THEORIES OF INTERNATIONAL RELATIONS AND THEIR PREDICTIONS FOR THE PROLIFERATION OF DRONES

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THE STORY OF AHMED al-JABARI

Ahmed al-Jabari was known to keep out of the spotlight. The "General," as his fellow soldiers called him, had a notorious past (Beaumont 2012). In 1982, Israeli authorities arrested him for armed smuggling, leading to a 13-year imprisonment (Beaumont 2012). Frustrated with the corruption and ineffectiveness of his organization, Fatah, he joined its rival Hamas upon release (Beaumont 2012). As a member, al-Jabari worked up the ranks, leading dozens of terrorist attacks that killed hundreds of Israeli civilians (Ravid 2012; Meo 2012). In 2006, he captured Israeli soldier Gilat Shalit and made international headlines when he escorted the prisoner five years later (Meo 2012). For one man, Israeli authorities released 1,000 Palestinians- 300 of them convicted killers (Meo 2012). But, that is not all. One year later, al-Jabari led Hamas to ruthless victory over his former organization to secure the Gaza Strip (Kershner and Akram 2012).

All the while, the Israeli Defense Forces tried in vain for over a decade to eliminate al-Jabari. They carried out four assassination attempts throughout the 2000s (Meo 2013). Yet, al-Jabari was able to survive each one due to his cunningness. He seldom made public appearances; few Palestinians in the Gaza Strip had ever seen him (Meo 2012). He also supposedly never carried a cell phone for fear of the Israeli Defense Forces tracing his position, and relocated nightly from house to house, never staying in the same place (Beaumont 2012).

But, on November 14th, 2012, al-Jabari's attempts to avoid detection were fruitless. High above the sky, an aircraft followed al-Jabari all day, without its pilot flinching, blinking, or feeling weary. In fact, the pilot did not breath. It was a drone. Probably, an IAI Eitan, capable of long endurance operations of more than 50 consecutive hours and able to fly upwards of 35,000 feet (Wright 2012). This particular drone could fire missiles. As al-Jabari drove his car down a calm street, the drone unleashed one. In a matter of seconds, the car was obliterated. The speed of the missile was so fast that one journalist remarked, “Jabari probably didn’t even hear the missile that killed him” (Meo 2012). There were no casualties (Meo 2012). Israeli Defense Forces posted on their Facebook page a picture of al-Jabari overwritten by the word “eliminated,” and a video on YouTube of the assassination (Kershner and Akram 2012; Borger 2012). The message had already been created prior to al-Jabari’s death, the video posted minutes afterwards.

The main event happened after al-Jabari’s assassination. Israeli Defense Forces let fly a combination of manned and unmanned aircraft over Gaza that conducted 20 missile attacks that day (Al Jazeera 2012). The amount of aircraft flying later that week were so plentiful that one reporter, Richard Engel, posted on Twitter: “So many drones over #Gaza city it sounds like everyone is out mowing their lawns in the dark” (Engel 2012). Other reports (Pearlman 2012) confirmed that the buzz of drones was nearly deafening.[1] Overall, drone strikes accounted for 36 deaths, while injuring more than 100 people (Wright 2012). According to the Palestinian Center for Human Rights (2012), the drone strikes were more efficient than manned ones. Although they accounted for five percent of all the strikes over Gaza, they caused 23% of the deaths. Most strikingly of all, drones killed more Palestinians in eight days than Palestinian rockets killed Israelis in the last eight years combined (Wright 2012).

[1] The buzz was so loud it led to Palestinians calling these drones “Zenana,” an onomatopoeia that sounds like the aircraft’s distinctive buzz. But, probably, the more legitimate reason for the name is due to its translation. It is Arabic slang for ‘nagging wife’.

THE IMPORTANT CONSIDERATIONS RAISED

Drones provided crucial advantages for the Israeli Defense Forces in the Gaza War. They were able to gather information of targets on the ground and strike those targets with pinpoint precision. Later, they unleashed widespread destruction over Gaza. Without a doubt, such capabilities raise important concerns in the realm of international relations. Do other countries besides Israel possess these technologies? If so, which theories of international relations explain the diffusion?

Everett Rogers (2003, 5) provides the seminal work on diffusion, defining it as the, "process by which an innovation is communicated through certain channels over time among members of a social system." Although Rogers described diffusion as it applied to consumer technology products, his definition aptly applies to military innovations (Horowitz 2012). In effect, the thesis is concerned with the diffusion of drones, a purely military innovation. It is important to note that diffusion explicitly refers to the number of states that acquire drones.

Three international relations theories posit specific ways in which diffusion may occur. The three theories are: offense-defense realism (hereafter known as offense-defense), power transition , and organization diffusion (hereafter known as organization). Specifically, adoption-capacity theory will represent organization theory, since the latter is an umbrella term for many theories. Data is compiled to demonstrate the diffusion of drones since the early 1960s. Then, each theory is assessed though statistical tests. In short, a case can be made for all three theories. However, the tests are limited, and the theories suffer from notable flaws. Future research should address both qualms.

The thesis is divided into four main sections. The introduction affords a brief overview of drone development, with a special emphasis on the United States, a key first adopter.[2] The discussion will serve as a basis for the rest of the thesis. The second section describes the major international relations theories and how they relate specifically to the process of diffusion. Each theory hypothesizes how diffusion takes place. The third section compiles the data concerning the diffusion of drones. It shows the rate of the diffusion of the technology from the years 1960 to 2011. The last section presents the verdict assessing each theory. In order to do this, each theory is compared to the data and statistical tests are undertaken.

INTRODUCTION

Drones have many names, including robot planes, pilotless aircraft, remotely piloted aircraft, remotely piloted vehicles and unmanned aerial vehicles (UAVs). The Department of Defense (2013) defines a drone as, "a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly itself (autonomously) or be remotely piloted, can be expendable or recoverable at the end of the flight, and can carry a lethal or nonlethal payload." Often times, the main difference between a drone and a guided missile is this ability to be recoverable at the end of the flight. A pilot using a controller operates the drone from a ground control station, and together the drone and control station are deemed unmanned aircraft systems (UAS).[3]

Although drones are increasingly receiving a lot of media attention, they are not a new military innovation. The United States military has researched and developed drones

[2] This will be discussed in more detail.

[3] Peter Singer (2009, 33) notes that the pilots can be located as far as 7, 500 miles away (often times in Nevada) from the drones they are flying. They control drones through the use of satellite communications.

since at least the middle of the 20th century.[4] Jeremiah Gertler (2012), a specialist in military aviation technologies, finds archival evidence that drones were tested in World War I, although not used in the war.[5] The story of significant drone development begins in the early 1960s (Ehrhard 2012). According to recently declassified reports analyzed by Thomas Ehrhard (2010, 5), three United States intelligence agencies worked together to fund more than 40% of the total drone investment from the 1960 to the early 2000s. The three agencies were the Central Intelligence Agency, the Air Force and their combined interaction agency: the National Reconnaissance Office, whose existence was so secret its name was declassified only after the Cold War.

In many ways, the Cold War served as a constant impetus to drone development. The intelligence community largely invested in drone development for fears of manned pilots falling into Soviet hands and disclosing sensitive secrets (Ehrhard 2010, 6). In the late 1950s, Air Staff reconnaissance officer Col. Hal Wood voiced such fears, and three popular incidents confirmed them (2010, 6). Each led to the development of increasingly superior drones. The first instance occurred on May 1, 1960, when the Soviets shot down Francis Gary Powers' U2 high above the Soviet Union. His eventual captivity alarmed those in the intelligence community, leading to a defense contract for the Red Wagon, one of the first drones produced in the United States (Ehrhard 2010, 6).[6] There was more

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[4] See Thomas Ehrhard (2010) for perhaps the most complete historical accounting of the development of drones in the United States.

[5] For an interesting story about how drones were tested, review Operation Aphrodite, a secret drone operation that led to the death of Joseph P. Kennedy, the older brother of John F. Kennedy. Joseph died in a bomber that was being remotely controlled by a nearby plane (Olson 2004). The bomber-drone prematurely detonated. His death led to the drone program's hiatus in World War II, and the loss of a young man slated to take the political reins of his father.

[6] Indeed, the 1960 incident had deep implications for the drone program, even years later. In 1966, Deputy Secretary of Defense Cyrus Vance emphasized drone development, of one the most advanced early drones

funding from the National Reconnaissance Office for the drone program following the Cuban Missile Crisis. In one of the most dangerous times during the Cold War, the Soviet Union shot down and killed Major Ralph Anderson. But, this time, something interesting happened: one day after, Fire Fly drones, one of the most significant operational drones, were deployed to Florida to continue Major Anderson's original reconnaissance mission (Ehrhard 2010, 8). Ironically, however, they would return because the intelligence community, "did not want to tip the Soviet Union to the presence of this super-capability" (2010, 8). In a twist, the same reasons the United States did not wish to fly manned aircraft, for fear of revealing to much sensitive information, would deter the use of Fire Fly drones- the very embodiment of 'sensitive information'. A third popular event exists. On April 18, 1968, North Korea shot down an EC-121 Super Constellation Signals Intelligence (SIGINT) aircraft that was flying over international but volatile airspace at the time, killing 31 crewmen. The incident caused the National Reconnaissance Office to contract with a private defense company, the Ryan Aeronautical Company, to build four Firebee drones to replace the SIGINT (2010, 12). This time, these drones replaced the SIGINT's duties, and eventually led the way to what Ehrhard (2010, 28) calls the most significant drone ever produced: the Lightning Bug, which was later used in hundreds of missions in the Vietnam War. Over 1,000 were produced and hundreds lost during the campaign (2010, 28).

Although it seems that each incident fueled drone development, the overall growth of the drone program was slow for a number of reasons. In perspective, the development of drones in the second half of the twentieth century was constantly plagued

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produced, the D-21B. The reason, he noted, was to, "never again allow a Francis Gary Powers situation to develop…All our flights over denied territory will either be satellites or drones" (Rich 1994, 267).

and their true role in war limited. The most important reason, Ehrhard observes (2010, 4), is that “drones never developed a tiered operational constituency- that is, one that spanned the operational structure from the flight line to the chief of staff.” In other words, the heads of the National Reconnaissance Office each had different reservations concerning the importance of drones, leading to fluctuations in funding. Another main reason was that drones were expensive to produce (Ehrhard 2010, 57). There was no cheap and reliable method to produce drones, making drones like the Red Wagon or Lightning Bug costly (Ehrhard 2010, 45). In fact, the Lightning Bug project cost the Air Force and CIA a combined 5.8 billion dollars (in today’s dollar), the most expensive drone program before the new millennium (2010, 24). Furthermore, the technology was immature. Drones failed to offer advantages over other conventional alternatives like satellites and manned aviation that could perform the same reconnaissance missions (Ehrhard 2010, 4). These two technologies were preferred time and again and received the most funding from the intelligence community (2010, 4). The same competition exists today, although it is dwindling. Besides the lack of support, high cost of production and lack of technology, other formidable obstacles loomed. Ehrhard (2010, 39 and 56) claims that international air traffic controls limited the airspace in which drones could fly and that arms control regimes, such as the Missile Technology Control Regime (MTCR) or 1988 Intermediate Nuclear Forces arms control agreement, halted their construction.

The majority of these obstacles are dwindling today. Peter Singer (2009, 100) explains how advances in drone technology have accelerated as a direct result of the new information age- which he likes to describe as an ongoing revolution. He (2009, 101) observes that, “major shifts are already going on in computing power and machine intelligence," to the point that drones are increasingly being used by the United States military. In fact, as will be shown, they are starting to replace manned aircraft in various roles, especially information gathering (DOD 2012; Gertler 2012). As a result of advanced navigation and communications technologies, drones are more reliable to control and can fly autonomously. Gertler (2012, 1-2) describes two other cardinal reasons for the increase in the use of drones: satellite bandwidth and the nature of present wars. Satellite bandwidth allows drone pilots from more than a thousand miles away to control drones. Meanwhile, drones are advantageous in asymmetrical warfare. Insurgents in Afghanistan and Iraq exemplify the use of this type of warfare. Stephen Biddle (2004) cites that the modern system of force employment caused asymmetrical warfare. Asymmetrical warfare is a response by insurgents to the great power of weapons on the battlefield. They hide behind trees, up on mountains, or behind any other natural and man-made barrier for protection (Biddle 2004). But, as Gertler (2012, 2) observes, drones can often times locate these insurgents in any locale from high above.[7] A single drone cannot be heard or seen at high altitudes. The result is that insurgents, like al-Jabari, stand little chance of avoiding detection. As one United States Navy researcher tells Singer, "To me, the robot [or drone] is our answer to the suicide bomber" (2009, 62).

There are a number of reasons drones are advantageous in warfare besides their ability to detect the enemy from high above noiselessly and unseen. First and foremost, the key advantage of drones lies in their ability to save the lives of the pilots and troops they replace. Without a risk to life, they can conduct missions in areas that are too dangerous for manned aircraft to access. Thomas Ehrhard (2010, 28) notes numerous

[7] In a way, drones help lift the 'fog of war' originally discussed by Carl von Clausewitz. See Michael Howard's *Clausewitz: A Very Short Introduction* (2002) for a summary.

examples in the Vietnam War in which a particular drone, the Buffalo Hunter, operated in conditions impossible for manned aircraft.[8] Using drones also ensures that sensitive information will not be leaked should the aircraft be shot down and the pilot captured. Another key advantage of drones is that they can conduct a variety of missions. The Department of Defense (2009) describes their numerous capabilities: "In today's military, unmanned systems are highly desirable…for their versatility and persistence. By performing tasks such as surveillance; signals intelligence; precision target designation; mine detection; and chemical, biological, radiological, nuclear reconnaissance, unmanned systems have made key contributions."

Moreover, drones are comparatively cheaper than manned aircraft. Singer (2009, 33) estimates that for the price of one new F-22 jet fighter, the Air Force could purchase 85 Predator drones that have the ability to conduct strikes, albeit weaker ones than the jet. Lastly, as the al-Jabari incident highlights, drones are not prone to any 'human baggage'. Singer (2009,63) explains in more detail: "They don't show up at work red eyed…they don't think about their sweethearts at home…they don't get jealous when a fellow soldier gets a promotion…they don't participate in inside jobs." Undeterred by human emotion or weariness in warfare, they can outlast any human pilot or insurgent on the ground if recently deployed for combat.

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[8] In one operation in the Vietnam War, codenamed United Effort, Lightning Bug drones were sent on suicide missions. Surface-to-air missiles destroyed them as they purposefully continued to gain intelligence (Ehrhard 2010, 25).

THE THREE INTERNATIONAL RELATIONS THEORIES OF DIFFUSION

Clearly, drones offer many advantages in warfare. But, do other states possess them? The answer, in short, is yes. Three theories are analyzed to explain their diffusion. The three are offense-defense, power transition and organization theory. Offense-defense and power transition are not necessarily concerned with the diffusion of military innovations, but each does touch upon the subject enough to posit rudimentary hypotheses about how drones may diffuse. Each theory provides an estimate concerning the rate and scope of diffusion. The rate refers to the speed of diffusion, and is classified as either fast or slow. The scope refers to the systemic character of the diffusion. It may be even (or uniform), in which states have an equal chance to adopt the innovation, or uneven (not uniform), in which only certain states will adopt it.[9] A complete review of each theory is later provided in Table 1.

Offense-defense theory is the first to be assessed. The theory is grounded in the notion of neorealism. Kenneth Waltz (1979) first provided clues as to how the theory relates to the diffusion of military innovations. His assumption that anarchy dominates the system eventually explains how diffusion occurs. According to Waltz, states living in anarchy have no guarantee of their existence. States seek one major goal- security- and are self-helpers. As a result of states seeking security, competition erupts. Competition becomes synonymous the possibility of conflict. Waltz (1979, 127) explains, "The possibility that conflict will be conducted by force leads to competition in the arts and instrument of force." Waltz cautions that when a state becomes too strong, the lesser states feel threatened (1979, 126). They will try and balance against the state, either

[9] What exactly fast/slow and even/uneven mean is uncertain. No theory provides an explicit definition for the terms. Future work should address the issue.

internally or externally. Internal balancing refers to states building up their own forces to curb the threat. External balancing refers to states forming alliances in order to achieve the same result.

Waltz's notion of internal balancing refers to the process of diffusion. When states internally balance, they look unto the greater states for cues as to which military weapons and doctrines or strategies in war they should adopt. Thus, the structure of the international arena can play a fateful role dictating states' behavior involving emulation, if internal balancing occurs. Joao Resende-Santos (1996) explains the underlying mechanism. When a technology or strategy's advantages become apparent to other states, a demonstration effect occurs. The demonstration effect is defined as a process signaling to states the importance of a military innovation or strategy. According to Resende-Santos (1996, 200, 211), war often serves to provide a demonstration effect. He explains (1996, 211), "In the military sphere, it is the victorious military system of every great war that sets the standard by which all others measure themselves and which acts as the model imitated by all." War is the proving ground.

However, Waltz's basic notion of neorealism is too limited to predict the possible diffusion of drones. He does not provide an exact rate of a state's adoption of the innovation.[10] His theory merely predicts that states that feel threatened should adopt an innovation. Goldman and Andres (1999) rightfully assume from the theory that threatened states should automatically adopt an innovation when they choose to respond by internal balancing. But, states could also externally balance against a power and

[10] Resende-Santos (1996, 1950) critiques the theory for the same reason, "After putting forth a theory of emulation, Waltz leaves it largely unexplored. He does not discuss why and how emulation vary in pace and scope."

choose to not adopt the innovation. This leads to variance in any prediction of diffusion using neorealism.

Due to the fact that neorealism is undeveloped, Resende-Santos (1996; 2007) posits a more updated theory of neorealism to better explain diffusion. He suggests offense-defense theory in order to better predict the rate and scope of the diffusion of military innovations. Resende-Santos's goal is to provide a more full developed underlying mechanism in which neorealism can predict diffusion (1996, 197).[11] He uses Waltz's ideas concerning the process of internal balancing as a springboard to put forth his theory (1996, 204). In his theory, states remain self-helpers in an anarchic realm. The demonstration effect also remains pivotal in showcasing other states which military innovations are useful. But, the one major difference, according to Resende-Santos (1996, 215), is the mechanism he posits: "The primary factor determining the pace and scope of military emulation is the offensive-defensive balance." Essentially, the type of balance a state is in, whether offensive or defensive, determines its chances to adopt an innovation.

Offense-defense theory thus adds specificity to Waltz's neorealism theory. Resende-Santos (1996, 217-218) argues that the nature of the existing balance of power in the system affects the rate of diffusion.[12] The balance can be offensive or defensive. An offensive balance is one in which all states are disadvantaged defensively. Resende-Santos (1996, 218) explains, "When the state finds it difficult to defend its national

[11] In fact, unlike Waltz, Resende-Santos (1996; 2007) is explicitly concerned with diffusion of military innovations.

[12] In a way, this is not different than what Waltz contends. Both Waltz and Resende-Santos credit the system for influencing whether a state adopts an innovation. The difference is that Resende-Santos identifies the importance of balances, and thereby he adds specificity to neorealism.

territory because of geographic liabilities and the nature of the existing military technology, it is at a defensive disadvantage." This means that the state's security is not ensured in the balance. Its technology is insufficient for the purpose of protecting it borders. A state's vulnerability induces emulation of new military technology, "…when offense is easy for potential attackers, even minor shifts in the regional balance and strategic environment will heighten the insecurity of the disadvantaged state; such shifts of threats will trigger immediate and substantial [internal] balancing efforts on its part" (Resende-Santos 1996, 218). States in an offensive balance will try to adopt the latest military innovations in order to better protect their borders.[13] Thus, the scope and rate of diffusion should be even and rapid among states in the offensive balance.

A defensive balance means that the states involved do not face a security threat (Resende-Santos 1996; 2007). They are defensively advantaged; the technology they possess can safeguard their borders from potential attackers (at least, that is what state leaders believe). Their defenses can handle the offensive prowess of any other state in the balance. As Jack Levy (1984) notes, Carl von Clausewitz was one of the first military thinkers to hypothesize the notion of defensive balances when he suggested that the superiority defenses in war leaves both sides without an incentive to attack. Robert Jervis (1978, 188-190) concurs. When there is a defensive balance, in theory, states should feel less need to adopt any type of military innovation. The theory is concerned with states wanting security. If there is a defensive balance, there are no perceived threats to leaders. Resende-Santos (1996, 218) further developed the notion, "Defensive dominance allows states to react more slowly and with greater restraint to the capabilities-enhancing efforts

[13] States will try to adopt the innovation largely provided that a demonstration effect has taken place. Such an effect often times determines which innovations states find useful to adopt (Resende-Santos 1996, 211).

and gains of neighbors. Defensive dominance means offensive disadvantages for prospective attackers." Thus, the rate and scope of diffusion in such balances will be uneven and slow. However, the type of balance present is not always indicative of whether a country will or will not adopt an innovation. Sometimes, the nature of the weapon itself matters to whether states adopt it.

In offense-defense balance, the nature of the innovation or practice that is diffused also matters in certain instances. In offensive balances, George Quester (1977) explains, the characteristic of the innovation can determine which state adopts it. On the one hand, if the innovation is offensive in nature, stronger states will adopt it. On the other hand, if the innovation is defensive, weaker states will adopt it. They will have the desire to adopt the innovation for security purposes. Acquiring the offensive innovation may not afford any advantages to the weaker state- it probably cannot compete with the stronger state in an arms race of the technology. Thus, sometimes the scope and rate of diffusion in offensive balances is not even and rapid due to the nature of the innovation being diffused. Diffusion may vary.

In the case of drones, then, it matters whether they are defensive or offensive in nature. If they are defensive, offense-defense theory suggests that states in an offensive balance will likely adopt them to improve security. A case can be made that drones are defensive. The United States Government Accountability Office (2012, 11) concludes from their review of the drones that have proliferated that, "According to available analysis, the majority of foreign UAVs that countries have acquired fall within the tactical category. Tactical UAVs primarily conduct intelligence, surveillance, and reconnaissance missions and typically have a limited operational range of 300 kilometers." It seems that the missions drones perform are defensive. They can fly only a limited distance from their ground control stations, and can only gather intelligence. They cannot conduct armed strikes. In some instances, like in the United States, such drones patrol the border for surveillance (Constantini 2012). Thus, an argument can be made that the majority of drones are defensive.

But, a caveat to this exception in offensive balances is that, sometimes, the characteristic does not matter. Stephen Van Evera (1984), another offense-defense theorist, notes that offensive technologies can sometimes diffuse among weaker states in an offensive balance due to a perceived offensive bias. These threatened states might prefer innovations that are offensive simply because they are offensive, and so the rate and scope of diffusion for offensive technologies might not change whatsoever. In the same scenario, defensive innovations do not enjoy such partiality- the threatened states largely adopt them, not the offensive (Resende-Santos 1996, 220).

Hypothesis 1: Under offense-defense theory, the nature of the balance can determine the adoption of military innovations. In an offensive balance, states are threatened and are more likely to adopt drones, especially because drones are defensive. States in a defensive balance are less likely or have fewer incentives to adopt drones because their security is not necessarily at stake.

There are a myriad of problems with offense-defense theory. Jack Levy (1984) critiques the hypothesis because it is based on the notion that state leaders perceive the correct type of balance. Sprout and Sprout (1965) echo the concern: too commonly, a leader perceives a 'psychological' environment quite different than the objective operational environment. Secondly, as Levy (1984, 222) and Resende-Santos (1996, 215) observe, there is no explicit definition for an offensive or defensive balance. They do point to the fact that historians seem to have little difficulty categorizing some balance. For example, it is easy to classify trench warfare in World War I as defensive, with many of the weapons and strategies available favoring the defense (Levy 1984). Moreover, Quester (1977) states it is clear that historical empires were typically in offensive balances, due to their nature of trying to expand their borders. Still, Levy (1984, 235), is disillusioned with the ambiguity, concluding "…the concept of offense/defense balance is too vague and encompassing to be useful in theoretical analysis." One other reason upsets Levy. Since offense-defense theory is a neorealist theory, it is perhaps too concerned with the external structure of the international arena dictating state behavior. Perhaps, there could be other reasons affecting adoption like a state's domestic politics.

The second international relations theory presupposing how diffusions occur is power transition theory. It is important to note that power transition theory is not primarily concerned with diffusion. Instead, the theory is concerned with what its name implies: power transitions (Organski 1958; Tammen et al. 2000). War is most likely when a hegemon's power is challenged by a weaker, but increasingly powerful, state. The challenger is dissatisfied with the status quo established by the hegemon (Organski 1958; Tammen et al. 2000).

Robert Gilpin (1981) further developed the theory and argued how it relates to the process of diffusion. Essentially, power transitions are synonymous with the diffusion of military technologies. The reason is not because both states are getting ready for war, per se. Rather, power transitions signify that the challenger state is experiencing national growth. This growth largely determines whether the state adopts the innovation (Goldman and Andres 1999). Goldman and Andres (1999, 86) explain, "Military best practices will diffuse differently among states, and the rate and scope of diffusion depends on levels of national development, which determine the capacity of states to adopt and leverage innovations." Specifically, a country's level of industrialization can be the most important factor determining growth (Tammen et al. 2000).[14] Tammen et al. (2000, 16) explain that those countries that extract natural resources should be more likely to become stronger.[15]

Hypothesis 2: Under power transition theory, the rate and scope of the diffusion of drones will vary. The states with the greatest national power, or level of industrialization, should adopt drones while the least industrialized states are not expected to adopt them.

The main issue with power transition theory is its emphasis on industrialization determining whether a state has the capacity to emulate. Why should an industrialized state adopt an innovation in the first place? The theory requires revision and more exploration in the area of diffusion. Moreover, Alvin and Heidi Toffler (1993) argue that national power does not need to be so closely tied to the level of industrialization in the new 'information era'. Goldman and Andres (1996) agree, "the information revolution suggests the process of improving resource utilization does not end with industrial maturity…the macrosocial foundations of success in the information age are not limited

[14] Note: Power transition theorists state that other factors are important to determining national growth. Tammen et al. (2000, 18) write that a state's total population is the, "sine qua non for great power status." But, they note its effects are important in the long term. Eventually, a larger population will determine the level of industrialization. For the purpose of this thesis, which is concerned with the short term diffusion of drones, the level of industrialization of states in the recent past is taken into account to determine national growth, and thereby, the ability to adopt a military innovation.

[15] However, power transition theory needs to better explain why a state's level of industrialization translates into adopting military innovations.

to industrialization." They cite a counterexample to the theory (Goldman and Andres 1996, 85). Industrialization was not necessarily indicative of a country's power throughout the Cold War. In 1985, the Soviet Union was producing 160 million tons of steel per year. At the same time, the United States was producing 74 million tons. Steel production should be one of the most important indicators of a country's industrial prowess. Still, the United States, not the Soviet Union, was the country left standing only a few years later. Furthermore, power transition theory fails to provide an explicit definition for how industrialized a nation needs to be in order to adopt a military technology.

Organization theory provides the last major prediction for the diffusion of drones. Under the auspices of the theory, a state's particular society, culture, government and military organization affect the rate of adoption (Goldman and Eliason 2003). Quincy Wright (1958) argues for the special importance of culture in determining whether a state will adopt an innovation. By culture, he means whether the technology 'fits' in with the organizations of the state that are adopting the innovation (he remains somewhat vague on this point). If a state's military invests heavily into researching new technologies, for example, it is more likely to adopt military innovations. Wright (1988) explains (Goldman and Andres 1996), "Technologies are not superficial devices from which all cultures can benefit and which may originate anywhere and diffuse easily and rapidly. On the contrary, technologies are related to the culture as a whole." Goldman (2003) also makes similar arguments about the importance of culture.

Organization theory has one major advantage over the other theories: it is the most state-centric. A common critique of offense-defense theory is that it expects the international structure to solely dictate adoption. Power transition theory is more state-centric, but only expects a country's level of growth, or industrialization, to dictate possible adoption. Organization theory resolves these problems and focuses upon many domestic factors that can affect adoption (Goldman and Andres 1996, 90). The theory does acknowledge how competition might lead to diffusion as in neorealism and offense-defense (Horowitz 2010 is one example). Goldman and Andres (1996, 96) find in their exhaustive review of the theory that the scope and rate of diffusion of innovations should be the least uniform and rapid of the theories. In the words of Goldman and Andres (1996, 96), "states are just as likely to offset as to emulate the capabilities of the superior power." Since states have their own unique organizations, there could be a number of reasons a state does not adopt the innovation.

But organization theory is too broad, and Goldman and Andres's (1996) review of the theory and what it predicts concerning diffusion are shaky, at best. Therefore, in order to test organization theory, Michael Horowitz's (2010) adoption-capacity theory will represent it. The theory is chosen because of its modernity. Horowitz (2010, 9) explains the theory: "once states have the necessary exposure to an innovation, the diffusion of military power is mostly governed by two factors: the level of financial intensity required to adopt a military innovation, and the amount of organization capital required to adopt the innovation." Similar to offense-defense theory, a demonstration effect takes place-indicating what the best military innovations are to adopt. Horowitz (2010, 31) defines financial intensity as, "the particular resource mobilization requirements involved in attempting to adopt a major military innovation." Two factors largely determine it: the state's economic power and the financial costs of the innovation. Since drones are much cheaper than aircraft, they would classify as possessing a low financial intensity requirement. Organization capital refers to the intangible characteristics of a state's organizations that determine its ability to adopt an innovation. Horowitz (2012, 36) proposes three measures to determine it: the organization's age, the amount of resources it devotes to military experimentation and its critical task focus. In short, the adoption of an innovation is likely when the organization is young (less steeped by tradition), more willing to invest in research (more innovative), and has broad critical tasks (meaning its goals are general, allowing the organization to be more open-minded about adopting new military innovations). In short, since drones are simply unmanned aircraft, meaning they are similar to manned aircraft, it should not be difficult for states' organizations to adopt them- as long as that state already has manned aircraft.

Hypothesis 3: The diffusion of drones is determined by financial intensity and organizational capital. Drones are cheap so more countries are expected to adopt them. Moreover, organization capital matters. Organizations that are young, invest more in research and development, and have broader critical tasks should adopt drones more quickly.

Table 1: The three major IR theories and their predictions of drone diffusion

International Relations theory	**Motivation to adopt innovation**	**Capacity to adopt innovation**	**Hypothesis concerning diffusion**
Offense-Defense	The type of balance present, which determines if states face a security threat. The threat determines adoption	[Not necessarily addressed]	Drones will diffuse more rapidly in an offensive balance but more slowly in a defensive one. The type of innovation (offensive or defensive) matters.
Power transition	Level of national development, i.e. industrialization	Level of industrialization	The more industrialized nations are expected to adopt drones.
Organization Theory (Adoption-Capacity Theory)	Competition is one factor. But, it also depends if the state can adopt the innovation	Financial intensity and organizational capital	Since drones require low levels of financial intensity, more states should adopt them. Moreover, the organizational capital should not matter too much since drones are similar already to manned aircraft.

Source: Goldman and Andres (1996), among others

THE DATA CONCERNING THE PROLIFERATION OF DRONES

The major sources publically available detailing the proliferation of drones are the Stockholm International Peace Research Institute (SIPRI) and the Government Accountability Office (GAO). Both provide enough data to definitively estimate the diffusion of drones since the 1960s. It is important to note that there are two major international regimes that attempt to limit the spread of drones and may hinder each theory's ability to predict diffusion: the Missile Technology Control Regime (MTCR) and the Wassenaar Arrangement (Wassenaar). The MTCR was originally created to halt the diffusion of ballistic missiles in the Cold War, while the Wassenaar originally aimed at halting the diffusion of conventional weapons. Of the two, the MTCR has the most leverage inhibiting the diffusion of drones. The MTCR passes legislation on a consensus basis. Once proposals are passed, all 34 member states are strongly expected to follow the proposals. Notable members of the regime include Canada, France, Germany, Great Britain, Italy, Japan and the United States. Israel and China are not members.

The MTCR defines drones into two categories (GAO 2012, 5). Category I drones are those that are the largest and most capable. Once a drone can carry a 500 kg (or 1102 pounds) payload for more than 300 km (or 186 miles), it is classified as a category I drone. The drone that killed the Hamas leader al-Jabari was one such drone, albeit it was armed. Regime members hoping to export such drones must first apply a strong presumption of denial standard, meaning that the transfer should occur only in rare instances already defined under the guidelines. Israel, not a member, has become the first-mover, or primary exporter of drones. Unlike Category I drones, Category II ones are not subject to the presumption of denial in order to export. They are less sophisticated and do not meet the payload and distance criteria of their category I counterparts. They are often outfitted for information gathering missions. The United States and Israel are by far the major exporters of such drones.

Overall, the MTCR has enjoyed limited success.[16] In fact, the GAO (2012) argues that it is failing its mission to halt the diffusion of drones. Figure 1 highlights the scope of drone diffusion as of 2011. Approximately 76 countries, shaded in the map, possess drones. The list below the map identifies them. However, the United Kingdom's Ministry of Defense (2012) recently reported in Parliament that over 80 countries to their knowledge have drones. Of these, around a dozen or so possess drones capable of carrying out armed attacks. As for the rate of diffusion, the GAO (2012) details that it has been rapid. Although no data on the rate of diffusion is provided before the year 2004, since that year 35 new countries have obtained them, increasing from 41 to 76 by 2011. Taking the Ministry of Defense assessment at heart, in which 80 countries now possess drones, the diffusion has almost doubled since 2004. A more in depth review is startling. In 2004, the GAO reported that around 32 nations were developing or manufacturing 250 models. In 2011, the number increased to at least 50 countries developing more than 900 different drone systems- 700 more systems than in 2004. The proliferation is happening so quickly that the report (2012, 25) admonishes that the United States government, "has no comprehensive view of the volume of UAV technology it authorized for export."

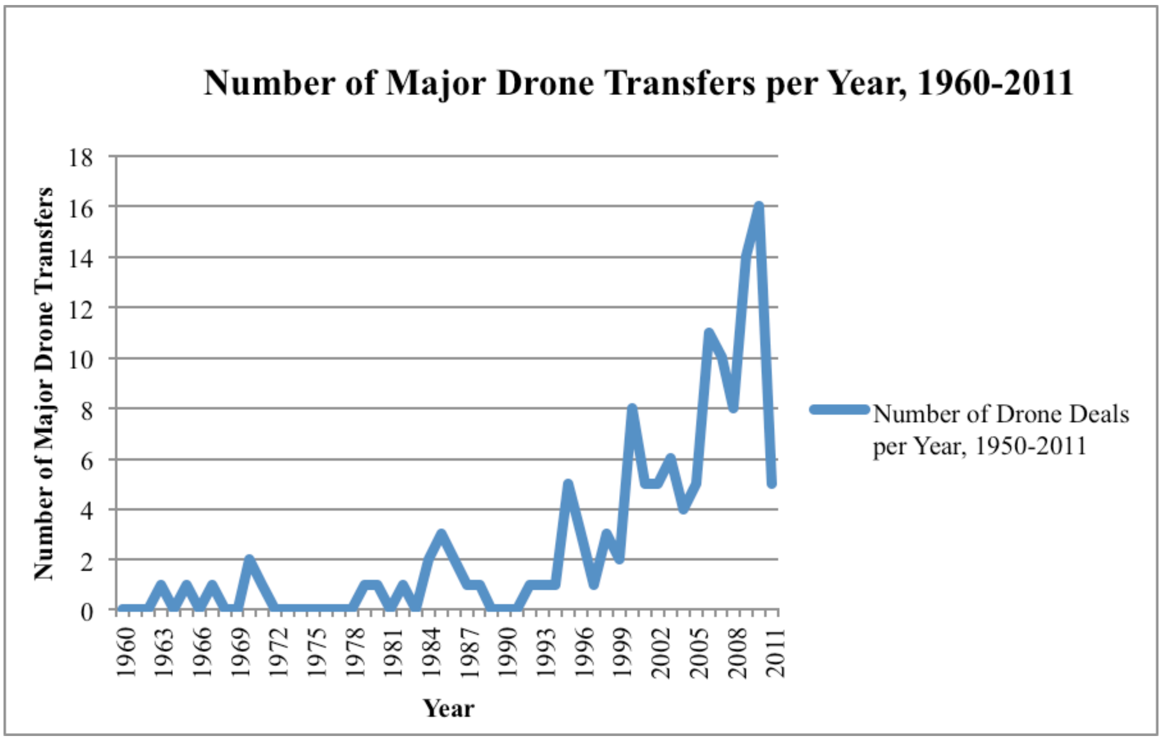
[16] This news may be hopeful in the sense that perhaps such control regimes are not affecting the theories' ability to predict diffusion. However, future studies on drone proliferation should assess these claims.

Figure 1: The number of countries possessing drones in 2011

Algeria	Chile	Greece	Libya	Poland	Syria
Angola	China	Hungary	Lithuania	Republic of Korea	Taiwan[a]
Argentina	Colombia	India	Malaysia	Romania	Thailand
Australia	Croatia	Indonesia	Mexico	Russia	Trinidad and Tobago
Austria	Czech Republic	Iran	Morocco	Serbia	Tunisia
Azerbaijan	Denmark	Israel	Netherlands	Singapore	Turkey
Belarus	Egypt	Italy	New Zealand	Slovakia	Uganda
Belgium	Estonia	Ivory Coast	Nigeria	Slovenia	Ukraine
Botswana	Ethiopia	Japan	Norway	South Africa	United Arab Emirates
Brazil	Finland	Jordan	Pakistan	Spain	United Kingdom
Bulgaria	France	Kazakhstan	Panama	Sri Lanka	United States
Burundi	Georgia	Latvia	Peru	Sweden	
Canada	Germany	Lebanon	Philippines	Switzerland	

Source: GAO analysis of various unclassified sources.

Although the GAO may provide the most comprehensive report detailing the scope and rate of drone diffusion, it only provides the bare facts. SIPRI (2012) provides a more detailed account tracing the major exporters and recipients or licensees of drones from the year 1960 to 2011.[17] Compiling the data from its armed transfers database, it is evident that the diffusion of drones has been rapid. Although the data may not be as definitive as the GAO (2012) report, it is possible to determine the number of drone deals between countries since 1960- the decade in which the first drone exports occurred. Drone deals refer to the transaction of ready-made drones or drone parts (with an instruction manual for building the drone) between two countries (SIPRI 2012). They are important in the sense that they may be responsible for the majority of states acquiring drones.[18] Figure 2 provides a graph showcasing the number of drone deals. Drone proliferation was slow around 1960 and 1970, but then accelerated around the 1990s.



Source: SIPRI armed transfers database

Figure 2: The number of drone deals per year 1960-2011

[17] According to SIPRI (2012), a recipient state is one who receives the already manufactured drone. A licensee is a nation "granted permission to produce major conventional weapons from kits or blueprints" provided by the exporter.
[18] Only a few states possess their own drone industries, or the ability to manufacture their own drones (GAO 2012).

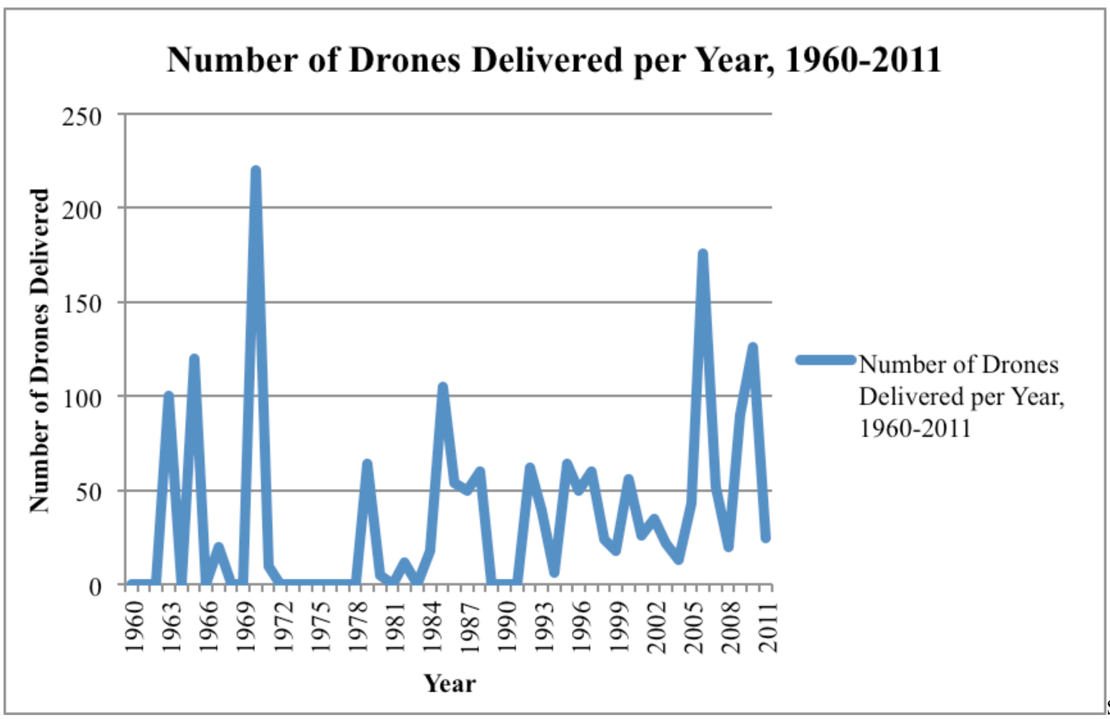
The results from Figure 2 clearly demonstrate that drone deals rapidly increased starting in the mid 1990s. It seems that 1994 marks the first step in the 'ladder' in the graph. For the next 17 years, there is a growth trend in which by 2000, the number of deals does not fall below four a year. From 2004 to 2011, there were approximately 115 deals, while from 1960 to 1993, there were only 21 deals. This means that over 84% of the deals happened after 1993.[19] The problem with the graph is that it does not specify the number of countries that received drones.[20] Analyzing the SIPRI database from 1960 to 1993, the year just before that critical 1994 year, there were 13 different states that received drones from four principal exporters. Since 1994, there were at least 42 new countries that acquired drones.[21] What is more, there were 13 exporters.

The SIPRI database differs from the GAO (2012) report in the number of countries that have drones. The GAO contends 76 countries acquired them by 2011, while SIPRI counts 60 countries. The discrepancy is probably due to secret transactions SIPRI is unaware of, or the fact that nations acquired drones by producing them, not importing them. Still, unlike the GAO, it deserves credit for perhaps being the only available dataset disclosing the suppliers and recipients or licensees of drones.

How about the number of drones dealt to different countries? Did these numbers increase over time as the number of drone deals increased? Figure 3 details the number of drones that have been delivered to countries. It shows that even though the number of drone deals has increased, the number of drones dealt have not. The 1960s and early 1970s, which mark the onset of drone proliferation, seem to have the same amount of

[19] The United States and Israel accounted for 101 of the total deals since 1960, or 74%.
[20] To recall, diffusion is defined as the number of countries that adopt an innovation.
[21] This number is a conservative estimate. The SIPRI database includes three deals in which the recipient country is unknown, one deal in which the recipient is NATO, and one deal in which the recipient is Hezbollah, not classified as a country.

drones transferred as in the 1990s or 2000s. There was one major but unexpected state in that time that dealt many drones: Canada. It was involved in every major drone transfer in the early years. In 1963, 1965, and twice in 1970, it respectively struck deals of 100 drones or more with the United Kingdom, West Germany, and France/Italy. The type of drone dealt was a CL-89, a small surveillance drone produced by a private company from Canada called Canadair (Flight International 1965, 683). Although it is surprising that one private company was able to strike all these deals, the reality was that Canada, Britain and West Germany equally were involved in the production of the drone. The project was a rare collaborative effort through Canadair (Flight International 1965).



Source: SIPRI armed transfers database

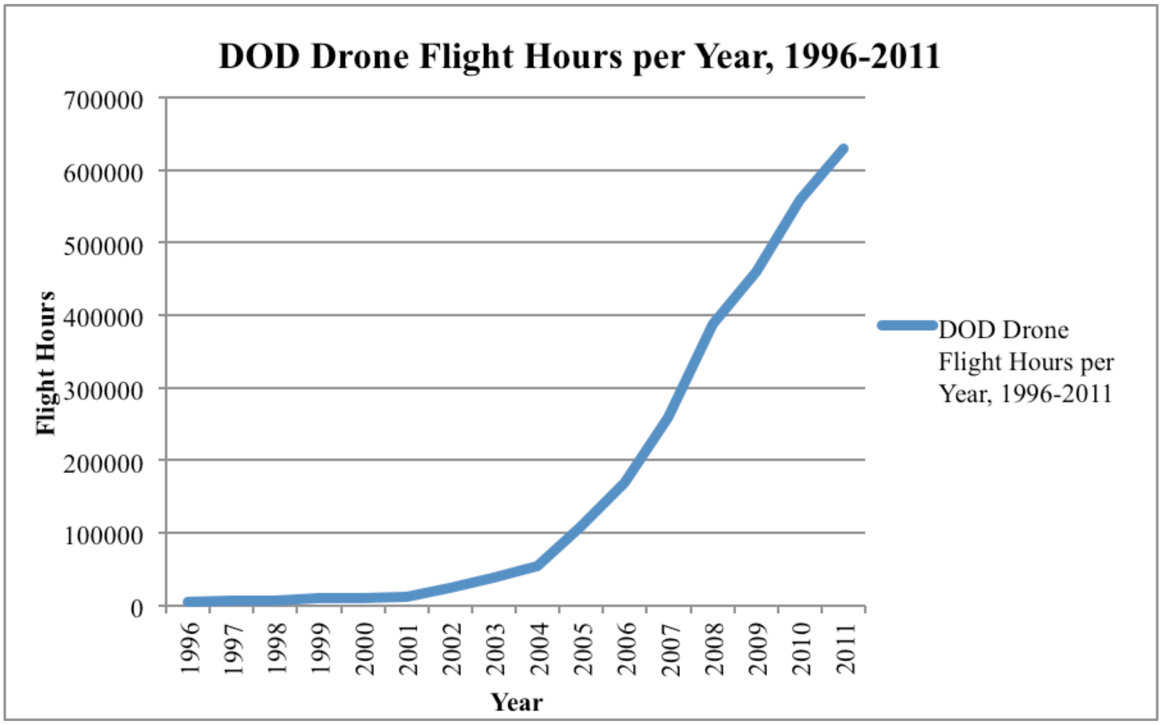
Figure 3: The number of drones delivered per year, 1960-2011

THE EVIDENCE FOR A DEMONSTRATION EFFECT

Before the methodology of the study is described, it is important to take into account that two of the three theories, offense-defense and adoption-capacity, place special importance on a demonstration effect. Competition is central to both theories. In such a competition, a demonstration effect alerts states as to which military innovations they should adopt. It is highly possible that such an effect occurred through the Afghanistan and Iraq wars. The United States can be credited for bringing drones to the forefront. Ehrhard (2010, 3) concurs, "The terror attacks of Sept. 11, 2001, were just around the corner, and it was in the resulting wars- Afghanistan, Iraq- that the unmanned systems burst into full view and became matters of wide public discussion. Singer (2009, 35) and Gertler (2012, 1) also support the claim. There are three statistics that may evidence a demonstration effect in the wars: the number of hours drones flown, the number of drones manufactured and the amount of money invested in them.[22] All these measures helped drones possess greater visibility during the wars. Other states are likely to have observed their potential.

First, the Department of Defense (2011, 22) estimates it has increased the use of drones in both wars significantly. Figure 4 traces the almost exponential increase in the hours drones flew from 1996 to 2011. The first major increase occurs in 2004, when total drone flight for that year was 5,000 hours. One year later, the amount doubled to over 10,000 hours. By 2011, the latest estimates, they flew a total of 600,000 hours. This represents a 120-fold change in hours flown in comparison to the year 2004.

[22] To reiterate, it is assumed that the international community noticed the United States built more drones, flew them more, and invested in them more during the wars. If countries did not notice, then the idea of a demonstration effect is ill supported, and offense-defense and adoption-capacity theory's rationales for the mechanism causing diffusion of innovations among states are weakened.



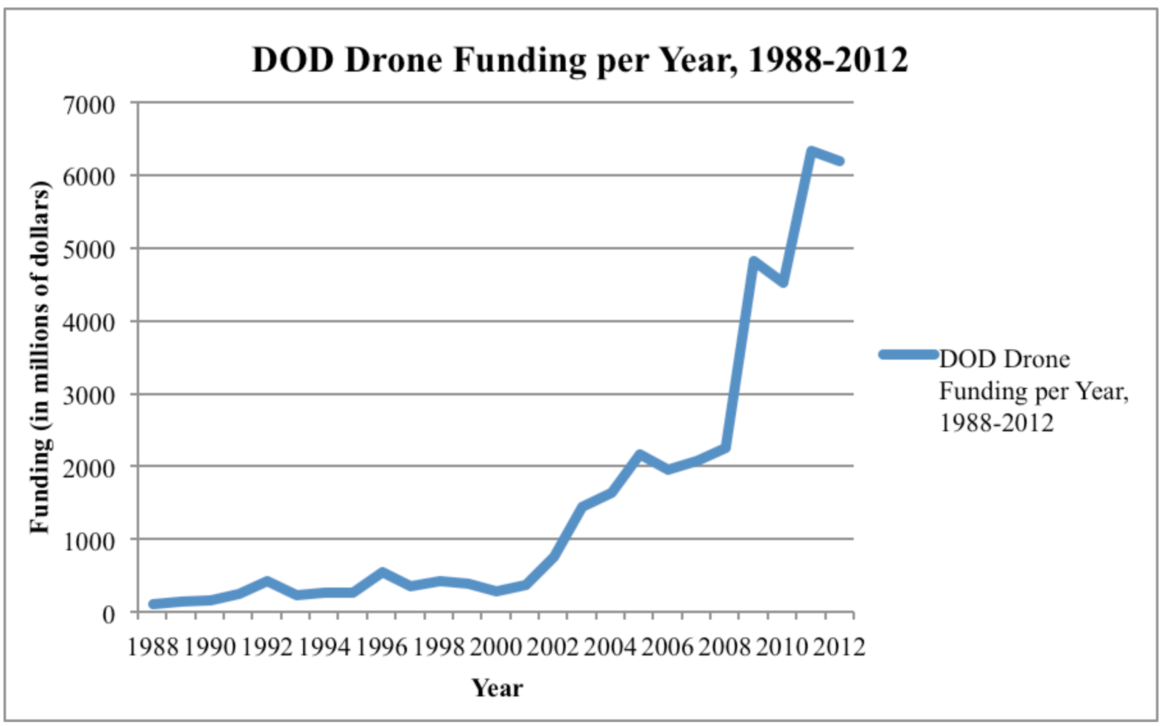
Source: UAS Integrated Roadmap 2011-2035 (2010)

Figure 4: DOD drone flight hours per year, 1996-2011

The second indicator supporting the notion of a demonstration effect is the rate at which the United States produced drones throughout the wars. According to Gertler (2012), the Department of Defense possessed 167 drones in 2002. Eight years later, they possessed over 7,500. This represents a 45-fold change. Consequently, by 2011, drones constituted more than 41% of the total aircraft inventory of the Department of Defense (2012, 9). This means that 41% of all aircraft in the Air Force, Army and Navy/Marine Corps are drones. The percentage of aircraft that was manned in 2005 was 95%. The number drops steeply in the following years.

The last indicator of a demonstration effect is evident in the funding for drones throughout both wars. Figure 5 provides a graph of the amount of money invested into drones from 1988 to 2012. Gertler (2012, 14) tracks the funding. From 1988 to 2000, the

Department of Defense spent 3.9 billion dollars on drones.[23] In the decade or so after, 2001 to 2013, the total funding was around 26 billion dollars. This represents a 6.5-fold change. The investments have grown so dramatically that the Department of Defense spent the same amount this past year on drones as they did in 1988 to 2000 (Gertler 2012, 13). To further support the trend in funding, the United States Congressional Budget Office (2012) predicts that in the years 2011 through 2020, more than 36 billion dollars will be spent on UAS. Without a doubt, the United States is planning to invest greatly in drones. Will more states take notice? Perhaps, the theory most able to predict the present diffusion will be more apt to predict the future course of their diffusion. Some possible ways to test the theories for accuracy are presented.



Sources: UAS Roadmap 2005-2030 (2004); UAS Roadmap 2009-2034 (2008); UAS Roadmap 2011-2036 (2010)

Figure 5: DOD funding per year, 1988-2012

[23] These numbers refer to the amount of funding in UAS, not just drones. To recall, the UAS include the drones and their support systems on the ground that help fly or monitor them.

THE METHODOLOGY TO ASSESS THE THEORIES

In this section, some ways to test each theory are presented. The tests are limited, but hope to find preliminary evidence arguing for or against a theory. By and large, bivariate logit regressions and correlation tests are the two methods utilized. In the logit regressions, drone ownership by the year 2011 is the dependent, binary variable. The Government Accountability Office (2012) provides the data detailing which countries specifically owned drones by that year. Two states are added to the list since they recently acquired drones after the report was released. These two states are Venezuela and Iraq (see Michaels 2012 and Beckhusen 2012). The independent variable in each regression will differ from theory to theory.

(a) Offense-defense theory

Offense-defense theory postulates that states in an offensive balance will seek to adopt innovations. These states are 'defensively disadvantaged' and are threatened. In offensive balances, diffusion of military innovations should take place. Two different types of tests are performed to assess these claims. The first is a logit regression, in which, theoretically, states that enter into a militarized interstate dispute are expected to have a higher probability of adopting a drone by 2011 in comparison to states without such a dispute. Being in a dispute does not indicate whether that state is in an offensive balance. But, the presence of the dispute tests the underlying rationale for offense-defense theory, namely, that states that feel threatened should be more likely to adopt military innovations. The Correlates of War Militarized Interstates Disputes dataset is utilized (Ghosn et al. 2004). Jones et al. (1996, 163) define militarized disputes as, "united historical cases of conflict in which the threat, display or use of military force short of war by one member state is explicitly directed towards the government, official representatives, official forces, property, or territory of another state. Disputes are composed of incidents that range in intensity from threats to use force to actual combat short of war." The mean score for the number of militarized interstate disputes for all countries is calculated from 1990 to 2005 and then run against whether the state possessed drones. The years 1990 and 2005 are chosen for consistency; they are the years used for other independent variables in other bivariate logit tests.

The second test will try and assess the notion of offensive and defensive alliances. This time, it will test whether states that have recently adopted defense weapons have also adopted drones. A correlation will be determined between states that adopted defensive weapons between the years 1990 and 2005 and those states that adopted drones by 2011. The SIPRI armed transfers dataset provides information concerning the transfers of air defense systems. It (2012) defines air defense systems as, "(a) all land-based surface-to-air missile systems, and (b) all anti-aircraft guns." Without a doubt, air defense systems are defensive in nature. Perhaps, if a meaningful correlation is found between states that imported air defense systems and states that imported drones, a minor case can be made that these states adopted drones because they felt threatened. Recall that the majority of drones proliferated was used for information gathering purposes. Finding a correlation could lend support for offense-defense theory in so far as states adopting drones did so because they felt threatened. However, it is possible that a correlation also be found between states adopting offensive weapons and states adopting drones. Unfortunately, this is a difficult test to conduct since there is no weapon provided by the SIPRI armed transfers dataset that classifies as offensive in nature.

(b) Power transition theory

The second theory assessed is power transition. It postulates that states with higher levels of national development, or levels of industrialization, are more likely to adopt an innovation. These claims can be tested by using the Correlates of War Composite Indicator of National Capability (CINC) dataset (Singer et al. 1972). One indicator in the dataset can be used to test the theory: iron and steel production (in thousands of tons). Some scholars have argued that steel production (but less so for iron), is a valid indicator of industrial activity (Singer et al. 1972).[24] The mean score of a state's iron and steel production from 1990 to 2005 is calculated. I estimate a logit regression of drone possession by 2011 on iron and steel production. The rationale is that states with strong levels of national development in the years prior to 2011 should significantly increase their chances of possessing a drone by that year.

(c) Adoption-capacity theory

Adoption-capacity posits that financial intensity as well as organizational factors largely determine whether a state will adopt an innovation (competition is also a causal factor according to Horowitz 2010). In order to test financial intensity, a state's GDP per capita (United States dollars in 2011) is averaged from the years 1990 to 2005. The World Bank World DataBank (2011) provides the data. Horowitz (2010, 111) uses the same measure to test for financial intensity. A logit regression is conducted between a state's mean GDP per capita and whether or not the state possessed drones in 2011. The underlying notion is that the wealthier states should have drones. Despite the relative cheapness of drones in comparison to manned aircraft, GDP per capita is expected to

[24] However, Singer et al. (1972) cautions that, "Steel production is currently declining for some highly developed states, and many scholars argue that it is no longer a valid indicator of industrial activity." Another indicator could be used instead in future work.

have a positive relationship on drone possession. The reason is that the most common drones proliferated, the Category II ones, still on average cost millions of dollars (GAO 2012; SIPRI 2012). For a developing country, this is not an insignificant investment.

As for testing organization capital, Horowitz (2012, 37) operationalizes the term by describing how an organization's age, critical task focus, and amount invested into research and development all affect a state's ability to adopt an innovation. For the purpose of testing the theory, only one proxy of organization capital- investment into research and development- is utilized. The Correlates of War CINC dataset (Singer et al. 1972) provides a military expenditure indicator (in thousands of US dollars 2011) that will be used to test whether investments into research and development affect the chances of a state possessing a drone by 2011. Singer et al. (1972) define military expenditure as, "the total military budget for a given state for a given year." According to Horowitz 2010, 113), included in the military budget are investments into research and development of weapons. Horowitz (2010, 113) uses the CINC estimator throughout his book. A logit regression of military expenditure on whether a state possessed a drone is run. Like before, the mean score for each state's military expenditure is taken from 1990 to 2005. If there is a positive link between a state's military expenditures and whether it possessed a drone by 2011, perhaps adoption-capacity theory is supported.

RESULTS

In short, the logit regressions and correlations performed found preliminary evidence for each theory. The results of the tests are analyzed.

(a) Offense-defense theory

The first test for offense-defense theory supports the notion that threatened states should be more likely to adopt military innovations. It validates the underlying rationale for offense-defense theory. The logit regression found that the mean militarized interstate dispute score of a state from 1990 to 2005 did have a sizable influence on whether a state possessed a drone by 2011. The results were statistically significant at the .05 level, and positive. The second test also supported the theory. It sought to find a correlation between states adopting defensive technologies and states adopting a drone. If states are adopting defensive technology, perhaps they feel threatened. Threatened states should adopt more military innovations. A drone, which might be defensive in nature because it often serves to gathers information, could be a possible candidate to adopt. A correlation of 70% is found between such states.

(b) Power transition theory

It seems that initial support is found for power transition theory. Its hypothesis, that levels of national development affect whether a state adopts an innovation, is validated.. At minimum, the logit regression finds evidence that a state's average amount of industrialization between 1990 and 2005 is a strong predictor of the state possessing a drone by 2011. The coefficient is positive and statistically significant at the .05 level.

(c) Adoption-capacity theory

The first test found that a state's average GDP per capita from 1990 to 2005 did not seem to be a significant predictor for whether a state had a drone by 2011. The relationship was statistically insignificant. This could be due to the fact that drones are relatively cheap in comparison to manned aircraft, and so states might have less barriers to adopting drones, whether they are wealthy states or not. This is in line with the hypothesis of the theory (that since drones are cheap, more states should acquire them). Perhaps, GDP per capita is not the best indicator, and is somewhat an unnecessary predictor. However, it must be noted that the range for the independent variable, GDP per capita, was great. It ranged from 135.1335 to 88,926.16 (United States dollars in 2011). Thus, to perhaps minimize the outliers, a log of GDP per capita was taken. When the log was used in a logit regression, a significant relationship was found between the variable and whether states possessed drones by 2011. It seems, then, that even though drones are relatively less expensive than manned aircraft, they still cost millions of dollars and are not necessarily 'easy' for developing states to acquire. The second test for organizational capital obtains results that were supportive for the theory. A relationship was found between a state's mean military expenditures from 1990 to 2005 and drone ownership in 2011. The results were statistically significant at the .05 level, and the direction was positive.

CONCLUSION

In conclusion, the results find preliminary evidence for offense-defense, power transition, and adoption-capacity theory. For offense-defense, a state's mean score for militarized interstate disputes from 1990 to 2005 is a significant predictor for determining if states possess drones by 2011. The second test found that there was a correlation between states that adopted air defense systems, from 1990 to 2005, and those that adopted drones by 2011. Perhaps, states initially adopted defensive technologies because they were threatened. If that was the case, then those states should be more likely to adopt drones. As for power transition theory, a significant and positive relationship was found between a state's mean iron and steel production from 1990 to 2005 and drone ownership by 2011. Lastly, some evidence was found for adoption-capacity theory. To test whether financial intensity is a predictor for drone ownership, a logit regression was run between a state's logged mean GDP per capita, from 1990 to 2005, and drone ownership. The results confirmed that financial intensity seemed to play a role. The results were significant and the coefficient was positive. As for testing whether organizational capital plays a role determine whether a state had a drone by 2011, a state's average military expenditure from 1990 to 2005 was tested on drone ownership in a logit regression. In it, the variable's effects are statistically significant and positive.

Without a doubt, the diffusion of drones seems to be a complicated process with varied incentives and constraints that seem to affect the acquisition of drones. All three theories received some level of empirical support in these preliminary tests. But, future work should address the limited methodology that obtains these conclusions. Perhaps, fully specified models will overturn the preliminary findings and ultimately determine which theory is the most accurate.[25] Future tests might also be able to sort out which of the incentives and constraints matter the most to the process of diffusion. However, it is important to keep in mind that perhaps, all factors matter to the same degree.

Overall, the thesis was concerned with two questions: have drones diffused, and what are some possible international relations theories that explain the diffusion of such military innovations? The second question, it seems, needs more answering. But, the first

[25] For instance, when testing adoption-capacity theory, the bivariate regression for military expenditure on drone ownership was statistically significant. However, when other CINC scores were included into the regression, military expenditure suddenly lost statistical significance. The sign also changed from positive to negative, but this does not matter so much since the relationship is no longer significant, holding all else constant.

does not. From 1960 to 2000, the proliferation of drones was nonexistent or slow. But sometime around the 2000s, the proliferation was wide and rapid. Specifically, 40 countries acquired drones from 2005 to 2012. This might be the result of a demonstration effect occurring through the Afghanistan and Iraq wars. Drone production, flight hours, and investments all (nearly) exponentially increased. In both wars, drones demonstrated their major advantages. They can save the lives of the pilots they replace, are not prone to human emotion and weariness, and are much less expensive than manned aircraft. All the while, advances in technology and the nature of asymmetrical wars are making them even more useful. States are recognizing the value of drones.

But, there may be an issue: the majority of drones diffused thus far are only capable of surveillance, reconnaissance and other information gathering duties. It seems that states are employing them for defensive purposes. As the technology advances, what will happen if states obtain drones that are offensive in nature, capable of carrying out strikes much like in the al-Jabari case? This question might gain increasing importance as the diffusion of drones continues. Perhaps, the diffusion will have great implications on the balance of power in the international arena.

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