International Studies Quarterly (2017) **61**, 704–720

Military Technology and the Duration of Civil Conflict

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Why do some civil conflicts end quickly, while others last for years? We argue that an incumbent government's military forces play a crucial role in conflict duration. Specifically, combined arms militaries—which bring to bear a mixture of mechanized infantry, armor, and aircraft—make short conflicts more likely. The use of mechanized ground forces in combination with airpower increases the likelihood of decisive engagements early in a conflict, helping to mitigate information asymmetries that can drive violence. By contrast, less-mechanized forces face greater difficulty bringing the fight to the enemy. Combined arms militaries therefore tend to bring conflicts to more rapid conclusions. However, like maneuver warfare in conventional interstate conflict, these outcomes do not always favor incumbent governments. To test this argument, we employ new, detailed data on military mechanization and airpower from civil conflicts between 1967 and 2003. The results indicate that national militaries with high combined arms capabilities are associated with significantly shorter conflicts. Perhaps surprisingly, this relationship remains robust even when we limit the analysis to insurgencies.

Some intrastate conflicts last for days, while others last for years. This wide variation distinguishes civil conflicts from interstate wars; the longest interstate war during the past two centuries lasted eleven years, whereas conflicts in Colombia, Myanmar, and elsewhere have persisted for decades. At the same time, some civil conflicts end quickly. It took just eight months for rebels to defeat the Gaddafi regime in Libya in 2011, in part due to intervention by Western airpower. Yemen crushed a 1994 separatist movement in a mere two months without outside assistance, confounding widespread expectations of a lengthy stalemate. Most civil conflicts, in fact, last less than two years. What explains such dramatic variation?

This article examines the role of military technology in explaining the duration of civil conflicts. Specifically, it evaluates how *mechanization*—that is, a military's relative reliance on airpower, armor, and vehicles rather than on manpower—can influence the likelihood that a conflict will reach a rapid conclusion. National militaries vary widely in the degree to which they rely on mechanized forces. Some militaries consist almost entirely of manpower, while others possess vast fleets of aircraft, armored vehicles, and tanks. How does this variation shape the nature of conflict? Do highly mechanized militaries bring about quicker resolutions to military conflicts, or do they prolong them by precluding decisive victories?

We argue that mechanized militaries can bring about more rapid resolutions to civil conflicts. Incumbent governments that can draw on a diverse military portfolio of mechanized infantry, armor, and aircraft—combined arms in military parlance—tend to fight significantly shorter conflicts than those that do not. Our explanation derives from an information-centric theory of conflict termination. Military conflicts often arise from information asymmetries, that is, disagreements among the combatants about which side is stronger or more resolved (Fearon 1995). These disagreements arise because military strength depends not only on observable material capabilities, but also on a variety of unobservable, intangible factors (Biddle 2004). To end a conflict, information asymmetries must be mitigated—typically, by decisive battles that reveal each side's true fighting ability.

Combined arms forces help facilitate these battlefield engagements early in conflicts, leading to more rapid resolutions. First, their superior mobility and logistics allows them to reach conflict zones more quickly, thus minimizing the time lag between the onset of a conflict and a decisive military engagement. Second, the combination of airpower and mobile ground forces helps prevent opponents from retreating and regrouping. Instead of merely scattering rebel forces during an attack, government forces are more likely to engage them, increasing the likelihood of an informative military result. Third, combined arms operations require a significant level of effort, quickly exposing a military's material capabilities, organizational competence, and resolve. A military's ability to effectively execute its strategy therefore becomes more quickly apparent when it employs a combined arms approach, compared to less-demanding doctrines.

In short, combined arms militaries facilitate decisive battles that allow combatants to learn—and agree—about the true balance of power and resolve, thus enabling quicker settlements to civil conflicts. Combined arms militaries are not necessarily more likely to *win* these conflicts,

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Authors' note: For helpful comments on previous drafts, the authors thank Nikolaos Biziouras, Alexander Downes, Scott Gartner, Benjamin Graham, Mark Paradis, Brian Rathbun, Elizabeth Saunders, Brian Urlacher, and the anonymous reviewers at *International Studies Quarterly*. Thanks to Mauro Gilli, Callum Ingram, David Peyton, and Abigail Post for expert research assistance.

Caverley, Jonathan D, and Todd S. Sechser. (2017) Military Technology and the Duration of Civil Conflict. *International Studies Quarterly*, doi: 10.1093/isq/sqx023

but their unique features make it more likely that a verdict will be reached rapidly.

To test this theory, we employ a new dataset containing detailed information on the military manpower, armored vehicles, tanks, and combat aircraft of states embroiled in civil conflicts. A series of survival models and logistic regressions provides evidence that military mechanization is correlated with shorter conflicts—but only when mechanized ground forces and airpower are combined. This result holds even after accounting for factors such as national wealth, external assistance, geography, and other factors that influence the duration of conflicts. Perhaps most surprisingly, the effect of combined arms remains robust even when we limit our analysis to insurgencies.

This article proceeds in four parts. The first section explains combined arms warfare and discusses its impact on civil conflict duration. It then derives several explicit hypotheses about the effects of mechanization and combined arms. The second section describes our data on combined arms and our empirical approach to modeling duration. The third section presents results from a series of event-history models and logistic regressions. The final section offers conclusions and discusses implications for future research.

Military Technology and Civil Conflict Duration

Explanations for the duration of civil conflicts tend to cluster into three broad groups. The first group of theories emphasizes *rebel capacity* for sustaining the fight and evading government attack. Factors such as material capabilities, rebel strategy, and external supporters play a central role in these explanations. Several studies, for example, find that military capabilities (Cunningham et al. 2009; Hultquist 2013), third-party assistance (Balch-Lindsay and Enterline 2000; Regan 2002; Cunningham 2010; Bakke 2014), guerrilla strategies (Balcells and Kalyvas 2012), and access to natural resources or primary commodities (Fearon 2004; Lujala 2010) enable rebels to prolong civil conflicts,[1] whereas measures designed to undermine combatant capacity (such as economic embargoes) tend to shorten civil wars (Escribà-Folch 2010). Along similar lines, several studies find that rebels based in remote, rough terrain are better positioned to prolong conflicts (Buhaug et al. 2009; Bleaney and Dimico 2011).[2]

A second body of research identifies the role of *information problems* in explaining conflict duration. Like many interstate wars, civil conflicts often arise—and persist—because the combatants disagree about their relative power or resolve (Fearon 1995; Kirschner 2010). Information problems prove particularly acute in the early stages of conflicts, when combatants are more poorly informed about their opponents' capabilities (Walter 2009, 250). The existence of multiple factions and outside actors can exacerbate the problem, making information about combatants both difficult to obtain and likely to become quickly obsolete (Cunningham 2006; Nilsson 2008; Pearlman and Cunningham 2012). Governments face further challenges collecting information on rebel groups operating in remote regions, across borders, or within large sympathetic populations (Salehyan 2009). All of these factors make information problems difficult to ameliorate, thereby impeding the resolution of conflicts.

Third, scholars highlight the importance of *commitment problems* in explaining civil conflict duration. When the parties to a civil conflict cannot credibly commit to uphold a peace deal after it is signed, according to this view, termination will be very difficult to achieve without a decisive victory by one side (de Figueiredo and Weingast 1999; Walter 2002). Settlements may prove elusive if rebel groups expect that the government will grow stronger over time and eventually renege on the deal (Fearon 2004). This may explain why ethnic wars in particular tend to last longer than other conflicts (for example, Collier et al. 2004; Wucherpfennig et al. 2012).

Mechanization and Air Power: Prescriptions for Stalemate?

Together, the literature on civil conflict paints an extensive picture of the geographic, economic, and political factors underlying civil conflict duration. The effects of military technology and force employment, however, have gone largely unexplored. Yet conflict duration is fundamentally a military outcome: lengthy conflicts occur when both sides lack the ability to achieve a decisive military victory. Military factors—hardware, technology, and doctrine—thus likely play at least some role in shaping the likelihood of conflict termination.

The nature and technology of fighting in civil conflicts differ in important ways from that of combat in conventional interstate wars. Whereas interstate wars tend to feature direct, force-on-force engagements with the central objective of seizing territory, civil combatants tend to rely on rapid hit-and-run strikes against both military and civilian targets. Direct military engagements, when they occur, often involve smaller numbers of troops fighting in rough terrain such as jungles or mountains. Further, civilians often play a greater role in intrastate conflicts by providing information to combatants and sometimes taking up arms themselves. While seizing or defending territory remains an important goal in these conflicts, obtaining and preserving support from local populations plays an even more critical role.

Stalemate on the Ground

The received wisdom holds that the unique characteristics of intrastate conflicts lend themselves poorly to mechanized warfare. Krepinevich (1986) famously blamed the American quagmire in Vietnam on the US military's vehicle- and firepower-intensive doctrine, which was unable to achieve decisive results against North Vietnamese guerrillas.[3] Several influential studies (for example, Lyall and Wilson 2009; Lyall 2010) have since concurred that mechanized ground forces are ill-equipped to achieve rapid, decisive victories in unconventional conflicts.[4]

Mechanized ground forces are poorly suited for collecting information about local allies and adversaries, especially in urban settings (Lyall and Wilson 2009). In intrastate conflicts—and particularly counterinsurgency campaigns—combatants must recruit informants and identify enemy collaborators among the local population, since enemy personnel may hide among local inhabitants instead of waiting in uniform on the battlefield. Nonmechanized infantry forces tend to integrate more

[1] Humphreys (2005), however, finds that natural resources are associated with shorter wars.

[2] For a contrary view see Rustad et al. (2008).

[3] See Caverley (2009) for a review of the debate surrounding US counterinsurgency strategy in Vietnam.

[4] For dissenting views, see Smith and Toronto (2010) and MacDonald (2013).

successfully into the local population, since they lack vehicles for protection and depend more on local sources for food and supplies. As a result, dismounted forces can enmesh themselves into local networks and accumulate information about the enemy.

Mechanized armies, by contrast, tend to operate in isolation from local populations, resulting in "information starvation" (Lyall and Wilson 2009, 68). With advanced transportation and logistics, mechanized troops depend more on external supply lines for provisions, which in turn reduces interaction with the local population. Mechanized forces also tend to be garrisoned on isolated bases, furthering their estrangement. Consequently, mechanized armies have lower levels of information about enemy locations and must therefore choose between using violence indiscriminately (and losing the support of the local population) or allowing enemy combatants to operate with relative impunity. Neither of these options favors a rapid resolution.

At the same time, according to this argument, rebels struggle to defeat mechanized incumbents outright. Mechanized forces often station themselves away from urban areas on well-protected bases that are difficult for rebels or insurgents to destroy. While limiting contact with local populations can inhibit an army's ability to collect information, it bolsters force protection by minimizing troops' exposure to potential guerrilla attacks. Moreover, mechanized forces enjoy greater mobility than their nonmechanized counterparts and therefore can evade or escape perilous engagements more easily. These advantages impede rebel forces from quickly imposing costs on government armies; instead, they must bleed the enemy gradually over time.

Mechanized ground armies, in short, are less likely to achieve outright victory but are also more difficult to defeat. We should therefore observe that civil conflicts involving mechanized armies last longer, on average. We test the following hypothesis:

H1: *Civil conflicts that involve highly mechanized government ground forces will be longer, on average, than conflicts in which a government's ground forces are not highly mechanized.*

Stalemate in the Air

A related perspective suggests that militaries that rely primarily on airpower face similar challenges in bringing civil conflicts to an end. Kocher et al. (2011) and Lyall and Wilson (2009) suggest that the problems of information starvation, civilian casualties, and alienation of local populations also characterize airpower-intensive strategies. Pape (1996, 74) likewise argues that airpower is ineffective against guerrillas and rebels, and Allen and Martinez Machain (forthcoming) find statistical support for this claim.[5] According to this perspective, then, relying on airpower alone to combat rebels and insurgents precludes decisive outcomes by limiting the capacity of each side to defeat the other outright.[6] This logic yields a second testable hypothesis about military technology and the duration of civil conflicts:

H2: *Civil conflicts that involve militaries with a high proportion of combat aircraft will be longer, on average, than conflicts in which a government's air forces are limited.*

Mechanization and Civil Conflict: A Revised Perspective

Existing research on military technology in civil conflicts tends to examine ground mechanization and airpower in isolation.[7] However, this approach offers an incomplete picture of how these weapons can be used by incumbent governments to fight rebels. We argue that the interaction of a government's airpower and mechanized ground forces—in other words, its combined arms capability—encourages rapid decisions in ways that each platform in isolation does not. In this section, we describe the basic components of combined arms doctrines and explain why they tend to shorten civil conflicts.

Combined Arms in Theory and Practice

While the term *combined arms* can encompass a wide variety of strategic and tactical variations, the integrated use of multiple combat platforms to exploit enemy vulnerabilities remains central to all of them. Mechanized ground forces and airpower each offer features that the other cannot, mitigating the independent limitations of each type of force when used in tandem.

Tanks, armored personnel carriers, and self-propelled artillery offer superior mobility, firepower, force protection, and the ability to seize and hold ground. Patrolling aircraft simply cannot target enemy combatants on the ground with the same scale, immediacy, and degree of precision as nearby vehicles. Airpower also cannot take and hold territory by itself. Aircraft, however, offer their own unique advantages: fixed-wing transports and rotary aircraft can deliver soldiers to remote areas more rapidly—and more safely—than ground vehicles, and they can bring more firepower per vehicle to decisive points on the battlefield. Airborne assets also perform reconnaissance, communication, and command and control functions that ground units cannot. Perhaps most importantly, close air support can quickly prepare a battlefield for an armored assault by destroying large weapons and disrupting enemy positions.

Reflecting on the lessons of World War II, Omar Bradley observed that "the air-armor team is a most powerful combination in the breakthrough and in exploitation" (US Army 1945, 61), and modern militaries have tended to follow his prescription. The US Army's famous AirLand Battle doctrine of the 1980s, for example, envisioned the integration of armored ground units with aggressive airstrikes designed to disrupt the enemy's ability to reinforce its lines and coordinate a defensive response.[8] According to this doctrine, "arms and services complement each other by posing a dilemma for the enemy. As he evades the effects of one weapon, arm, or service, he exposes himself to attack by another" (US Army 1986, 25).

[5] Pape (1996) notes, however, that bombing can assist interdiction campaigns against rebel supply lines.

[6] Even the most vocal proponents of airpower in unconventional settings acknowledge the need for ground support. See, for instance, Andres et al. (2006) and Dunlap (2008), who discuss the role of airpower in support of counterinsurgency ground operations.

[7] An exception is Lyall and Wilson (2009), who include helicopter usage in their analysis of mechanization.

[8] See, for instance, US Army (1981) and Lock-Pulla (2004).

In conventional interstate wars, the integrated use of mechanized ground forces and airpower is thought to favor quick and decisive battlefield outcomes. Indeed, that is frequently the explicit objective; combined arms doctrines aggressively employ maneuverable ground and air forces in *blitzkrieg* offensives to pursue rapid knockout victories (Mearsheimer 1983; Stam 1996; Kier 1997). Airpower and mechanized ground forces play critical roles in these operations, which rely foremost on speed and mobility. And as Stam (1996, 52) notes, maneuver strategies tend to result in wars that end quickly: decisive engagements occur early in the war, so "rapid success or failure becomes apparent." Bennett and Stam (1998) find that the maneuver strategies enabled by combined arms doctrines produce more rapid decisions in interstate wars—although not necessarily more favorable outcomes. Martinez Machain (2015) likewise finds that the combination of air and ground in interstate wars can shorten conflicts.

While militaries originally developed combined arms doctrines for conventional combat at the interstate level (House 2001, 77–81), they are also frequently applied in intrastate conflicts.[9] One reason is that many civil wars are fought conventionally. Conflicts triggered by territorial separatist movements or intra-army fractures lend themselves to fights involving armor, well-trained and organized armies, and direct battlefield engagements. According to Kalyvas and Balcells (2010), roughly one-third of all civil wars since 1944—and half of those beginning after 1990—have been primarily conventional conflicts.

The role of combined arms in intrastate conflicts, however, has not been limited to strictly conventional wars. Indeed, they have also played an important role in several recent counterinsurgency campaigns. In the first Chechen War, for example, Russian forces employed an integrated air and ground doctrine, incorporating elements of attrition and maneuver warfare to isolate and destroy rebel forces (Toft and Zhukov 2012). After a failed initial assault on Grozny, in early 1995 the Russians reorganized their "forces into small mobile assault groups, made better use of snipers and heavy artillery, and made sure that units talked to each other and to air assets, so that mutual support was possible" (Oliker 2001, 24). The brutal but rapid resulting conquest of the Chechen capital paved the way for a negotiated settlement that had appeared improbable at the war's outset. When Chechen forces invaded Dagestan three years later, the Russians returned to Grozny and neighboring towns with an even more intensive combined arms approach (Johnson et al. 2008, 114–23), using "massive artillery and air strikes followed by dismounted forces . . . artillery, tanks, surface-to-surface missiles, attack helicopters, and bombers" (Oliker 2001, 78).

The Russian example also demonstrates that combined arms can support strategies other than maneuver warfare (Mearsheimer 1983, 105–12; Biddle 2004, 18–19). In both Chechen conflicts, Russian forces quickly delivered massive amounts of firepower to central rebel strongholds (with little regard to civilian casualties).

Combined Arms and Conflict Duration

Military conflicts occur when two sides cannot reach a bargain that resolves their dispute without fighting. Bargaining failures, in turn, often arise from disagreements about the balance of power. If the combatants disagree about which side is more powerful, they may hold incompatible views about what a fair bargain looks like and thus fail to locate a settlement that satisfies both parties (Fearon 1995; Walter 2009). Such disagreements emerge because the "true" balance of power is difficult to observe without actually fighting. The ability of a government or rebel group to prevail in battle depends not only on material factors such as weapons and troops, but also on intangible factors such as training, strategy and doctrine, troop discipline, leadership, and skill. While combatants typically understand their own abilities, they often lack reliable information about those of the other side.

Combat outcomes, then, serve as a common metric of military strength, helping to mitigate disagreements about the balance of power.[10] They allow combatants to discover the actual balance of power and facilitate their ability to locate a settlement that both sides can accept. A rebel group, for example, may discover that it is weaker than expected and sue for peace. Alternatively, the government may experience unexpected setbacks that make a settlement appear more attractive. Either way, factors that favor large-scale, decisive engagements early in a conflict will generate shorter conflicts. Early engagements allow the combatants to quickly learn about the capabilities of the other side, laying bare each side's true fighting ability. By contrast, campaigns involving small, scattered skirmishes with irregular fighters will last longer because they provide fewer opportunities to expose this information.

Combined arms doctrines help facilitate decisive early engagements in four key ways. First, the enhanced mobility of a mechanized army enables it to attack distant enemy strongholds quickly, thereby reducing the ability of rebels in remote locations to draw out a conflict simply by remaining unreachable. Conflicts that feature mechanized government forces therefore are less likely to feature long periods of low-intensity fighting, since government forces are better able to locate and strike the enemy. The integration of airpower with ground forces also enables incumbent forces to supply operating bases in enemy territory, further bolstering their ability to press the fight (Read 2010). In Colombia, for example, the Revolutionary Armed Forces of Columbia (FARC) successfully coordinated insurgency activities for decades in part because their location—largely in remote, rural areas—insulated them from attacks by the poorly equipped Colombian military.

Second, combined arms strategies help prevent rebels from retreating and prolonging conflicts. The combined employment of tanks, armored vehicles, helicopters, and close-air support enables rapid strikes against elusive rebel targets that might otherwise scatter or retreat. Airpower is an essential component here, working in tandem with motorized ground forces to help incumbent governments flush out, surround, and contain enemy forces (Biddle 2003). In Algeria during the 1950s, for example, France employed more than eight hundred fixed-wing aircraft alongside a well-equipped general reserve of parachutists and mobile Foreign Legion forces to attack enemy

[9]According to the US Army's 1986 *Operations* manual, for instance, "the tenets of AirLand Battle doctrine apply equally to the military operations characteristic of low-intensity war" (US Army 1986, 6).

[10]Note, however, that information is not always a sufficient condition for conflict termination. As Fearon (2004, 290) observes, "after a few years of war, fighters on both sides of an insurgency typically develop accurate understandings of the other side's capabilities, tactics, and resolve." Even with complete information, he argues, commitment problems can still preclude peaceful settlements. See also Fearon (1995); Sechser (2010, forthcoming); Powell (2012).

concentrations before they could disperse (Alexander and Keiger 2002; Griffin 2010).

Third, combined arms operations are extremely demanding from an organizational perspective. To deliver a high level of concentrated violence in a short period of time, militaries must possess not only sufficient equipment but also a high level of training, leadership, and coordination (for example, Brooks and Stanley 2007; Talmadge 2013, 2015). This implies that combined arms doctrines expose ineffective militaries rapidly. Less-demanding strategies—attempting to overwhelm the enemy with sheer manpower, for example—take longer to achieve their intended objectives, so it takes time to assess their effectiveness. High-tempo, combined arms strategies, by contrast, quickly reveal a military's ability (or inability) to execute. As a result, they more rapidly resolve information problems—specifically, disagreements about relative power of the combatants—that inhibit peaceful settlements.

By contrast, when used in isolation, airpower and mechanized ground forces are unlikely to produce these same effects. Airpower alone can rapidly deliver firepower to targets, but because aircraft cannot take and hold territory, air operations without ground support carry a greater risk of allowing the enemy to scatter and retreat (Corum and Johnson 2003, 425–28). Mechanized ground forces, for their part, can more effectively cut off enemy lines of retreat, but they cannot reach the battlefield as quickly, nor do they benefit from the degree of real-time intelligence and reconnaissance that airpower offers. In isolation neither delivers the incumbent's maximum effort in a rapid fashion.

We hypothesize the following from this logic:

H3: *Civil conflicts that involve government military forces with both a high degree of airpower and ground force mechanization will be shorter, on average, than conflicts in which government forces lack these capabilities.*

Combined Arms in Civil Conflicts: Illustrations

Combined arms strategies have been used in a variety of civil conflicts during the last half-century. Below we discuss four cases that illustrate the effects of combined arms in civil conflicts. In the first case (Yemen), government forces employed a combined arms doctrine from the beginning and brought the conflict to a rapid conclusion. The second case (Nigeria) offers a contrasting example of a military that failed to adopt a combined arms strategy and consequently fought a longer war than necessary. The final two cases (Sri Lanka and Chad) illustrate how the adoption of a combined arms doctrine in the midst of a conflict can help end fighting.

YEMEN, 1994

The Republic of Yemen was only four years old when the southern portion broke away in 1994 to declare the Democratic Republic of Yemen. Unionist forces counterattacked quickly, employing an aged but relatively mechanized force of roughly eighty aircraft, 1,500 tanks and armored vehicles, and 40,000 ground troops. The government's campaign began on May 4, 1994, with a four-column offensive. The widely dispersed columns quickly cut the southern territory in half and then converged on Aden from three directions. After a two-week siege of the city, Aden fell on July 7, confounding widespread predictions of a long stalemate (Ayalon and Maddy-Weitzman 1994).

The Yemen episode illustrates how the use of combined arms can yield rapid and decisive results in a civil conflict fought with conventional weapons and tactics. The mobility of northern forces was critical in enabling government troops to seize territory, maintain long supply lines, and force decisive engagements during the first weeks of the war (Kostiner 1996, 80–81). Indeed, the war lasted just two months, an outcome that would have been unthinkable if the government had lacked the ability to quickly press the fight against rebel forces.

NIGERIA, 1967–1970

Unlike Yemen in 1994, the Nigerian military found itself ill-equipped to suppress a rebellion when the region of Biafra broke away in June 1967. At the outset of the conflict, Nigerian forces had no working combat aircraft, tanks, or heavy artillery. As a result, the federal government reacted slowly to Biafra's declaration of independence, and the military missed key opportunities to put an early end to the conflict. After a surprise rebel strike into Nigeria's Midwest in August 1967, the Biafran army found itself overextended and in hostile territory. If the Nigerian army had been more mobile, according to one general, it could have ended the war then and there simply by cutting Biafran supply lines and surrounding enemy units (Obasanjo 1980). Instead, Biafran troops were able to outrun Nigerian forces and regroup.

Recognizing this deficiency, within a few months the Nigerian military obtained several Soviet MiG fighters and Czech Delfin light attack planes. These were joined by IL-28 bombers in early 1968 (Brown 1968, 25–26). However, these aircraft were rarely employed in tandem with ground forces as close air support; instead, they were used to bombard key occupied towns in advance of ground offensives (Barua 2013, 19). Furthermore, the federal air wing engaged in indiscriminate bombing and strafing of civilian targets, often with large numbers of civilian casualties. The use of airpower alone may have prolonged the war: although it was soon apparent that the numerically superior federal military would eventually defeat Biafran forces, the Biafrans were encouraged to fight on by fears that the Nigerian military was planning a genocide.

Without the hardware and doctrine necessary to employ combined arms, Nigerian operations during the conflict were the antithesis of rapid and decisive. Ground vehicles played little role in combat and were kept well behind the front lines (Samuels 1969, 19; de St. Jorre 1972, 279). One observer described federal operations during the war as featuring "slow, cautious probes, and long distance bombardments of doubtful object with doubtful accuracy," punctuated by "aimless and wasteful shooting" (Cervenka 1971, 51). Furthermore, the army's poor logistics and lack of mobility hindered its resupply operations, causing delays of several months between major engagements. This resulted in "plodding war of attrition" (Stafford 1984, 35).

After two years of stalemate, however, the Nigerian military gradually surrounded Biafran territory, ultimately imposing a suffocating blockade that caused widespread famine. Biafra capitulated in January 1970. Although the conflict ended decisively, Nigeria's inability to employ integrated air/ground operations weakened its ability to

end the war quickly, allowing the outnumbered Biafrans to resist until they were overwhelmed by sheer numbers.

Sri Lanka, 1983–2009

In the early 1980s, the Liberation Tigers of Tamil Eelam (LTTE), seeking autonomy for the nation's ethnic Tamils, launched an insurgency campaign against the Sri Lankan government. For years, the government struggled to quell the insurgency, and the LTTE seized more than 15,000 square kilometers of territory—nearly a quarter of the country. But in 2009, to "collective global surprise" (Hashim 2013, 6), the government achieved a crushing victory, in part due to its adoption of combined arms tactics.

After years of disappointing operations against the LTTE, Sri Lanka's armed forces embarked on a methodical reform program in the early 2000s, modernizing both its armor and airpower. Operationally, the Sri Lankan army deemphasized capturing and holding territory—"we are not interested in real estate," declared Defense Secretary Gotabaya Rajapaksa (Seneviratne 2008)—and instead aimed to inflict high attrition rates on the LTTE through coordinated offensive operations. The new doctrine called for small units of commandos working closely with air platforms to launch surprise lightning raids deep inside enemy territory, dividing enemy units and destroying them before they could retreat (Amarasinghe and Kahandawaarachchi 2009; Hashim 2013, 138). Using helicopters and fixed-wing fighters such as the MiG-27, the Sri Lankan military carried out more than 20,000 sorties in support of ground offensives between 2006 and 2009 (Reddy 2009). This resulted in a crushing defeat for the LTTE. While the LTTE's demise was due to a variety of factors—including the loss of international supporters as well as a naval blockade—the Sri Lankan military's effective use of combined arms played a key role in bringing the twenty-six-year conflict to an abrupt and unexpected end.

Chad, 2005–2010

In 2005, aided by the Sudanese government, rebel groups in eastern Chad mounted a rebellion against Chadian president Idriss Déby. In April 2006, more than one thousand rebels drove from bases in Darfur, Sudan, across the desert to the Chadian capital, N'Djamena, and attempted to overthrow the government. Although Chadian forces repulsed the attack, the assault's brazenness motivated Déby to embark on a major military modernization program.

Over the next few years, as the rebellion continued, Chad imported Mi-24 combat helicopters, Su-25 "Frogfoot" fixed-wing aircraft, and more than 150 armored ground vehicles. In addition, Chad received considerable amounts of training from the French and US militaries (Wezeman 2009, 4; Hansen 2013). On a global scale, Chad remained one of the least mechanized armies in the world, but these acquisitions nevertheless represented a major upgrade for a military whose equipment was described by one observer as "sparse, old, and barely serviceable" (Seibert 2007, 15).

In May 2009, one year after a second failed rebel assault on N'Djamena, the Chadian army launched a counterattack against a pair of towns held by the Union of Resistance Forces, an umbrella rebel group. Accompanied by air support from four Su-25 fighters and five Mi-24 helicopters, flanking columns of armor and soldiers quickly took the towns. The small air component played a pivotal role in the offensive, demonstrating that the revamped Chadian army now had the ability to project power against rebel strongholds inside Sudan's territory (Feichtinger and Hainzl 2011; Wezeman 2009). Shortly afterward, Sudan and Chad reached an agreement to terminate hostilities, reopen their shared border, and establish a joint force to monitor rebel activity (International Crisis Group 2010).

Speed, Not Victory: Georgia, 1992–1993

As these examples suggest, militaries with extensive combined arms capabilities are likely to fight shorter civil conflicts. However, this logic does not necessarily imply that combined arms militaries are more likely to win these conflicts. Maneuver strategies are quick and decisive, but risky. They require extensive training and close coordination between air and ground forces and can fail if not employed correctly (Stam 1996). Brevity and victory do not necessarily go hand in hand.

The case of Georgia in the early 1990s offers a useful illustration of this distinction. In the database we describe below, Georgia during the early 1990s boasted the highest combined arms score of any civil conflict incumbent since 1967. In 1992 and 1993, the Georgian military fought an unsuccessful campaign to suppress the separatist region of Abkhazia. The conflict began with a swift, violent Georgian invasion into the disputed area. The operation petered out within weeks, however, in part because Georgia could not sustain its long lines of communications and ran out of resources to keep its mechanized forces forward deployed.

In July 1992, the Georgian army received an installment of armaments from Russia as part of the Tashkent Treaty on Collective Security. This consisted, by one estimate, of several hundred tanks and armored combat vehicles, one hundred fixed-wing aircraft, and fifty attack and transport helicopters (Baev 1996, 117).[11] When Abkhazia declared independence later that month, the Georgian military launched an invasion of the Abkhazian city of Sukhumi by using its newly acquired weapons (Cheterian 2011, 187). Conducting what one analyst describes as a *blitzkrieg*, the Georgian force took Sukhumi in just two days (Baev 2003, 138). But this ambitious mechanized thrust also exposed fatal Georgian weaknesses. The Georgian force exhibited poor discipline and little coordination, with different units operating independently and often for personal profit through banditry (Cheterian 2011, 194). Moreover, the operation exposed the Georgian military's lines of communication, which came under attack by the so-called "Zviadist" militia (named for ousted president Zviad Gamsakhurdia), a rebel group operating in areas between Abkhazia and Tbilsi (Cheterian 2011, 192–93).

The pivotal battle for Gagra in October 1992 illustrates the risk of overextension in combined arms warfare. The Georgian military's tanks and armored vehicles, in addition to air support from Su-25 Frogfoot ground-attack aircraft, allowed it to occupy this strategic town with a considerably smaller force than its enemy (Billingsley 2013, 152). But the Abkhazian force was able to regroup, and using their own ex-Soviet heavy weapons, launched a surprise attack, which quickly cut off and then destroyed the Georgian force. The Georgian military did not mount

[11] O'Ballance (1997, 132–33) provides similar numbers with more specific weapons classifications.

another offensive operation for the remainder of the war (Billingsley 2013). In 1993, Georgian President Eduard Shevardnadze settled with Abkhazia, allowing Abkhazia to remain effectively autonomous.

In short, the Abkhazia conflict illustrates the double-edged nature of combined arms operations in civil conflicts; the conflict lasted just over a year, but ended in failure for the heavily mechanized Georgian military. Georgia's mechanized capabilities allowed it to mount a rapid offensive immediately upon Abkhazia's declaration of independence, but its lack of training and experience in employing such a strategy led to a rapid defeat. Importantly, Georgia's combined arms strategy was not the key reason for its loss. Georgia's military problems stemmed from vulnerable supply lines and poor troop discipline, neither of which were rooted in its use of combined arms. Indeed, Georgia's success in using the same strategy to defeat the Zviadist rebels during this period suggests that doctrine alone was not responsible for its defeat against Abkhazia. The role of combined arms in this conflict therefore was not to alter the eventual outcome, but rather to bring about that outcome more quickly: combined arms facilitated rapid engagements that exposed Georgia's weaknesses early on, leading to a shorter conflict.

Data and Research Design

Our analysis employs an adapted version of the Uppsala Conflict Data Program/Peace Research Institute Oslo (UCDP/PRIO) Armed Conflicts Dataset, v. 3–3005 (Gleditsch et al. 2002).[12] The unit of analysis in this dataset is the conflict-year. The dependent variable in the analysis is the duration of intrastate conflict, measured in days. According to the UCDP coding rules, conflicts are included in the dataset if they reach twenty-five deaths in a single year.[13] The dataset overall contains 147 unique intrastate conflicts (excluding coups), all of which began between 1967 and 2003.[14] The duration of these conflicts ranges from a low of one day (three conflicts) to a maximum of 9,380 days, with a mean of 1,710 days.

Measuring Mechanization and Combined Arms

The explanatory variable of greatest interest to this study is the use of combined arms by government militaries. As we discuss below, we measure combined arms by evaluating the possession of hardware (armored vehicles and aircraft) rather than examining each military's fighting doctrine in each conflict. While a precedent exists for using a military's material capabilities as a proxy for doctrine (Reiter and Meek 1999, 374–75, Biddle 2004, 160), we nevertheless acknowledge that our hardware-based measurement is likely an imperfect proxy. We choose this route because directly coding an incumbent state's doctrine is not only highly subjective, but can also be done only after the war has concluded, introducing the risk of retrospective bias. Moreover, data on the battlefield employment of forces are scarce, particularly for smaller conflicts from decades past.

Measuring the degree to which a military can employ a combined arms doctrine requires data on the doctrine's two material requirements: mechanized air and ground forces. First, we obtained data on national stockpiles of armored ground vehicles (including main battle tanks, heavy armored combat vehicles, armored personnel carriers, and infantry fighting vehicles) from Sechser and Saunders' (2010) National Mechanization Index.[15] Using information contained in the International Institute for Strategic Studies' *Military Balance* series of publications (1968–2004), this index reports the number of armored vehicles per one hundred soldiers for most countries. The variable *ground mechanization* is calculated by dividing an army's number of motorized vehicles by the number of ground soldiers and then calculating the natural logarithm of the resulting figure.[16]

Second, we measure air force mechanization by collecting annual data from *The Military Balance* on each country's holdings of combat aircraft. Our measure includes fixed-wing fighters, bombers, and command and control planes, as well as helicopters of all types. The variable *aircraft mechanization* represents the natural logarithm of a country's ratio of combat aircraft to soldiers.

As Figure 1 illustrates, there is a distinct positive correlation between air and ground mechanization ($r = 0.52$). Countries that have large proportions of armored ground vehicles are also likely to have large numbers of combat aircraft. Yet, this correlation is far from perfect; a simple linear regression of aircraft mechanization against ground mechanization reveals several significant outliers.[17] Croatia and Thailand, for instance, exhibited high levels of aircraft mechanization but relatively middling levels of ground mechanization, whereas Yemen and Angola possessed disproportionately more armored ground vehicles than aircraft. Countries experiencing civil conflicts tend to lie toward the bottom of the mechanization scale, compared to the rest of the world. Sechser and Saunders (2010) find that the average mechanization rate worldwide between 1979 and 2001 translated to roughly two armored vehicles per one hundred soldiers. In our dataset, however, the mean value of ground mechanization during the same period translates to less than 0.7 vehicles per one hundred soldiers. Since military mechanization is strongly associated with economic wealth (Sechser and Saunders 2010) and conflicts are much more common in poorer countries (for example, Fearon and Laitin 2003), these countries unsurprisingly exhibit lower levels of mechanization when compared to their less conflict-prone counterparts.

[12]These data have been adapted for duration analysis by Gates and Strand (2004); we obtained these data from Buhaug et al. (2009).

[13]If our argument is correct, combined arms militaries can result in very brief conflicts, often ending before they escalate to drawn-out wars. A higher fatality threshold (say, one thousand) would risk excluding many of the briefest conflicts, thereby preventing us from observing the full effect of combined arms doctrines. For this reason, a low fatality threshold is more appropriate (for example, Nilsson 2008; Buhaug and Gleditsch 2008; Buhaug et al. 2009; Østby et al. 2009; Cunningham et al. 2009; Cunningham 2010). Following Buhaug et al. (2009, 556), we consolidated conflicts involving the same actors and locations into a single conflict, so long as they were not separated by more than two years of inactivity.

[14]Conflicts ongoing in 2003 are right-censored.

[15]The data collected by Sechser and Saunders (2010) contains ground mechanization information for all odd-numbered years from 1979–2001. Using the same sources and procedures, we extended the dataset's temporal range and collected data for even-numbered years, resulting in a dataset of annual ground mechanization rates for most civil conflict combatants between 1967 and 2003.

[16]Note that vehicles belonging to marine or naval infantry units are included in the count of armored vehicles. We follow Sechser and Saunders (2010) in excluding personnel and vehicles belonging to strategic nuclear forces, paramilitary forces, domestic police forces, and reserves from these measurements.

[17]In such a regression, $\beta = 0.499$, with a standard error of 0.032. The predicted values in Figure 1 were derived from this regression.

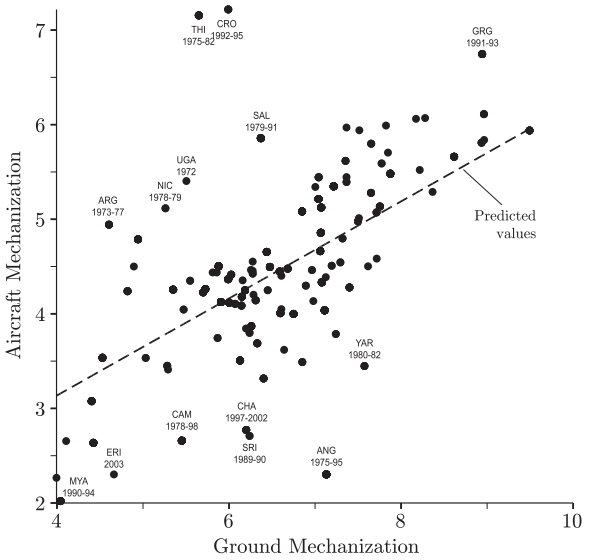

Figure 1. Mechanization rates of civil conflict incumbents, 1967–2003

Combined arms represents the central explanatory variable in the analysis below. We calculate this variable by interacting ground mechanization with aircraft mechanization. The resulting variable ranges from a value of 8.2 (Myanmar, 1991–1994) to 60.3 (Georgia, 1991–1993), with a mean of 29.1 and median value of 27.0. Our analyses employ combined arms scores from a country's first year of participation in a conflict. This variable provides the central test of the hypotheses outlined in the previous sections. Our theory expects that aircraft and ground mechanization in isolation lengthen conflict duration; at the same time, it also expects that the interaction of these two types of mechanization—combined arms—leads to shorter conflicts.[18]

As Table 1 demonstrates, incumbent states vary widely in their combined arms capabilities. States with (comparatively) high combined arms capabilities include major powers (Great Britain and Russia), former Soviet republics (Georgia and Uzbekistan), and Eastern European states (Romania and disintegrated Yugoslavia). States in the Middle East and North Africa also tend to rank highly, with Saudi Arabia, Algeria, Yemen, Egypt, and even Mali appearing toward the top of the list. Conversely, states in Sub-Saharan Africa and Southeast Asia tend to have a smaller combined arms capability: Eritrea, Uganda, Myanmar, Cambodia, Chad, and Indonesia all have manpower-dominated militaries with few armored vehicles and combat aircraft.

Our analysis in this study focuses on the duration of civil conflicts from the incumbent's perspective, rather than the duration of third-party interventions. External interventions into civil wars—on either side—tend to prolong them (Balch-Lindsay and Enterline 2000; Regan 2002; Cunningham 2010). However, external interveners generally devote only a portion of their forces to far-flung interventions. By contrast, incumbent governments have stronger incentives to throw the full weight of their military capabilities against incipient rebellions. Since we base our measurement of combined arms on observed holdings, our index is likely to more accurately represent the military strategies of incumbents rather than interveners. We therefore focus on the capabilities of incumbent states rather than third-party interveners. Measuring and assessing the nature of interveners' military forces, however, will be a crucial task for future research.

[18]The combined metric therefore captures the "force multiplier" effect theorized in counterinsurgency literature (U.S. Army and U.S. Marine Corps 2007, E-1)

Control Variables

We include several additional variables that may shape the duration of civil conflicts. First, we include several measures of a conflict's geographic proximity to the incumbent's capital, including the distance between the capital and the conflict zone (Buhaug and Gates 2002), a variable denoting conflicts fought along international boundary lines (Buhaug et al. 2009), and an interaction between the two terms. Second, we measure the material capacity of rebel groups, drawing on data from Cunningham et al. (2009) to measure rebel fighting capacity as well as the relative strength of rebel forces. Third, we include an indicator for the presence of lootable resources such as diamonds and gemstones, illicit drugs, and petroleum deposits in the conflict zone (Lujala et al. 2007; Lujala 2009; Gilmore et al. 2005; Buhaug and Lujala 2005). Fourth, we control for rough terrain with a dichotomous variable that is coded 1 if the conflict zone in question was covered by either 60 percent mountainous terrain or 60 percent forested terrain (Fearon and Laitin 2003; Buhaug et al. 2009). Fifth, democracies may have a tendency to capitalize to minimize casualties (Caverley 2014). We therefore employ the Scalar Index of Polities (Gates et al. 2006), which contains a measure of regime type on a scale of 0 to 1. Sixth, we include gross domestic product (GDP) per capita both because wealthier governments tend to fight shorter conflicts (for example, Balcells and Kalyvas 2012) and because scholars also have identified GDP as one of the most reliable predictors of military mechanization (Sechser and Saunders 2010). GDP therefore is not only an alternative cause of conflict duration, but also a potential confounding cause of military mechanization. By controlling for this confounding factor, we aim to determine whether military technology exerts an effect on conflict duration independent of its relationship to overall military capacity. Seventh, we account for external assistance from third-party governments to the incumbent government and rebels (Cunningham et al. 2009). Finally, we include dichotomous variables denoting "sons of the soil" civil wars (Fearon 2004), civil conflicts fought during the Cold War era, and insurgencies and irregular conflicts (Lyall and Wilson 2009).

Estimation Techniques

We employ two approaches to estimating the effect of combined arms on conflict duration. First, we utilize Weibull accelerated failure time regressions in which combined arms is a central independent variable; second, we estimate a series of logistic regressions with time-dependence controls.[19] Because countries in the UCDP data can experience multiple conflicts at the same time, all of our regressions employ robust standard errors clustered on country.

[19]Both are standard approaches to assessing the duration of civil conflict. For example, the Weibull technique is used by Fearon (2004); Gates and Strand (2004); Buhaug et al. (2009); Balcells and Kalyvas (2012). Logistic regressions have been used by Cunningham (2006); and Escribà-Folch (2010), among others.

Table 1. Average combined arms scores of civil war incumbents, 1967–2003

Country	*Period*	*Average Combined Arms Score*	*Country*	*Period*	*Average Combined Arms Score*
Georgia	1991–93	60.3	Coôte d'Ivoire	2002–03	29.6
Russia	1999–2003	56.4	Iran	1996–2001	29.3
Russia	1993–96	54.2	Philippines	1994–2003	29.1
Soviet Union	1990–91	51.9	Ghana	1982	29.1
Great Britain	1998	50.2	Sudan	1983–2003	28.7
Yemen (South)	1986	49.5	Pakistan	1990	28.6
South Africa	1981–88	48.8	Pakistan	1995–96	27.8
Togo	1991	46.9	Guinea-Bissau	1998–99	27.4
Romania	1989	45.4	Spain	1980–81	27.4
Uzbekistan	2000	44.8	Burundi	1991–2003	27
Saudi Arabia	1979	44.6	Nicaragua	1978–79	26.9
Yugoslavia	1991	44.4	Tunisia	1980	26.8
Yemen	1994	44.3	Malaysia	1981	26.8
Mali	1990	44	Pakistan	1974–77	26.6
Serbia	1998–99	43.5	Ethiopia	1976–91	26.5
Croatia	1992–95	43.2	Somalia	1981–96	26.4
Algeria	1991–2003	43.2	Yemen	1980–82	26.1
Congo	1997–99	41.3	Mexico	1996	26
Thailand	1974–82	40.4	Mexico	1994	25.8
Syria	1979–82	40.4	India	1978–2003	25.2
Mali	1994	40.1	Indonesia	1997–2003	24.7
Egypt	1993–98	39.8	Ethiopia	1996–2003	24.4
Congo	1993–94	39.7	Malaysia	1974–75	24.1
Iraq	1973–96	37.9	Nicaragua	1981–89	23.7
Congo	2002	37.6	Rwanda	1990–94	23.3
El Salvador	1979–91	37.3	Argentina	1973–77	22.8
Azerbaijan	1992–95	36.8	Indonesia	1990–92	22.6
Afghanistan	1978–2003	36.7	Angola	1975–2003	22.4
Peru	1982–99	36.2	Laos	1989–90	22.1
Spain	1991–92	35.1	Pakistan	1971	22
Lebanon	1975–90	34.3	India	1967–72	20.4
Guinea	2000–01	33.1	Indonesia	1976–78	18.2
Iran	1979–93	33	Chad	1997–2002	17.2
Senegal	1990–2003	32.9	Sri Lanka	1989–90	16.9
Spain	1987	31.3	Cambodia	1978–98	14.5
Turkey	1984–2003	30.8	Myanmar	1990–2003	14.2
Uganda	1978–91	30	Uganda	1994–2003	13.5
Dem. Rep. Congo	1996–2001	29.9	Eritrea	2003	10.7
Uganda	1972	29.7			

Results

Table 2 presents the results of a battery of Weibull hazard models designed to estimate the effect of mechanization and combined arms on conflict duration.[20] Interpretation of these results is straightforward; factors with negative coefficients are associated with shorter civil wars, whereas positive coefficients denote factors that lengthen conflicts. Model 1 includes only measures of military technology. Models 2–9 gradually incorporate different sets of control variables. Model 10 includes mechanization, combined arms, and the full range of control variables simultaneously. Model 11 employs a rescaled version of the three military technology variables, in which the variables have been standardized on a scale of 0 to 10 to minimize the possibility that differences in scaling might skew the interaction between air and ground mechanization scores.

First, we evaluate Hypotheses 1 and 2, which suggest that army mechanization and airpower—when employed independently—lengthen the duration of civil conflicts by both shielding and handicapping government forces, thus preventing either side from achieving decisive victory. The primary test of these hypotheses is provided by the ground mechanization and aircraft mechanization variables, which measure the effect of each type of mechanized force when the other is absent. In all eight regressions, both variables are positive and significant at the 90 percent level or above, suggesting that states with either highly mechanized ground armies or comparatively large air forces—but not both—tend to fight longer conflicts. These findings offer confirmation for Lyall and Wilson (2009) and others who have pointed out the drawbacks of military mechanization in intrastate conflicts.

Matters change, however, when we evaluate the interactive effect of ground and air mechanization. Hypothesis 3 argues that, even if these two types of mechanization prolong conflicts when employed independently, their simultaneous use can have the opposite effect. This hypothesis expects that states employing combined arms should fight shorter conflicts, on average, than those employing just one form of mechanized force. The regressions in Table 2 provide consistent support for this view; in each of the eleven models, the coefficient for combined arms is negative and

[20]To check the robustness of these findings, we reestimated the models in Table 2 using a Cox proportional hazards model, a semiparametric model that uses less restrictive assumptions than the Weibull model. The results were virtually identical.

Table 2. Accelerated failure time hazard analysis of the duration of civil conflict, 1967–2003

	(1) *Combined Arms*	*(2)* *Geography*	*(3)* *Fighting Capacity*	*(4)* *Terrain*	*(5)* *Regime Type*	*(6)* *State Wealth*	*(7)* *External Actors*	*(8)* *Sons of the Soil*	*(9)* *Insurgencies*	*(10)* *All Controls*	*(11)* *Standardized IVs*
Ground mechanization	1.080**	1.118***	1.180***	1.185**	1.240**	1.130**	1.102***	1.192**	1.079**	1.448***	0.909***
	(0.337)	(0.316)	(0.330)	(0.379)	(0.385)	(0.345)	(0.324)	(0.369)	(0.402)	(0.423)	(0.266)
Aircraft mechanization	1.342***	1.216***	1.466***	1.556***	1.384***	1.355***	1.364***	1.603***	1.161*	1.402**	0.952**
	(0.380)	(0.333)	(0.372)	(0.445)	(0.378)	(0.385)	(0.369)	(0.416)	(0.482)	(0.512)	(0.348)
Combined arms	−0.250***	−0.238***	−0.265***	−0.276***	−0.274***	−0.240***	−0.251***	−0.289***	−0.233**	−0.261**	−1.360**
	(0.063)	(0.058)	(0.060)	(0.069)	(0.067)	(0.063)	(0.061)	(0.072)	(0.076)	(0.083)	(0.431)
Distance to capital		0.537***								0.537**	0.537**
		(0.151)								(0.180)	(0.180)
Conflict at border		0.954**								0.792*	0.792*
		(0.334)								(0.345)	(0.345)
Border × distance		−0.594***								−0.698**	−0.698**
		(0.168)								(0.216)	(0.216)
Rebel fighting capacity			−0.120							0.102	0.102
			(0.549)							(0.647)	(0.647)
Rebels' relative strength			−0.336							−0.455	−0.455
			(0.770)							(0.801)	(0.801)
Natural resources				0.667*						0.579†	0.579†
				(0.305)						(0.328)	(0.328)
Rough terrain				0.573*						0.303	0.303
				(0.277)						(0.280)	(0.280)
Incumbent democracy					0.472					0.635	0.635
					(0.503)					(0.436)	(0.436)
GDP per capita						−0.361†				−0.475†	−0.475†
						(0.208)				(0.269)	(0.269)
External support: rebels							0.150			0.052	0.052
							(0.284)			(0.281)	(0.281)
External support: government							−0.173			−0.215	−0.215
							(0.359)			(0.443)	(0.443)
Sons of the soil								1.386*		0.917	0.917
								(0.621)		(0.975)	(0.975)
Insurgency									0.738*	0.532	0.532
									(0.327)	(0.339)	(0.339)
Post–Cold War years										−0.436	−0.436
										(0.435)	(0.435)
Constant	1.886	−1.951	1.454	0.323	1.213	3.866†	1.726	1.102	1.834	−1.177	2.192
	(1.845)	(1.886)	(1.907)	(2.418)	(1.887)	(2.105)	(1.792)	(1.895)	(2.302)	(3.400)	(2.735)
Number of Conflicts	129	129	119	129	122	122	122	122	122	112	112
Number of Failures	109	109	100	109	103	109	109	109	109	94	94
Observations	678	678	662	678	633	676	678	678	664	603	603

Notes: (1) Robust standard errors in parentheses. (2) Statistical significance: ***$p<0.001$, **$p<0.01$, *$p<0.05$, †$p<0.10$.

statistically significant at the 95 percent level or above, indicating that the use of armored ground vehicles in tandem with airpower may reverse the independent effects of each type of mechanization.

As a robustness check of these results, Table 3 presents a series of logistic regressions with conflict termination as the dependent variable. The regressions are specified identically to those in Table 2, with the exception that we include three time-dependence variables in the models to control for duration.[21] The substantive results are consistent with those in Table 2: while independent measures of mechanization are associated with longer conflicts, the combination of ground and air mechanization is associated with a higher likelihood of conflict termination.[22]

To illustrate the substantive impact of combined arms, Figure 2 plots a three-dimensional surface of the predicted probability that a civil conflict will terminate in a given year, as the three mechanization variables vary.[23] First, the graph illustrates the conflict-lengthening effects of air or ground mechanization for states that score low on both measures. Consider, for example, a state that begins with an unmechanized ground force and a small air force, thus falling toward the near-left corner of the figure. Bolstering the state's ground mechanization alone—thus moving it toward the near-right corner—reduces the likelihood that the conflict will end at any given point, resulting in longer conflicts on average. Likewise, adding air power without mechanized ground forces—thus moving from the near-left to the far-left corner—also results in longer conflicts. In isolation, both air and ground mechanization therefore are associated with longer conflicts.

The relationship changes, however, after combining mechanized ground forces with airpower. At high levels of each mechanization variable, increases in the other mechanization score are associated with a higher probability that a conflict will end. For example, for a state that already possesses a mechanized ground force (toward the near-right corner of the chart), adding air power (moving toward the far-right corner) results in an increased probability of conflict termination. Adding mechanized ground forces to a military with ample air power has a similar effect. This supports the following combined arms hypothesis: combining aircraft with highly mechanized ground forces better positions the state to force a rapid decision one way or another on the battlefield. In sum, combined arms doctrines lead to shorter civil conflicts, whereas unevenly mechanized forces lengthen them.

The analysis yields several other interesting results as well. Consistent with the findings of Rustad et al. (2008) and Buhaug et al. (2009), distance exerts a strong effect on conflict duration. Conflicts fought far from a nation's capital, as well as those fought along international borders, tend to last longer, on average.

Other factors do not reliably affect civil conflict duration in our analysis. First, conflicts fought on forested or mountainous terrain do not appear to last longer; although the *rough terrain* variable achieves 95 percent significance in one regression, this result does not survive alternate model specifications or estimators. This finding conforms with several other studies that also find rough terrain unrelated to civil war duration (for example, Collier et al. 2004; Rustad et al. 2008; Escribà-Folch 2010; Bleaney and Dimico 2011). Second, democracies do not seem to fight shorter wars; *incumbent democracy* does not achieve statistical significance in any of the regressions, echoing the findings of Fearon (2004) and Balcells and Kalyvas (2012). Third, the findings are mixed with respect to the presence of lootable resources—oil, drugs, and gemstones—in the conflict zone. In some regressions, lootable resources appear to be associated with longer wars, but this result is not robust.[24]

Combined Arms and War Outcomes

As we have noted, the theory presented in this article centers around the effects of military technology on the duration of civil conflicts—not their outcomes. Whereas the debate about military mechanization has focused primarily on whether mechanized militaries win or lose (Lyall and Wilson 2009; Smith and Toronto 2010; Friedman 2011; MacDonald 2013), our interest is in whether such militaries fight longer conflicts. Nevertheless, the outcomes of conflicts can offer some insight into the logic of our argument. In particular, the logic of Hypothesis 3 implies that militaries using combined arms should be neither more nor less likely to prevail in their conflicts. Using combined arms may force an earlier verdict in a conflict, but not necessarily a more favorable one.

Table 4 puts this hypothesis to the test, using logistic regressions to examine the relationship between military mechanization and the likelihood of either an incumbent victory (Models 23 and 24) or a rebel victory (Models 25 and 26). Because the UCDP dataset does not code conflict outcomes, however, we turn to Balcells and Kalyvas (2012), who code outcomes for all civil wars in the UCDP dataset involving at least one thousand fatalities.[25] If combined arms is reliably associated with either victory or defeat for the incumbent government, this would suggest that the logic described in this article is at best incomplete and that combined arms strategies have either more strengths or weaknesses than we have acknowledged.

The results in Table 4, however, suggest that this is not the case. Models 23 and 24 indicate that mechanization is a poor predictor of incumbent victory; states with high mechanization scores are neither consistently more nor less likely to prevail in civil wars. Likewise, in the second set of models, the three mechanization variables exhibit no reliable correlations with rebel victories in civil wars. This evidence suggests that both victories and defeats are responsible for the observation that mechanized militaries fight shorter conflicts. A combined arms strategy does not guarantee victory in intrastate combat.

[21]Specifically, the variable *time* measures the number of days a conflict has been ongoing at the time of observation. The variables $time^2$ and $time^3$ are included as well (Carter and Signorino 2010). Table 3 does not report these coefficients.

[22]Note that the substantive interpretation of logit coefficients in Table 3 is opposite that of Table 2; negative coefficients in Table 3 signify factors that reduce the likelihood of war termination, whereas positive coefficients indicate factors associated with shorter conflicts.

[23]This figure uses coefficient estimates from Model 12 in Table 3.

[24]Other studies have also found inconclusive evidence regarding the impact of lootable resources. A somewhat more consistent finding is that oil exerts little systematic effect on civil war duration, which could drive the mixed findings here (Collier et al. 2004; Escribà-Folch 2010; Bleaney and Dimico 2011; Balcells and Kalyvas 2012).

[25]The analyses also include the same control variables used in Balcells and Kalyvas (2012).

Table 3. Logit analysis of civil conflict termination, 1967–2003

	(12) Combined Arms	*(13) Geography*	*(14) Fighting Capacity*	*(15) Terrain*	*(16) Regime Type*	*(17) State Wealth*	*(18) External Actors*	*(19) Sons of the Soil*	*(20) Insurgencies*	*(21) All Controls*	*(22) Standardized IVs*
Ground mechanization	−0.880**	−0.921**	−0.995***	−0.958**	−0.946**	−0.930**	−0.907**	−0.874**	−0.882**	−1.290**	−0.809**
	(0.287)	(0.288)	(0.294)	(0.325)	(0.343)	(0.301)	(0.278)	(0.307)	(0.330)	(0.412)	(0.259)
Aircraft mechanization	−1.004**	−0.962**	−1.147***	−1.159**	−0.965**	−1.036**	−1.036**	−1.117**	−0.889*	−1.153*	−0.783*
	(0.332)	(0.306)	(0.318)	(0.384)	(0.342)	(0.358)	(0.324)	(0.369)	(0.383)	(0.482)	(0.327)
Combined arms	0.189***	0.187***	0.211***	0.207***	0.194**	0.186**	0.191***	0.201**	0.178**	0.218**	1.137**
	(0.055)	(0.053)	(0.054)	(0.061)	(0.062)	(0.061)	(0.054)	(0.062)	(0.064)	(0.080)	(0.415)
Distance to capital		−0.344*								−0.447**	−0.447**
		(0.136)								(0.145)	(0.145)
Conflict at border		−0.722**								−0.715**	−0.715**
		(0.245)								(0.273)	(0.273)
Border × distance		0.383**								0.580***	0.580***
		(0.147)								(0.157)	(0.157)
Rebel fighting capacity			0.024							−0.300	−0.300
			(0.414)							(0.518)	(0.518)
Rebels' relative strength			0.213							0.405	0.405
			(0.613)							(0.619)	(0.619)
Natural resources				−0.478*						−0.660*	−0.660*
				(0.225)						(0.288)	(0.288)
Rough terrain				−0.358†						−0.278	−0.278
				(0.217)						(0.235)	(0.235)
Incumbent democracy					−0.259					−0.571	−0.571
					(0.359)					(0.381)	(0.381)
GDP per capita						0.260†				0.414*	0.414*
						(0.143)				(0.211)	(0.211)
External support: rebels							−0.152			−0.172	−0.172
							(0.211)			(0.238)	(0.238)
External support: government							0.204			0.305	0.305
							(0.251)			(0.312)	(0.312)
Sons of the soil								−1.015*		−0.848	−0.848
								(0.479)		(0.819)	(0.819)
Insurgency									−0.559*	−0.454	−0.454
									(0.229)	(0.300)	(0.300)
Post–Cold War years										0.450	0.450
										(0.394)	(0.394)
Constant	3.660*	6.261***	4.205**	4.786*	3.908*	2.313	3.835**	3.812*	3.751*	6.938*	3.877†
	(1.525)	(1.727)	(1.517)	(1.960)	(1.675)	(1.866)	(1.472)	(1.616)	(1.808)	(2.897)	(2.188)
Observations	678	678	662	678	633	676	678	678	664	603	603

Notes: (1) Three time-dependence variables not reported. (2) Robust standard errors in parentheses. (3) Statistical significance: ***$p<0.001$, **$p<0.01$, *$p<0.05$, †$p<0.10$.

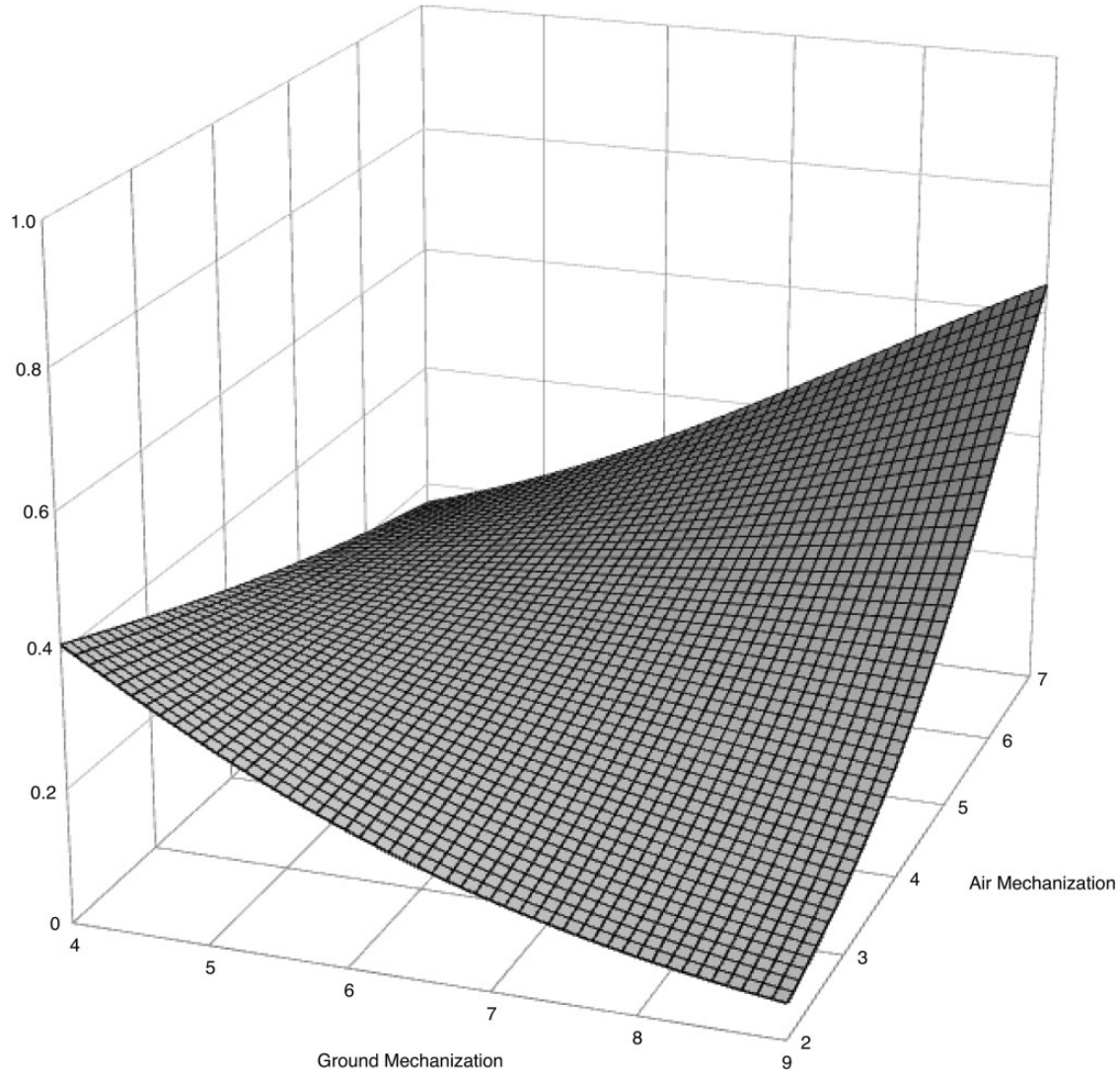

Figure 2. Predicted probability of conflict termination as ground mechanization and aircraft mechanization vary (Model 12 estimates)

Combined Arms and Insurgencies

While these results demonstrate the importance of combined arms in the broad category of civil conflicts, not all intrastate conflicts are alike. Kalyvas and Balcells (2010) demonstrate that civil conflicts may take the form of conventional set-piece battles, peasant revolts, or urban insurgencies. The mode of combat—and therefore the utility of mechanized military forces—may vary widely across different types of conflicts. Insurgencies in particular may pose special challenges to mechanized militaries, since fighting often occurs house-to-house rather than in open battlefields. Insurgencies therefore represent the "hard cases" for combined arms warfare. Do the effects of combined arms hold for insurgencies as well? Table 5 evaluates this question by estimating two of the regressions in Table 2 against a subsample of only insurgencies.[26] The results suggest that combined arms have duration effects not only in conventional civil wars but also in counterinsurgencies. Consistent with Lyall and Wilson (2009), the coefficient for ground mechanization is positive and statistically significant at the 99 percent level or above in both regressions, indicating that incumbent states with mechanized ground forces but little airpower fight longer insurgencies. But when combined with airpower, the effect of mechanized ground forces is reversed; the coefficient for combined arms in Table 5 is negative and achieves statistical significance at the 95 percent level in both models. The overall conclusion is that combined arms doctrines are strongly associated with shorter civil wars—even insurgencies.

Implications and Conclusions

This article evaluates the role of military technology in explaining the duration of civil conflicts. While conventional wisdom holds that mechanized land armies tend to produce lengthy, indecisive stalemates, we argue that the opposite effect results when mechanized ground forces are combined with airpower. The simultaneous, coordinated use of land-based armor and combat aircraft—known as a combined arms doctrine—can create the conditions for more rapid, decisive battlefield outcomes, leading to shorter conflicts. Using fine-grained data on the military forces of incumbent states, we

[26]The other six model specifications used in Table 2 yield similar results. We did not report these models here to avoid unnecessary repetition.

Table 4. Logit analysis of civil war outcomes, 1967–2003

	Incumbent Victory		*Rebel Victory*	
	(23) Combined Arms	*(24) All Controls*	*(25) Combined Arms*	*(26) All Controls*
Ground mechanization	0.337	2.153	−1.065	−2.528
	(0.933)	(1.605)	(0.933)	(2.247)
Aircraft mechanization	0.398	2.442	−0.679	−2.050
	(1.086)	(1.909)	(1.141)	(2.447)
Combined arms	−0.084	−0.404	0.211	0.472
	(0.169)	(0.308)	(0.167)	(0.433)
Conventional war		0.045		−0.178
		(1.602)		(1.381)
Irregular war		1.868		−2.756**
		(1.319)		(1.058)
Oil exporter		−0.194		0.435
		(0.790)		(1.088)
Ethnic fractionalization		1.481		−1.584
		(1.317)		(1.597)
Rough terrain		−0.131		0.022
		(0.272)		(0.354)
Incumbent democracy		0.214		−1.157
		(0.891)		(0.939)
GDP per capita		0.147		−0.240†
		(0.104)		(0.138)
Post–Cold War		−0.722		−0.204
		(0.661)		(0.880)
Population (log)		0.286		−0.096
		(0.280)		(0.417)
Constant	−1.126	−17.642†	2.231	14.562
	(5.609)	(10.494)	(5.755)	(13.940)
Observations	95	72	95	72

Notes: (1) Robust standard errors in parentheses. (2) Statistical significance: ***$p<0.001$, **$p<0.01$, *$p<0.05$, †$p<0.10$. (3) Control variables are from Balcells and Kalyvas (2012).

Table 5. Accelerated failure time hazard analysis of the duration of insurgencies, 1967–2003

	(27) Combined Arms	*(28) All Controls*
Ground mechanization	1.543***	1.542**
	(0.416)	(0.519)
Aircraft mechanization	1.748***	1.816**
	(0.378)	(0.702)
Combined arms	−0.324***	−0.279*
	(0.078)	(0.110)
Distance to capital		−0.031
		(0.147)
Conflict at border		1.138**
		(0.434)
Border × distance		−0.328*
		(0.165)
Rebel fighting capacity		−0.326
		(0.558)
Rebels' relative strength		−0.351
		(0.674)
Natural resources		1.549*
		(0.672)
Rough terrain		0.651†
		(0.362)
Incumbent democracy		−0.097
		(0.615)
Post–Cold War years		−1.269*
		(0.601)
GDP per capita		−0.810†
		(0.490)
External support: rebels		−0.318
		(0.324)
External support: government		−0.528
		(0.442)
Sons of the soil		2.032*
		(0.986)
Constant	−0.339	4.010†
	(1.795)	(2.430)
Number of conflicts	60	52
Number of failures	42	37
Observations	341	300

Notes: (1) Robust standard errors in parentheses. (2) Statistical significance: ***$p<0.001$, **$p<0.01$, *$p<0.05$, †$p<0.10$.

evaluate this claim by conducting a systematic empirical analysis of the relationship between military technology and civil conflict duration.

Our analysis produced three key results. First, we found support for Lyall and Wilson's (2009) finding that mechanized ground forces favor stalemate rather than victory. Second, we found evidence that airpower alone is likely to extend civil wars. Third, and most importantly, the analysis revealed that using mechanized ground forces in conjunction with airpower can offset these effects. States that combine airpower with mechanized armies tend to fight shorter—not longer—civil conflicts. These results offer an important revision to our understanding of military mechanization in intrastate conflicts. While mechanized ground forces indeed appear to suffer serious limitations against nonconventional opponents, as Lyall and Wilson (2009), Lyall (2010), Friedman (2011), and others find, our analysis suggests that the addition of airpower may help states overcome some of these limitations. Ground force mechanization on its own may be problematic, but militaries that use armored vehicles in combination with combat aircraft fight shorter wars, on average, than militaries that rely strictly on ground-force mechanization. While our analysis focuses on incumbent states rather than third-party interveners, these findings may offer a warning to policymakers against precipitously reducing the role of armor and airpower in counterinsurgency operations.

In addition to shedding light on how, why, and when civil conflicts end, our findings also add to a growing body of research about the role of military technology in armed conflict. Numerous studies argue that explaining the nature and outcomes of violent conflicts—both within and among states—requires that we understand the military forces and strategies employed by combatants (for example, Biddle 2004; Balcells and Kalyvas 2012). While many scholars agree that mechanization is likely to yield short, sharp, and decisive *interstate* wars (for example, Bennett and Stam 1996), the effect of mechanization on *intrastate* conflicts remains less clear. Further, the debate on military mechanization tends to emphasize the effects of military technology on the outcomes of conflicts—especially insurgencies.[27] We add a new dimension to the debate by demonstrating that mechanization carries important consequences for the duration of conflicts as well. By

[27]See, for example, Lyall and Wilson (2009); Smith and Toronto (2010); Friedman (2011); MacDonald (2013).

introducing the concept of combined arms to this literature, we demonstrate the need for greater specificity in how we conceptualize and measure force structure.

At the same time, this study leaves two important questions unanswered. First, although conflicts involving combined arms militaries may be shorter, this does not mean that they are less costly. Indeed, Balcells and Kalyvas (2012) provide evidence that since the end of the Cold War, civil wars have grown shorter but more destructive. We need further research to determine the effects of combined arms on both military fatalities and civilian collateral damage. Even if combined arms yield shorter conflicts, those conflicts may prove no less devastating than their longer, low-intensity counterparts.

Second, as noted earlier, shorter civil wars do not necessarily imply that incumbent governments are more successful in prosecuting civil wars. Combined arms militaries may increase the likelihood of achieving quick victories—but they may also produce more rapid losses. Additional research could help isolate the connections between the outcomes of civil conflicts—particularly noninsurgencies—and military technology.

In general, our study points to the need for more fine-grained data about military capabilities and doctrine in civil wars. Although our analysis utilizes new and detailed data on the weapons stockpiles of civil war combatants, raw stockpile data do not tell us how combatants used these weapons in combat. New data on the military doctrines of civil war incumbents would permit a more direct assessment of combined arms operations in these conflicts. On a similar note, our study accounts only for the mechanization levels of incumbent governments. It does not include the military profiles of rebel groups. Yet, as several studies demonstrate, the military strategies employed by rebels and insurgent groups vary even more widely than those of incumbent governments. Many such groups utilize armor and even airpower. New data about how rebels fight could help researchers better specify the effects of military technology on the duration and outcomes of civil wars.

Most broadly, the findings of this study underscore the importance of incorporating military technology into our theoretical models of civil conflict. Explaining the dynamics of intrastate conflict requires an understanding of how the technology of warfare interacts with geographic, economic, and political factors to shape battlefield events and political decisions. Further investigation into the role of military technology is likely to yield new insights both for researchers interested in explaining costly conflicts and for policymakers interested in preventing them.

Supplementary Information

Supplementary Information is available at the *International Studies Quarterly* data archive.

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