Structural Determinants of War Longevity

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Motivation

Wars are exceedingly rare events. When we further divide armed conflict into categories such as inter- and intra-state wars, the number of observations for each type dwindles quite rapidly. More importantly, we might be looking at an unrepresentative sample of the overall phenomena [1]. I argue that, although war is a strategic tool to achieve political ends, what transpires between the onset and the termination of a conflict can be modelled non-strategically, i.e. as a reactive process. A unified model is better equipped to uncover the systematic pattern underlying war duration [2], and will aid in forecasting the longevity of ongoing conflicts.

Theory

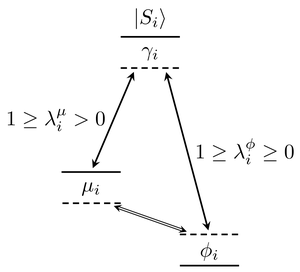

Figure 1: The entropy production process

Waging war requires having both material (μ) and political capability (ϕ); the means and the intention to bend the opposition to your will. In a dyadic setting, two actors project a certain percentage of their absolute material capability ($\tau \rightarrow \mu$) based on the salience of the issue. This projection constrains the amount of applicable force (γ) in two ways: physical limitations λ^{μ} (terrain, weapons technology) [3] and political constraints λ^{ϕ} (opposition, public opinion) [4]. This *applied* force, in turn, contributes to the overall **entropy** (S) in the system, which assigns the conflict a theoretical maximum duration value (MDV) based on the usage rate of available material capability. As the relationship between material and political capability is endogenous, the conflict terminates when an actor reaches a critical point of either α^{μ} or α^{ϕ}.

Model

I employ a physics-inspired framework of entropy production. Applied forces in a dyadic setting are treated as *energy* in a closed system. A MDV is assigned to the conflict based on the total amount of energy in the system while allowing for *friction*, i.e. projection decay:

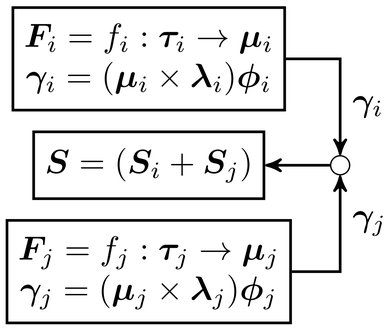

Figure 2: War duration as an entropy-based process

Actors' absolute and relative capabilities are dichotomously coded as either **H**igh or **L**ow, resulting in ten unordered (repetition allowed) combinations

$$\Omega = \{HH \times HH, HH \times HL, \ldots, LL \times LL\}$$

Then, the total energy is mapped to temporal categories based on its magnitude:

$$\Omega : \frac{(n+r-1!)}{r!(n-1)!} \rightarrow \omega$$

$$\hat{\omega} = \min \begin{pmatrix} \alpha_i^{\mu}, \alpha_i^{\phi} \\ \alpha_j^{\mu}, \alpha_j^{\phi} \end{pmatrix}$$

The conflict terminates when an actor reaches a critical point α for either μ, ϕ; a percentage of its MDV. This *fulfilment* ratio will be used as the primary determinant.

Methods

- **Survival Analysis**
  The counting model variant with multiple entries
- **Bayesian MCMC**
  Convergence tests for robustness

Expected Findings

The total entropy in a system influences both the expected average duration and the temporal variation; but the *dyadic characteristics* of the actors govern the predictions.

- **Average duration**
  Higher amounts of absolute material capability enable two conditions, the ability to project and withstand punishment for longer periods of time. Given that this quality can either shorten or prolong the conflict, its interaction with the projection rate is crucial for estimating an average.
- **Temporal variation**
  As variation depends on having more options—one cannot project what one does not have—absolute capabilities are the main determinants of temporal variation. A conflict between two highly capable actors projecting a majority of their power can play out in many different ways compared to a low-intensity skirmish between less capable actors.

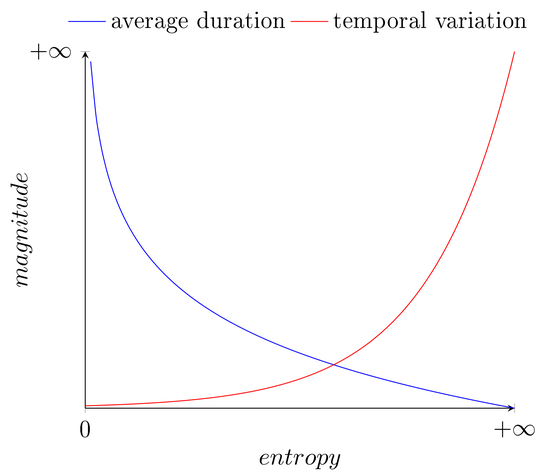

Figure 3: Exponential effects of entropy

Temporal variation **grows** exponentially with entropy, as the increasing number of potential outcomes go up in every turn. The average conflict duration **decays** as the entropy increases; higher amounts of energy make the system unsustainable for long periods of time.

Data

There are three main categories of data; absolute material capability, political capability, and projection modifiers. For modelling simplicity, all three will be aggregated to an index value.

- *Material capability:* Correlates of War datasets.
- *Political capability:* POLITY IV, POLCON, and Relative Political Capacity datasets.
- *Projection modifiers:* UCDP/PRIO Armed Conflict Dataset, Non-State Actor Dataset, and some (deployment numbers) manually coded [5].

References

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