Online Appendices A, B, and C For "What Determines Military Victory? Testing the Modern System"

APPENDIX A

CODING RULES FOR MODERN SYSTEM ADOPTION AND OTHER VARIABLES, CASES INCLUDED, DESCRIPTIVE STATISTICS

I. Modern System and Other Variable Definitions and Coding Rules

Two challenges, in particular, made coding elements of the modern system difficult. First, Biddle's description of what constitutes the modern system is fairly vague in its details. If one thinks solely in terms of 'cover and concealment,' 'dispersion,' 'small-unit independent maneuver,' and 'tactical combined arms,' it is possible to identify such elements in fighting forces several centuries into the past. We have attempted to remedy this problem with specific coding rules that define exactly what constitutes the modern system as we have conceived of it here. Additionally, we checked for accuracy and consistency in coding through several means. Initial provisional codings were assigned and then checked by both authors before final acceptance. More difficult coding decisions were subject to an additional check by an independent research assistant. Finally, internal consistency in decisions was checked by recoding several operations six months after their original coding; in all cases the values assigned in the later assessment were identical to those assigned in the original. This procedure allowed us to construct a closely-defined, fully replicable dataset that includes coded values for the components of the modern system as they were specified theoretically by Biddle. The second, and more important, challenge in coding modern system adoption arises from the fact that many of the particular data about events on the battlefield needed for the construction of this dataset are not readily measurable or necessarily tracked by militaries over the course of a war. As such, we were forced to rely on the published recollections of participants and accounts written by historians. With personal accounts of fighting, we attempted both to account for the potential of narrator license and guard against the generalization of one soldier's experience to his unit or the army as a whole. Like narrators of personal accounts, historians approach their subject with a particular perspective that affects the way in which they recount events. In many cases, historians do not address the tactical and operational conduct of war. When they do, it is often their personal preference that dictates whether they use terms like "massed frontal assaults" or "well-concealed gun nest" (accurately or otherwise) that can affect coding decisions. To help guard against biases arising from personal recollections and historical works, we found multiple accounts of the fighting whenever possible. If we could not find multiple sources and/or the reliability of the work in question was not readily apparent, entries were left blank. Additionally, as described in the text of the article and elaborated in the discussion of the variables *mstac*, *msop*, and *mscat2* below, these variables were used solely as the source of more general assessments of the implementation of the modern system.[1] Below is the codebook for our modern system, strategy, and terrain variables.

[1] On the perspective of individual soldiers on the battlefield, see S.L.A. Marshall, *Men against Fire: The Problem of Battle Command* (Norman: University of Oklahoma Press, 2000 [1947]). On the problems inherent to historical accounts, see David H. Fischer, *Historian's Fallacies: Toward Logic of Historical Thought* (New York: Harper Perennial, 1970).

Cover and Concealment (covcon):

Aggressors are coded 1 if there is evidence that they deliberately used cover and concealment to protect against defensive fire in the assault on defensive positions. If attacks are described as “massed frontal” or if there is evidence of the use of cover and concealment only after the aggressors come under fire, they are coded 0.

Defenders are coded 1 if they establish defenses in a way to take advantage of extant terrain to conceal their own positions and deprive assaulting aggressors the benefit of cover. Where defenses are not established in such a manner, defenders are coded 0.

Dispersion (disper):

Aggressors and defenders are coded 2 if they are initially deployed in a manner to deny the adversary the capacity to destroy friendly formations through mass fires and maintain such formations throughout the campaign/battle. They are coded 1 if they are initially deployed in such a manner but tend to bunch up under fire. They are coded 0 if no attempt has been made to disperse formations.

Small-unit Independent Maneuver (suim):

Aggressors and defenders are coded 1 if there is evidence of company or platoon commanders being authorized to exercise their own initiative in the planning and conduct of missions or if tactical and operational plans depend on the accomplishment of key missions by such formations. They are coded 0 if company and platoon commanders are not evidenced to have been invested with such authority.

Tactical Combined Arms (taccomarm):

Aggressors and defenders are coded 1 if there is evidence of the combined use of arms at the battalion level or below, 0 if not or if observers and historians noted that any attempt was carried off exceptionally poorly.

Frontage (frontage):

This variable is coded only for aggressors and denotes the width of the front along which the attack is conducted in kilometers.

Force-to-Force Ratio (ffr):

This variable is coded only for aggressors and denotes the ratio of attackers to defenders present on the battlefield during the operation/battle.

Operational Depth of the Defender (opdepthkm):

> This variable is coded only for the defender and denotes the depth of the coherent, connected defenses established by the defender prior to the assault measured in kilometers. This is not the depth of multiple defensive lines spanning into the rear that are not connected or intended to provide a continuous 'defense in depth.'

Operational Reserves of the Defender (defres):

> This variable is coded only for the defender and denotes the percentage of the operational-level forces available for combat in the operation/battle that are held in reserve for deployment at the point of an aggressor's breach.

Modern System Implementation at the Tactical Level (mstac):

> Aggressors and defenders are coded in this variable in accord with how well they have implemented the modern system at the tactical level of war (specifically, the use of cover and concealment, dispersion, suppressive fire, small-unit independent maneuver, and tactical combined arms). Using Biddle's definition of the modern system at the tactical level and his assessments of Britain's and Germany's forces in Operations Michael and Goodwood and the United States' and Iraq's armies in Operation Desert Storm as benchmarks, belligerents are coded either as 2 (thorough implementation), 1 (moderate implementation), or 0 (failure to implement or minimal implementation).

Modern System Implementation at the Operational Level (msop):

> Aggressors and defenders are coded in this variable in accord with how well they have implemented the Modern System at the operational level of war (specifically the width of frontage and differential concentration for aggressors and defensive depth and operational reserves for defenders). Using Biddle's definition of the modern system at the operational level and his assessments of Britain's and Germany's forces in Operations Michael and Goodwood and the United States' and Iraq's armies in Operation Desert Storm as benchmarks, belligerents are coded either as 2 (thorough implementation), 1 (moderate implementation), or 0 (failure to implement or minimal implementation).

Role in Campaign/Battle (aggress):

> This variable is coded for aggressors and defenders and is coded 1 if the belligerent is the aggressor in the campaign/battle. It is coded 0 if the belligerent is the defender.

Outcome of the Campaign/Battle (win):

> This variable is coded for both aggressors and defenders and is coded 1 if the belligerent achieves its military goals in the engagement or 0 if it does not. Our codings are most often derived from Clodfelter.[2] Where his encyclopedia is silent, we rely on the

[2] Michael Clodfelter, *Warfare and Armed Conflicts*, 3rd ed. (Jefferson, NC: McFarland & Company, 2007).

assessments of scholars working on the military history of the war in question. In cases where the decisive engagement is considered a draw, operating from the view that neither achieved its military objectives, both sides are coded as having lost the battle.

Modern System Composite Index (mscat2):

This variable is categorical and is coded on the basis of belligerent scores in mstac and msop. Where mstac and msop are coded as 2 or either mstac or msop is coded as 2 and the other is coded as 1, mscat2 is coded 3. If both mstac and msop are coded as 1 or one of the two variables is coded as 2 while the other is coded as 0, mscat2 is coded as 2. If either mstac or msop is coded as 1 while the other is coded as 0, mscat2 is coded as 1. If both mstac and msop are coded 0, mscat2 is coded 0.

Strategy (strat):

Following Stam, as well as Reiter and Stam, this variable is coded on the basis of the combination of the strategies employed by the attacker and defender in a given engagement. This variable duplicates their variable but extends the values through 2003. To avoid multicollinearity issues, we reduce the variable down to five combinations, ranked from least successful to most successful. Each value of the variable contains one possibility for an attacker (the first option) and one possibility for a defender (the second option). For more on the specific coding scheme, see Stam[3] and Reiter and Stam.[4]

The variable is coded as follows:

(1) OADP/DAOM: offensive attrition, defensive punishment/defensive attrition, offensive maneuver
(2) OADM/DAOP: offensive attrition, defensive maneuver/defensive attrition, offensive punishment
(3) OADA/DAOA: offensive attrition, defensive attrition/defensive attrition, offensive attrition
(4) OPDA/DMOA: offensive punishment, defensive attrition/defensive maneuver, offensive attrition
(5) OMDA/DPOA: offensive maneuver, defensive attrition/defensive punishment, offensive attrition

Terrain (terrain):

The *Terrain* variable is also drawn directly from Stam, Reiter and Stam, and Bennett and Stam and updated through 2003.[5] It is based on the New York Times Atlas. The *Terrain*

[3] Allan C. Stam, *Win, Lose, or Draw: Domestic Politics and the Crucible of War* (Ann Arbor: University of Michigan Press, 1996), 51-58.
[4] Dan Reiter and Allan C. Stam, *Democracies at War* (Princeton: Princeton University Press, 2002), 41-43.
[5] Stam, *Win, Lose, or Draw*; Reiter and Stam, *Democracies at War*; D. Scott Bennett and Allan C. Stam, "The Duration of Interstate Wars, 1816-1985," *American Political Science Review* Vol. 90, no. 2 (June 1996): 239-257.

variable describes the topography in the location where the decisive engagement occurs. The variable varies from a high of 1.2, signifying open, rolling terrain, and .3, which signifies terrain that it is nearly impossible to move through.

II. Cases Included in the Dataset

Definition:

Our unit of analysis – the operation – highlights actions fought at or about the operational level of war. It is difficult to define the activities conducted at the operational level of war precisely, however. Biddle defines an operation as: "a series of interconnected battles resulting from a prior single plan."[6] Allan Millett and Williamson Murray offer a slightly more expansive definition, suggesting that operational military activity "involves the analysis, planning, preparation, and conduct of the various facets of a campaign."[7] We take a view that is both slightly more and slightly less restricted than that offered by these scholars and suggest that an operation is a major action (which may involve a single large battle or series of smaller battles) that is undertaken by the belligerent(s) for the purposes of achieving strategic ends in the larger conflict.

Selection:

Just as conflicts are not uniform in size, intensity, or lethality, operations are not uniform across (and sometimes within) wars. Accordingly, the operations that we chose are not uniform in size, intensity, or lethality. They are, however, among the largest actions fought during their respective wars.

In choosing which of the operations within each war was "decisive," we labored to rely as often as we could on the expert opinion of military historians. Where descriptions in Clodfelter's *Warfare and Armed Conflicts* noted one engagement as decisive in shaping the outcome of the larger conflict, we selected that fight.[8] When such a designation was absent from Clodfelter, we searched for a similar designation from scholars working on the military history of the conflict in question. Absent some designation from such sources, we selected the major action in which the eventual victor of the war first established the successful momentum that carried that combatant through to the end of the war. In instances where the war in question resulted in a draw and scholars fail to note a specific engagement that established the fact that the conflict would end in a tie, we selected an important action that established (at least a portion of) the final line of demarcation.

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[6] Stephen D. Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004), 6.
[7] Allan Reed Millett and Williamson Murray, eds., *Military Effectiveness*, vol. 1 (Boston: Allen & Unwin, 1988), 12.
[8] Micheal Clodfelter, *Warfare and Armed Conflicts: A Statistical Reference of Casualty and Other Figures, 1494-2007*, 3rd ed. (Jefferson, NC: McFarland & Company, Inc., 2008).

Cases:

War	Engagement
World War I (Eastern Front)	Kerensky Offensive
World War I (Western Front)	Second Marne Counter Offensive
Russo-Polish	Polish Counterattack at Warsaw
Greco-Turkish	Sakarya
Franco-Turkish	Marash
Chaco	Canada El Carmen
Italo-Ethiopian	Ogaden
Changkufeng	Changkufeng Hill
Nomohan	Soviet Counteroffensive
Russo-Finnish	Summa
World War II (Germany/USSR)	Soviet Winter Counteroffensive from Moscow
World War II (Germany/Netherlands)	Battle of Netherlands
World War II (US, UK/Germany, Italy)	Operation Diadem
World War II (US, UK/Germany)	Operation Cobra
World War II (Germany/France)	Battle for France
World War II (Germany/Poland)	September Campaign
World War II (Germany/Denmark)	April 9 Landing
World War II (Germany/Greece)	Metaxas Line
World War II (Germany/Norway)	Trondheim
World War II (Germany/Yugoslavia)	April Offensive
World War II (Germany/Belgium)	Even-Emael
World War II (Italy/Greece)	Greek Counteroffensive
World War II (US/Japan)	Guadalcanal, Henderson Field
1st Kashmir	Naushera
Palestine (Israel/Syria, Lebanon)	Operation Hiram
Palestine (Israel/Egypt, UAR)	Operation Horev
Palestine (Israel/Jordan, Iraq)	Jerusalem Corridor
Korean (ROK/PRK)	Invasion over 38th Parallel
Korean (US, ROK/PRK)	Inchon-Seoul Campaign
Korean (US, ROK/China, PRK)	Punchbowl Battles
Offshore Islands War	PLN/PLA Landings

Sinai (Israel/Egypt)	Sinai
Russo-Hungarian	Budapest
Ifni	Spanish-French Offensive
Sino-Indian	2nd NEFA
Vietnamese (US/Vietnam)	Tet Offensive
2nd Kashmir	Sialkot
Vietnamese (S. Vietnam/N. Vietnam)	Xuan Loc
Six-Day (Israel/Syria)	Northern Golan
Six-Day (Israel/Jordan)	Samaria
Six-Day (Israel/Egypt)	Sinai
Soccer	Neuva Ocotepeque
Communist Coalition	Late March Offensives
Bangladesh	Operation Windfall
Yom Kippur (Israel/Egypt)	Initial Egyptian Offensive
Yom Kippur (Israel/Syria)	Southern Golan
Vietnamese-Cambodian Border	Advance on Phnom Phen
Sino-Vietnamese	Lang Son Campaign
Falklands	East Falkland Island
Lebanon	Operation Peace for Galilee
Aouzou Strip	Aouzou
Iraqi-Kuwaiti	Iraqi Offensive
Gulf War	Operation Desert Storm
Azeri-Armenian	Azeri Offensive
Kargil	Tooling
Afghanistan	Operation Anaconda
Iraq	Operation Iraqi Freedom

III. Descriptive Statistics and Correlation Matrix

There are 274 total war participants in all interstate wars from 1917-2003. Due to multiple counts of some participants in some wars, there are a total of 286 potential observations. For variables designating force employment, we lack full coverage of the universe of cases due to a few reasons already briefly described in the paper. First, even though a state may have been a

participant in a given war, its forces may not have participated in the decisive operation that we code in our data. Second, given the challenges of coding force employment described above, we were not able to ascertain reliable codings for each of those states that did participate in the decisive operation for all variables. Finally, some wars did not have decisive land battles and, therefore, the force employment decisions of the participants were not relevant for testing Biddle's claims about the modern system. For other variables that we used as controls, limitations were imposed externally by the relative (in)completeness of the datasets employed. For example, the education level data in the Banks dataset covered only 215 of 286 potential participants even after we imputed values by extending the data to cover a four year period if the interim data was missing. The variables coded from the Polity and COW datasets cover the most observations, with regime type and material capabilities codings covering 281 and 286 observations, respectively. See Table A.1 for more information about the number of observations covered by each variable as well as other descriptive statistics. See Table A.2 for a correlation matrix describing the relationship between the variables we employ.

Table A.1: Descriptive Statistics

Variable	Code	Minimum Value	Maximum Value	Mean	Standard Deviation	Observations
Cover and Concealment	covcon	0	1	0.385	0.488	130
Dispersion	disper	0	2	0.769	0.721	130
Small-Unit Independent Maneuver	suim	0	1	0.435	0.513	131
Tactical Combined Arms	taccomarm	0	1	0.662	0.475	136
Width of Front (km)	frontage	2	1000	98.321	160.006	53
Force-to-Force Ratio	ffr	0.17	10	2.053	1.632	63
Defense in Depth (km)	opdepthkm	0	48	6.367	8.615	51
Ratio of Operational Reserves	defres	0	0.7	0.231	0.166	48
Modern System Implementation at the Tactical Level	mstac	0	2	0.746	0.771	130
Modern System Implementation at the Operational Level	msop	0	2	0.770	0.781	126

Overall Modern System Implementation	sideamscat2	0	3	1.456	1.235	125
Battle Outcome	win	0	1	0.506	0.501	164
Regime Type	polity21	1	21	11.160	7.714	281
Regime Type Squared	polity21squared	1	441	183.843	184.169	281
Material Capabilities	cinc	0.001	0.2844	0.0366	0.0612	286
Terrain	terrain	0.3	1.05	0.717	0.204	242
Troops Employed in the Engagement	troopsengaged2	100	2,300,000	132,722	276,233	158
Balance of Forces Engaged	sideAbof	0.002	0.992	0.507	0.317	265
Strategy	strat	1	5	2.946	0.894	258
Education Levels	school06copy	42	3,092	1,480.797	590.322	215
GDP Per Capita	loggdpcopy	4.484	10.239	7.992	1.151	241
Civil-Military Relations	fiveyearcoupscopy	0	4	0.234	0.613	256

Table A.2: Correlation Matrix For Key Variables in Table 2 In Paper

	Modern System Adoption Level	Polity Score	Polity Squared	Material Capabilities	Strategy (Maneuver/ Attrition/ Punishment)	Terrain	Troops Engaged	Opponent Troops Engaged	Human Capital	Logged GDP Per Capital	Civil-Military Relations
Modern System Adoption Level	1										
Polity Score	0.1152	1									
Polity Squared	0.1814	0.9879	1								
Material Capabilities	0.4759	-0.0733	-0.0149	1							
Strategy (Maneuver/Attrition/ Punishment)	0.524	0.0993	0.1205	0.3037	1						
Terrain	0.0361	0.0984	0.1149	-0.2502	0.0416	1					
Troops Engaged	0.1244	-0.1791	-0.144	0.2343	0.0251	-0.018	1				
Opponent Troops Engaged	0.1141	-0.0454	-0.0144	0.1687	0.0287	0.0372	0.8437	1			
Human Capital	0.1144	0.0862	0.1162	0.1311	-0.0743	-0.0361	-0.0416	-0.0426	1		
Logged GDP Per Capital	0.5125	0.3582	0.4275	0.3537	0.3421	0.1529	0.0494	0.1487	0.3767	1	
Civil-Military Relations	-0.1192	-0.184	-0.2151	-0.2431	-0.2417	0.0803	-0.1023	-0.1229	-0.2261	-0.2267	1

APPENDIX B

FREQUENCY OF MODERN SYSTEM ADOPTION AND EXTENSIONS ON REGRESSION RESULTS

I. Frequency of Modern System Adoption

Testing the frequency with which the modern system is employed on the battlefield is an important step in assessing the potential utility of Biddle's claims. If, as Biddle argues, militaries frequently employ the modern system, subsequent assessments of the link between force employment and military victory are likely to tell us more about the sources of modern military effectiveness than if the it is only infrequently employed.[9] There are reasons to think that adoption of the modern system may be quite difficult even if it is the preferred system for achieving victory. First, given challenges like popular resistance to defenses in depth or high-quality military training, extension of decision-making authority to low-ranking officers, and resolution of civil-military tension that must be navigated in adopting the modern system, it might be very difficult for many states to employ.[10] Second, even the post-World War II United States military, a prototypical adopter of the modern system in Biddle's analysis, has experimented with military systems based on different force employment principles. For example, the Pentomic Division introduced by the United States Army during the early Cold War responded to the challenges of the nuclear age by promoting static defenses and minimizing the possibility of friendly and enemy offensive advances.[11] Twenty years later, the United States developed an operational doctrine referred to as Active Defense that similarly emphasized reliance on strong, well-established defenses and minimal, local counterattacks.[12] If these kinds of alternative tactical and operational approaches have frequently been employed in place of the modern system since 1917, the modern system may not be the orthodox system of warfare.

Appendix Table B.1 displays a simple ratio of the number of war participants that have used the modern system since 1917. About 68% of all war participants have employed some form of the modern system (minimal, moderate, or high) at either the tactical or operational level since World War I. Considering the tactical and operational levels separately, we found that 55% of war participants have employed some form of the modern system at both the tactical and operational levels of war.[13] Table B.2 breaks down the frequency of implementation in more detail, highlighting observed variation in the overall level of adoption as well as that at the tactical and operational levels.

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[9] Stephen D. Biddle, "Strategy in War," *PS: Political Science & Politics* 40, no. 3 (July 2007): 463.
[10] Biddle, *Military Power*, 49-50; Biddle, "Strategy in War," 463.
[11] Andrew Bacevich, *The Pentomic Era: The US Army between Korea and Vietnam* (Washington, DC: National Defense University Press, 1986).
[12] John L. Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, VA: U.S. Army Training and Doctrine Command Historical Office, 1984).
[13] As referenced in the paper and above, these findings, however, do not include a number of conflicts in Africa, Latin America, Southeast Asia, the Middle East and the Caucuses due to our present inability to collect reliable data on force employment in these wars.

The results suggest that while Biddle's specified form of force employment is a relatively common mode of fighting, it is not the overwhelming preference of belligerents in conventional wars in the modern era. There are a few possible explanations for this adoption pattern. First, it may be that more belligerents have not adopted the modern system because they perceive that it is not as successful as Biddle argues; while such perceptions would be contrary to the much of the evidence presented in the text of this article, human prejudices and mistaken understandings of battlefield force employment may cause states to be reluctant in adopting it tenets. Second, it may be that only about half of the war participants since 1917 have employed the modern system at the tactical or operational level because it is difficult to adopt and implement successfully. Third, states concerned with maximizing things other than combat effectiveness, perhaps because they worry about the impact of an effective military on internal regime stability, might be more hesitant to adopt the modern system. Further research on the question of the frequency of adoption, especially that which extends the research we present here, is warranted.

Table B.1: Frequency of Modern System Implementation Since 1917

Frequency of Modern System Implementation since 1917	
	Observed Implementation
Any Modern System Usage	68% *n* = 125
Any Tactical Usage	54.62% *n* = 130
Any Operational Usage	55.55% *n* = 126

Table B.2: Breakdown of Modern System Implementation Since 1917

Breakdown of Modern System Implementation since 1917		
Operational Level Modern System Implementation	Frequency	Percentage of Total
No Implementation	56	44.44%
Partial Implementation	43	34.13%
Thorough Implementation	27	21.43%
Total	126	100
Tactical Level Modern System Implementation	Frequency	Percentage of Total
No Implementation	59	45.38%
Partial Implementation	45	34.62%
Thorough Implementation	26	20%

Total	130	100
Overall Modern System Implementation	Frequency	Percentage of Total
No Implementation	40	32%
Limited Implementation	27	21.6%
Moderate Implementation	19	15.2%
High Implementation	39	31.2%
Total	125	100

II. Extensions of Regression Models

In Table 2, Model 5, we drop the GDP per capita variable. Including it reduces our degrees of freedom too severely to allow the model to generate standard errors and p values. As a robustness test to check that this exclusion does not alter our results, we also excluded the relevant variables derived from Banks, human capital and comparative coups and re-ran Model 5. As Table B.3 below shows, excluding those variables and re-running Model 5 does not change the results.

Table B.3: Comparative Modern System Adoption and Victory Excluding Both GDP and Banks Variables

Variable	B/SE
Comparative Modern System Adoption Level	0.970***
	(0.255)
Polity Score	-0.312*
	(0.185)
Polity Squared	0.0139*
	(0.00776)
Polity Side B Score	0.258*
	(0.140)
Polity Side B Squared	-0.0146**
	(0.00592)
Comparative Material Capabilities	2.569***
	(0.648)
Terrain	1.176
	(0.882)
Strategy (Maneuver/Attrition/Punishment)	0.0391
	(0.191)
Comparative Troops Engaged	-0.185
	(0.919)

Constant	-2.485**
	(1.246)
Observations	94
Degrees of Freedom	9.000
Wald Chi2	122.803
log pseudolikelihood	-24.427
pseudo R2	0.625
Clusters	37.000

Another potential concern with the results in Table 2 is that they may not warrant asking the question we address in the second half of the paper – whether there is a chance that adoption of the modern system is the transmission mechanism whereby regime type and material capabilities are converted into actual battlefield power rather than an independent driver of military effectiveness. Such a claim would highlight that the additive nature of the predicted probabilities in Table 2 suggest the modern system has an independent impact on the probability of victory. While we agree that this interpretation is plausible and seek only to raise the possibility that the modern system *may* be a transmission mechanism based on the results in Table 4, we can partially test for this possibility within the confines of Table 2 through interaction terms. First we tried to generate a full set of interactions between the main variables of interest and control variables. As with the inclusion of the GDP variable above in Model 5 of Table 2, including so many variables causes the model to run out of degrees of freedom, making it impossible for Stata to generate standard errors and p values.

We therefore estimated a more stripped down model, Model 1 below, that only includes the key variables of interest and interactions. Unfortunately, this requires dropping our Polity Squared variable, since the interaction between that variable and the other variables is not theoretical coherent given the overlap between Polity and Polity Squared, as well as the required inclusion of lower order interaction terms.[14] That stripped down model converges and the results support our theory. Modern system adoption alone becomes insignificant, but the interactions with regime type and material power are significant and in the predicted direction. Given the difficulty in interpreting interaction terms using probit,[15] we also estimated Model 1's parameters using ordinary least squares regression. As Model 2 below shows, the results are consistent.

[14] For more on the inclusion of lower order interaction terms, see Bear F. Braumoeller, "Hypothesis Testing and Multiplicative Interaction Terms," *International Organization* 58, no. 1 (Fall 2004): 807-820.
[15] Thomas Brambor, William R. Clark, and Matt Golder. "Understanding Interaction Models: Improving Empirical Analysis." *Political Analysis* 14, no. 1 (Winter 2006): 63-82.

Table B.4: Predicting Victory Using Interaction Terms

	Model 1: Stripped Down Interaction Model	Model 2: Stripped Down Interaction Model - With Regression
	B/SE	B/SE
Modern System Adoption	-0.187	-0.0157
	(0.262)	(0.0791)
Polity	-0.0186	-0.00265
	(0.0328)	(0.00953)
Material Capabilities	17.61***	5.359***
	(4.30)	(0.859)
Polity * Material Capabilities	-0.656**	-0.169***
	(0.264)	(0.0518)
Modern System Adoption * Polity	0.0772***	0.0160***
	(0.0202)	(0.00410)
Modern System Adoption * Material Capabilities	-2.706*	-0.794*
	(1.539)	(0.398)
Strategy		
Terrain		
Troops Engaged		
Opposition Troops Engaged		
Human Capital		
Logged GDP Per Capita		
Civil-Military Relations		
Constant	-0.826**	0.190
	(0.419)	(0.120)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Model 1: N: 80, Wald chi2(0): --, log pseudolikelihood: 0, pseudo R2: 1, clusters: 30; Model 2: N: 124, Wald chi2(6): 74.901, log pseudolikelihood: -54.204, pseudo R2: 0.369, clusters: 47; Model 3: N: 124, F(6,46): 39.05, Prob >F: 0, R-Squared: 0.4149, Root MSE: 0.3937, clusters: 47

As noted in the article text, we estimated a model excluding the American and Nazi Germany cases to test the robustness of the relationship between regime type and modern system adoption.

Our data show that the relationship we find with respect to regime type and modern system adoption holds even when excluding these cases. The results are presented here in Table B.5.

Table B.5: Predicting Modern System Adoption Excluding US and Nazi Germany Observations

Variables	B/SE
Polity	-0.210*
	(0.112)
Polity Squared	0.0103**
	(0.00454)
Material Capabilities	2.979
	(5.527)
Terrain	0.404
	(0.607)
Strategy	0.362**
	(0.142)
Troops Engaged	4.04e-07
	(1.28e-06)
Opposition Troops Engaged	-3.31e-07
	(9.48e-07)
Human Capital	0.000435
	(0.000425)
Civil-Military Relations	0.350**
	(0.173)
Logged GDP Per Capita	0.123
	(0.267)
Constant	2.120
	(1.873)
Constant	3.172*
	(1.863)
Constant	3.838*
	(1.966)
Observations	60
Degrees of Freedom	10.000
Wald Chi2	56.711
log pseudolikelihood	-69.320
pseudo R2	0.143
Clusters	28.000

We also estimated a model to assess the plausibility of Biddle's hypothesized positive relationship between all-volunteer military forces and modern system adoption. Our data do not provide support for the hypothesis. The results are presented here in Table B.6.

Table B.6: Predicting Modern System Adoption Including Conscription Variable

Variables	B/SE
Polity	-0.208*
	(0.124)
Polity Squared	0.00890*
	(0.00522)
Material Capabilities	4.597**
	(2.094)
Terrain	-0.0159
	(0.693)
Strategy	0.414***
	(0.0896)
Troops Engaged	4.53e-07
	(6.91e-07)
Opposition Troops Engaged	-2.61e-07
	(8.32e-07)
Human Capital	0.000310
	(0.000371)
Civil-Military Relations	0.279**
	(0.136)
Logged GDP Per Capita	0.378
	(0.251)
Conscription	-0.442
	(0.455)
Constant	3.119**
	(1.489)
Constant	4.146***
	(1.481)
Constant	4.855***
	(1.595)
Observations	69
Degrees of Freedom	11.000
Wald Chi2	89.918
log pseudolikelihood	-70.993
pseudo R2	0.237
Clusters	25.000

APPENDIX C

SELECTION EFFECTS

As referenced in the paper, we were able to code for modern system adoption by 125 of the war participants in the dataset. As described in Appendix A, there are several factors, including participation in decisive campaigns, a lack of decisive land engagements, and limited coverage in historical works, that precluded our testing the relationship between force employment and victory for all of the participants. Excluding the first two classes of observations does not bias our results, however, because they represent instances where, by definition, we cannot test the validity of Biddle's argument. The list of potential belligerents that did not participate in the decisive operations we examine is extensive; the precise states can be found by examining the dataset provided in the replication materials and looking for those actors that are not coded "1" under the variable *Participate*. The number of observations excluded on the basis of not having fought a decisive land engagement during the war are less numerous. COW Wars that lacked decisive land engagements include:

- the Second Laotian War Phase 2 of 1968-1973
- the Kosovo War of 1999
- the War of Bosnia Independence of 1992
- the Taiwan Straits War of 1958

The exclusion of observations falling in the third category – those for which there is insufficient historical coverage – is potentially more problematic. For example, it could be that observations we could code were those in which historians believed elements of the modern system to be an important factor in deciding the battlefield outcome while those observations we could not code represent those cases such tactics and operational activities were not thought to be important and therefore not reported. While this concern has theoretical merit, we do not believe it actually skews our results. In those cases where we could not establish a value for adoption of the modern system, it was because we were unable to gather information on any form of tactical- or operational-level force employment, not just that which might signify modern system adoption. The key measures for adoption of the modern system described above, such as cover and concealment or the use of combined arms, are sufficiently relevant in modern warfare that, if tactical and operational force employment was covered at all in the secondary literature, we could discern whether the modern system or some other mode of force employment was adopted. Thus, it is not the case that our data coverage is influenced by historians wishing to propagate the utility of elements of the modern system in producing battlefield victory.

Additionally, we do not believe that there is any reason to assume that dropping the observations that we could not code introduces bias into our findings. While it is unlikely our missing cases are totally randomly distributed, there is also no reason to suspect that including the missing cases would undermine our results. The cases we were unable to code, like the Ugandan-Tanzanian War of 1978-1979 or the Turko-Cypriot War of 1974, are generally not considered crucial examples of modern warfare. To check for the possibility that such cases could alter our results and test for the importance of the cases, however, we ran a model where we made the

assumption that the selection effects argument was correct and assigned all of the missing cases 0 for the modern system adoption. Doing so did not change our results, making us confident that our findings are not an artifact of a selection effect based on the data we could gather.

Though we made every effort to preclude against the possibility that selection effects might influence our findings and are confident in the veracity of our results, we view continued work on coding missing cases and building a more complete understanding of the factors that drive modern system adoption, as well as the link between modern system adoption and victory, as a critical task for future research.