with the agency or province given in the Pakistan or Yemen drone dataset.

The BIJ data on drone strikes includes information on the date and location of each strike, the high and low estimates of civilian fatalities that have occurred in each strike, the high and low estimates of militant deaths that have occurred in each strike, and the sources of information that were used to compile each summary. The data were compiled from reports in reputed

international news media sources, such as CNN, the Wall Street Journal, and the New York Times, and from sources specific to the country where the drone strikes took place. In Pakistan, local sources included Dawn, Express Tribune, and The Nation, while in Yemen, local sources included Yemen Post, Yemen Times, and Yemen Observer. Other sources that are not traditional news outlets include the New America Foundation (NAF) and WikiLeaks diplomatic cables.

The GTD defines terrorist acts "as the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation," and it only includes acts that meet this definition. Additionally, the incident must be intentional and entail some level of violence or immediate threat of violence, and the perpetrators must be sub-national actors. Insurgency, hate crime, and organized crime are not included as terrorism.

Previous papers on drone strikes have used the NAF data. I am confident in the credibility of the BIJ data, as it has been cited by publications like the New York Times and the Economist. Also, the BIJ cross-references its findings with the NAF. Additionally, the NAF and the BIJ employ a similar methodology of collecting data on drone strikes by compiling information from many of the same international and local news sources. Previous papers on drone strikes have used the Worldwide Incidence Tracking System (WITS) data. I opted for the GTD because the WITS data was discontinued after 2011, while the GTD is still being maintained and has data as recently as 2015. The 2012-2015 period warrants analysis, as the drone strike program is robust in Yemen and is in decline but not insignificant in Pakistan. The BIJ is updated in real time as strikes are reported, but I could not use any of the 2016 drone data because the GTD has only released data through 2015.

My dataset contains information on the following variables at the agency-week (Pakistan) or province-week (Yemen) level.

Independent Variable

UAV: The number of drone strikes in a given agency (Pakistan) or province (Yemen) and week.

Dependent Variable

Incidents: The number of terrorist incidents or attacks in a given agency (Pakistan) or province (Yemen) and week.

Anyterror: A dummy variable with a value of one if there was one or more terrorist incidents in a given province or agency that week and a value of zero if there were zero terrorist incidents in a given province or agency that week.

4 Methods and Econometric Strategy

To examine the effects of drone strikes on terrorism in Pakistan and Yemen, I estimate a two-level fixed-effect (2FE) model with both agency and temporal (week) fixed effects, similar to that of Johnston and Sarbahi (2015). Letting *i* denote the cross sectional index, which for Pakistan are the FATA agencies and for Yemen are the provinces, and *t* the time index (weeks), a two-level fixed effect equation is given by

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

where *y* measures the incidents of terrorism, *x* is the number of drone strikes, α_i are agency or province fixed effects, and h_t are time (week) fixed effects. Additionally, I cluster standard errors by the agency and province level for Pakistan and Yemen, respectively, to allow for serial correlation within a province or agency.

To measure the effect of a drone strike in the future, I estimate a similar 2FE model with both agency and temporal effects as shown in the previous equation. However, I add in a distributed lag structure by including six one-week lags of drone strikes.

$$y_{it} = \alpha_i + \beta_0 x_{it} + \ldots + \beta_k x_{i(t-p)} + h_t + \epsilon_{it}$$

t is still the time index in weeks, and *p* represents the number of weeks since the drone strike occurred. For example, X_{t-1} or β_1 is a terror attack one week after a drone strike.

My decision to use the week, rather than the month, as the unit of analysis is motivated by the fact that the week-to-week timing of drone strikes is subject to several quasi-random factors, an idea advanced by Johnston and Sarbahi (2015). Although the planning of a drone strike for a specific target takes between five and seven months, the actual week the drone strike occurs once the target is definitively identified depends on plausibly exogenous factors (Drone Papers 2015). First, the weather conditions need to be correct; for example, it cannot be a cloudy day. Second, the correct lawyers and decision-makers in the U.S. need to be available when the strike is to occur. Although work schedules of these individuals may seem trivial, a drone strike cannot happen without proper sign-off. Third, the drone that ultimately identifies the target may not be a weaponized drone, as the military and CIA also employ non-weaponized drones used exclusively for surveillance. If this is the case, a weaponized drone will need to be requested for deployment on the target. Fourth, the timing of when drone operators are able to get a clean shot on the target is likely to be random within a week. These factors combined mean a drone strike could occur in the preceding or following agency-week/province-week as in the current one, and weekly comparisons of differences in terrorist violence across geographies become a means of causal identification. Finally, using weekly data makes the unit-of-analysis temporally small, which increases the validity of the identifying assumptions.

My analysis in Pakistan and Yemen differs in two fundamental ways, which is geography and terrorist group. In Pakistan, I examine FATA, a very specific region of Pakistan, because nearly all drone strikes occurred in this region. In Yemen, I examine 16 of the 21 provinces in the country because drone strikes in Yemen occur with greater geographic diversity, and there is not a region of the country that holds an historical significance in the way FATA does. I would have included all 21 provinces, but the AQAP were only active in 16 of them. In Pakistan, I examine terror activity by all terror actors, whereas in Yemen I examine terror activity by the AQAP only. Although there are other terror actors in Yemen, drone strikes in Yemen exclusively target AQAP. Additionally, not all terror actors in Pakistan claim responsibility for their attacks, so attributing terror attacks to specific actors would not be an effective strategy. The AQAP claims responsibility for their attacks.

5 Descriptive Statistics and Graphs - Pakistan

The time-series of my agency-week dataset spans the period from January 1, 2007 through October 30, 2015. The start date was chosen because drone strikes in Pakistan started occurring more frequently in January 2007. The end date was selected because it is about six weeks after the last drone strike of 2015. As of this paper's date, there have been 424 drone strikes in Pakistan between June 2004 and May 2016. After adding in my restrictions of geography (only those strikes occurring in FATA) and time frame, there have been 411 strikes. Descriptive statistics of key variables over this time period are shown in Table 1.

Figure 1 shows the time trends in drone strikes and terrorist attacks. Terror attacks began to increase in frequency during the end of 2007, and by early 2008 they were on a steady upwards trend. Drone strikes also increased in frequency during the beginning and middle of 2008, and this was likely a response to the increased terrorism. Drone strike activity peaked in

2011 before dropping off to a lower level for 2012 and 2013. 2014-2016 has seen drone activity similar to 2008. Terror activity reached its highest levels during the beginning of 2012 and 2014, but finally showed a downward trend during the end of 2015. At the agency level, Figure 3 shows that North Waziristan closely mirrors the macro trend, while South Waziristan and Khyber fluctuate more. Drone strikes are relatively rare in the rest of FATA. Figure 2 shows the spatial distribution of terror activity in the FATA region of Pakistan.

Figure 1. Pakistan Time Trends in Drone Strikes and Terrorist Attacks, Monthly

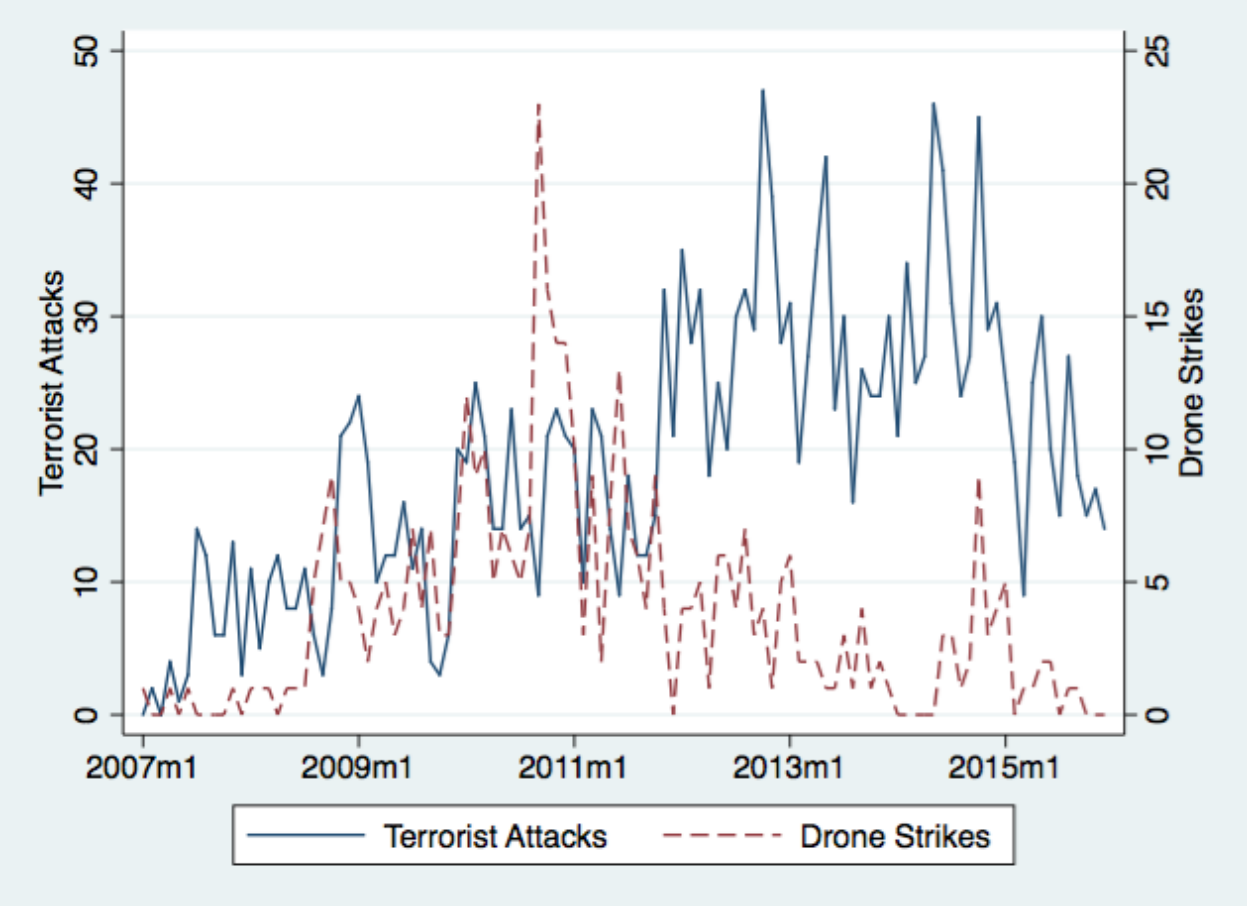
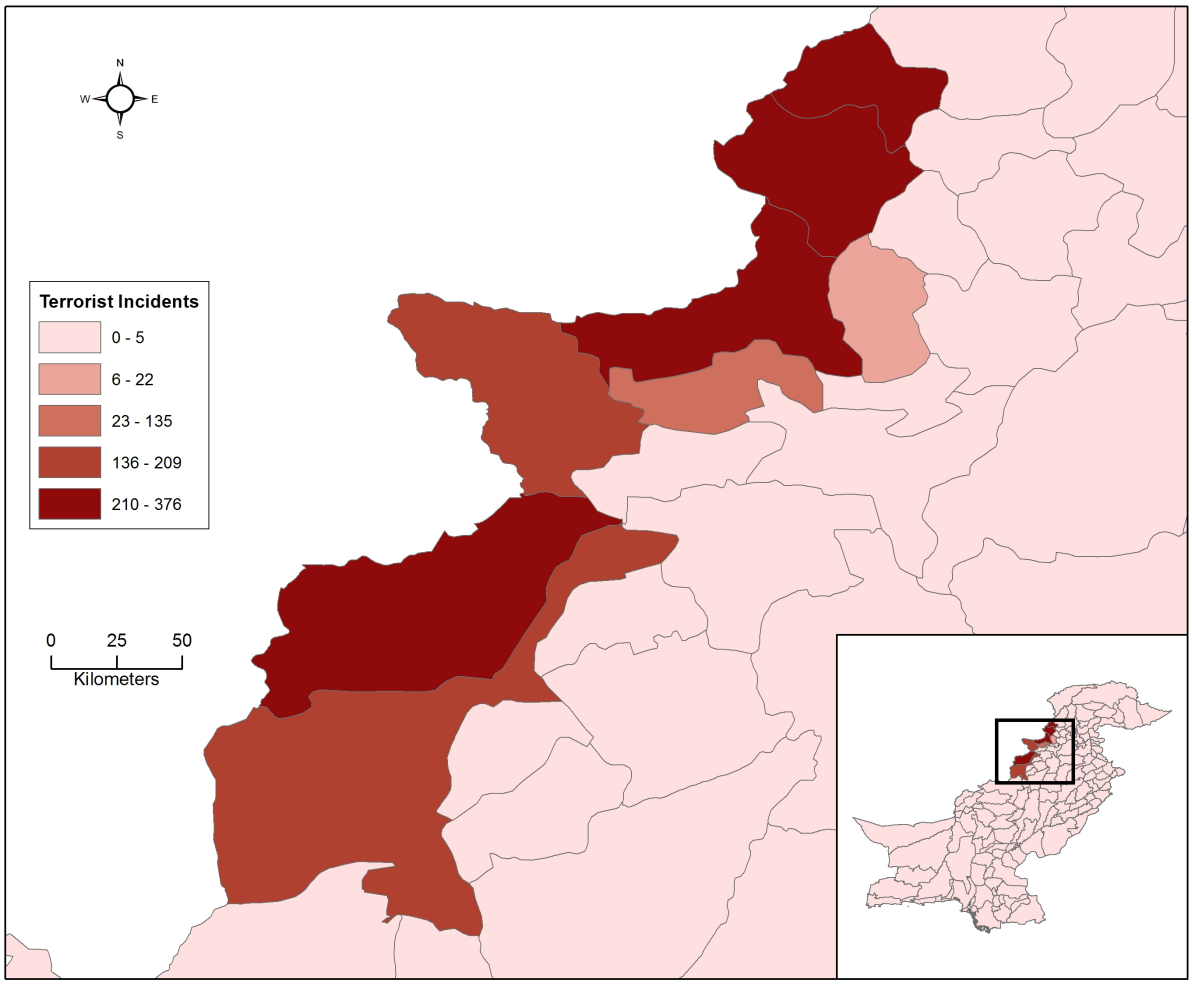


Table 1. Summary Statistics for Pakistan from Jan 2007- Nov 2015, Weekly

	FATA				
Variable	Total	Mean	Std. Dev.	Min	Max
UAV	411	0.112	0.511	0	8
Incidents of Terrorism	2,032	0.553	1.067	0	10
All Killed by UAV	2,361	0.643	3.551	0	77
Civilians Killed by UAV	326	0.089	0.866	0	22
Observations	3672				

Note: Reported figures on individuals killed by UAVs represent the minimum number of people killed. Actual figures may be higher.

Figure 2. Spatial Patterns in number of Terrorist Attacks in the FATA region of Pakistan Jan 2007 to Nov 2015



Notes: The Terrorist Incidents key applies to the FATA region only and not the rest of Pakistan. Map created by Harvard Center for Geographic Analysis.

Figure 3: Time Trends in Drone Strikes and Terrorist Attacks by Agency

6 Empirical Results - Pakistan

Table 2 gives estimation results of the drone strike reaction functions. A drone strike reduces the weekly rate of terror by 0.131 incidents of terrorism per week relative to a mean of 0.367 incidents of terrorism per week. This is a decline of 35.8% in the weekly rate of terror, and this decline is statistically significant at the 2.5% level of significance. Using the variable *Anyterror,* which is a dummy variable representing one if there was any terrorist attack in a given week and zero if there was not, I found a drone strike reduces the probability of a terrorist attack happening in a given week by 5.7%. This is statistically significant at the 5% level of significance.

Table 3 gives estimation results for the 2FE model that includes one one-week lead and six one-week lags, and Figure 4 depicts these results graphically. The independent variable is *UAV* and the dependent variable is the dummy *Anyterror.* What I found is a fade-out effect, where the drone strike is initially effective at reducing terrorism, but this effect does not persist long term. The impact effect of a drone strike on terrorism is to decrease the probability of a terrorist incident by 4.9%, and this is statistically significant at the 1% level of significance. However, at *t*-1*,* just one week after the drone strike, the probability of a terror attack happening *increases* by 4.2%, and this is statistically significant at the 5% level of significance. From weeks two through weeks six, the change in the probability of *Anyterror* was not significant. The cumulative two-week effect of drone strikes on *Anyterror* was also not significant. The one-week lead shows that the probability of *Anyterror* one week before a drone strike is 2.6% less than the mean, but this is not significant.

Table 2: Pakistan Drone Strikes and Terrorist Incidents: 2FE Estimates

	Incidents	Anyterror
UAV	-0.131**	-0.057**
	(0.04)	(0.02)
Observations	3,213	3,213
R-squared	0.207	0.218
Clusters	7	7
Time Fixed Effects	Yes	Yes
Agency Fixed Effects	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 4: The Duration of the Effect of Drone Strikes in Pakistan

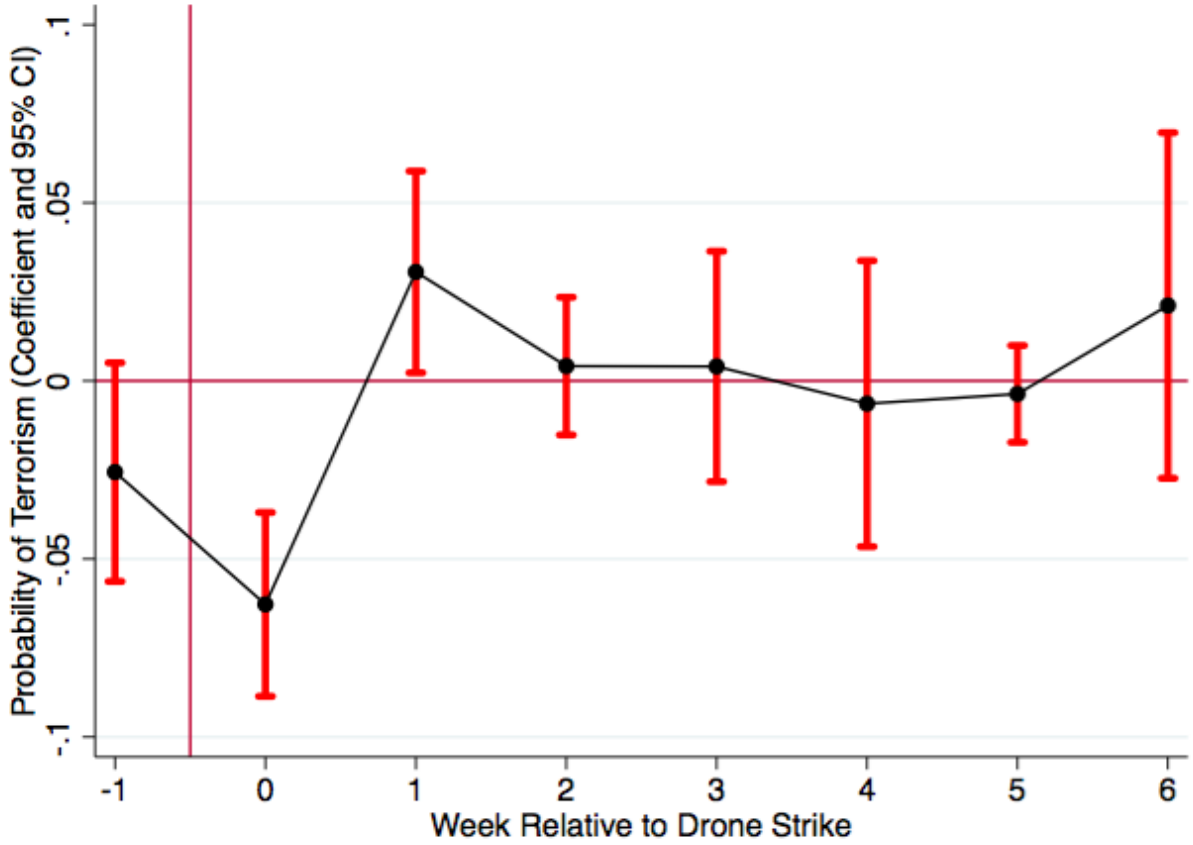


Table 3: The Duration of the Effect of Drone Strikes in Pakistan

	Anyterror
UAV_{t+1}	-0.026
	(0.02)
UAV	-0.050***
	(0.01)
UAV_{t-1}	0.042**
	(0.01)
UAV_{t-2}	0.015
	(0.01)
UAV_{t-3}	0.004
	(0.02)
UAV_{t-4}	0.000
	(0.02)
UAV_{t-5}	0.001
	(0.01)
UAV_{t-6}	0.030
	(0.02)
Cumulative Effect: 2 weeks	0.008
	(0.04)
Observations	3213
R-Squared	0.223
Clusters	7
Time Fixed Effects	Yes
Agency Fixed Effects	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7 Descriptive Statistics and Graphs – Yemen

The time-series of my province-week dataset spans the period from April 2011 through December 2015. The start date was chosen because drone strikes in Yemen started occurring with regularity in April 2011. The end date was selected because the last drone strike of 2015 occurred in December. As of this paper's date, there have been 249 drone strikes in Yemen

between March 2002 and October 2016. Restricting for the time frame this paper uses, there have been 198 strikes. Descriptive statistics of key variables over this time period are shown in Table 4.

Figure 5 shows the time trends in drone strikes and terrorist attacks throughout Yemen from January 2011 through December 2015. Drone strikes occur with regular frequency around April 2011, and they seem to be in direct response to increased AQAP activity. Drone strikes taper off but then reach their peak in the middle of 2012, which also seems to be in response to the spiked levels in AQAP activity from a month earlier. Indeed, early 2012 saw many political leaders in the Saudi and U.S.-backed Hadi regime targeted and assassinated by AQAP. Qualitatively, the U.S. seems to be behaving reactively rather than proactively in the beginning year of its drone strikes in both Yemen and Pakistan. Drone strikes and terrorism by AQAP in Yemen move roughly in tandem until the middle of 2014 when there is a big divergence between drone strikes, which reach their lowest levels, and terrorism, which reaches its highest level. Figure 6 shows the spatial patterns of terrorist attacks by AQAP. AQAP controls territory in the northwest region of Yemen but conducts its attacks primarily in the central and south provinces. The U.S. has concentrated its drone strikes in the central and south provinces.

Figure 5. Yemen Time Trends in Drone Strikes and Terrorist Attacks, Monthly

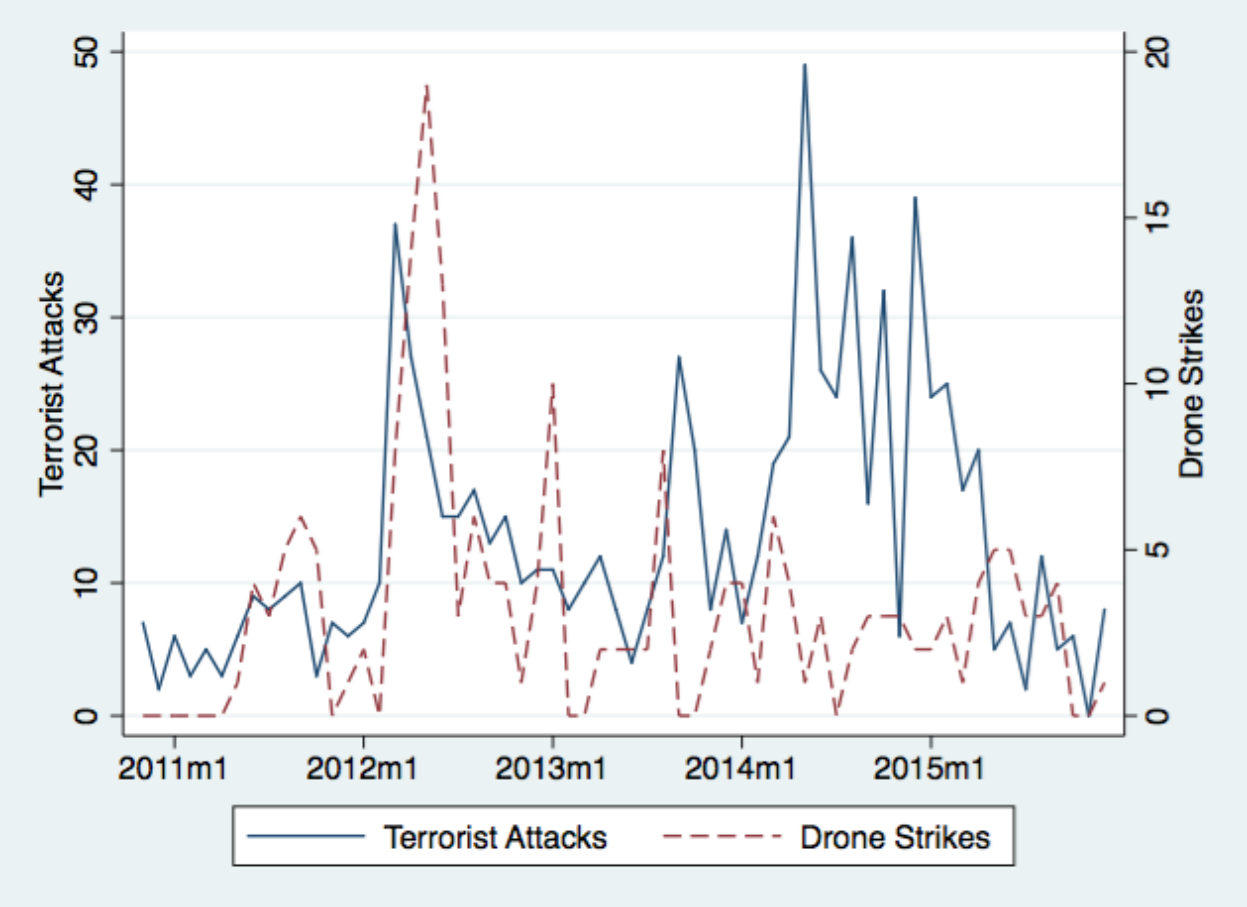
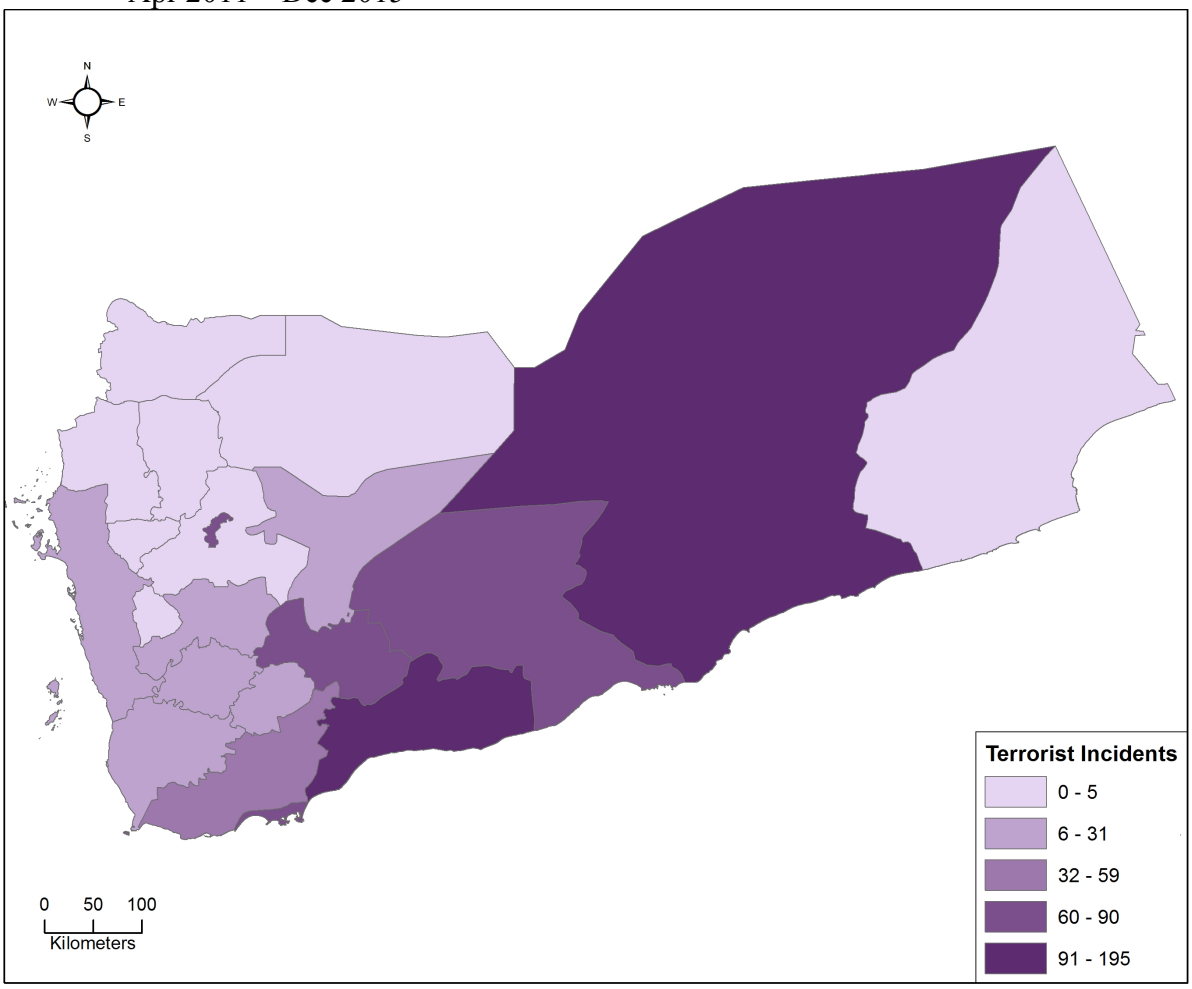


Table 4. Summary Statistics for Yemen from Apr 2011- Dec 2015, Weekly

	FATA				
Variable	Total	Mean	Std. Dev.	Min	Max
UAV	249	0.021	0.189	0	7
Incidents	871	0.075	0.403	0	10
All Killed by UAV	1,273	0.109	1.457	0	55
Civilians Killed by UAV	166	0.014	0.544	0	44
Observations	11,648				

Note: Reported figures on individuals killed by UAVs represent the minimum number of people killed. Actual figures may be higher.

Figure 6. Spatial Patterns in number of Terrorist Attacks by AQAP in Yemen
Apr 2011 – Dec 2015



Note: Map created by the Harvard Center for Geographic Analysis.

8 Empirical Results – Yemen

Table 5 gives estimation results of the drone strike reaction functions when *Incidents* is the dependent variable and when *Anyterror* is the dependent variable. I did not find that drone strikes changed *Incidents*, which is the weekly rate of terror, in a statistically significant way. Using the variable *Anyterror,* which is a dummy variable representing one if there was any terrorist attack in a given week and zero if there was not, I found a drone strike reduces the probability of a

terrorist attack happening in a given week by 5.0%. However, this is statistically significant at the 10% level of significance, which is a non-conventional measure of significance.

Table 6 gives estimation results for the 2FE model that includes six one-week lags, and Figure 7 depicts these results graphically. The independent variable is *UAV* and the dependent variable is the dummy *Anyterror.* The impact effect of a drone strike on terrorism is to increase the probability of a terrorist incident by 3.3%, and this is statistically significant at the 5% level of significance. However, at t-2*,* two weeks after a drone strike, the probability of a terror attack happening *decreases* by 2.1%, but this is statistically significant only at the 10% level of significance. The cumulative two-week effect of drone strikes on *Anyterror* was also not significant.

Table 5: Yemen Drone Strikes and Terrorist Incidents: 2FE Estimates

	Incidents	Anyterror
UAV	0.186	0.050*
	(0.11)	(0.03)
Observations	3,888	3,888
R-squared	0.098	0.093
Clusters	16	16
Time Fixed Effects	Yes	Yes
Province Fixed Effects	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 7. The Duration of the Effect of Drone Strikes in Yemen

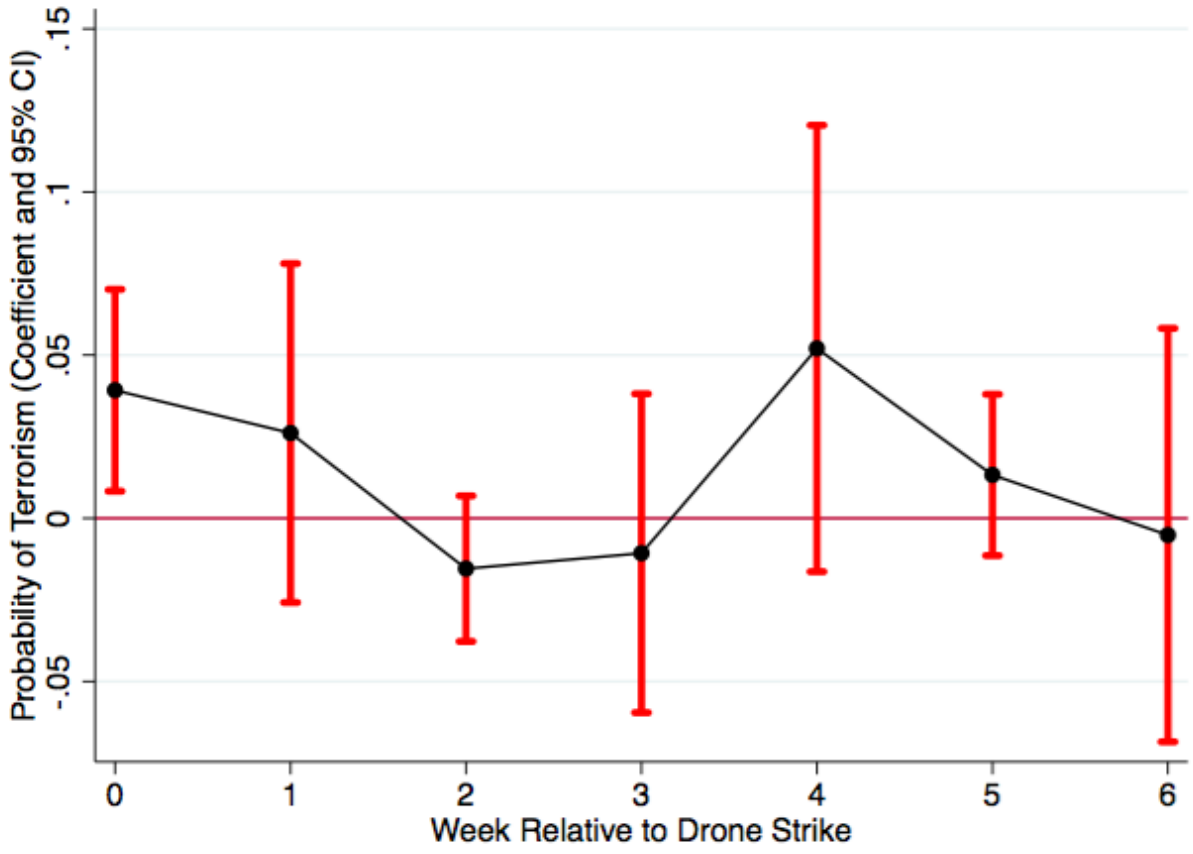


Table 6: The Duration of the Effect of Drone Strikes in Yemen

	Anyterror
UAV	0.033**
	(0.01)
UAV_{t-1}	0.019
	(0.03)
UAV_{t-2}	-0.021*
	(0.01)
UAV_{t-3}	-0.018
	(0.02)
UAV_{t-4}	0.050
	(0.03)
UAV_{t-5}	0.016
	(0.01)
UAV_{t-6}	-0.010
	(0.03)
Cumulative Effect: 2 weeks	0.030
	(0.03)
Observations	3,888
R-Squared	0.098
Clusters	16
Time Fixed Effects	Yes
Province Fixed Effects	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

9 Limitations

There are some limitations worth discussing in this analysis. There is a margin of error in using any dataset on drone strikes that does not come directly from the government. Since the government does not publish detailed records of its drone strikes, using data from a credible news organization that corroborates each report of a drone strike with multiple sources is the next best option. Another limitation was using clustered standard errors for the Pakistan analysis

because only seven clusters were used, biasing the standard error downwards. Lastly, although this paper provided a reasonable argument for interpreting drone strikes as causal, it is possible that simultaneous causality and omitted variable bias prevents a causal interpretation.

10 Conclusion

This paper used the Global Terrorism Database and the Bureau of Investigative Journalism's data on drone strikes to investigate the relationship between drone strikes and terrorism in both Pakistan and Yemen. My analysis produced results that were not consistent across Pakistan and Yemen, as the results in the two countries actually contradicted one another. In the FATA region of Pakistan, I observed a "fade out" effect; I found evidence that drone strikes decreased both the weekly rate of terror attacks and the probability of any terror attack, but these results were limited to a short time frame of within one week of the drone strike. After one week, the probability of a terror attack increased. This suggests that the effect of drone strikes is short term. From a policy perspective, this suggests that frequent drone strikes - as many as one a week - would be an effective way to decrease the probability of a terror attack. Indeed, from 2009-2012 the U.S. averaged at least one drone strike per week in Pakistan. My analysis on Yemen was less conclusive than on Pakistan, but it still produced results worth discussing. I found evidence that within the first week of a drone strike, the probability of a terror attack increased. The increased effect was not persistent past the initial days of the strike. In neither Yemen nor Pakistan was the two-week cumulative effect of drone strikes on terror attacks significantly different than zero.

Perhaps the effect differs across Yemen and Pakistan because of the vastly different political environments in these countries. Pakistan has a relatively strong central government with an engaged military that has been committed to fighting various militant groups since it entered into an armed conflict in 2004. The U.S. has thus been able to work in parallel with the

Pakistani government, even if the government has at times opposed U.S. actions. Yemen, in contrast, does not have a stable central government, and it is engaged in a civil war. When the U.S. works with Saudi Arabia to give support to Yemen's Hadi, it is fighting not only the AQAP but also the Houthi rebels and Iran. Drone strikes may merely contribute to the strife and chaos between the government and the Houthi rebels, providing more opportunities for AQAP than if the only actor the state had to fight was AQAP.

The question of drone warfare remains highly relevant. Although the drone targeting in Pakistan has been in decline, and the U.S. reduced their purchases of Reaper drones in 2014 in hopes of moving away from the Middle East, the purchases of Reaper drones in 2016 was the most since 2013 (Tucker 2015). This reflects a shift back to the Middle East with the rise of the Islamic State. In Yemen, 2016 has been the year with the second-most drone strikes since the program began in 2011. The U.S. is not the only country to be deploying drones. As recently as October 2016, the Islamic State successfully used a drone with explosives to kill Kurdish troops on the battlefield. Recognizing that the enemy is developing and using sophisticated weaponized drones will likely factor into the discussion about the U.S.'s use of the technology.

References

"Al-Qaeda in the Arabian Peninsula: An Exceptional Franchise | The Economist." *The Economist*. The Economist Newspaper, 25 Apr. 2015. Web. 27 Nov. 2016.

"CIA Drone Strikes in Pakistan, 2004 to Present." *The Bureau Investigates*. The Bureau of Investigative Journalism, 15 Oct. 2016. Web. 20 Nov. 2016.

"Drones: Killing Outside the Bounds of Law?" *Amnesty International USA*. 2016. Web. 27 Nov. 2016.

Entous, Adam. "Obama Acknowledges Drone Strikes." *WSJ*. Wsj.com, 15 June 2012. Web. 27 Nov. 2016.

Gentilviso, Chris. "Jimmy Carter: Drones Create More Terrorists." *The Huffington Post*. TheHuffingtonPost.com, 25 Mar. 2014. Web. 27 Nov. 2016.

Gertz, Bill. "Orlando Terror Attack 'Triggered' by Pentagon Drone Strike." *Washington Free Beacon*. 28 Sept. 2016. Web. 27 Nov. 2016.

"Global Terrorism Database." *Start.umd*. University of Maryland, 31 Dec. 2016. Web. 20 Nov. 2016.

Jaeger, David A., and Zahra Siddique. "Are Drone Strikes Effective in Afghanistan and Pakistan? On the Dynamics of Violence between the United States and the Taliban." *IZA* (2011): Web.

Johnston, Patrick B., and Anoop K. Sarbahi. "The Impact of U.S. Drone Strikes on Terrorism in Pakistan." *RAND Corporation* (2015): 1-52. Web.

Jordan, Jenna. "When Heads Roll: Assessing the Effectiveness of Leadership Decapitation." *Security Studies* (2009): 719-55. Web. 25 Nov. 2016.

Kutsch, Tom. "Documents Reveal Pakistan Approved US Drone Strikes." *Al Jazeera America*. 24 Oct. 2014. Web. 27 Nov. 2016.

Liptak, Kevin. "WH Reveals Number of Civilian Deaths from Drone Strikes." *CNN*. Cable News Network, 1 July 2016. Web. 27 Nov. 2016.

Maqbool, Aleem. "2011: New Low for US-Pakistan Relations." *BBC News*. N.p., 31 Dec. 2011. Web. 27 Nov. 2016.

Obama, Barack. "Remarks by the President at the National Defense University." *Whitehouse.gov*. 23 May 2013. Web. 24 Nov. 2016.

Price, Bryan. "Targeting Top Terrorists: How Leadership Decapitation Contributes to Counterterrorism." *International Security* 4.36 (2012): 9-46. Web. 23 Nov. 2016.

Smith, Megan, and James I. Walsh. "Do Drone Strikes Degrade Al Qaeda? Evidence from Propaganda Output." *Terrorism and Political Violence* (2013): 311-27. Web. 23 Nov. 2016.

"Summary of Information Regarding U.S. Counterterrorism Strikes Outside Areas of Active Hostilities." *Office of the Director of National Intelligence*. White House, 1 July 2016. Web. 27 Nov. 2016.

"The Drone Papers: Small Footprint Operations 2/13." *The Intercept*. N.p., 15 Oct. 2015. Web. 25 Nov. 2016.

"The Drone Papers: Small Footprint Operations 5/13." *The Intercept*. N.p., 15 Oct. 2015. Web. 25 Nov. 2016.

"Times Square Bomb Suspect Was Upset Over Drone Attacks, Source Says." *Fox News*. FOX News Network, 05 May 2010. Web. 27 Nov. 2016.

Tucker, Patrick. "White House Wants More Reaper Drones To Fight ISIS." *Defense One*. 2 Feb. 2015. Web. 24 Nov. 2016.

"U.S. Strikes in Yemen, 2002 to Present." *The Bureau Investigates*. The Bureau of Investigative Journalism, 15 Oct. 2016. Web. 20 Nov. 2016.

Walsh, James I. "The Effectiveness of Drone Strikes in Counterinsurgency and Counterterrorism Campaigns." *Strategic Studies Institute* (2013): 1-61, *U.S. Army War College*. Web. 24 Nov. 2016.

Williams, Brian G. "The CIA's Covert Predator Drone War in Pakistan, 2004–2010: The History of an Assassination Campaign." *Studies in Conflict and Terrorism*(2010): 871-92. Web. 25 Nov. 2016.