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Allies and Airpower in Libya

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The 2011 North Atlantic Treaty Organization (NATO) intervention in Libya was a success in several important respects: it helped topple Muammar Qaddafi's 42-year-old regime without the deployment of ground forces, with very low levels of collateral damage, and no NATO casualties.¹ The Libyan intervention exploited the synergy of precision airstrikes and local allies fighting on the ground, making the deployment of foreign ground forces unnecessary. The successful overthrow of the Taliban in 2001, following a similar strategy (but with a greater emphasis on Special Operations Forces (SOF)), led a number of observers and analysts to herald the coming of a new way of war, known as the "Afghan model."² Proponents of the model point to its ability to achieve military success with a significantly lower cost in blood and national treasure than previous conventional operations. It should be noted that success here refers to operations against the opponent's conventional forces, not to the target state's prospects for long-term stability. In this respect, the jury is still out on Libya, with the government struggling to consolidate its rule.³ An important debate has emerged regarding the conditions under which the Afghan model is effective and, therefore, the extent to which it can serve as a template for future operations. In particular, the author and strategist Stephen Biddle warns against learning the wrong lessons from Afghanistan, arguing that the campaign succeeded primarily due to the parity in military skill of local US allies and the Taliban/al Qaeda fighters.⁴ In his view, precision airpower and SOF cannot compensate for a major imbalance in the skill of ground forces.⁵ This analysis leads Biddle to claim that, "Syria and Iran, for example, are poor candidates for the Afghan model: Who is the trained local opposition in Syria or Iran?"⁶ It appears that Libya would also be an unpromising candidate for the Afghan model due to the absence of a trained local opposition identifiable at the outset of the intervention. Consistent with this observation, Biddle expressed concern about the viability of the intervention in Libya, expecting that the outcome "could easily be a drawn-out, grinding stalemate."⁷ Understanding why the poorly skilled opposition prevailed against superior government forces in Libya promises insight on the debate regarding the broader applicability of

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the Afghan model. This is critical not only for scholarly debates on the evolution of warfare but also for effective policymaking. As the United States tires of fighting drawn-out, troop-intensive wars such as Iraq and Afghanistan, future interventions are likely to mimic the Libyan experience. It is imperative that lessons-learned from the Libyan campaign be incorporated into any informed discussion of policy options related to the ongoing crisis in Syria.

The evidence presented in this article provides important qualifications to the main positions in the debate. The existing analyses of the Afghan model assume interventions will be short, which was the case in Afghanistan. The prolonged nature of the Libyan campaign, however, points to time as a critical element of the model. Time affected battlefield outcomes in Libya through two mechanisms. First, it made possible the attrition of Qaddafi's forces through precision airpower—although, airpower did not make close ground combat irrelevant. The process of attrition over time enabled unskilled rebel forces to make substantial progress against his ground forces. Second, time provided breathing room for the fledging opposition force to become more skilled. The primary lesson emerging from Libya is if an air campaign is sustained for a sufficient period of time, depending on the interveners' political will, it has the potential of tilting the balance in favor of a particular side, even if they are initially outmatched.

It appears that there is a qualified positive answer to Biddle's question, "can the [Afghan] model trump a major skill imbalance?" Policymakers should not expect military interventions to be easy and cheap.⁸ The Libyan conflict was characterized by sustained close combat and a prolonged aerial campaign of attrition. The political will required to execute a sustained intervention of this sort will not always be forthcoming; indeed, the NATO coalition suffered from divisions that threatened to undermine operations in Libya.

The Libyan Conflict

The Libyan conflict was characterized by three distinct phases. The first phase, which began on 18 February and lasted until international intervention on 19 March, displayed significant movement along the battlefield, but little sustained close combat. Initially, rebels in the east made rapid advances westward along the Libyan coastline from Benghazi to Bin Jawwad, seizing strategically important cities such as Ras Lanuf, Brega, and Ajdabiya in the east, and Misrata and Zawiyah in the west. Rebel gains were short-lived. On 6 March the rebel advance was halted at Bin Jawwad; Qaddafi's forces launched a counterattack, forcing the rebels to retreat. By the time the intervention started, Qaddafi had successfully pushed rebel forces all the way back to Benghazi, wiping out their fleeting territorial gains and threatening to destroy the movement.

During the second phase of the conflict, there was initially significant movement along the front as NATO's intervention halted Qaddafi's progress eastward, allowing rebels to advance as far west as Sirte. Rebel gains were again short-lived, as Qaddafi's forces pushed the rebels back toward Ajdabiya. By early April the front had stabilized along the road between Brega and Ajdabiya.

In the west, it remained stable at Misrata until mid-May, when rebels finally gained control of the city. Rebels were not able to advance beyond Misrata.

In the third phase of the conflict, beginning in mid-July, the situation on the ground gradually turned in favor of the rebels, culminating in the dramatic push to Tripoli in August. An offensive was coordinated across three fronts around Brega-Ajdabiya, Misrata, and the Nafusa Mountains. The residual pockets of resistance were suppressed by mid-October with the fall of Sirte and the killing of Qaddafi.

Assessing Competing Explanations

There are two competing schools of thought concerning the conditions under which the Afghan Model is effective, both stemming from a broad and longstanding debate about the role of airpower in modern warfare.⁹ The two schools are the balance of technology and the balance of skill. From these two schools we deduce observable implications, which can be evaluated against the empirical evidence of the Libyan conflict.

The balance of technology school claims that precision airpower has an overwhelming impact on the outcomes of war, while the skill levels of indigenous allies and adversaries play a negligible role.¹⁰ Technology can provide modern militaries with nearly perfect information about the location of enemy forces, as well as the capacity to destroy them from the air. The argument suggests the following observable implications. Airpower should destroy ground forces from great distances, or force them to disperse and thus render them incapable of maneuvering and massing at specific points to defeat an attacking force. This means engagements could be relatively short and limited to nominal mop-up operations, with “intense, prolonged combat on the ground [as] the exception rather than the rule.”¹¹ The balance of skill school claims that airpower is only effective under a restrictive set of conditions. Specifically, Biddle argues that the efficacy of precision airpower depends on the balance of skill between indigenous allies and government forces. If the adversary’s forces are poorly skilled, we should observe local allies taking and holding ground lost by adversaries decimated by superior airpower, without sustained close combat. If the adversary’s ground forces display a modicum of tactical proficiency (at least partial adoption of the modern system, in Biddle’s parlance), they will be considerably more difficult to defeat—a sufficient number of concealed and entrenched defenders will typically survive even massive amounts of precision firepower. Crucially, if local allies lack a skill level comparable to that of their opponents, the latter should prevail on the battlefield despite precision airpower. Conversely, if local allies are at least as skilled as their adversaries, the former should have the upper hand with the assistance of precision airpower.¹² Biddle’s close examination of the first few months of Operation Enduring Freedom in Afghanistan confirms his theory’s expectations. When the Taliban deployed unskilled fighters in the early stages of the Afghan campaign, they were promptly destroyed by precision airpower, rendering close ground combat irrelevant. Over time, as the Taliban deployed more effective fighters (especially al Qaeda members), precision airpower did

not eliminate the need for close combat. Ultimately, the United States and its local allies won individual engagements only when Northern Alliance forces were at least as skilled as their Taliban and al Qaeda counterparts.¹³

The two schools of thought have different implications for the applicability of the Afghan model to future contingencies. If the balance of technology school is correct, all but first-rate armies are potential targets for intervention. By contrast, if the balance of skill school is correct, the list of potential targets is limited by the requirement of a comparably skilled local opposition.

Evidence from Libya

This section assesses how closely the available evidence from Libya corresponds to the observable implications of each model. There is little support for the balance of technology model and evidence suggests important qualifications for the balance of skill model. Neither represents a perfect guide to understanding the Libyan case and, thus, to learning lessons for future contingencies. Instead, the analysis suggests the rebel ground forces' eventual success was made possible by NATO's gradual attrition of Qaddafi's forces from the air. Airpower also contributed to the rebel victory by providing breathing room that permitted rebel skill, armaments, and coordination with NATO to improve.

Evidence for the Balance of Technology Model

The available evidence does not provide strong support to the balance of technology argument. NATO airpower did not make close combat redundant.¹⁴ In fact, the months of the bombing campaign saw plenty of episodes of close and prolonged combat between rebels and government forces. Only the initial days of the intervention in eastern Libya provide evidence in line with the balance of technology argument: on the first day of bombing (19 March), allied planes struck Qaddafi's forces near Benghazi, stopping their offensive against the rebels' de facto capital. In the following week, airpower enabled the beleaguered rebels to push government forces 370 kilometers westward to the outskirts of Sirte, after taking over the government-held cities of Ajdabiya, Brega, and Ras Lanuf.¹⁵ The devastating effects of airpower on government ground forces are well documented in newspapers' accounts of operations in the vicinity of Ajdabiya: "Around town are the remains of over 20 tracked military vehicles—tanks, armored personnel carriers, and heavy artillery guns. Charred turrets 20 feet away from the tanks they were once attached to are evidence of precision strikes in recent days by British Tornados."¹⁶ The bombing destroyed much of the government armor and artillery that had been shelling the town for the best part of the week, enabling the rebels to acquire full control of the city by simply mopping up the remnants of Qaddafi's forces.¹⁷

Government forces reorganized and managed to retake much of the lost ground in the following days despite continuous NATO strikes.¹⁸ Government forces effectively employed cover and concealment to avoid providing easy targets to NATO aircraft. In particular, they reduced their reliance on large

formations of heavy armored vehicles and intensified their use of small units comprised of sport utility vehicles (SUVs) mounting light weapons, which resembled those employed by rebels. Armor, artillery, and rocket launchers were still used but were often concealed in populated areas and civilian buildings.¹⁹ Due to this tactical adaptation, significant numbers of Qaddafi's forces were able to survive NATO bombing and retained some mobility and ability to direct substantial amounts of firepower against rebel positions. For example, on 9 April, Qaddafi's forces were able to engage in a battle with rebel forces in Ajdabiya, notwithstanding NATO bombing, by advancing behind a barrage of rocket and artillery fire.²⁰ Similar patterns of sustained close combat characterized both the western and eastern fronts of the war in the ensuing months.

Evidence for the Balance of Skill Model

While the balance of skill model correctly predicts the pervasiveness of close combat, the outcome of the Libyan conflict is inconsistent with a critical prediction of the model, because less-skilled actors prevailed in the war with the support of a technologically superior ally. We find strong evidence of a major skill imbalance favoring Qaddafi's forces in the initial stages of the conflict—even though they were far from fully proficient in force employment. There is evidence that rebel coordination with NATO aircraft, organization, and tactical proficiency improved beginning in mid-May; in particular, rebels displayed better adoption of cover and concealment during the month-long offensive to retake Brega.²¹ This improvement can be attributed to training provided by the interveners, but it is not clear whether this change was sufficient to close the initial skill gap.²² In any case, this observation does not undermine the contention that the balance of skill model does not fully explain the Libyan case. If skill levels can improve over time, then preintervention skills are not definitive predictors of battlefield outcomes. Moreover, if NATO bombing had not prevented an imminent victory by Qaddafi's forces at Benghazi in late March, the increase in rebel skill would not have occurred.

In the initial stage of the conflict, the balance of skill between government and rebel ground forces favored the former. There is little evidence to indicate the rebels, on average, displayed even basic military skills. When rebels were confronted with superior firepower from Qaddafi's forces, rebel positions were often destroyed from significant distance or overrun. Massed in the open, the rebels were vulnerable to government firepower. For example, in Bin Jawwad in March, "rebels continued to flout standard military procedure by massing fighters in large groups."²³ Qaddafi's forces overran Bin Jawwad on their advance eastward to Benghazi, "[w]ith air raids and rocket fire from an unassailable distance . . . The rebels had no answer to an enemy that they rarely saw, and broke and ran under continuous barrages."²⁴ A rebel fighter is quoted as saying, "[rebels] need to understand that the enemy can see us, but they're hidden in the desert and in houses and we can't really see them."²⁵ The rebels' failure to employ cover and concealment permitted Qaddafi's forces to hit their

exposed positions from a distance with mortars and rockets.²⁶ As Qaddafi's forces pushed toward Benghazi, rebels were barely dug in to defend Brega, which was supposed to be the rebels' last line of defense: "Not a single heavy-gun emplacement is dug in along the 140-mile desert highway from the rebel fighters' new defensive line in Port Brega to Benghazi."²⁷ Similarly, "[w]hen a government rocket slammed into an unfinished mosque near the rebel-held port of Brega . . . , fighters responded not by digging trenches or attempting to camouflage anti-aircraft guns, but by chanting: 'God is greater than the bombs.'"²⁸ A similar pattern was repeated in Ajdabiya, where rebels "blasted away at [a high-flying government plane] with anti-aircraft guns, giving away their positions [D]espite a three-week-long opportunity for preparation, there was not a single sandbagged bunker, nor trench, nor earthen berm, nor line of barbed wire made ready to break Colonel Gaddafi's approach."²⁹ In all three towns—Bin Jawwad, Brega, and Ajdabiya—rebels were overrun by Qaddafi's advancing forces.

Throughout the NATO intervention, following an initial period of adjustment, Qaddafi's forces employed aspects of the modern system, retaining mobility and the ability to inflict casualties on the rebel ground forces. As the US Navy's Chief of Operations observed, by early April "Qaddafi's forces had broken into smaller and more nimble units that are not easily distinguishable from the rebels."³⁰ For example, in Brega, Qaddafi concealed his forces from NATO airstrikes by reconstituting them to resemble rebel fighters, creating "highly mobile units [with] weapons mounted on pickup trucks so as to be less vulnerable to the air strikes."³¹ Rebel fighters described a similar approach in June near Misrata, where Qaddafi's forces rode in "pickup trucks camouflaged to resemble those driven by rebels. They even had the letter 'N' painted in sliver on the roof to disguise themselves as friendly forces to NATO jets flying overhead."³² At the same time in Brega, the government continued to target rebel forces, sometimes from great distances, while remaining dug in and concealed from NATO airstrikes. A rebel fighter in Brega described how "NATO [aircraft] were covering us from above but Gaddafi forces fired rockets and mortars outside Brega,"³³ and rebel commanders pointed out that government "forces are dug in amid residential and commercial structures."³⁴ In mid-July, as rebels were breaking through Qaddafi's defenses at Brega, Qaddafi's military continued to display an ability to use concealment to shield themselves from NATO airpower, for example, by "set[ting] fire to ditches filled with oil to create black smoke to cover their movements from NATO aircraft."³⁵

Explaining Rebel Success

The cumulative attrition effects of months of NATO airstrikes enabled the ultimate success of rebel ground forces.³⁶ The length of the intervention also allowed for an increase in rebel skill and armaments as well as improved coordination between rebels and NATO, which likely contributed to the rebel victories on the ground.³⁷ NATO bombing did not result in the immediate and near-total destruction of enemy ground assets as predicted by the balance of

technology model, primarily due to government forces' rapid tactical adaptation. The bombing campaign had the important immediate effect of making it extremely dangerous for Qaddafi's forces to maneuver in the open or concentrate, reducing their ability to launch the large-scale offensives that had been so successful prior to NATO's intervention. Over time, airpower aided rebel advances by thinning the ranks of Qaddafi's frontline forces, as well as by preventing the replacement and resupply of government assets.³⁸

Throughout the months of the intervention, NATO airstrikes destroyed government trucks, armored vehicles, rocket launchers, artillery, and command and control assets across all major fronts. The scene described in one newspaper's account illustrates the cumulative effect of airpower: "airstrikes blew [Qaddafi's vehicles] to smithereens just south of Ajdabiya, leaving [government soldiers'] charred bodies and incinerated vehicles lying beside the carcasses of government tanks destroyed by the allies' aircraft two weeks earlier."³⁹ Between 31 March and 31 August NATO flew a total of 20,991 sorties, including 7,817 strike sorties.⁴⁰ One might profess that such targets were assets abandoned by Qaddafi's forces after their tactical adaptation in response to NATO intervention and, therefore, attrition did not facilitate the eventual rebel victory. This observation is unconvincing due to the fact that government forces continued to systematically use artillery and Grad rockets against the rebels. While the number of sorties per day was less than in Kosovo and the initial phase of Operation Enduring Freedom, NATO precision airstrikes destroyed a significant amount of Qaddafi's military assets. NATO reported hitting a total of 503 targets in Brega, 416 targets in Misrata, and 723 targets in Tripoli.⁴¹

The cumulative effect of the bombing of Qaddafi's forces in and around Brega, Misrata, and the Nafusa Mountains eventually enabled the rebel forces to advance on all fronts.⁴² This attrition argument combines important elements of both the balance of technology and balance of skill models. Consistent with the former, the destructive impact of precision airpower can affect battlefield outcomes even in the presence of a major skill gap. Consistent with the latter, even the moderate ability to use cover and concealment by opponents prevents airpower from having an immediate and overwhelming effect.⁴³ Airpower did not render ground combat irrelevant; in fact, the war was ultimately won through a rebel ground offensive, enabled by the gradual weakening of Qaddafi's forces through the use of airpower.⁴⁴

Conclusion

The cumulative attrition effect of precision airpower enabled a rebel victory on the ground. The protracted nature of the intervention also provided sufficient time for rebels to become more skilled and better armed, and to improve their coordination with NATO. The Libyan case implies that neither the balance of technology nor the balance of skill models provides a complete framework for analyzing the conditions under which an airpower-based intervention might succeed. The implication is not that skill does not matter or that technology is a more important determinant of battlefield success. Precision

airpower does not make close combat superfluous; in fact, it is effective only when employed in conjunction with ground forces. In cases of protracted conflict, the existence of an initial skill gap does not represent an insurmountable obstacle for interveners.

It is crucial for policymakers to understand the generalizability of the circumstances that led to success in Libya. A critical factor was the existence of political will on the part of NATO and its partners to sustain a campaign for a sufficiently long period. One should not underestimate the difficulty of maintaining a coalition—especially when the interveners' core security interests are not at stake. While NATO ultimately had the political will to see the Libyan intervention through, there were moments in which the cohesion of the coalition appeared at risk. The political repercussions of a prolonged stalemate threatened to undermine the campaign. In addition, the intervention strained the capabilities of alliance members, many of which encountered significant difficulties attempting to adequately resource operations. Without the US supply of precision-guided munitions, air-to-air refueling assets, and surveillance and intelligence capabilities, the United Kingdom and France would have been, in all likelihood, unable to continue operations.⁴⁵

The size and skill of the Libyan army and the logistical requirements of the intervention are also critical factors to consider when assessing the case. Given the attrition argument stated earlier, it is essential to consider the size of the opponent's ground forces. With sufficient time and airpower assets devoted to the mission, any force can, in principle, be attrited, but such assets are normally only available in limited numbers in real world contingencies. Qaddafi's 50,000-strong army represented an easier target for intervention than Iran and Syria's ground forces, for example, which are roughly seven and four times as large, respectively. The Libyan army was not an absolute outlier in the developing world at large, or even in the region (e.g., Yemen's ground forces number 60,000). Concerning skill, Qaddafi's pervasive fear of coups led to deeper politicization of the Libyan army than other regional militaries, which negatively impacted organizational training and skill. Nevertheless, as regional military expert Kenneth Pollack points out, Libya's overall military effectiveness for most of the post-World War II period was broadly comparable to that of other Arab states.⁴⁶ On the logistical front, the Libyan intervention occurred under favorable circumstances: the theater of operation is close to NATO's network of bases (for example, the Sigonella base in Sicily is only 500km from Tripoli), while the proximity of the major ground fronts to the Mediterranean Sea facilitated power projection from allied ships, as well as naval counterlogistics operations. Additionally, the coalition's campaign of attrition benefitted from the fact that Libyan cities are separated by vast expanses of desert, permitting NATO to impede Qaddafi's logistical operations.

While the conditions in Libya were, in many respects, conducive to a successful intervention, situations with broadly comparable characteristics could emerge in the future, which makes drawing the right lessons learned from Libya essential for policymakers. In this light, the analysis presented

warrants some caution related to any Libyan-style intervention in Syria. The sheer size of the Syrian ground forces would imply a longer attrition campaign than Libya, barring en masse defection by loyal Syrian forces that, thus far, has not occurred.⁴⁷ The campaign would also be impacted by Syria's ability to replace destroyed assets mainly due to Syria's more reliable allies. Additionally, Syria's stronger air defense would require longer and potentially costlier preparatory bombing.⁴⁸ Moreover, the Syrian rebels' limited territorial control implies that they lack the strategic depth that proved useful for training Libyan rebels in the Benghazi area. Finally, there is little available evidence regarding Syrian rebels' skill level. Reports suggest that their ranks include a higher percentage of defectors than was the case in Libya, which may imply a smaller initial skill differential.⁴⁹ It seems doubtful that this could compensate for the order-of-magnitude force differential between the government and the rebels.⁵⁰

The analysis presented should not be construed as making a normative claim regarding the desirability of intervention in any given case. This should depend on grand-strategic, political, and moral considerations beyond the scope of this article. Nevertheless, responsible decisionmakers cannot ignore considerations of military feasibility.

NOTES

1. C. J. Chivers and Eric Schmitt, "In Strikes on Libya by NATO, an Unspoken Civilian Toll," *The New York Times*, December 17, 2011. While NATO claimed a near absence of collateral damage during the campaign, subsequent reporting uncovered episodes of civilian casualties.

2. For example, see Michael Gordon, "'New' U.S. War: Commandos, Airstrikes, and Allies on the Ground," *The New York Times*, December 29, 2001; Michael Kelly, "The Air-Power Revolution," *Atlantic Monthly* 289, no. 4 (April 2002): 18-19; Thom Shanker, "Conduct of War Is Redefined by Success of Special Forces," *The New York Times*, January 21, 2002; James Webb, "A New Doctrine for New Wars," *The Wall Street Journal*, November 30, 2001; Fareed Zakaria, "Face the Facts: Bombing Works," *Newsweek*, December 3, 2001.

3. See, for example, J. David Goodman, "Rights Group Says Libya's Militias are 'Out of Control,'" *The New York Times*, February 16, 2012, <http://thelede.blogs.nytimes.com/2012/02/16/rights-group-says-libyas-militias-are-out-of-control/?ref=libya> (accessed April 5, 2012); "Libya: Western Militias Unite, Posing Challenge to Transitional Government," *The Associated Press*, February 13, 2012.

4. Stephen Biddle, "Afghanistan and the Future of Warfare: Implications for Army and Defense Policy," (November 2002), <http://www.au.af.mil/au/awc/awcgate/ssi/afghan.pdf> (accessed April 5, 2012). Stephen Biddle, "Allies, Airpower, and Modern Warfare: The Afghan Model in Afghanistan and Iraq," *International Security* 30, no. 3 (Winter 2005/06): 161-76.

5. Biddle, "Allies, Airpower, and Modern Warfare," 164.

6. Ibid.

7. Stephen Biddle, "The Libya dilemma: The limits of air power," *The Washington Post*, March 25, 2011, http://www.washingtonpost.com/opinions/the-libya-dilemma-the-limits-of-air-power/2011/03/25/AFfTVUYB_story.html (accessed April 5, 2012).

8. Biddle, "Allies, Airpower, and Modern Warfare," 164.

9. Important recent works on airpower include Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press, 1996); Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914-1945* (Princeton, NJ: Princeton University Press, 2002); Daryl Press, "The Myth of Air Power

in the Persian Gulf War and the Future of Warfare,” *International Security* 26, no. 2 (Fall 2001): 5-44; Daniel R. Lake, “The Limits of Coercive Airpower: NATO’s ‘Victory’ in Kosovo Revisited,” *International Security* 34, no. 1 (Summer 2009): 83-112.

10. Richard B. Andres, Craig Wills, and Thomas E. Griffith, “Winning with Allies: The Strategic Value of the Afghan Model,” *International Security* 30, no.3 (Winter 2005/06): 124-60. For an earlier claim about the revolutionary impact of precision airpower, see John A. Warden III, “Employing Air Power in the Twenty-First Century,” in *The Future of Air Power in the Aftermath of the Gulf War*, ed. Richard H. Schultz, Jr. and Robert L. Pfaltzgraff Jr., (Maxwell Air Force Base, Alabama: Air University Press, 1992), 57-83.

11. Andres, Wills, and Griffith, “Winning with Allies,” 138.

12. Biddle, “Allies, Airpower, and Modern Warfare,” 164.

13. Biddle, “Allies, Airpower, and Modern Warfare,” 167-73. Robert Pape is also skeptical about the independent effects of air power (“The True Worth of Air Power,” *Foreign Affairs* 83, no. 2 (March/April 2004): 116-30). He claims precision bombing can be effective only in conjunction with significant ground forces: through a “hammer and anvil” dynamic, airpower facilitates the defeat of enemy forces by weakening their front lines and preventing the forward the movement of reinforcements. Unlike Biddle, Pape does not explicitly identify balance of skill as a key factor.

14. The intervention in Libya was characterized by lower levels of SOF involvement in battle than in Afghanistan. This might lead some proponents of the balance of technology to claim Libya was not a proper implementation of the Afghan model and, therefore, close combat would have been much less pervasive with a greater role for SOFs. The evidence from Afghanistan suggests this counterargument is not persuasive because, even with a greater SOF presence, airpower did not obviate the need for ground combat (Biddle, “Allies, Airpower, and Modern Warfare,”). In any case, it is important for policymakers to consider the efficacy of a less robust implementation of the Afghan model, given that for political reasons it may not always be possible to deploy substantial number of SOFs.

15. Notice that NATO attacks on government forces besieging rebel-held Misrata in the west did not enable the insurgents to advance from their positions. Kareem Fahim and David D. Kirkpatrick, “Rebel Advance Halted Outside Qaddafi Hometown,” *The New York Times*, March 28, 2011; Charles Levinson, “Libya Rebels Tap Army Defectors: Commanders Guide and Train Ranks, but Leadership Squabble Risks Undermining Civilian Control,” *The Wall Street Journal*, April 3, 2011.

16. Dan Murphy, “Libyan rebels celebrate victory in Ajdabiya,” *The Christian Science Monitor*, March 26, 2011.

17. M.J.S., “The rebels advance,” *The Economist*, March 27, 2011.

18. Nathan Hodge, Stephen Fidler, and Charles Levinson, “Gadhafi Push Tests Allies—Rebel Retreat From Oil Town Fuels Debate on Wider Military Aid to Opposition,” *The Wall Street Journal*, March 31, 2011.

19. The change in government tactics was pointed out by several intelligence and military sources. See for example, Scott Peterson, “Libyan rebels offer cease-fire. Does Qaddafi have the upper hand?” *The Christian Science Monitor*, April 1, 2011; Steven Erlanger, “Changing Libyan Tactics Pose Problems for NATO,” *The New York Times*, April 7, 2011.

20. C. J. Chivers, “As Qaddafi’s Troops Move In, a Seesaw Battle for a Rebel City,” *The New York Times*, April 9, 2011.

21. Patrick J. McDonnell, “Libyan rebels’ uneasy lull; Rumors swirl over when fighting with Kadafi troops will resume,” *Los Angeles Times*, 10 May 2011; “War in Libya: Closing in on Tripoli,” *The Economist*, July 16, 2011; Andrew Beatty, “Libya rebels report heavy street fighting in Brega,” *The Daily News Egypt*, July 18, 2011.

22. Qatar provided training to rebels in the western theater, and there is evidence British and French SOF assisted rebels with the planning and coordination of the rebel breakthrough in Misrata and the advance to Sirte in August. Charles Levinson, “Rebel Chief Says Gadhafi, Family Can Stay in Libya,” *The Wall Street Journal*, July 25, 2011; “Front: Libya: UK special forces aid assault on Sirte: Troops coordinating air strikes as rebels prepare for attack on last coastal town in government hands,” *The Guardian*, August 26, 2011; Ian Black, “Qatar admits to sending hundreds of troops to

support Libyan rebels,” *The Guardian*, October 26, 2011. Qatar and France also provided military equipment and weapons to the rebels. Ben Barry, “Libya’s Lessons,” *Survival* 53, no. 5 (2011): 5-14.

23. David Zucchino, “Mistakes costing Libyan rebels: Untrained fighters miss opportunities and waste ammunition,” *Los Angeles Times*, March 8, 2011.

24. Dan Murphy, “How French jets saved Libya’s rebels at the last minute,” *Christian Science Monitor*, March 20, 2011.

25. Dan Murphy, “Qaddafi bombs oil facility in first blow to Libya’s oil infrastructure,” *The Christian Science Monitor*, March 9, 2011.

26. Dan Murphy, “Qaddafi rout of Libya rebels pulls morale to a new low,” *The Christian Science Monitor*, March 13, 2011.

27. David Zucchino, “Libyan rebels’ ragtag army left in disarray,” *Los Angeles Times*, March 13, 2011.

28. Jaber Hala, “West has sold us out scream ragtag rebels: Last week, a jubilant opposition fought off government forces at their country’s biggest oil refinery. Yesterday they were collapsing in shambolic defeat,” *London Sunday Times*, March 13, 2011.

29. Anthony Lloyd, “We were certain that Gaddafi’s forces were miles away. How wrong we were: Amid shellfire and snipers’ bullets, Anthony Loyd witnesses the sudden advance on Ajdabiya. Gaddafi advances on town,” *The London Times*, March 16, 2011.

30. Scott Peterson, “Libyan rebels offer cease-fire. Does Qaddafi have the upper hand?” *The Christian Science Monitor*, April 1, 2011.

31. Chris McGreal, “Libyan rebels deny crisis after assault on Brega fails,” *The Guardian*, March 21, 2011.

32. Sam Dagher and Joe Parkinson, “Clashes Break Near Misrata During Lull in NATO Strikes,” *The Wall Street Journal*, June 8, 2011.

33. “Libyan TV broadcasts footage of Qaddafi as his forces fight rebels at Brega,” *Alarabiya*, June 12, 2011.

34. Patrick J. McDonnell, “24 Libya rebels killed in fierce fighting in Port Brega,” *Los Angeles Times*, June 14, 2011.

35. David Zucchino, “Battle escalates for key Libyan oil center; Rebels seeking to advance on Port Brega meet deadly fire from government forces,” *Los Angeles Times*, July 20, 2011.

36. Several observers also explain the war outcome in terms of attrition through airpower. See, for example, Jeffrey White, “Toward the Endgame in Libya,” *PolicyWatch* no. 1817, The Washington Institute for Near East Policy, <http://www.washingtoninstitute.org/templateC05.php?CID=3370>; “‘Stalemate’ in Libya, NATO says; Anonymous, Pentagon chairman optimistic; ‘In the long run, I think it’s a strategy that will work,’ retiring general says,” *The Gazette*, July 26, 2011.

37. An alternative explanation focused on numerical preponderance does not hold in this case. The available evidence does not suggest that the rebels had a numerical advantage in the major fronts; for example, see data on Misrata reported by Anthony Bell and David Witter, “The Libyan Revolution: Stalemate & Siege, Part 3,” *Institute for the Study of War* (2011), 21-2.

38. For evidence of NATO counter-logistics operations, see, for example, “Qaddafi’s artillery fails to stop rebels’ advance on Misrata,” *The National*, June 14, 2011; James Blitz, Michael Peel, and Anna Fifield, “Libya: An uncertain mission,” *Financial Times*, June 22, 2011; Lutfi Abu-Aun, “Libyan rebels say they have encircled Brega,” *The Daily Star*, July 20, 2011.

39. Martin Fletcher, “Anti-Gaddafi forces are stuck in the stony desert: The Nato airstrikes have invigorated the rebels but have not swung the balance their way,” *The London Times*, April 14, 2011.

40. Data was collected from NATO’s daily Operational Media Updates, NATO and Libya, 25 October 2011, http://www.nato.int/cps/en/natolive/news_71994.htm. Each daily update contains information on the number of sorties, strike sorties, and “key hits” of particular military assets and geographical location. Note that this information does not cover the first few days of the bombing campaign, during which operations were not under NATO command.

41. In the first Gulf War and in Kosovo, early estimates of the effects of airpower on enemy ground forces were highly inflated, which suggests that these figures should be considered as rough and probably biased upwards.

42. For the Nafusa front, see Derek Henry Flood, “Special Commentary from Inside Western Libya—The Nalut Offensive: A View from the Battlefield,” The Jamestown Foundation, August 3, 2001, http://www.jamestown.org/single/?no_cache=1&tx_ttnews%5Btt_news%5D=38275. For Brega, see “Medical official: 10 Libyan rebels killed in push for eastern oil town,” *Associated Press*, July 16, 2011; for Misrata, see Lin Noueihed, “NATO strikes in Misrata but Shelling Resumes,” *Reuters*, April 27, 2011.

43. It is important to note that our attrition argument does not imply an expectation that rebel advances would occur only after the complete destruction of Qaddafi’s defenses. Gradual attrition of ground assets may affect the calculations of surviving units, which may project the ongoing trend into the future and conclude that they would be better off abandoning their position now rather than waiting to be eventually hit and overrun.

44. Our argument is consistent with Biddle’s analysis of Afghanistan. He correctly points out that the US and its local allies won individual battles only when Northern Alliance forces were at least as skilled as their Taliban or al Qaeda counterparts—in the two instances in which Northern Alliance fighters were overmatched, they were unable to take enemy positions (Biddle, “Allies, Airpower, and Modern Warfare,” 171). Those engagements lasted only a few days, which prevented the attrition mechanism from playing a decisive role.

45. Barry, “Libya’s Lessons,” 9-11.

46. Kenneth M. Pollack, *Arabs at War: Military Effectiveness, 1948-1991* (Lincoln: University of Nebraska Press, 2002), 422.

47. Neil MacFarquhar, “Syria Military Routs Rebels In Stronghold,” *The New York Times*, March 2, 2012.

48. This point has been stressed by the US Chairman of the Joint Chiefs of Staff; see Elisabeth Bumiller, “Obama asks for military options against Syria: Pentagon leaders assert diplomacy and sanctions remain the best solution,” *International Herald Tribune*, March 8, 2012. For a comparison of the two countries’ air defense assets, see The International Institute for Strategic Studies, *The Military Balance 2011*, 320-1 (for Libya) and *The Military Balance 2012*, 349-50 (for Syria).

49. See Greg Miller and Karen DeYoung, “Assad ‘very much in charge’ in Syria,” *The Washington Post*, March 10, 2012; Nour Malas, “World News: Syrian Brass Defect, Buoying Rebels,” *The Wall Street Journal*, March 10, 2012; Julian Borger, “More reports of Syrian officers defecting,” *The Guardian*, March 10, 2012.

50. Estimates of rebel size vary widely, with 20,000 as an oft-mentioned figure. See Mohammed Najib, “Assad’s nemesis: analyzing the FSA,” *Jane’s Defense Weekly*, December 14, 2011. *The Military Balance* reports a 220,000-strong army in Syria (*The Military Balance 2012*, 349).