

**Research Report:**

**Predicting the Duration of the 2003 Gulf War**

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Data and spreadsheets to accompany this report are available online at:  
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## Overview

In 1996, we analyzed the duration of interstate wars between 1816-1985 (Bennett and Stam 1996). The primary focus of our analysis lay in determining how several theoretical factors have influenced the duration of war, and whether their influence matches our theoretical understanding of war. The model may also be used to forecast the duration of other out-of-sample wars (in the 1996 article we post-dicted the length of the 1990-1991 Gulf War, which was not in our sample). In this report, we use the model presented in Bennett and Stam (1996) to predict the likely duration of the 2003 war between the United States and Iraq.

Our model includes military, political, demographic, industrial, and geographic factors. It is not based on the type of intense wargaming that has been conducted by the U.S. military, but rather is based on a statistical model that quantifies the effect of multiple factors on the duration of wars since 1816. By focusing on the factors that have affected war duration historically, and comparing the duration of many wars over a long time period, we can make projections about current and future conflict. Since 1816, the median war has lasted approximately 5 months, with the mean duration at approximately 17 months. Our model can do better than just predicting the mean or median however, and ultimately, we present our estimates of the likely duration of the 2003 U.S.-Iraq war under four scenarios. Our best estimate of the likely duration of the war (given the evolution of the war thus far, and assuming that the United States is able to maintain its maneuver-based strategy) is approximately 2½ months. If the U.S. is forced to turn to a pure attrition-based strategy in which it is forced to defeat most or all Iraqi units through direct combat, our estimate of the war's possible duration stretches to nearly a year.

## The 1996 Model

Bennett and Stam (1996) used a statistical model applied to a database of 78 wars between 1816 and 1985 to determine what factors influence war duration, and how. Specifically, a hazard model with a Weibull formulation was employed on a data set constructed with time-varying covariates, with each observation in the data set consisting of a war-year (hazard models are also referred to as event history models, survival models, or duration models in various disciplines). After adequate control variables were introduced, duration dependence was found to be nearly eliminated in the data.

The data set analyzed in the statistical model included all interstate wars fought between 1816 and 1985 for which adequate statistical data were available. Wars were identified by the Correlates of War Project according to standard criteria; independent variable data in the project came from the Correlates of War Project data sets (e.g. Small and Singer 1982; <http://cow2.la.psu.edu>), the Polity data project (e.g. Jagers and Gurr 1995; <http://www.cidcm.umd.edu/inscr/polity/index.htm>), and research by Bennett and Stam (e.g. Stam 1996). The Correlates of War project is a 40+ year long project originally started at the University of Michigan (now continuing at the Pennsylvania State University), which is designed to categorize and systematically collect statistical data relevant to international conflict over a long timespan. Of particular importance to predicting war duration, the project has catalogued the national capabilities of every country in the international system since 1816 (including military and industrial capabilities, and demographic characteristics), has identified and measured critical aspects of every international war since 1816, and has identified each militarized dispute short of war occurring between countries since 1816.

Factors (independent variables) in the statistical model included:

- the military strategy of the two sides fighting the war;
- the terrain on which the war was fought;
- how well the terrain suited the strategy employed by each side;
- the balance of military capabilities between the two sides;
- the total reserves of the two sides in terms of total military personnel, and total national population;
- the difference in quality and equipment of the militaries involved;
- the presence or absence of major military surprise in the war;
- the salience of the issues at stake in the war;
- the political characteristics of the regimes engaged in the war, in terms of internal repression and democracy;
- the background of the contest in terms of the presence or absence of prior disputes before the war;
- the number of states involved on each side of the war.

Expectations about how these factors (variables) were expected to influence war duration were developed and fully explained in the original article. For instance, we expected that the more imbalanced any military contest (in terms of military capabilities), the shorter the war would be. Similarly, we expected that the more imbalanced the training and equipment between the two sides, the shorter the war would be. By contrast, we expected that the greater the reserves of the two sides in military personnel and population, the longer the war would be. The statistical model ultimately included 17 variables, each of which had some expectation attached to it. More importantly for our purpose here, however, statistical analysis of the set of wars over the past two centuries revealed the magnitude of effect of each variable on war duration, allowing us to make numeric forecasts about any situation by applying our quantitative coefficient estimates to that situation.

Two critical factors deserve special highlighting here. First, we categorized military strategy into three broad types, *maneuver* or movement strategies, *attrition* strategies, and *punishment* strategies. Maneuver strategies (often referred to as “blitzkrieg” strategies) are those where states focus on the use of speed and mobility to cut supply and communication lines, isolate enemy units, and disarm the opponent by disrupting their ability to effectively organize their forces. Under this strategy, the enemy is defeated without necessarily destroying each enemy force. By contrast, attrition strategies seek to destroy or capture opposing forces through direct combat, without necessarily using mobility to achieve this. Typically an attrition strategy seeks large confrontations with the enemy, and seeks actual physical destruction of enemy forces. Punishment strategies attempt to inflict such high human and material costs (ultimately influencing political calculations) on an opponent that they cease an attack or surrender even though their military forces may not actually be defeated in battle. Punishment counts on being able to break the resolve of the enemy, and is often not a purely counter-force (counter-military) strategy. In any war, we identify the primary strategy of both the offensive and defensive side; 9 strategy combinations are possible. Wars where one or both sides employ movement strategies have been the quickest historically, while wars where one or both sides employ punishment have been the longest.

Second, we code terrain on a 0 to 1 scale, where “0” marks open or rolling terrain and “1” marks impassable terrain. Dense terrain (heavy woods, jungles, swamps, mountains, or some cities) hinders the movement of military forces, and allows military forces to hide quite easily.<sup>1</sup> Such terrain makes ambushes possible, while also allowing forces suffering damage to move out of the battle and hide. Wars fought in dense terrain will last longer, while wars fought on flat, more open terrain will be shorter, as forces can move quickly and fight decisively with little time lost in finding the opponent.

Terrain and strategy choice also interact, as some strategies work better in particular terrain than others. For example, rough terrain is better suited to use of a punishment strategy than a maneuver strategy, since rugged terrain hinders rapid movement and decisive battle but allows forces to inflict costs upon their opponent with relative impunity. On the other hand, open terrain is better suited for the use of a maneuver strategy, as forces can spot enemy forces and move quickly to cut supply and communication lines.

### 2003 Extensions

The 1996 model included wars begun between 1816 and 1985 (data on key independent variables were not yet available for wars after 1990). Before forecasting the duration of the 2003 war between the United States and Iraq, we re-estimated the model after adding data on wars during the 1985 to 1992 period. In particular, this period included 2 military contests of great relevance to a model predicting current war duration, the Iraqi invasion of Kuwait in 1990, and the subsequent invasion of Iraq (and corresponding expulsion of Iraq from Kuwait) by the United States in 1991. It was important to add these wars because the 1991 Gulf War in particular was seen by many as surprisingly quick, and perhaps as a harbinger of a new type of war. In fact, the 1991 Gulf War fits into the model very well historically as a quick war; it was a war with limited aims, with clear military and technological superiority of one side over the other, and with a maneuver strategy on the ground executed well by United States military forces. But as additional data to be considered in comparison to other wars, the speed and characteristics of that war are particularly important.

Our re-analysis actually adds two new military conflicts corresponding to two distinct phases of the 1990-1991 Gulf War, the Iraqi invasion of Kuwait in 1990, and the U.S. war on Iraq in 1991. It is important to include these in the analysis as separate military contests, in keeping with our prior split of major wars such as WWII,

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<sup>1</sup> In practice, the densest terrain type we observe has a scaled value of 0.75. We can code terrain for wars fought over multiple terrain types by using a weighted average. In practice, many wars with a mix of terrain had terrain values between 0.4 and 0.5, with the European theater of WWII (with a mix of dense woods, open hills and fields, and cities) having a value of 0.45.

because the military aspects of the first invasion were clearly well-settled before the second could be planned, let alone launched.

The statistical estimates of the resulting model after adding these two wars look generally similar to the estimates from the 1996 model, certainly at the level of hypothesis testing as conducted in Bennett and Stam (1996). The values of some parameters did change, particularly the estimated effects of terrain and the terrain/strategy interaction. It is particularly important to use the new values for forecasting purposes in the current war. The new statistical results are contained in the Appendix below, and in the forecasting spreadsheet. The data set, command file to reproduce the analysis, and forecasting spreadsheet are available on our website for this report.

### Assumptions and Values

In this forecast, we assume a 3-state war involving the United States, Britain, and Iraq. The United States and Britain are the major “coalition” partners at this juncture, with over 250,000 and 45,000 troops in the region respectively engaged in the war. Australian forces numbering approximately 1000, and Polish forces numbering approximately 200, are not adequate to substantially shift the balance of forces or the basis of political discussion. On the Iraqi side, although there have been reports of shipments of equipment to Iraq from Russia and Syria, no other state has military forces actively engaged in the war, and shipments appear quite small relative to total forces involved.

In the scenarios presented, we vary two critical components of the model for forecasting purposes, namely strategy and terrain. Other aspects of the model – military capabilities, population, government characteristics, achievement of strategic surprise (in this case, the lack thereof) – are fixed in the time frame of the model. But depending upon the evolution of the war over the next weeks, the strategy employed by the United States may change, along with the terrain in which it must fight. We assume in alternative scenarios that the United States will be able to maintain its maneuver strategy against an Iraqi attrition-style defense, or will be forced to shift to a more purely attrition-based offensive seeking to destroy Iraqi forces directly. We also assume in alternative scenarios that the United States will maintain its ability to remain in and attack on relatively open terrain, or will begin to engage in battle in cities as well as open terrain. We thus vary strategy between OMDA (offense-maneuver, defense-attrition) and OADA (offense-attrition, defense-attrition), and vary terrain between 0 (open, rolling) and 0.45 (mix of open and dense terrain).

### Summary of Forecasts

We make a set of contingent predictions about the 2003 war.

<b>Scenario:</b>	<b>1.</b>	<b>2.</b>	<b>3.</b>	<b>4.</b>
	<b>U.S. Maneuver; Iraq Attrition; Open Terrain</b>	<b>U.S. Maneuver; Iraq Attrition; Mixed Terrain</b>	<b>U.S. Attrition; Iraq Attrition; Open Terrain</b>	<b>U.S. Attrition; Iraq Attrition; Mixed Terrain</b>
<b>Expected Duration (months):</b>	0.88	2.50	10.63	12.27

If the conditions of scenario 1 hold, a war in which the U.S. continues to rely on maneuver while being able to remain in open terrain, the war would be expected to last about 1 month. As of this date, however, it appears that this situation may not hold. The U.S. has been forced to return units from the front to guard its own supply lines, not all bypassed Iraqi units have collapsed, and the U.S. and allies have begun entering cities, suburbs, and villages to search for Iraqi forces. It appears that we may soon be past this scenario.

In the second scenario, we assume that the U.S. is able to maintain and use its airpower and highly mechanized forces in movements to fight Iraqis on U.S. terms, but in a mix of open and city terrain. As of this report date, this is what we currently see – the U.S. is using its technology, and tactical and strategic mobility, to attack Iraqi forces by-and-large when and how it chooses. U.S. ground forces are remaining largely in the open looking for opportunities, but are increasingly engaged in searches of villages and battles within towns such as Nasiriyah, while not committing to full-scale city warfare. We believe this is currently the most likely scenario for the war in the near future. If the U.S. must engage in battle in both open and dense terrain, the model forecasts that the war is likely to last 2½ months. By historical standards (with over half of all wars since 1816 lasting more than 5 months), this would still be a short war.

In scenario 3, we assume that the reliance on movement, airpower, and disarming the Iraqi army does not work. If isolated Iraqi units do not collapse, have large weapons caches accessible without supply lines, and continue to fight around the country without central orders, then the U.S. might be forced to turn to a classic attrition strategy. In scenario 3, the assumption is that the U.S. military will need to largely destroy the Iraqi military unit by unit, but will manage to do so while staying out of cities. In this case, the expected length of a war jumps to 10½ months.

In scenario 4, we begin with the scenario 3 assumptions that the reliance on movement, airpower, and disarming the Iraqi army does not work, and that the U.S. will turn to an attrition strategy. However, we also assume that the U.S. military will be required to fight in major cities as well as in more open terrain. This further lengthens the expected duration of war to approximately a full year.

An attrition war that must be fought in the cities of Iraq brings the most uncertainty in duration of all the scenarios. The U.S. has an unprecedented advantage in technology and training over the Iraqi army that could lead to a further change (shortening) of war duration in any of the scenarios. On the other hand, the U.S. military has not fought to take a major city in the recent past; modern urban warfare may prove more difficult than anticipated. This may be offset if Baghdad proves to not be the urban warfare nightmare envisioned in worst-case scenarios; some commentators have noted that the city has relatively low buildings and large open areas (at least near the political district). If this makes the difference, then even if the U.S. fights in Baghdad, military progress could be faster than expected.

Finally, given United States objectives, it is important to note that the war could end at any time if the current top leadership of Iraq is killed, deposed, or goes into exile. But to the extent that prediction is possible in the absence of such an unexpected event, the forecasts produced by the historical model suggest that the U.S. ability to execute its maneuver strategy in the face of opposition will make the largest difference in the likely duration of the war.

## **Bibliography**

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## Appendix: Technical Details

### 1. Hazard Model Coefficients

(Revised Model: Bennett and Stam 1996 data, plus 1990, 1991 Iraq, Kuwait, U.S. Wars)

Variable	Coefficient	Standard Error	t-ratio	Probability
Strategy: OADM	2.287	0.539	4.24	0
Strategy: OADA	2.495	0.489	5.1	0
Strategy: OADP	4.857	1.084	4.48	0
Strategy: OPDA	8.495	2.063	4.12	0
Terrain	2.323	2.571	0.9	0.366
Terrain x Strategy	-1.002	0.669	-1.5	0.134
Balance of Forces	-4.470	1.226	-3.64	0
Total Mil. Personnel	0.123	0.039	3.19	0.001
Total Population	0.825	0.552	1.5	0.135
Population Ratio	0.008	0.012	0.65	0.513
Quality Ratio	0.007	0.006	1.05	0.292
Surprise	-0.176	0.559	-0.31	0.753
Saliency	0.387	0.207	1.87	0.061
Repression	-0.223	0.113	-1.97	0.049
Democracy	-0.104	0.055	-1.9	0.058
Previous Disputes	-0.006	0.057	-0.11	0.911
Number of States	-0.193	0.092	-2.09	0.037
Constant	2.641	1.233	2.14	0.032
$\rho$ (duration param.)	0.923	0.083		

n= 80 wars, 171 data points (war-years)

### 2. Estimation Procedure

Analysis was conducted in the statistical program Stata v7.0 (Statacorp, <http://www.stata.com>), using the streg procedure with a Weibull specification, robust standard errors, and the “nohr time” options for purposes of coefficient presentation. Estimation of the initial model presented in Bennett and Stam (1996) was conducted in the LIMDEP software.

### 3. Expected Duration

Expected duration is estimated following the corrected version of Greene’s *Econometric Analysis* as noted in Bennett and Stam (1996), namely,  $E(t|X) = \exp(b'x) * \text{Gamma}(1/\rho+1)$ ;