The Microdynamics of Reciprocity in an Asymmetric Conflict : Hamas, Israel, and the 2008-2009 Gaza Conflict*

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Abstract

The Gaza Conflict (2008-2009) between Hamas and Israel was defined by the unequal balance of military power. Hamas used the civilian population and hit-and-run tactics to reduce Israel's military advantage. Israel was forced to adapt and try to target Hamas, while minimizing collateral damage. Building on previous theories of strategic interaction between strong (Israel) and weak (Hamas) actors, I develop a theory of asymmetric conflict. Using a novel data set of hourly conflict intensity scores from `Twitter` and other social media sources over the nearly 600 hours of the conflict, I test the theory's implications. I find that over the whole course of the conflict Israel more responds to Hamas provocations than vice versa. Additionally, I find that both Hamas' and Israel's response intensity change after the Israeli Ground Invasion (they both increase) and the UN Security Council Vote (Hamas' increases and Israel's decreases).

1 Introduction

> "We were fighting a modern 21st-century army, and we're just a guerrilla resistance movement... what did you expect–for us to stand in a field and wait for the Israelis to mow us down?"- Gaza commander in the Izzedin al-Qassam brigades on Hamas' tactics during the conflict (McGirk and Klein, 2009)

On December 27, 2008, at approximately 11:30 am (Israeli time), the Israeli Air Force (IAF) began a massive bombardment of Hamas targets throughout the Gaza Strip.[1] The IAF bomardment was in response to the barrage of Qassam and Grad rockets[2] fired into Israel since Hamas ended its

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[1] See http://www.israelemb.org/ for more information.

[2] Most of the rockets fired into Israel are of the "homemade" Qassam variety with a range of 3-12 km and are highly inaccurate. However, the longer range Grad rocket has a range of 18-20 km, and is manufactured by the Iranians. See `http://www.globalsecurity.org/military/world/para/hamas-qassam.htm`

self-imposed cease-fire on December 19th, 2008. The continued Hamas rocket attacks would serve as the pretext for the eventual Israeli ground invasion.

On January 4th, 2009, Israeli Defense Force (IDF) ground forces, including tanks and large-scale infantry, entered Gaza and remained until January 21st, 2009. Occasional heavy skirmishes and fierce battles (particularly around Gaza City) occurred, yet the ground conflict mostly mirrored the asymmetry in air power with Hamas using close-quarter, hit-and-run tactics and Israel heavy, mechanized infantry. Israel's overwhelming superiority of force was also reflected in the lopsided casualty numbers. By the cessation of hostilities, approximately 1300 Palestinian deaths compared to just 13 Israelis killed were attributed to the month long fighting (The Economist, 2009). Experts argued that the specter of the February 2009 Israeli elections and Hamas' continued struggle with Fatah (Palestinian Authority) for political control of Gaza further shaped the conflict and each actors' strategic interests (Hass, 2009; Press, 2009).

The September 2009 release of the controversial[3] *Report of the United Nations Fact Finding Mission on the Gaza Conflict* (otherwise known as "The Goldstone Report"[4]) questions the proportionality of the Israeli military response and criticizes Israel for targeting civilians (United Nations Human Rights Council, 2009). The Mission concluded that

> "The principle of proportionality acknowledges that under certain strict conditions, actions resulting in the loss of civilian life may not be unlawful. What makes the application and assessment of proportionality difficult in respect of many of the events investigated by the Mission is that deeds by Israeli forces and words of military and political leaders prior to and during the operations indicate that as a whole they were premised on a deliberate policy of disproportionate force aimed not at the enemy but at the 'supporting infrastructure."'- (par. 1683)

Central to the Mission's criticism is an implicit argument that stronger actors (Israel) should

[3]Much has been made of the perceived impartiality, or lack there of, of the Mission and its subsequent report. Israel has refused to cooperate with the investigation, citing biases against Israel in its dealings with the UN Human Rights Council's. The Head of the Palestinian Authority, Mahmoud Abbas, after responding to domestic political pressure over his initial reluctance to support the report based on US pressure, endorsed the report. See `http://www.nytimes.com/2009/10/17/world/middleeast/17nations.html?ref=middleeast` for more information.

[4]This is for the namesake of the head of the Mission, former South African Judge Richard Goldstone

use tactical restraint (proportionality) when facing a weaker actor (Hamas) to avoid high civilian casualties. Recent U.S. military campaigns in Afghanistan and Iraq echo this sentiment and highlight the difficulties faced by traditional militaries in conflicts waged amongst a civilian population (US Army and Marine Corps, 2007). Weaker actor's (Hamas) may choose to mitigate a stronger actor's (Israel) perceived advantage by refusing to directly confront a stronger opponent and hiding amongst the civilian population (Galula, 2006). The conundrum faced by a stronger actor, and Israel in the Gaza Conflict, is how to target the weaker actor without alienating the civilian population (and world opinion in the case of Israel).

The Gaza Conflict saw the emergence of social networking and new media sources that vastly increased the speed and dissemination of information from the battlefield. Due to Hamas isolation and the danger of reporting from Gaza, many traditional news media outlets removed their reporters. Al-Jazeera was one of the few news agencies that had reporters on the ground in Gaza. To facilitate information collection, they set up a crowdsourcing reporting platform through `Ushahidi`.[5] This allowed citizens and reporters to send `SMS` and `Twitter` messages through their cellular phones or computer to a database where Al-Jazeera would then authenticate the stories (AJGaza, 2009).

Most dynamic studies of conflict use data that are aggregated monthly (Brandt, Colaresi and Freeman, 2008; Goldstein and Freeman, 1990) or occasionally daily (Kavanagh, 2009) and are from a single source. The widespread interest and introduction of social media sources allowed minute-by-minute monitoring of conflict dynamics in Gaza, with the ability to cross-check sources. From the Israeli perspective, real-time live-bloggers, including the *QassamCount* `Twitter` feed (QassamCount, 2009) and *The Muqata* blog (The Muqata, 2009) also kept minute-by-minute accounts of Hamas rocket fire and updates of Israeli positions in Gaza. The IDF also kept a blog in which they gave daily summaries of their battle interactions (Israeli Defense Forces, 2009*b*). Merging these sources, I have created a unique database that codes Hamas and Israeli dyadic actions in 15-minute intervals and aggregates those interactions to the hour level.

Building on previous work of conflict dynamics (Brandt, Colaresi and Freeman, 2008; Goldstein

[5] `Ushahidi` is a platform that allows for researchers and organizations to track information and violence in conflict zones using a computer platform and `SMS` messaging (text messages). For more information visit `http://www.ushahidi.com/`

and Freeman, 1990), this unique data set provides a means for testing theories of strategic interaction in asymmetric conflict–particularly how control of the terrain (the Israeli Ground Invasion) and each sides' sensitivity to international pressure (UN Security Council Vote) shape the actors' response dynamic. Since Hamas and Israeli interactions are functions of each other's actions and their own, a vector autoregression (VAR) is an appropriate method to explore strategic dynamics (Brandt and Williams, 2007). Using the cumulative impulse response function in the VAR framework, I find evidence that Israel responds with greater intensity (about five times as much as Hamas did) to a Hamas escalation. Additionally, I find that both Hamas' and Israel's cumulative response to an escalation by the other increases two-fold after the Israeli Ground Invasion begins. Hamas' response slightly increases after the UN Security Council vote on January 8th, 2009 for an immediate cease-fire, while Israel's response is cut in half.

The structure of the paper is as follows. In Section 2, I explore previous research on violence and reciprocity and introduce a theory of asymmetric conflict. Sections 3 and 4 outline my method of data collection and empirical framework. Sections 5 and 6 report the results of the statistical analysis and substantive interpretation. Section 7 provides a detailed case study of the shelling near the UNRWA[6] school (Al-Fakhura) that highlights the difficulty faced by IDF soldiers operating in a civilian population. Section 8 offers some suggestions for future research. For further explanation of the coding method and statistical analysis refer to the Appendix.

2 Theories of Violence and Reciprocity in an Asymmetric Conflict

2.1 Previous Work

Asymmetric conflict–where weaker opposition face a smaller opponent–was originally posed as an international relations puzzle by Mack (1975). If military power is the main determinant of victory, how do stronger powers lose conflicts against weaker ones (France in Algeria and the U.S. in Vietnam)? More recent work by Arreguín-Toft (2001, 2006) argues that tactics determine the outcomes

[6]United Nations Relief and Works Agency for Palestine Refugees in the Near East

of war. When strong actors confront weak actors with like-minded tactics (i.e. conventional with conventional or unconventional with unconventional), strong actors prevail. However, when they mix tactics and try to fight a weak opponent using unconventional tactics with conventional tactics, they tend to be less successful. While Mack (1975) and Arreguín-Toft (2001, 2006) both provide insights into how tactics affect the outcomes of asymmetric conflict, they do not provide rigorous framework as to why such weak and strong actor's choose their various tactics.

Studies of conflict escalation and deescalation between state actors are based on theories of cooperation. Threats of escalation (punishment) can induce strategies of cooperation even when actors have incentives to defect in the short-term (Axelrod, 1984). A strategy of "tit-for-tat," whereby actors respond to overtures from their opponents in turn —cooperation is met with cooperation and defection with defection— underlines the nature of reciprocity. The dynamics of any conflict involve the strategic use of force in responding to violent or cooperative overtures. Most international relations studies of reciprocity examine this pattern of cooperation and escalation between states largely at parity with each other (Cold War) (Goldstein and Freeman, 1990).

However, there is reason to believe that the Israel-Hamas interactions (2008-2009) might not follow Cold War patterns of reciprocity due to the asymmetry in military power between the two. Bueno de Mesquita and Dickson (2007) present a formal model of interactions between a terrorist group and state (Bueno de Mesquita and Dickson, 2007). They show that under certain conditions, terrorists might attack government forces in order to induce a government response. The harsh government response then further alienates the local population and solidifies the terrorist's support. Lyall (2009) examines the Chechen Conflict (2000-2005) and the role that indiscriminate Russian violence had on insurgency attacks. He hypothesizes that contrary to the extant literature, large-scale, random violence against a civilian population by the state may not induce insurgent recruitment, as it presents organizational obstacles to rebel groups and may turn the population against them (the insurgents) (Lyall, 2009). Using random artillery fire from Russian bases as an instrument, he finds that indiscriminate perpetuated by an incumbent force (Russia) reduces insurgent violence.

With respect to the Israeli-Palestinian conflict, several scholars have found evidence of each

side responding to cooperative or violent overtures. Brandt et al. (2008) study the effects of Israeli and Palestinian public opinion on the Hamas and Israeli cooperation patterns (Brandt, Colaresi and Freeman, 2008). They find evidence of asymmetric reciprocity in "that more bellicose Israeli opinion leads to more immediate cooperation by the Palestinians" and vice versa, sustaining "low-level conflict" (3-4). Kavanagh (2009) studies Israeli and Palestinian response patterns to violence during the Second Intifada (2000-2005). Using VAR analysis of counterterror operations, suicide attacks, and targeting killings she finds evidence of reciprocity, albeit differing in intensity and certainty (Kavanagh, 2009). Israel reacts more intensely and immediately to Palestinian escalation than Palestinians do to Israeli escalation. Based on her analysis of daily fatalities, she finds that Palestinian shocks lead Israel to ramp up their counterterror operations and result in an average of 27 Palestinian deaths in the post-shock week. Palestinian response to Israeli shocks leads to only 1 death in the post-shock week (18-19). Kavanagh's finding of asymmetric responses fits the casualty pattern of the most recent Gaza Conflict.

Tactically, asymmetric conflict tends to be correlated with population-centric warfare (i.e. Vietnam War, Israeli-Palestinian, and Second Boer War etc.). One strategy a weak actor may undertake to mitigate a strong actor's military advantage is to make it difficult for the strong actor to distinguish between them (the weaker adversary) and the civilian population (Arreguín-Toft, 2001, 2006; Mack, 1975). In such a conflict, the civilian population itself becomes the focus of the conflict, with a weaker actor hoping to sway civilians to their side through force, by providing protection, and/or inducing attacks against civilians by the strong actor that bolster the weaker actor's support (Bueno de Mesquita and Dickson, 2007). The stronger actors is thus forced to expand more resources (intelligence and maintaining local presence) to identify the enemy from civilian population or risk alienating the civilian population with indiscriminate violence (Kalyvas, 2006). Lyall and Wilson III (2009) and US and Army and Marine Corps (2007) both argue that in order to defeat a weaker enemy in a counterinsurgency (COIN), or population-centric war, it is necessary to get "boots on the ground" (Lyall and III, 2009; US Army and Marine Corps, 2007). Similarly Lt. Col. John Paul Vann observed in Vietnam:

> "This (the Vietnam War) is a political war and it calls for discrimination in killing. The best weapon for killing would be a knife, but I am afraid we can't do it that way. The worst is an airplane. The next worst is artillery. Barring a knife, the best is a rifle, –you know who you're killing."

While more costly than indiscriminate violence, maintaining a local presence for the stronger actor facilitates more accurate information on who and where the enemy are and the use of more precise firepower (small arms compared with large-scale artillery), allowing for more selective violence (Kalyvas 165-172). This translates into a stronger actor that uses more precise and proportioned response.

2.2 A Theory of Asymmetric Conflict

The increasing intensity of rocket fire after Hamas ended its cease-fire in late December —while ostensibly the main trigger for the Israeli escalation— conceals a more complicated international and domestic calculus by both sides. To sort out the incentives behind each actor's response pattern during the conflict, it is necessary to analyze the internal and external factors that shaped their responses. For Israelis, several factors contributed to their decision to use large-scale aerial and ground forces. The Israeli elections were a month away and the ruling Kadima party, expecting to face a stiff test from the more right-wing Likud, was loathe to be perceived as "weak" in the face of Hamas antagonism (Press, 2009). Furthermore, the Israeli military was worried about Hamas' increasing military prowess and were mindful of the large casualties they suffered two years previously in their invasion of Lebanon and conflict with Hezbollah (which was widely deemed a failure) (The Economist, 2009). The IDF was hoping to weaken Hamas' ability to launch rockets into Israel while it still enjoyed tactical superiority.[7] Finally, Israel was trying to avoid becoming entangled in a guerilla campaign in the Gaza strip, with entrenched Hamas fighters in densely populated urban environments. Rather, they sought to use their overwhelming force and technological advantages to stymie Hamas' rocket attacks.

[7]Many Israeli observers were worried about Hamas obtaining longer range rockets that were allegedly being smuggled in through tunnels from Egypt from Iran with the capability of striking deeper into Israel.

Hamas was in the midst of its own power struggle with Fatah for the hearts and minds of the Palestinian people. Several pundits have argued that they were banking on a strong Israeli response to their increased rocket fire. This in turn would put Fatah in an awkward place, as they would have to support the Palestinians (and hence Hamas) against Israeli aggression. Furthermore, Fatah would have to deal with dimmer prospects for the peace process with an emboldened right-leaning bloc in Israel(Press, 2009). By engaging Israel militarily before the election, Hamas may have been hoping to marginalize Fatah and insure their own domestic political support. Reports have surfaced that Hamas may also used the conflict in Gaza as a means of arresting and torturing Fatah sympathizers, further emphasizing the internal dimension of Hamas' decision-making (Hass, 2009; International, 2009).

Hamas would not want to confront the stronger Israeli military directly. Rather, one would expect them to use the civilian population to their advantage. If Israel chose to respond to a Hamas attack from a civilian area, then they risked hitting the civilian population. If they restrained from responding to a Hamas attack, then they (Israel) let Hamas escape. Either way, it was advantageous for Hamas to use the civilian population as a tactical advantage.

There were also international constraints on the conflict. Both Hamas' and Israel's domestic security and political concerns were the main constraints on their action, however international pressure to ratchet down the intensity was particularly strong after the UN Security Council Vote (El-Khodary and Kershner, 2009). However, one would expect Israel to be affected more by international pressures than Hamas, as Hamas was already isolated internationally and Israel was diplomatically engaged with Syria and Turkey.[8].

Both domestic and international constraints shaped each actor's tactical interaction. Given election concerns and force superiority, I expect Israel's military actions to be more sensitive to a Hamas provocation (e.g. rocket attack) actions than Hamas's to an Israeli provocation. Israel's ability to respond is shaped by its ability to gather information, identify, and target Hamas militants, many of whom operated among the civilian population. This identification problem, central

[8]See the BBC News Story for more information on the effect of the Gaza Conflict on Israel-Turkey relations. Furthermore, Israel as the perceived aggressor and stronger power would not be wanted to be seen as wantonly attacking Palestinian civilians. This international pressure to discriminate between civilians and combatants will constrain IDF decisions. `http://news.bbc.co.uk/1/hi/world/middle_east/7831496.stm`

to many asymmetric conflicts, defines the precision with which the Israeli military could respond. Before the Israeli Ground Invasion, the IDF would be forced to rely on artillery, bombs, and other blunt (as compared to infantryman) tools of war. Additionally, while the IDF has many hi-tech methods of surveillance and information gathering, having troops on the ground facilitates information gathering and the use of selective force–a key to success population-centric warfare (US Army and Marine Corps, 2007).

The effect of the Israeli Ground Invasion on Hamas is not as clear cut. It placed tremendous pressure on Hamas' senior leadership through targeted air strikes and Israeli occupation that greatly restricted its freedom of movement and communications. Hamas, not wanting to confront the stronger forces out in the open may have chosen pull back. This hypothesis seems to be supported by several IDF officers who stated, "there was never a single incident in which a unit of Hamas confronted our soldiers...we kept waiting for them to use sophisticated antitank and antiaircraft missiles against us, but they never did" (McGirk and Klein, 2009). An alternate hypothesis is that the Israeli Ground Invasion may have afforded Hamas more opportunities to respond to Israel. Before the invasion, Hamas was tactically confined to lobbing rockets and threatening Israel. Whereas after the Israeli Ground Invasion, Hamas could and did perpetrate ambushes, attempted suicide attacks, mortar attacks etc. (AJGaza, 2009; The Muqata, 2009)

The UN Security Council voted on a resolution on January 8th, 2009, the 13th day of the conflict, that called for an immediate cease-fire. 14 out of the 15 members favored the resolution, with the U.S. abstaining (AJGaza, 2009). The Security Council vote placed strong international pressure (particularly on Israel) to end the conflict and civilian suffering. Tactically it may have also placed a constraint on Israeli action by increasing the cost of continued civilian casualties. Israeli military planners would be less inclined to plan operations with a high chance for civilian casualties after the resolution. Hamas faced a different trade-off than Israel to international pressure. A constrained Israel presented Hamas with the opportunity to attack Israel with a lower probability of reprisal, without fully provoking Israel and international opinion. Additionally, Israel's use of blogs, press spokesman, and other medium highlighted the importance they placed on not being seen as wantonly attacking civilians (Israeli Defense Forces, 2009*b*). In contrast, as my case study

of the UNRWA school will illustrate, Hamas' actions were not as highly scrutinized giving them more tactical latitude (El-Khodary and Kershner, 2009).

These strategic and tactical considerations provide the underpinnings for the the following hypotheses:

- *Proposition 1: Throughout the conflict, Israel will react more to a Hamas escalation than Hamas will to an Israeli escalation.*
- *Proposition 2: Israel's reaction to a Hamas escalation will increase after the Israeli Ground Invasion, while Hamas' reaction to an Israeli escalation is uncertain.*
- *Proposition 3: Israel's reaction to a Hamas escalation will decrease more after international pressure (UN Security Council Vote) than Hamas' will.*

Table 1 below presents how each hypothesis will be tested.

[Table 1 about here.]

3 Data

3.1 Sources

The Gaza Conflict provided unprecedented coverage of combat events in near real-time. For the first time, social networking platforms allowed reporters and individuals to synthesize and relay information directly from the conflict zone. Both Hamas and Israel utilized these tools to get their point of view across and, in some, cases intimidate the other side.[9] For researchers of conflict dynamics, the plethora of data provided a new means with which to study conflict interactions at a micro level.

Data gleaned from social media also presents researchers with unique challenges. How do researchers verify the efficacy of information, a job traditionally done by editors? If two sources

[9]Hamas sent text messages to random Israeli numbers warning them of large scale rocket attacks. Meanwhile, IDF called residents warning them that they had minutes to evacuate because there was a bomb in their house. See `http://www.guardian.co.uk/world/2009/jan/03/israelandthepalestinians-middleeast` for the full story. Both sides also extensively used internet media through various `Facebook` groups to encourage solidarity among sympathizers. For more information see `http://www.time.com/time/world/article/0,8599,1871302,00.html`

have conflicting reports on an event, how does one determine which is more trustworthy? All of these challenges must be answered in order to harness new social media as data sources.

For my data collection, I relied principally on three sources. The first, Al-Jazeera's *War on Gaza: Experimental Beta*[10] used the `Ushahidi` platform to collect and evaluate reports from the Gaza Conflict as they occurred. `Ushahidi` worked with Al-Jazeera to track events on the ground in Gaza via `SMS` messages, email, or the web. Events were then sent in by reporters and civilians through the platform and put into a `Twitter` feed entitled *AJGaza*, which gave the event a time stamp (AJGaza, 2009). By cross-checking with other sources such as *Reuters*, the UN, and the Israeli newspaper *Haaretz*, I was able see that the time stamp was usually within a few minutes of event occurrence. *AJGaza* provided excellent coverage of the Israeli air strikes and ground offensives including geographic and temporal information on where skirmishes were occurring. Since the platform was set up to report on conditions on the ground in Gaza, it had a tendency to underreport Hamas rocket fire into Israel.

In order to capture the Hamas rocket fire, I turned to two sources: the *QassamCount* `Twitter` feed and the *The Muqata* blog (QassamCount, 2009; The Muqata, 2009). The *QassamCount* reported where Hamas rockets landed, when they landed, and what type of rocket was used (Qassam or longer range Grad rocket). Each rocket incident was accompanied by a link to the *Haaretz* or *Ynet.com*[11] article that allowed me to verify its accuracy. *The Muqata* is a Pro-Israel blog that live-blogged as events unfolded in the conflict. It provided links to news stories, information on skirmishes, and details on Hamas rocket attacks at an even finer level than the *QassamCount*. They also received input from contributors, as their chief concern with tracking Hamas aggression against Israel. Occasionally, the time between a rocket attacked posted on *QassaCount* and *The Muqata* would differ, with the latter usually being faster at reporting events than the former. I therefore used *The Muqata* as my time stamp for when the event occurred.

Wikipedia's *Timeline of the 2008-2009 Gaza Conflict* was particularly helpful in sourcing and targeting events that might have diverging reports (i.e. controversial) (Wikipedia, 2009). For

[10] See http://labs.aljazeera.net/warongaza/

[11] Another Jewish/Israeli newspaper that kept copious track of the rocket fire `http://www.ynetnews.com/home/0,7340,L-3083,00.html`

example, the Israeli shelling (on or near) the UNRWA school that occurred on January 6th, the 11th day of the conflict, was viewed around the world with outrage. Israeli media sources stated that Hamas militants had been firing from the school, whereas Palestinian and UNRWA officials claimed otherwise and that the school received a direct hit (AJGaza, 2009; The Muqata, 2009). It was important to determine (to the best of my ability) whether or not militants were operating in the school and whether or not Israel had actually hit the school, as it would influence how I would eventually code Israel and Hamas actions. Wikipedia provided links to reports that supported both sides' versions of an event and I determined that indeed it was more than likely that Hamas had been near, but did not use the school as a place to fire on Israel troops. I also was fairly certain that Israel had not directly hit the school. The UN later clarified its initial statements saying that rockets had struck near the school, but not hit the school itself (McGirk, 2009). The IDF also backed away from its claim that Hamas was operating in the school, but rather were firing from "80 meters from the school" (Israeli Defense Forces, 2009*a*).

As discussed above, one must be leery with relying entirely on news sources subject to political bias or persuasion. However, the advantage of using social media as data sources in the Gaza Conflict, is that global interest in the Israeli-Palestinian conflict insured that the mainstream media were also involved in the reporting. I used *The New York Times*, *BBC*, and *Haaretz* to make sure that reports from *AJGaza*, *The Muqata*, and *QassamCount* were not off-base from general news reporting (Times, 2009). For almost all large events (battles, air strikes, artillery fire), the aggregated social media sources mirrored the mainstream reporting. It was in the details (i.e. individual rocket attacks, statements by ministers, low-level skirmishes, and psychological operations), where these new sources fleshed out the micro interactions of the conflict. This level of detail is particularly important when analyzing interactions in asymmetric conflict, as weaker actors such as Hamas may choose to respond to Israeli escalation in non-traditional manners —precisely the kind of response that mainstream media does not report with as much frequency or accuracy.

3.2 Coding Methods

To measure Israeli and Hamas hostility towards each other over the 598 hours of the Gaza Conflict (from the first IAF air strikes to the last IDF troop leaving Gaza), I used 21-point variant of the CAMEO Events coding scheme (Schrodt, 2009). The ordinal scale goes from 0 (no action taken) to 20 (massive aerial bombardment), with everything from heightened posture (7) to misinformation/psychological warfare (11) in between.(see Appendix for full list of codings) The coding scheme states that events that are given higher values on the scale represent a greater escalation of hostilities relative to those given lower values. It would be false to infer that at a tactical level a one unit change from mortar fire to endangering civilians (12-13 on the scale) is the exact same as moving from artillery fire to large-scale ground forces (18-19). Rather, these coding schemes are handy ways of quantifying hard-to-quantify actions. This distinction will become important when discussing the substantive interpretation of the empirics.

I used the reports of Hamas and Israeli actions from *AJGaza*, *The Muqata*, *QassamCount*, and *Haaretz* cross-referenced with mainstream media sources to determine the level of conflict intensity. Reports took the form of an actor(s) (Israel or Hamas, or both sides) and the action taken (demand, lob mortars, ground forces). If events happened concurrently, such as the following report: "IDF tanks and ground troops engage Hamas in fierce clashes", both sides would receive a score for that time period.[12] These events were then coded at the 15-minute interval.[13] If two events were reported in the same 15-minute interval for an actor I took the higher event score.[14] 15-minute intervals made the most sense, as occasionally there was an initial report of an event, shortly followed (usually within 2-5 minutes) by a follow-up post that further clarified the initial report. In an ideal world, every 15-minute period would have some "event" reported. However,

[12] In this example Hamas' event score would be a 17 for "limited ground forces", whereas Israel would be scored a 19 for "large-scale ground forces". In some sense, Hamas is constrained by the fact that it does not possess tanks, and large-scale infantry so one would not observe Hamas involved into large-scale firefight or engaged aerial bombardment, so its response is constrained below 19. One might be concerned that Hamas could never respond as strong as Israel by convention. However, because I aggregate the data to the hour level, this is not always the case. Moreover, this constraint on Hamas is simply a fact of asymmetric warfare.

[13] It would be preferable to have machine-coded the events using software such as the Kansas Events Data System `http://web.ku.edu/~keds/`. However, the structure of the `Twitter` feeds and *The Muqata* blog updates– with embedded links and reports that corrected –were not in an easily digestible format like a Reuters news article (the original impetus behind machine-coded events data). This made hand-coding preferable.

[14] This happened very rarely.

even the micro reporting of *AJGaza* and *The Muqata*, did not have an incident for every interval, so I aggregated the 15-minute interval data to the hour level.[15]

For Hamas, two reports (15-minutes apart) of intense rocket fire followed by a Hamas ambush and no even reported would be scored[16] for Hamas:

$$14 + 14 + 17 + 0 = 45$$

Additionally, four periods for which no actions for Israel were reported would be scored for Israel as a zero:

Summary statistics of the whole conflict —from the first Israeli air strikes to the last Israeli soldier leaving— are coded in the above manner and presented in Table 2 below.

[15] I ran the VAR analysis at the 15-minute interval level with a log transformation of the Hamas and Israel series to account for the non-normality of the data. I find that the results are not too different than the aggregated ones, so the temporal aggregation does not appear to be problematic.

[16] Whenever coding content analysis, it is necessary to provide a measure of intercoder reliability. On a subset of the data, I measured my coded responses against those of another coder using my the framework in the Appendix. I found that we had 84% agreement. Cohen's κ (Cohen, 1960), a more robust measure of intercoder reliability, was 0.76. When $0.61 \leq \kappa \leq 0.80$, this indicates substantial agreement (Landis and Koch, 1977). It should also be pointed out that Cohen's κ probably understates the level of agreement, as it is biased against the inclusion of larger numbers of categories.

[Table 2 about here.]

Figure 1 on the following page graphs Hamas' and Israel's hourly conflict intensity scores as a time series with key events annotated.

[Figure 1 about here.]

4 Method

4.1 The VAR Model: Motivation and Derivation

In examining the time series graph and taking into account my theory of Hamas' and Israel's actions during the Gaza Conflict, an appropriate empirical strategy needs to account for the simultaneous nature of each actor's decision to escalate or de-escalate. Thus, Hamas' action in the current period depends on its own past actions and the past action of Israel. The same is true for Israel. A vector autoregression approach (VAR) is one way to model this interaction. The VAR approach builds on the work of the structural equation models (SEQ) while relaxing several of its strong assumptions (Sims, 1980). As both Hamas' and Israeli actions depend on each other's actions, the strict assumption about inclusion or exclusion of lagged variables in the SEQ method may lead to an omission of important lagged variables and omitted variable bias (Brandt and Williams, 2007). By testing for lag lengths and rejecting strong assumptions not theoretically motivated, the VAR technique takes a more experimental approach to model specification. The central trade-off in VAR modeling is between reducing bias (including more lagged variables) versus efficiency (less lagged variables). Below I derive the VAR model specification using Floyd (2005) and Enders (2004) as references (Enders, 2004; Floyd, 2005).

Consider the following model of Hamas and Israeli interactions during the Gaza Conflict, where Hamas (y_1) and Israel (y_2) depend on the present value and one lagged value of both its action and that of the other side.

$$y_{1(t)} = b_{10} - b_{12}y_{2(t)} + \gamma_{11}y_{1(t-1)} + \gamma_{12}y_{2(t-1)} + \varepsilon_{1(t)} \tag{1}$$

$$y_{2(t)} = b_{20} - b_{21}y_{1(t)} + \gamma_{21}y_{1(t-1)} + \gamma_{22}y_{2(t-1)} + \varepsilon_{2(t)} \tag{2}$$

Equations (1) and (2) assume that both y_1 and y_2 are stationary and that $\varepsilon_{1(t)}$ and $\varepsilon_{2(t)}$ are white noise residuals uncorrelated with each other (Enders 264)(Enders, 2004).

The above systems of equations is expressed below as a function of n endogenous variables and

p lags:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + E_t \tag{3}$$

where:Y_t =an $n \times 1$ vector of the endogenous variables in VAR

A_0 =an $n \times 1$ vector of intercepts

A_i =an $n \times n$ matrix of coefficients

E_t =an $n \times 1$ vector of error terms

Equation (3) is identified and can then be estimated using ordinary least squares (OLS). Two things should be noted. First, including an extra lag in the equation, increases the number of coefficients in the model by n^2 (where n is the number of endogenous variables), so theory and parsimony should be used in determining the lag length. Second, in order for the Hamas-Israel VAR to be identified, I need to impose one identification restriction.

In the next section, I discuss the lag specification tests and identification of the VAR model.

4.2 Model Specification

In order to choose an appropriate lag length, it is important to think not only about each sides' short-term responses (i.e. within the first couple of hours), but also tactical shifts that may take up to a day to incorporate into outcomes. Israel might strike a Hamas rocket launching site an hour after an attack, but respond tactically with preventative air strikes or ground raids much later. It is important to include enough lags to fully incorporate the short-term and medium-term response to the initial responses and prevent serial correlation (Enders, 2004).

All models, plots, and accompanied statistics were calculated using the `MSBVAR` package in `R`Brandt and Appleby (N.d.). With hourly data, I chose a lag specification test of up to 25 hours ($p = 25$), enough time to include a full day response to the initial change in Hamas or Israel's

intensity.

The results of the lag specification tests are presented in Table 3 below.

[Table 3 about here.]

The table shows that a case could be made for 5 lags as there is a small difference in the AIC between 3 and 5 lags and a larger difference between 5 and 6 lags. The $p - values$ of the X^2 test also support a 5-lag model. However, it is also apparent that 9 lags might be a correct specification, as the AIC at 9 is lower than that at 5 and increases in value fairly quickly afterwards (Brandt and Williams, 2007). The impulse response function plots for the two models do not differ (Figure 2 compared to Figure 7[17]), so I choose the more parsimonious 5-lag model.

In order to identify and estimate the Hamas-Israel VAR with 5 lags, it is necessary to restrict the model. This is done by restricting either b_{12} or b_{21} to equal zero in equations (1) and (2), which prevents either Hamas or Israel from reacting contemporaneously to the other (Enders, 2004). There is evidence to suggest that Israel has the capacity to respond much more quickly to Hamas, than vice versa. Israel's military contains state-of-the-art equipment, laser-guided missiles, and predator drones able to strike and reconnoiter at will in Gaza (Israeli Defense Forces, 2009*b*; Wikipedia, 2009). Moreover, the IDF and Israel's security service, due to Israel's precarious relations with neighboring countries and various Palestinian groups (such as Hamas), have been built around the ability to rapidly respond to threats (Times, 2009). Hamas' capabilities do not match that of Israel for sophistication, organization, or manpower. There is also a strong reason to believe that Hamas' ability to respond to Israel militarily was impaired by Israel military operations far greater than Hamas was able to affect Israel's ability to respond militarily. Therefore, I restrict Hamas to not respond contemporaneously to Israel. I do this by ordering Hamas first,[18] so that the Choleski decomposition method[19] restricts the upper right-hand corner (b_{12}) to zero in the B matrix (and hence the A_0 matrix). I will examine this identification restriction by testing the ordering of the variables in the decomposition of forecast error variance.

Finally, since a VAR system is an equilibrium representation, responses are calculated by examining how shocks propagate through the system. In other words, how does a surprise escalation by

[17]The impulse response function plots for 9-lag model can be found in the Appendix

[18]This is the default setting in the `MSBVAR` package in `R`. The order of the variables "forces" the structure upon the system by constraining the leading column variable (Hamas) to not react contemporaneously (to Israel) for the system to be identified.

[19]For further discussion of the Choleski decomposition method see Enders (2004) (Enders, 2004).

Hamas affect both Hamas and Israel and vice versa? Equation (3) can be expressed in terms of E_t, yielding the Vector Moving Average (VMA). The VMA centers the system around its equilibrium values, and then tracks shocks as they move through the system and die out over time through impulse response function (IRF) plots (Brandt and Williams, 2007). IRF plots provide a handy way to interpret dynamically how Hamas and Israel respond to each other. If their IRF plots are more or less the same, then one could conclude that they respond in-kind to escalatory shocks. If their IRF plots differ, then this is evidence of an asymmetric response.

For VAR models, regression tables are not presented, as the joint behavior of the system and not individual coefficients are of interest (Brandt and Williams, 2007). In the following section, I present the results of the 5-lag VAR model (Hamas initially constrained at zero) including tests of Granger causality, forecast error decomposition, and plots of the impulse response functions.

5 Results

5.1 Granger Causality and Forecast Error Variance

Using the the 5-lag VAR model as my specification, I test whether Israel and Hamas Granger cause each other.[20] The null hypothesis is whether the lagged coefficients (*Block Coefficient Restricted*) do not explain the *Hypothesized Exogenous Variable*.

Table 4 below presents the results from the Granger Causality.

[Table 4 about here.]

For both Granger Causality tests, the F-statistic is large enough to reject the null hypothesis. There is evidence that Israel depends on past values of Hamas and vice versa.

Table 5 below presents the forecast error decomposition.

[20] Granger causality does not imply causality in the strict sense. Rather, it shows that past Hamas actions are useful for predicting Israel actions and vice versa. For a more detailed discussion of issues surrounding Granger causality and VAR see Brandt (2006) (Brandt and Williams, 2007).

[Table 5 about here.]

It is useful to see how the fitted VAR model differs from the actual values and how these errors changes over time. Forecast error decomposition provides such a method by using the orthogonalized vector moving average (VMA) representation to compute forecast errors over different time horizons (Brandt and Williams, 2007). If Israel reacts more to Hamas than Hamas to Israel, then a greater proportion of the forecast errors in Israel are explained by a shock to Hamas than forecast errors in Hamas are explained by a shock to Israel. The second and third columns are the proportion of forecast error for the Hamas based on shocks to Hamas and Israel. As Hamas cannot react to Israel contemporaneously (by assumption), all of the error is placed on the Hamas variable in hour 1. As the number of hours increases, a greater proportion of the error variance is attributed to Israel. After 12 hours, about 1% of the forecast error in Hamas is attributed to Israel. Israel comparatively sees a much larger percentage of its variation in forecast error is attributed to innovations in Hamas. After 12 hours, 18% of the forecast error is attributed to innovations in Hamas. This meshes with my hypothesis, that Israel reacts more to Hamas, than Hamas is to Israel.[21] This confirms my hypothesis that Israel reacts more to Hamas than vice versa.

5.2 Impulse Response Analysis

The impulse response function (IRF) plots are constructed from the VMA representation and trace the effect of a one standard deviation shock in the residuals of the estimated 5-lag VAR model (Hamas constrained at zero).[22] For instance, if one were looking to see the effect that a shock in Hamas had on Israel, one would take the standard deviation of the residuals in the Hamas VAR equation. To ease interpretation, I normalized all residuals to 1, so all responses are in proportion to the original shock. Figure 2 is the IRF plot for Hamas and Israel sampled from the full 598

[21] Some might be concerned that the identification restriction is imposing the forecast error result of Israel being more reactive to Hamas than vice versa. I reran the decomposition of forecast error variance with Israel not being able to react contemporaneously to Hamas. After 12 hours, about 6.3% of the forecast error in Hamas is attributed to Israel. The same is true of Israel, where after 12 hours, about 5.5% of the forecast error in Israel is attributed to Hamas. While the results change given the reverse constraint, Hamas is approximately as reactive to Israel as vice versa. This suggests that constraining Hamas by the Choleski Decomposition, is robust.

[22] Plots for the 9-lag VAR model are presented in the Appendix for comparison

hours of the conflict.

[Figure 2 about here.]

The columns in the 2×2 plots above represent the actor that propagates the shock and the rows are the actor that responds to the shock. The solid line is the impulse response function. The dashed red lines represent 95% confidence intervals derived from $10,000$ Monte Carlo simulations (Brandt and Appleby, N.d.). The on diagonal (upper left and bottom right) plot the shocks in Hamas and Israel and their self-response. The response to a shock in their own values causes a relatively steep initial response that dies out rather quickly.[23] This logically makes sense, as self-induced shocks should not change actors' behavior. Hamas' reaction to a shock in Israel (upper right) is initially constrained at zero. Recall that this is a modeling assumption —Hamas cannot react contemporaneously to Israel. In comparing Israel's reaction to a Hamas shock (bottom left) to Hamas to a shock in Israel, it is apparent that Israel reacts stronger initially. Israeli response is greater than 0, whereas Hamas' dips below the 0 on the *y-axis* after the second hour.

Given that I am interested in how Hamas and Israeli responses change across the conflict, I subset the data before and after important change-points in the conflict and apply the same 5-lag VAR specification as I did for the full model.[24] I then investigate whether the Israel and Hamas IRFs change with Ground Invasion and the UN Security Council Vote. The IRF plots for the Pre- and Post-Ground Invasion are in Figures 3 and 4 below.[25]

[23]For the rest of IRF plots I omit these plots of self-response for the rest of the IRF analysis (UN vote and ground invasion) as they all resemble those in Figure 2. The more interesting plots as far as testing my hypotheses are those that show IRF for Hamas to shocks in Israel and vice versa. All self-reaction plots closely resemble those in the on-diagonal plots in Figure 2.

[24]The lag specification tests for the subsets of the data mirror those of the full data. The tests support a 5-lag model for all subsets of the data.

[25]It may be inappropriate to subset the data and then analyze how IRF plots change if there is a not a statistically significant difference in the VAR model before and after the change-points (Park, 2007). I rerun my 5-lag model including the dummy variables *Pre Invasion* and *Pre UN Vote* to test for this. I find a statistically significant change for both Hamas and Israel associated with the UN Security Council Vote, but only for Israel after the Israeli Ground Invasion. For a recent, more sophisticated treatment of Markov processes and structural breaks in dynamic multiple time series see Brandt (2009).

[Figure 3 about here.]

[Figure 4 about here.]

It is interesting to compare the plots in Figure 3 to those in Figure 4. In the Pre-Invasion Phase, Hamas's reaction to Israel contain larger confidence intervals and are less measured. Following the Ground Invasion, Hamas reactions seem predictable with less possibility of both negative and positive responses to Israeli provocations. Another key observation is that the confidence intervals are much wider in the Pre-Invasion Phase than Post-Invasion. Hamas is somewhat less predictable in its tactical response to Israeli escalation before IDF troops enter Gaza. In fact the upper bound It might be of concern that the number of data points from which I am sampling the IRF on Pre-Invasion is only 173 compared to 525 in the Post-Ground Invasion, and that this is driving the confidence interval difference. However, in looking at the Israeli plots in Figures 3 and 4, it is apparent that this is not necessarily the case. Israel's IRF to a Hamas shock, while more erratic, still contains fairly tight confidence intervals. Israel's Pre-Invasion response to a surprise Hamas escalation indicates a less coherent response pattern, whereby escalatory shocks in Hamas' behavior are met with strong initial responses, then oscillating responses of deescalation and escalation. In the Post-Ground Invasion Phase, Israel's response is much smoother and coherent the same spike after the 9th hour as in Figure 2.

The results partially support the conclusions of the "boots on the ground" hypothesis. Having troops on the ground facilitates more precise Israeli targeting of Hamas. This allows Israel to respond to a greater extent to Hamas provocations than in the Pre-Invasion. Additionally, Hamas's response Post-Invasion is much more certain (a tighter confidence interval), its most violent response is lower (the height on the upper confidence band), but on average is higher. The Invasion affords Israel more precise targeting and response to Hamas attacks, a greater certainty about Hamas' actions, but also affords Hamas the ability to respond more to Israel (higher average response).

Figures 5 and 6 below plot the IRF for the Pre and Post-UN Security Council Vote.

[Figure 5 about here.]

[Figure 6 about here.]

It is interesting to compare the changes in Israel's and Hamas' IRF Pre-UN vote versus Post-UN vote. In looking at the responses it appears that the Security Council resolution marked a larger turning point for Israel than for Hamas. Israel's initial reaction to a Hamas shock is more muted after the vote (lower y intercept). Hamas' plot, while also somewhat more muted after the vote, does not shift down at all, in fact it may move up. This does not necessarily imply that Israel was more responsive to the UN resolution. It could be that the UN waited until they felt that Israel was more or less finished with its invasion, in order to insure the appearance of "compliance" with the resolution. The pressure placed on Israel by the UN can be viewed as a higher cost to Israel of continued Palestinian casualties. The cost to Hamas (in terms of civilian casualties) of continuing to fire on Israel may have also increased. However, their lack of a reaction after the UN vote suggests that this increase may be offset by the smaller chance of an Israel response to an attack (i.e. they can attack Israel with greater impunity). A concrete example of the asymmetric response dynamic Post-UN Vote are the Hamas initiated shooting incident and rocket attacks that occurred on January 20th,2009, just as Israel in the midst of pulling out of Gaza (AJGaza, 2009; The Muqata, 2009).

The Cumulative IRF functions are reported below in Table 6. They are the cumulative effect of the shock after 24 hours.

[Table 6 about here.]

In sampling over the full 598 hours of the conflict, Israel's cumulative reaction to Hamas after 24 hours is on average (i.e. midway between the upper and lower 95%) five times as strong (1.49/0.32) as a Hamas response.[27] Furthemore, Israel's cumulative response is bigger than Hamas' in every phase of the conflict. After the Invasion, both Israel's and Hamas' response to a shock by the other increase by about two fold (2.36 times for Israel 2.15 times for Hamas). Additionally, the UN vote decreases Israel's response magnitude by almost a half (47% decrease) while Hamas' average response actually slightly increases (by about 14%).

6 Implications

Substantively, the cumulative IRF allows for some interesting comparisons and analysis within the context of my coding scheme. Using the statistics generated in Table 6, I am able to see how the cumulative IRFs translate into events on the battlefield. For the period covering the whole conflict, Hamas would react (on average) to a "surprise" 2 recorded attacks (15 minute-intervals) of Israeli artillery shelling with the equivalent of 1 extra incident of sporadic mortar fire. Pre-Invasion, Hamas would respond to a 1 hour shock of targeted air strikes with text messaging Israelis civilian cell phones threatening messages.[28] Comparatively, after the invasion, Hamas would only respond to that same Israeli shock with 2 incidents of mortar fire. Another interesting observation is the smaller confidence intervals on the Hamas cumulative IRF Post-Ground Invasion compared to Pre-Ground Invasion. The size of the confidence intervals can be viewed as a measure of Israeli certainty

[26] Recall that the standard shock in impulse response function analysis is one standard deviation in the residuals equation of the variable in which the shock is propagated (Brandt and Williams, 2007). All shocks have been standardized to one for ease of interpretation.

[27] As noted previously, this quantification of 2 times stronger is dependent on the ordinal coding scheme. A different coding scheme might yield a stronger response by making the intensity assigned to a targeted air strike (16) more than just 2 higher than a rocket attack (14). However, there is little evidence to suggest that I have "overstated" the magnitude difference, as I used a very conservative (1 unit shift between higher intensity events). However the benefits of being able to discuss magnitudes of response is useful as long as the reader remembers that it refers to my coding scheme.

[28] There were recorded cases of Hamas sending threatening texts to Israelis. See `http://www.guardian.co.uk/world/2009/jan/03/israelandthepalestinians-middleeast`

about Hamas' actions. I measure certainty as the difference between the highest and lowest values in the 95% confidence interval. The extra certainty gained by Israel Post-Ground Invasion is quite substantial (44%). Or in substantive terms, the difference between Hamas reacting to 2 Israeli special forces raid witha suicide bombing, or not at all.

Over the whole course of the conflict, Israel responds to Hamas firing a Grad Rocket with a large air strike. Pre-Invasion, Israel would respond to 2 incidents of mortar fire with targeted air strike. The same mortar fire Post-Invasion leads 2 incidents of large movement Israeli mechanized infantry.[29] The difference in Israeli reaction Pre- and Post-UN Security Council vote to 2 incidents of Hamas using human shields is 1 less massive Israeli air strike. These substantive interpretations of the cumulative IRF analysis convey differing Hamas and Israeli reactions to surprising opposition behavior. Furthermore, as the conflict progresses Hamas' and Israel's responses change in opposing manners (Post-Ground Invasion) and to differing degrees (Post-UN Vote), underscoring the asymmetric nature of the conflict.

The variability in IRF's and cumulative IRF's confirm most of the hypotheses (Israel's response increases Post-Invasion and decreases more Post-UN Vote than Hamas does) and offers some new insight (the Israeli Ground Invasion increases Hamas' average response, but also increased Israeli certainty about their action). From anecdotal evidence and the IRF analysis, the Israeli Ground Invasion seems to have dampened Hamas' unpredictability, suggesting that Israel was at least partially successful. However, it also afforded Hamas more opportunities to retaliate against Israel. These results also reject suggestiont that Israel was able to completely dictate Hamas' ability to react (i.e. their military superiority completely swamps Hamas' tactics). This meshes with Kavanagh (2009) who finds that Israel's counterterror operations only have limited effects in terms of decreasing Palestinian reactions. Furthermore, in asymmetric warfare, a central tenet is using alternative (any) means to defeat a stronger enemy. Hamas was one of the early advocates of

[29] A cursory conclusion from the cumulative IRF analysis is that if Israel is "reacting more" Post-Invasion, does not that mean that they are using greater force and so nullifies the "boots on the groung" hypothesis? However it is important to have some context when interpreting the IRF plots. The IRF analysis does not measure the conflict intensity itself, but rather each sides' reactions to surprise attacks by the other. So if Israel was simply bombing Hamas throughout the conflict and not caring what Hamas did, one would observe an Israeli IRF (with respect to Hamas) that does not appear to be very reactive. So Israel's IRF may have increased post-Invasion, but its use of measured force (infantry and close-quarter tactics as opposed to artillery shelling and wide-spread bombing) may have increased (the likely scenario).

suicide attacks as a way to circumvent precisely this Israeli force superiority. The Ground Invasion also allowed Hamas to use their knowledge of terrain and populace to their advantage, further contradicting Israel's ability to completely dictate the terms of engagement. While Hamas may not have been able to fire as many rockets Post-Ground Invasion, they had increased opportunities to ambush and use unconventional (suicide attacks/kidnappings) against IDF soldiers. The certainty the IDF gained Post-Ground Invasion (an extra 44%) about Hamas' reactions may be more significant. Yet, Hamas rocket fire and attempted ambush of Israeli soldiers towards the end of the conflict suggest that their Israeli "certainty" about Hamas reaction Post-Invasion may be a short-lived phenomenon, rather than a sustained victory by Israel.

It is important to also point out the asymmetric impact that international pressure (Post-UN Vote) had on Hamas' and Israel's responses. Israel's ability to respond to a Hamas escalation are significant reduced by the UN Security Council resolution, whereas Hamas' actually slightly increases. This may be an artifact of the UN waiting until the conflict died down until putting forth a resolution. However, as the case study of the IDF shelling near the UNRWA school in the subsequent section discusses, international pressure to minimize civilian casualties constrained the IDF's ability to use their full arsenal to target Hamas. This is a classic asymmetric and general warfare practice. Hamas knew that Israel was concerned with not being seen as indiscriminately targeting civilians, and so Hamas exploited the Israeli's weakness by operating among the civilian population and making it difficult for the IDF to target them.

7 A Case Study of UNRWA School Incident

It can be useful, particularly when analyzing strategic decisions in a conflict, to include a case-specific analysis that can pick up on nuances and flesh out the broader empirical findings. The shelling outside of a UNRWA school housing civilians (Al-Fakhura School) by IDF mortars on the 11th day of the conflict, presents an ideal case for study. It shows the importance of selectivity and targeting in population-centric conflicts, how weaker adversaries (Hamas) adapt their tactics to stymie stronger adversaries, and the role that international pressure played in shaping Israel's actions.

On January 6th, 2009, IDF troops operating in northern Gaza attempted to take out a Hamas mortar team firing near[30] the UNRWA school housing some 400 civilians taking refuge from the conflict (McGirk, 2009). The IDF was aware that the UNRWA school housed a large number of civilians (El-Khodary and Kershner, 2009). The IDF troops used a global position satellite (GPS) mortar to target and fire at the militants. The GPS mortar system had a margin of error of 30 meters. The IDF fired three mortars. Two hit their intended target and a third strayed into the adjacent UNRWA school courtyard where a number of civilians were gathered (Harel, 2009; Israeli Defense Forces, 2009*a*). Initial reports from UNRWA and Hamas officials, claimed that the school had received a direct hit, however the UN eventually backed away from this statement (McGirk, 2009). The exact number of civilian casualties remains disputed with the UN stating that up to 40 civilians were killed and Israel arguing that only 3 civilians were killed along with 9 Hamas members (Israeli Defense Forces, 2009*a*; McGirk, 2009). The IDF mortar strike was met with widespread condemnation by the UN and international community (El-Khodary and Kershner, 2009). Many observers argued that the Al-Fakhura incident helped galvanize public opinion and international pressure on Israel for a cease-fire in operations (El-Khodary and Kershner, 2009). While the cease-fire would not take place for another two weeks, the media coverage and perceived Israeli aggression against civilians highlighted the difficulties the Israelis faced in confronting Hamas in a conflict fought amongst a civilian population.

The success of a stronger actor (Israel) in population-centric warfare–such as the Gaza Conflict–hinges on its ability to distinguish enemies (Hamas) from civilians (Kalyvas, 2006). Asymmetric warfare and COIN doctrine state that the intelligence necessary to accomplish this is established through control of the terrain (Lyall and III, 2009). The UNRWA school incident, however conveys the difficulty of putting this doctrine into practice. Even though the IDF had good intelligence on the location of the Hamas mortar team (and the UNRWA school) they faced a difficult choice–take a chance of taking out the team and risk endangering civilians, or let Hamas slip away. This

[30]IDF forces initially claimed that the militants were firing actually from the school (McGirk, 2009). However, UN officials and Hamas deny the fact that militants were firing from the school and instead stated they were firing from a courtyard across the street (El-Khodary and Kershner, 2009). The Israel officials eventually backed away from their initial statements and in a follow-up investigation said that the Hamas mortar team was 80 meters from the school in a courtyard (Harel, 2009).

highlights another important point of asymmetric conflict: control of the terrain is a necessary, but not sufficient condition for engaging in selective violence. As IDF troops moved into Gaza, Hamas melted into the civilian population and avoided direct confrontation with the Israelis (McGirk and Klein, 2009). Thus, the advantage the IDF troops gained in information and the ability to target Hamas with small arms from the control of terrain was partially mitigated by Hamas' evasive tactics. IDF officers were quoted as saying that "the (IDF) force should have refrained from using mortar rounds and relied instead on more accurate fire" in regards to the IDF troops tactical decision in the incident (Harel, 2009). The selective use of violence, key to population-centric warfare, forces soldiers on the ground to make difficult targeting decisions.(US Army and Marine Corps, 2007) In this engagement Hamas did not strictly defeat the IDF. Instead they positioned themselves close to civilians, forcing the IDF soldiers to make a precarious decision on whether or not to fire, and mitigated the IDF's advantage from being on the ground in Gaza with superior forces.

The other important factor in the UNRWA school incident was the negative press that Israel received both within Gaza and in the international community for the Palestinian civilian casualties. The perception of the IDF having directly shelled a school housing refugees–as initially errantly reported–resulted in swift condemnation internationally (El-Khodary and Kershner, 2009). What received somewhat less attention was Hamas' proximity to the UN compound. Whether or not firing mortars approximately 80 meters from a compound harboring civilians constitutes "endangering civilians" in the the densely populated Gaza Strip is open to interpretation. However, as the weaker adversary, Hamas was able to operate with a degree of freedom (with respect to endangering civilians) that the invading IDF was not. Israel was forced to at least attempt to discriminate between civilians and non-civilians. Meanwhile, Hamas' main retaliatory weapon against the Israelis, the Qassam rockets, were inherently non-selective. Both international opinion that Israel was so much stronger militarily and Hamas's international isolated position allowed Hamas was to engage in the cheaper, non-selective violence and use the civilian population for cover (without the same international scrutiny that Israel received). As the fallout from the UNRWA school incident shows, Hamas was able to use this to mitigate the IDF's military superiority, and score an important public relations victory–which in population-centric warfare may be more important than a straight

military victory (US Army and Marine Corps, 2007).

8 Future Research

In exploiting new data sources on conflict (`Twitter` and `Ushahidi`) between a strong and weak actor, this paper makes an important contribution to the literature of microdynamics of asymmetric warfare. I find support for my hypotheses that each side's response rate is not constant throughout the conflict. Rather, they are phase dependent (Pre/Post-Ground Invasion and Pre/Post-UN Security Council Vote).

This is however, a first step in untangling the complicated dynamics at work in asymmetric conflict fought by strategic actors. Improved measurement of conflict intensity is needed to more accurately scale and test (empirically) models of conflict. Both Israel's and Hamas' decisions on whether or not to escalate were partially based on domestic political concerns such as Hamas' popularity relative to Fatah and the February Israeli election. If possible, inclusion of these factors could further yield important information on the connection between domestic concerns and international conflict intensity as it relates to the Gaza Conflict.

As Signorino (1999) and Bas, Signorino and Walker (2008) show, the recovery of strategic interaction in conflict through statistical analysis merits special attention. Hamas and Israel are not static actors, but dynamic strategic actors. The case study of the UNRWA school is an example of how an actor (Hamas) adapts (firing near civilian refugees) to negate a perceived advantage (the IDF's superior ground capabilities). A framework for empirically capturing this dynamic in a strategic context would improve the underlying test of the theory. Additionally, the incorporation of the recent work of Brandt (2009) on international conflict and Markov processes (MSVAR) and refinement of testing for structural changes (Park, 2007) could prove valuable in teasing out additional conflict dynamics.

Finally, as many pundits have noted,[31] traditional, all-out war between nation states is quickly being replaced by multi-dimensional conflict (cyberwarfare, transnational terrorism, etc.). The

[31] See *Danger Room's* blog entry "How to Win a Fifth-Generation War" `http://www.wired.com/dangerroom/2009/01/how-to-win-a-fi/`

recent Gaza Conflict represents a particularly pertinent example. More scholarly attention to additional dimensions of conflict and their implications is needed to better understand the threats nations and groups will face in the immediate future.

A.1 Data Coding Procedure

[Table 7 about here.]

A.2 Forecast Error Decomposition (Israel Constrained at Zero)

[Table 8 about here.]

[Figure 7 about here.]

References

AJGaza. 2009. "AJGaza on Twitter.". available at `http://twitter.com/AJGaza`.

Arreguín-Toft, Ivan. 2001. "How the Weak Win Wars: A Theory of Asymmetric Conflict." *International Security* 26(1).

Arreguín-Toft, Ivan. 2006. *How the Weak Win Wars: A Theory of Asymmetric Conflict.* 1^{st} ed. Cambridge University Press.

Axelrod, Robert. 1984. *The Evolution of Cooperation.* 1^{st} ed. Basic Books.

Bas, Muhammet A., Curtis S. Signorino and Robert W. Walker. 2008. "Statistical Backwards Induction: A Simple Method for Estimating Recursive Strategic Models ." *Political Analysis* 16(1):21–40.

Brandt, Patrick T. 2009. "Empirical, Regime-Specic Models of International, Inter-group Conict, and Politics." *Presented at the meeting of the Midwest Political Science Association* .

Brandt, Patrick T. and John Taylor Williams. 2007. *Multiple Time Series Models.* 1^{st} ed. Sage Publications, Inc.

Brandt, Patrick T. and Justin Appleby. N.d. "MSBVAR: Bayesian Vector Autoregression Models, Impulse Responses and Forecasting." *R package version 0.40.* Forthcoming.

Brandt, Patrick T., Michael Colaresi and John R. Freeman. 2008. "The Dynamics of Reciprocity, Accountability, and Credibility." *Journal of Conflict Resolution* 52(3):343–374.

Bueno de Mesquita, Ethan and Eric S. Dickson. 2007. "The Propaganda of the Deed: Terrorism, Counterterrorism, and Mobilization." *American Journal of Political Science* 51(2):364–381.

Cohen, Jacob. 1960. "A Coefficient of Agreement for Nominal Scales." *Educational and Psychological Measurement* 20(1):37–46.

El-Khodary, Taghreed and Isabel Kershner. 2009. "Israeli Shells Kill 40 at Gaza U.N. school." *The New York Times* .

Enders, Walter. 2004. *Applied Econometric Time Series, 2nd Edition.* 2^{nd} ed. Wiley.

Floyd, John E. 2005. "Vector Autoregression Analysis: Estimation and Interpretation.". available at `http://www.economics.utoronto.ca/jfloyd/papers/varnote.ps`.

Galula, David. 2006. *Counterinsurgency Warfare: Theory and Practice.* 1^{st} ed. Praeger.

Goldstein, Joshua S. and John R. Freeman. 1990. *Three-Way Street: Strategic Reciprocity in World Politics.* 1^{st} ed. University Of Chicago Press.

Harel, Amos. 2009. "IDF investigation shows errant mortar hit UN bulding in Gaza." *HAARETZ.com* .

Hass, Amira. 2009. "Hamas executes collaborators and restricts Fatah movement." *HAARETZ.com* .

International, Amnesty. 2009. "Palestinian Authority: Hamas' deadly campaign in the shadow of the war in Gaza .".

Israeli Defense Forces. 2009*a*. "IDF Releases Information on Military investigations.". available at `http://dover.idf.il/IDF/English/News/today/09/4/2201.htm`.

Israeli Defense Forces. 2009*b*. "Israel Defense Force Spokesperson.". available at `http://idfspokesperson.com/`.

Kalyvas, Stathis N. 2006. *The Logic of Violence in Civil Wars.* 1^{st} ed. Cambridge University Press.

Kavanagh, Jennifer. 2009. "Externally-Deadly, but Internally-Directed: Constituent Demands, Legitimacy, and the Politics of Violence in the Second Palestinian Intifada ." *Presented at the meeting of the Midwest Political Science Association* .

Landis, J.R. and G.G. Koch. 1977. "The Measurement of Observer Agreement for Categorical Data." *Biometrics* 33:159–174.

Lyall, Jason. 2009. "Does Indiscriminate Violence Incite Insurgent Attacks? Evidence from a Natural Experiment." *Journal of Conflict Resolution* .

Lyall, Jason and Isaiah Wilson III. 2009. "Rage Against the Machines: Explaining Outcomes in Counterinsurgency Wars." *International Organization* 63(1):67–106.

Mack, Andrew J.R. 1975. "Why Big Nations Lose Small Wars: The Politics of Asymmetric Conflict." *World Politics* 27(2).

McGirk, Tim. 2009. "U.N.: No Hamas Fighters in Bombed Gaza School." *TIME Magazine* .

McGirk, Tim and Aaron J. Klein. 2009. "Israel and Hamas Prepare for the Next Gaza War." *TIME Magazine* .

Park, Jong-Hee. 2007. "Bayesian Analysis of Structural Changes: Historical Changes in U.S. Presidential Uses of Force Abroad." *presented at the Annual Meeting of Society for Political Methodology* .

Press, Associated. 2009. "PA: Hamas rockets are bid to sway Israeli election ." *HAARETZ.com* .

QassamCount. 2009. "QassamCount on Twitter.". available at `http://twitter.com/QassamCount`.

Schrodt, Philip A. 2009. "CAMEO Event Codes.". available at `http://cameocodes.wikispaces.com/EventCodes`.

Signorino, Curtis S. 1999. "Strategic Interaction and the Statistical Analysis of International Conflict." *American Political Science Review* 93(2):279–297.

Sims, Christopher A. 1980. "Macroeconomics and Reality." *Econometrica* 48(1):1–48.

The Economist. 2009. "Israel after Gaza: Counting the Cost.".

The Muqata. 2009. "The Muqata Blog.". available at `http://muqata.blogspot.com/`.

Times, The New York. 2009. "Israel and Hamas: Conflict in Gaza.". available at `http://www.nytimes.com/interactive/2009/01/07/world/20080104-conflict-graphic.html`.

United Nations Human Rights Council. 2009. "Report of the United Nations Fact Finding Mission on the Gaza Conflict.".

US Army and Marine Corps. 2007. *Counterinsurgency Field Manual No. 3 – 24*. 1^{st} ed. Chicago University Press.

Wikipedia. 2009. "Timeline of the 2008/2009 Israel-Gaza conflict.". available at `http://en.wikipedia.org/wiki/Timeline_of_the_2008-2009_Israel-Gaza_conflict`.

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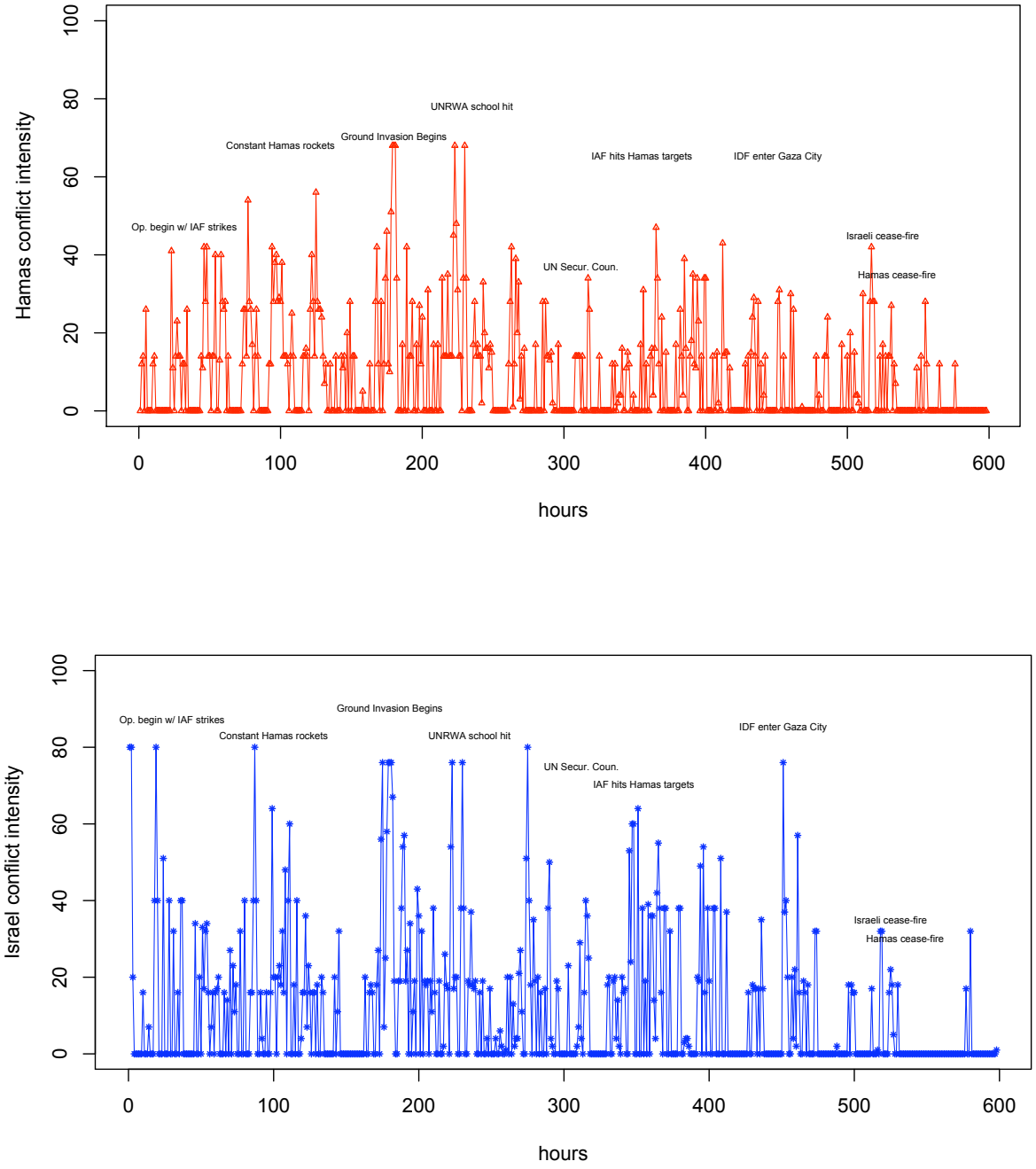

Figure 1: **Time Series Graph of the Gaza Conflict by the Hour (Key events are annotated)**

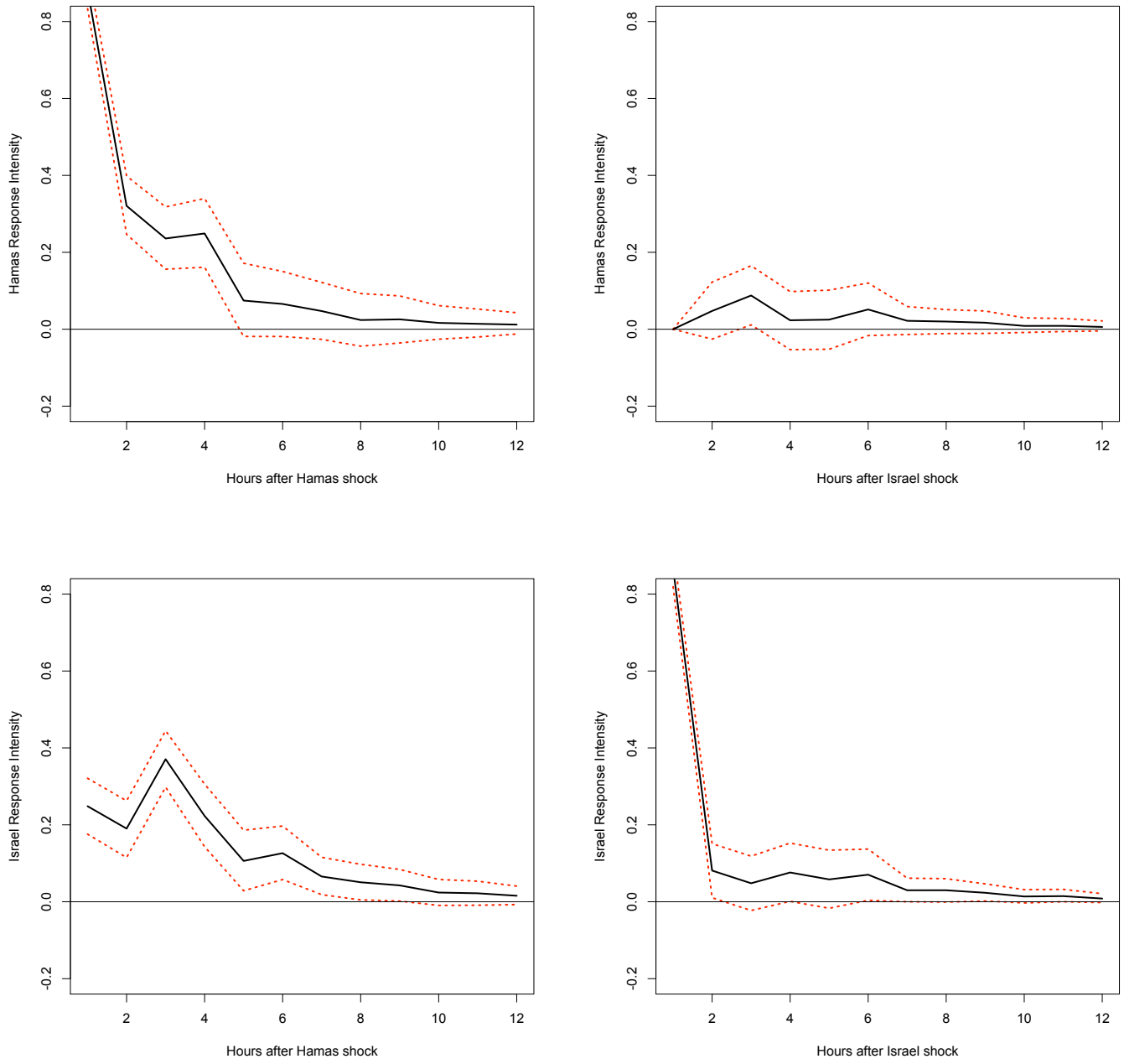

Figure 2: Impulse Response Analysis for the Whole Duration of the Conflict

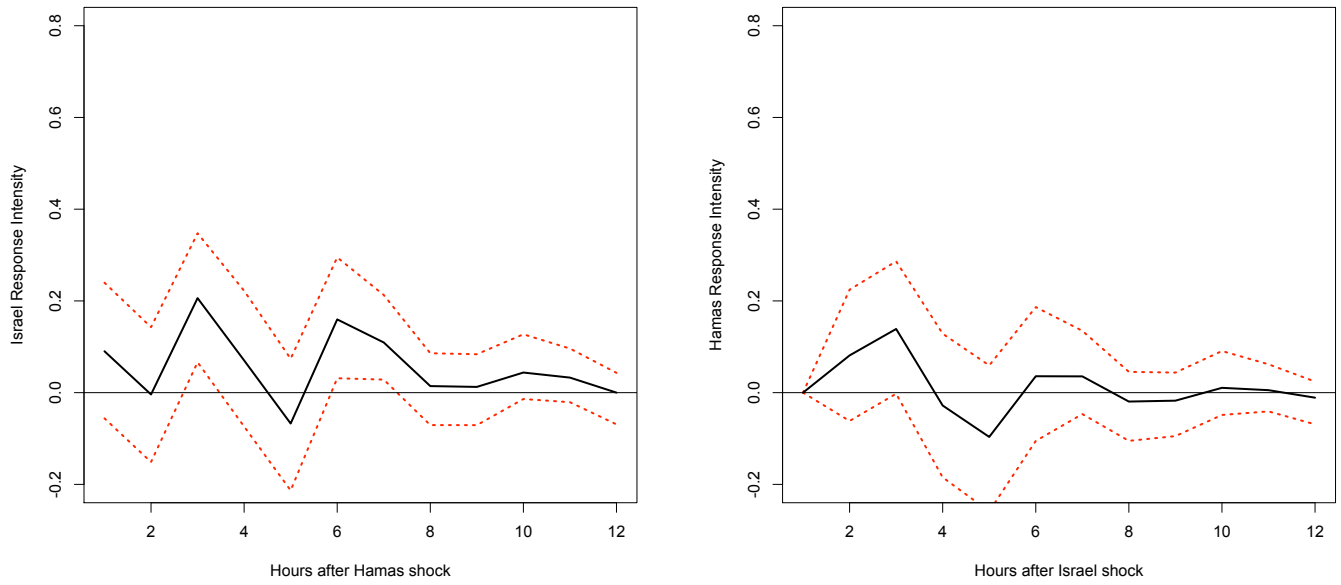

Figure 3: Impulse Response Analysis for the Pre-Invasion Phase (first 173 hours)

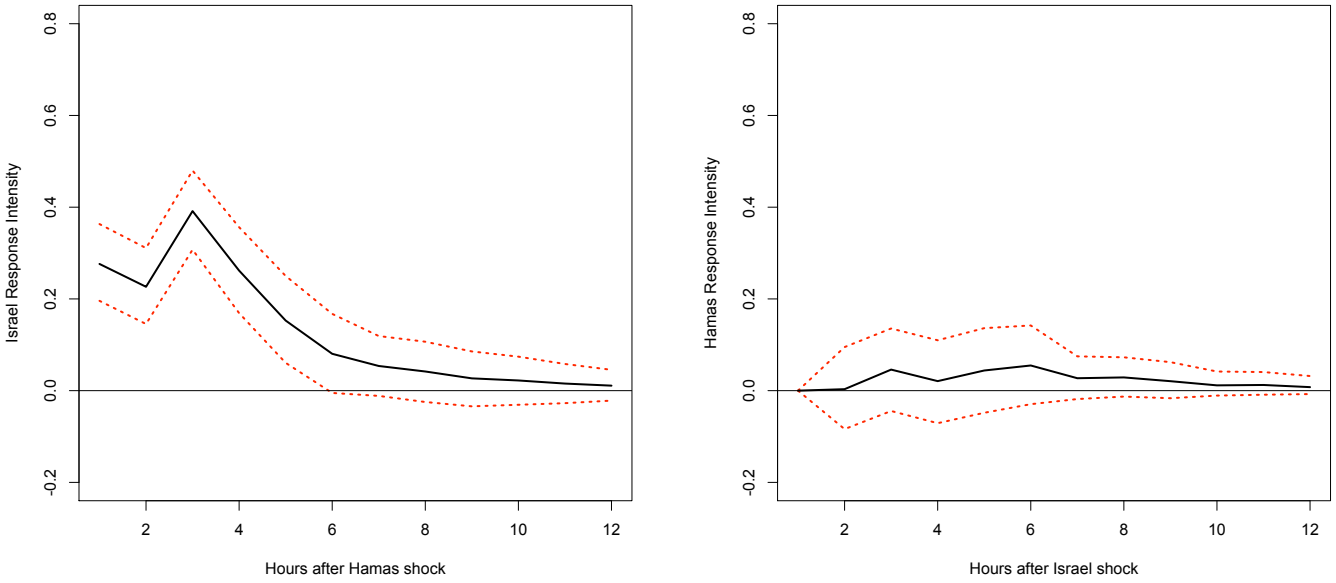

Figure 4: Impulse Response Analysis for the Post-Invasion Phase (174th hour and after)

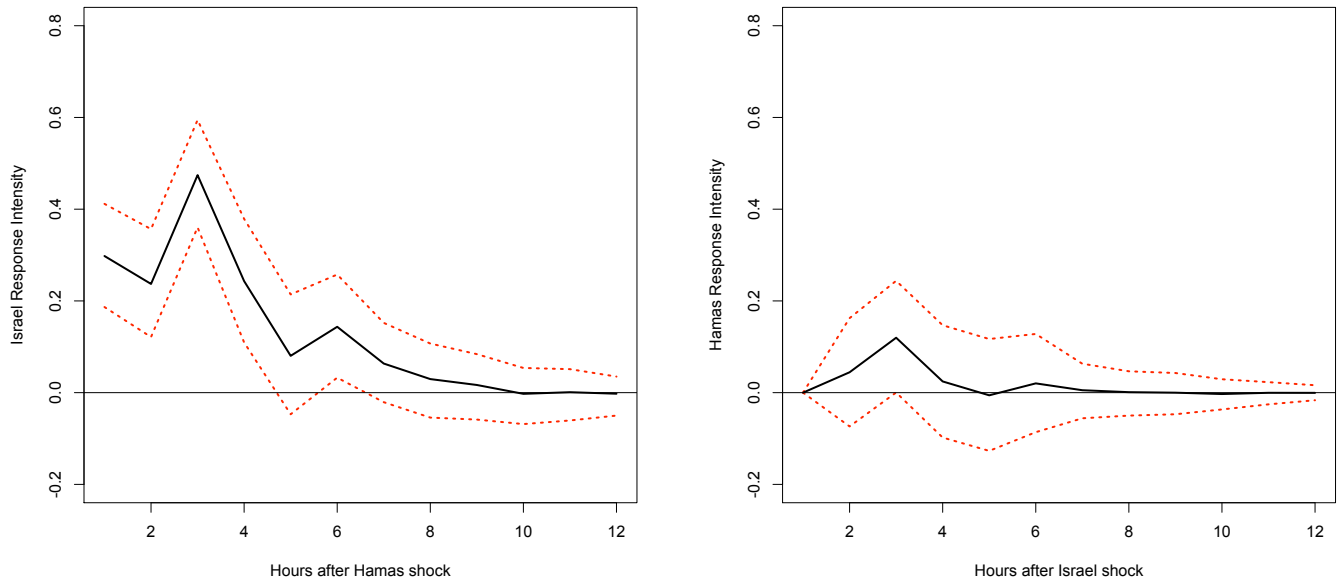

Figure 5: Impulse Response Analysis for the Pre-UN Security Council Vote (first 305 hours)

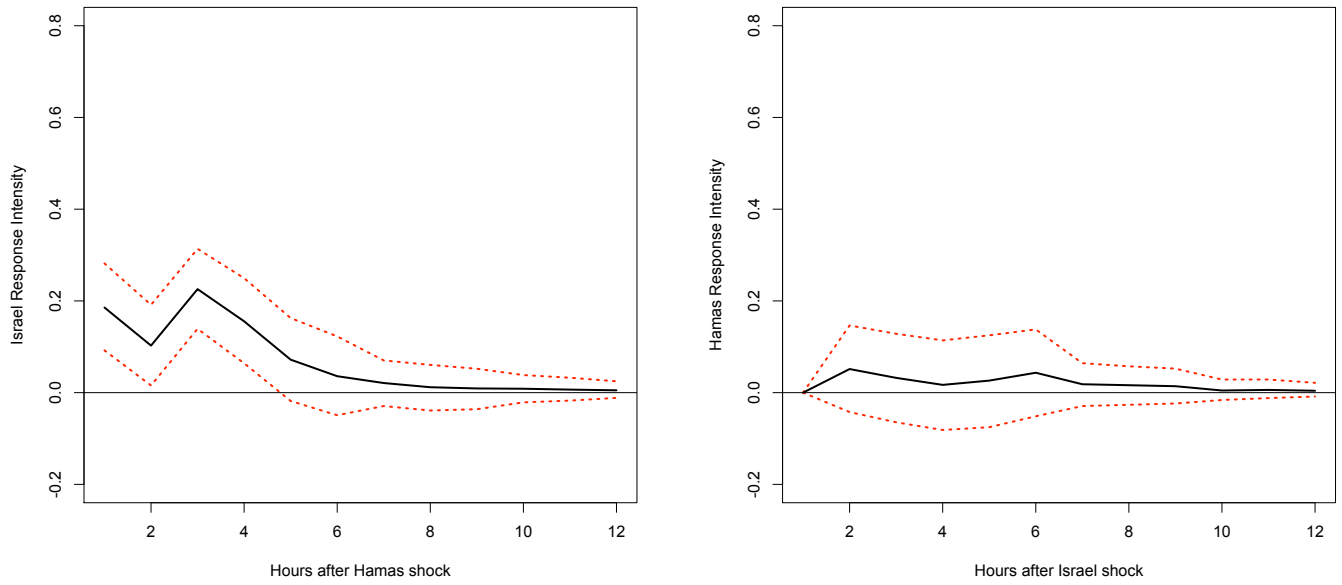

Figure 6: Impulse Response Analysis for the Post-UN Security Council Vote (306th hour and after)

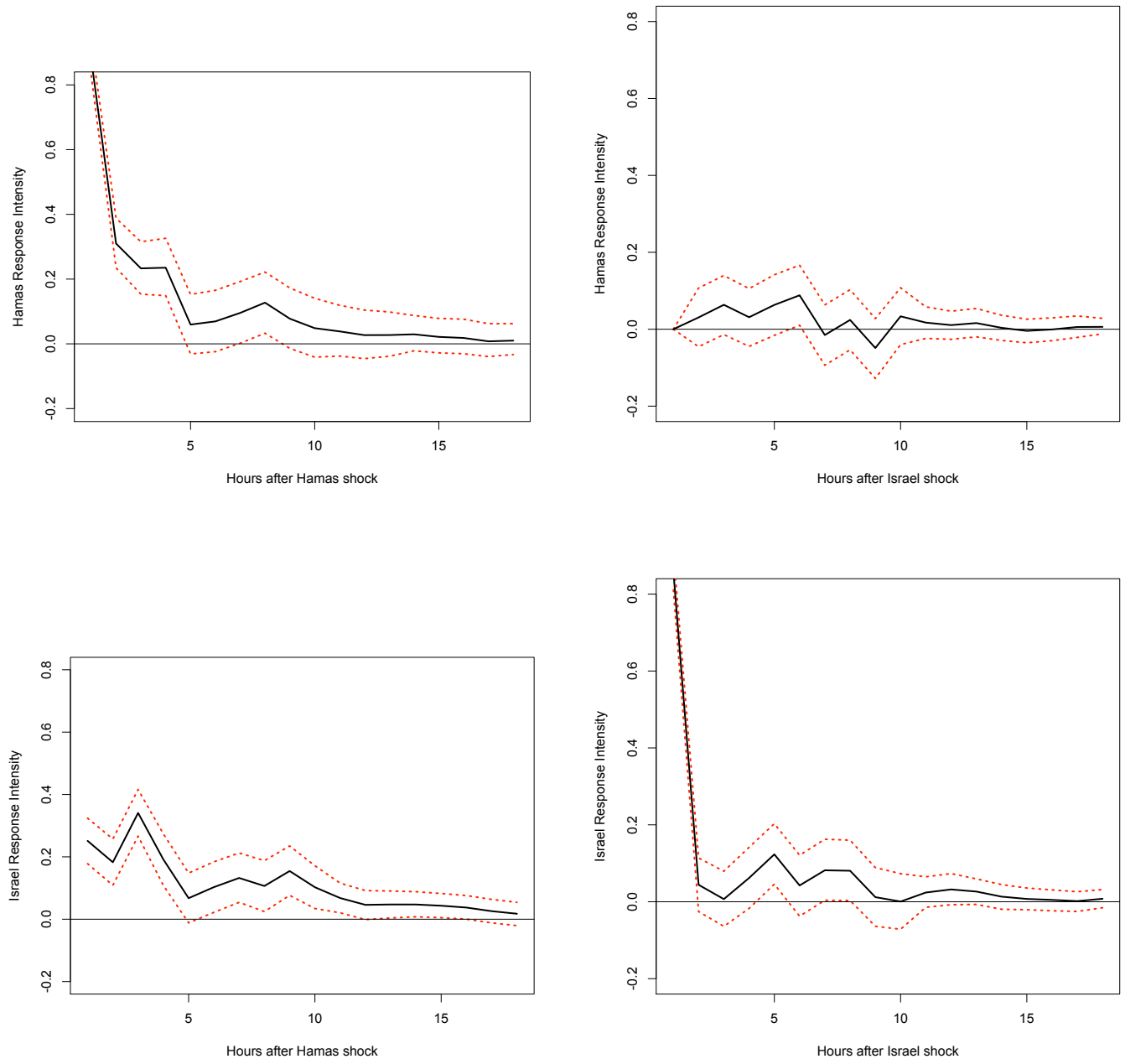

Figure 7: Impulse Response Analysis for the 9-lag VAR Model over the Whole Conflict

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Table 1: **Testing of Hypotheses**

Hypothesis	*Method of Testing*
Proposition 1	Decomoposition of Forecast Error Variance
Proposition 2	Comparison of Impulse Response Function (Plots and Cumulative)
Proposition 3	Comparison of Impulse Response Function (Plots and Cumulative)

Table 2: **Summary Statistics for Hamas and Israel Action Intensity**

Group	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Hamas	9.11	13.27	0	68
Israel	11.13	17.63	0	80

Table 3: **Lag Length Specification Test**

Lags	*AIC*	*BIC*	χ^2	*p-value* (χ^2)
1	10.370	10.415	0.000	0.000
2	10.356	10.432	15.525	0.004
3	10.353	10.460	9.637	0.047
4	10.353	10.490	7.998	0.092
5	10.362	10.529	2.610	0.625
6	10.366	10.564	5.610	0.230
7	10.359	10.587	11.668	0.020
8	10.352	10.611	11.534	0.021
9	10.357	10.645	5.556	0.235
10	10.379	10.688	0.902	0.924
11	10.381	10.730	0.943	0.918
12	10.387	10.766	4.566	0.335
13	10.397	10.807	2.155	0.707
14	10.400	10.840	6.080	0.193
15	10.395	10.866	10.112	0.039
16	10.400	10.900	4.896	0.298
17	10.409	10.940	2.809	0.574
18	10.409	10.970	7.444	0.114
19	10.419	11.011	1.912	0.752
20	10.427	11.050	2.902	0.574
21	10.435	11.088	3.549	0.471
22	10.438	11.122	5.531	0.237
23	10.447	11.161	2.556	0.635
24	10.451	11.195	5.361	0.252
25	10.453	11.227	6.459	0.167

Table 4: **Granger Causality Tests for Hamas and Israel Based on the 5-lag VAR Model**

Hypothesized Exogenous Variable	*Block Coefficient Restricted*	*F Statistic*	*P-Value*
Israel	Hamas	3.041	0.010
Hamas	Israel	2.080	0.066

Table 5: **Decomposition of the Forecast Error Variance for 5-Lag VAR Model (Hamas Constrained at Zero)**

	Forecast Error % for Shock to Hamas		*Forecast Error % for Shock to Israel*	
hour(s)	*Hamas*	*Israel*	*Hamas*	*Israel*
1	87.715	12.284	0.000	100.000
2	84.630	15.370	0.847	99.153
3	84.200	15.800	0.933	99.067
4	83.624	16.376	0.953	99.047
5	83.122	16.878	0.945	99.055
6	82.368	17.632	1.027	98.973
7	81.969	18.031	1.053	98.947
8	81.753	18.247	1.064	98.936
9	81.612	18.388	1.069	98.931
10	81.505	18.495	1.077	98.923
11	81.434	18.566	1.082	98.918
12	81.390	18.610	1.085	98.915

Table 6: **Cumulative Impulse Responses Given a 1 Unit Shock**[26]

Shock In	*Time Period*	*Response By*	*Response Magnitude after 12 hrs.*	*95% C.I.*
Israel	Whole Conflict	Hamas	0.32	(−0.20, 0.84)
Israel	Pre-Invasion	Hamas	0.13	(−1.02, 1.28)
Israel	Post-Invasion	Hamas	0.28	(−0.35, 0.94)
Israel	Pre-UN Vote	Hamas	0.21	(−0.61, 1.02)
Israel	Post-UN Vote	Hamas	0.24	(−0.41, 0.91)
Hamas	Whole Conflict	Israel	1.49	(0.83, 2.16)
Hamas	Pre-Invasion	Israel	0.66	(−0.61, 1.96)
Hamas	Post-Invasion	Israel	1.56	(0.71, 2.41)
Hamas	Pre-UN Vote	Israel	1.58	(0.44, 2.69)
Hamas	Post-UN Vote	Israel	0.84	(0.06, 1.60)

NOTE: 95% confidence intervals calculated from 10000 Monte Carlo simulations using the `MSBVAR` package in `R`

Table 7: **Conflict Intensity Coding Scheme**

Score	*Action Taken*	*Definition/Scope*
0	No action taken	
1	Cease-fire	
2	Investigate	
3	Demand	
4	Reject	
5	Admonish	
6	Protest	
7	Threaten/Heightened alert	Use of threats or provocations
8	Reduce relations	
9	Engage militarily	Hamas action when invasion begins
10	Occupation	Israeli action when ground fighting begins
11	Misinformation,	Psy-Ops, Cyber Warfare
12	Sporadic mortar rocket fire	Intention to harass
13	Endangering civilians	Use of human shields, intentionally endangering a civilian population
14	Large-scale/Longer range rockets	Use of Grad and/or multiple rockets
15	Unconventional tactics	Improvised explosive devices/ suicide attacks etc.
16	Limited/Targeted air strikes	Assassination, specific targets (small collateral damage)
17	Limited ground forces	Small unit firefights/ special forces/ambushes
18	Artillery fire	Tank and other artillery batteries
19	Large ground forces	Movement of large infantry and mech. divisions
20	Wide-spread air strikes	Large collateral damage/attacks infrastructure

Table 8: **Decomposition of the Forecast Error Variance for 5-Lag VAR Model (Israel Constrained at Zero)**

	Forecast Error % for Shock to Hamas		*Forecast Error % for Shock to Israel*	
hour(s)	*Hamas*	*Israel*	*Hamas*	*Israel*
1	100.000	0.000	3.932	96.068
2	97.968	2.032	5.918	94.082
3	97.090	2.910	5.914	94.086
4	96.518	3.482	6.032	93.968
5	96.073	3.927	6.051	93.949
6	95.461	4.539	6.021	93.799
7	95.069	4.931	6.268	93.732
8	94.830	5.170	6.299	93.700
9	94.679	5.321	6.316	93.684
10	94.568	5.432	6.331	93.669
11	94.494	5.506	6.342	93.658
12	94.447	5.553	6.348	93.652