Time to War in the Thucydides Trap

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Abstract
Harvard Kennedy School Professor Graham Allison has published many articles and a book on the Thucydides Trap. The basic idea is that "when one great power threatens to displace another, war is almost always the result". For the 16 cases listed by Professor Allison, we quantified the time from competition engagement to outbreak of war in order to model the time course pattern. First, we fit six parametric survival models to the “time to war” data. Based on the AICc criterion, the exponential model is identified as the best model. Then, we combined all six models using Akaike weights. Based on the combined model, we predict that the risk or hazard of war is about 37% per decade, but in the first decade the risk is slightly elevated to 40%, and in the fifth decade the risk is slightly depressed to 34%. These findings may inform us about the trajectory of current and future great power competitions with Thucydides Trap dynamics.

Key Words: time-to-event, survival analysis, model averaging, AIC

1. Introduction

Professor Graham Allison has published many magazine articles and a book on Thucydides Trap. The main idea is that "when one great power threatens to displace another, war is almost always the result". Since the 15th century, there have been sixteen major conflicts that involved a rising and ruling power, much like the current one between China and the USA. Of these, only four have been resolved without a war. So, the overall probability of war is 75%, which is lower than what most people think is “almost always.”

To further quantify the analysis, we set out to study the statistical pattern of “time to war” with “time to event” survival models. Based on the 16 case files on “Thucydides's Trap” website by Belfer Center of Harvard Kennedy School, we estimated the “time to war” or “time to censoring” which means war averted due to attention shifted away from the Thucydides Trap dynamics. We studied each historical case to identify the beginning of the Thucydides Trap dynamics, which we call an “engagement event.” The beginning of wars is typically easy to identify in the historical records. We treat historical cases with no wars as being censored with the assumption that other dynamics overtook the Thucydides Trap dynamics in these cases. For these cases, we identify a “censoring event” for each so that we can calculate “time to censoring.” Please see the table in the Appendix for a summary of the 16 cases. The following Kaplan Meier Curve below provides a visual representation of the raw data.

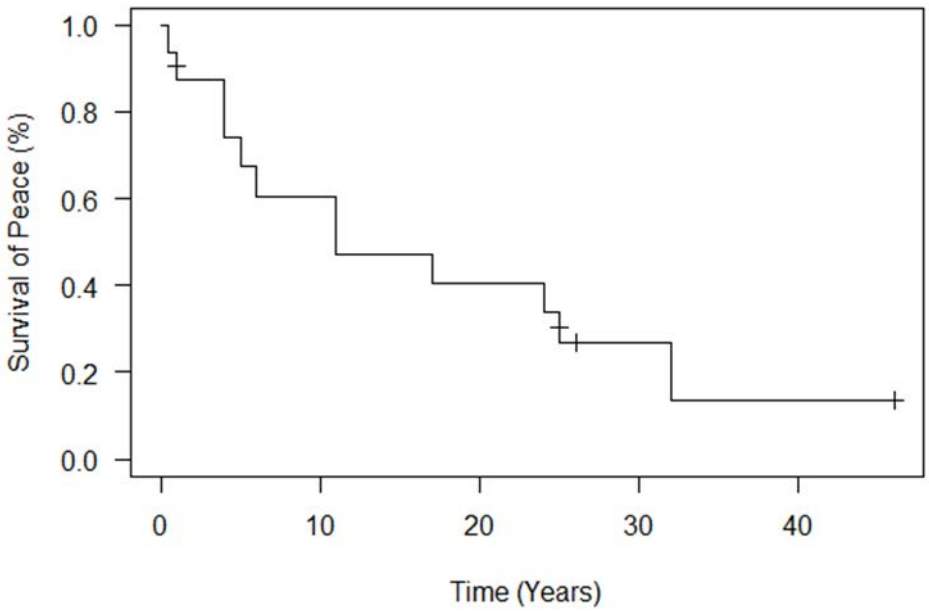

Figure 1: Kaplan Meier curve of survival of the peace

Our goal is to fit a smooth survival curve to the raw data so that we can make some predictions based on the fitted curve. In Section 2, we fit six parametric survival models to the raw data. We also evaluate the goodness-of-fit for each model using AICc. In Section 3, we develop a combined model using Akaike weights. In section 4, we reach some conclusions based on the combined model. In Section 5, we discuss some challenges.

2. Six Parametric Models

Table 1 below summarizes six parametric survival models that we used to fit the raw data. We chose only the common models that can be fitted with the R package "survival." Due to the limited sample size of 16, we limited ourselves to models with one or two parameters.

Takeuchi's Information Criterion (AIC) is a well-known metric based on log likelihood, number of parameters k, and sample size n for comparing goodness-of-fit of different models fitted to the same data. AICc is a small sample size adjusted version of AIC.

$$AIC_c = -2\log\left(L(\hat{\theta})\right) + 2k\left(\frac{n}{n-k-1}\right)$$

The model with the smallest AICc is considered the "best model" among the set of models. In our case, the Exponential model is the "best model" among the six models. Furthermore, the difference Δ between the model's AICc and the smallest AICc is a measure of lack of fit. In our case, Weibull, Gaussian, Lognormal, and Log-logistic models are similar in performance, but the Logistic model fits quite worse.

Table 1: Six Parametric Survival Models

Model	k	AICc	Δ	Akaike Weight
Weibull	2	100.40856	2.3757	0.1442
Exponential	1	98.03282	0	0.4729
Gaussian	2	100.67018	2.6374	0.1265
Logistic	2	111.54128	13.5085	0.0006
Lognormal	2	100.60521	2.5724	0.1307
Log-logistic	2	100.69062	2.6578	0.1252

Figure 2 below is a visual representation of the Kaplan Meier Curve and the six parametric models.

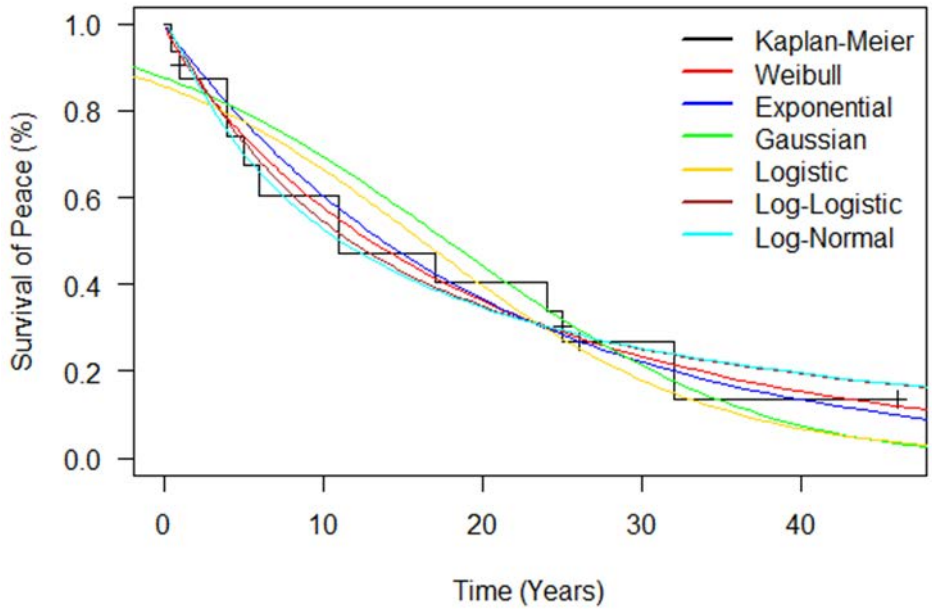

Figure 2: Six parametric survival models

3. Combined Model

It is known that the likelihood of a model is proportional to $\exp(-\Delta_i/2)$. Instead of choosing one model and discarding the rest, we developed a combined model using Akaike Weights w_i:

$$w_i = \frac{\exp(-\Delta_i/2)}{\sum_{i=1}^{6} \exp(-\Delta_i/2)}$$

The calculated Akaike weights are listed in Table 1. The survival function of the combined model is $S(t) = \sum_{i=1}^{6} w_i\, S_i(t)$, where w_i is the Akaike weight and $S_i(t)$ is the survival function of the model i. Note that the Exponential model contributes nearly half of the weight to the combined model, the Logistic model contributes little, while the other four models contribute about equally. Figure 3 below is a plot of the combined model with the Kaplan Meier Curve.

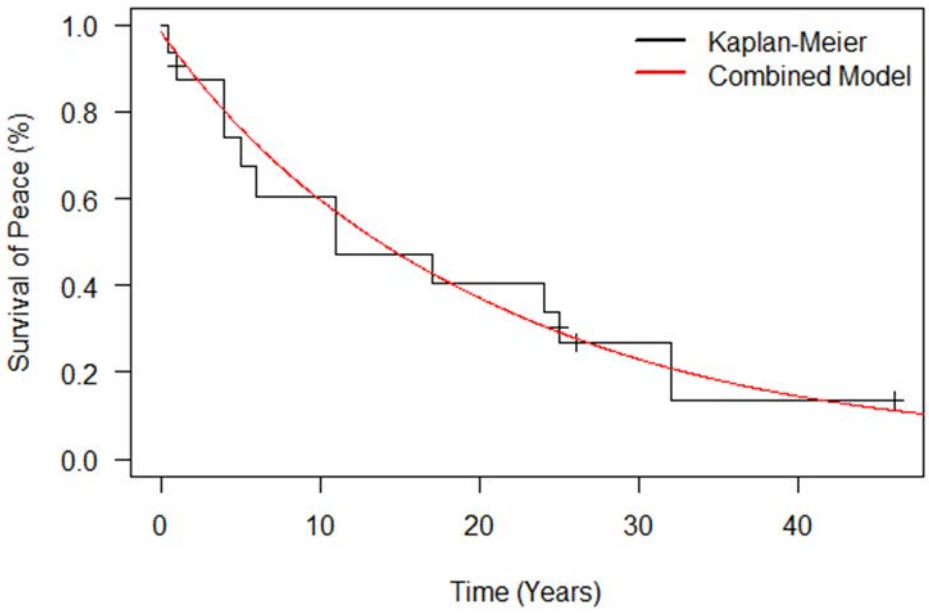

Figure 3: Combined survival model

4. Conclusion and Discussion

Based on the combined model obtained above, Table 2 below lists the predicted probability of peace surviving to the end of a decade and the probability of war during the decade assuming peace surviving to the beginning of the decade. It is interesting to note that the risk of war is relatively flat. This is not surprising since the Exponential model contributes nearly half of the weight in the combined model. The key characteristic of the Exponential model is its constant hazard ratio. The combined model also predicts slightly elevated war risk during the first decade and slightly depressed during the fifth decade. This shows the value of additional models' contributions. Since the largest data point is a censoring case at 46 years, we think that it is prudent to stop prediction at 50 years.

Table 2: Predicted Probability based on Combined Model

Decade	Peace Surviving	War
1st	60%	40%
2nd	37%	38%
3rd	23%	38%
4th	14%	37%
5th	10%	34%

In studying each case, the most challenging aspect is often identifying the engagement event. The best way to illustrate this challenge is using the case of the currently ongoing Thucydides Trap dynamics between a rising power China and ruling power US. Both events below can be reasonably argued as an engagement event. But there is a six-year difference between them.

1) Obama administration's "Pivot to East Asia" in 2012
2) Trump administration's trade war with China in 2018

We also have doubts whether Case 16 should be considered as a case of the Thucydides Trap since a reunited Germany dominated by Western Germany was not considered by many in western Europe as a threat. However, to maintain consistency with Prof. Allison's theory, we keep the case in.

There are certainly challenges in quantifying history. Reasonable people may make different judgement calls. But we certainly feel that the effort is rewarding in furthering our understanding.

References

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Appendix

Table 3: 16 case Files

Case	Time Period	Ruling Power vs. Rising Power	Outcome	Engagement Event	Censoring Event or War	Time to War or Censoring (Year)
1	Late 15th century	Portugal vs. Spain	No War	Marriage of Isabella of Castile and Ferdinand of Aragon (1469)	Treaty of Tordesillas (1494)	26 years
2	First half of 16th century	France vs. Hapsburgs	War	Charles V of Spain Appointed Holy Roman Emperor (1520)	Hapsburg-Valois Wars (1551)	32 years
3	16th and 17th centuries	Hapsburgs vs. Ottoman Empire	War	Mehmed the Conqueror Sacks Constantinople	Beginning of Great Turkish War (1683)	6 years

				(1678)		
4	First half of 17th century	Hapsburgs vs. Sweden	War	Gustavus Adolphus announces that the Hapsburg Empire should be challenged militarily to the Swedish Rijkstag (1627)	Sweden Enters Thirty Years War (1630)	4 years
5	Mid-to-late 17th century	Dutch Republic vs. England	War	English Navigation Acts (1651)	Beginning of Anglo-Dutch Wars (1652)	1 year
6	Late 17th to mid-18th centuries	France vs. Great Britain	War	France Obtains Largest Army and Navy (1689)	Beginning of 9 Years War (1689)	½ year
7	Late 18th and early 19th centuries	United Kingdom vs. France	War	End of 7 Years War (1763)	French Revolutionary Wars (1792)	24 years
8	Mid-19th century	France and United Kingdom vs. Russia	War	Treaty of Adrianople (1829)	Beginning of Crimean War (1853)	25 years
9	Mid-19th century	France vs. Germany	War	Prussian Annexations (1866)	Beginning of Franco-Prussian War (1870)	5 years
10	Late 19th and early 20th centuries	China and Russia vs. Japan	War	Tonghak Uprising/Triple Intervention (1894)	Beginning of First Sino-Japanese War (1894). Beginning of Russo-Japanese War (1904)	11 years
11	Early 20th century	United Kingdom vs. United States	No War	US GDP overtakes UK GDP (1871)	The Great Rapprocheme nt (1895)	25 years

12	Early 20th century	United Kingdom (supported by France, Russia) vs. Germany	War	First Naval Act of Germany Passed (1898)	Beginning of WWI (1914)	17 years
13	Mid-20th century	Soviet Union, France, and United Kingdom vs. Germany	War	Reoccupation of Rhineland (1936)	German military enters Poland (1939)	4 years
14	Mid-20th century	United States vs. Japan	War	Japanese Occupation of Manchuria (1931)	Attack on Pearl Harbor (1941)	11 years
15	1940s-1980s	United States vs. Soviet Union	No War	Long Telegram/Churchill's Iron Curtain Speech (1946)	Dissolution of the Soviet Union(1991)	46 years
16	1990s-present	United Kingdom and France vs. Germany	No War	Fall of the Berlin Wall (1989)	German-Polish Border Treaty (1990)	1 year