INFLUENCE NETWORKS IN INTERNATIONAL RELATIONS

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In this project, we present a novel bilinear network autoregression model that can be used to understand how actors within directed relational data structures influence one another. Within this framework we can also estimate the characteristics of actors that determine why some actors are more influential for some than others. Both measuring influence and determining the drivers of it are topics of perennial interest in network analysis and political science. In the networks literature, discussions around measurements of influence often begin and end with the use of various centrality measures. Yet, centrality measures just provide a representation of how "important" a node is within a network, and do not detail how a pair of nodes might be influencing the actions of one another. Determining whether and how actors within relational systems influence one another is a topic of intrinsic interest to political science as well, particularly, in regards to deriving measures surrounding the relative "power" of states.

Though drawing upon power based theories to assess world events are widespread in political science, extant operationalizations of this concept are lacking. Gilpin (1975, page 24) has suggested that the way in which political scientists define and deal with the concept of power is an "embarrassment." The standard approach of assessing the relative power of a pair of states is derived by calculating the ratio of their material capabilities (e.g., Slantchev 2004; Reed et al. 2008; Butler and Gates 2009; Gartzke and Weisiger 2014). The availability of quantitative data on material characteristics of states (e.g., population, iron and steel production, military size) was to influence greatly the scholarship in this area and many scholars continue to rely on the Correlates of War's Composite Index of National Capabilities (CINC) as a way of assessing power (Singer, Bremer and Stuckey, 1972). This pushed scholarly consideration of power into a capabilities direction, rather than a direction in which power was seen as relational.

These approaches have implicitly assumed that power is material *and* fungible. If China has more capabilities than India, it has more power. If India and Japan together have more capabilities than China, then they have more power. Yet, relying on CINC as the principal measure of power that a state has over others ignores the nuances of regional as well as global interactions, and disregards the contexts in which states interact. Further, the narrow interpretation of power characterized by CINC detracts from a more relevant question regarding relational data, namely, how do the actions of actors within a network influence the actions of others.

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We instead begin with utilizing data from the from the Integrated Crisis Early Warning System (ICEWS) event data project. The ICEWS event data are constructed by applying natural language processing and graph theory techniques (Boschee, Natarjan and Weischedel, 2013) to a corpus of about 30 million media reports from about 275 local and global news sources in or translated to English. Each media report is coded in accordance with an ontology of events that is derived from the Conflict and Median Event Observation (CAMEO) scheme (Schrodt, Gerner and Yilmaz, 2009). We aggregate this data to the country-country-month level and distill the different kinds of event counts into four broad types, which are commonly known as *quad code* variables: material conflict, verbal conflict, material cooperation, and verbal cooperation.

Our focus for this project is centered around predicting monthly level material conflict events between states based on influence relationships among international actors. To measure power in this context, we develop a network-based approach that allows us to assess the influence that a country has on the actions of others in the system.[1] Let $Y = \{Y_t : t = 1, \dots, T\}$ be a time series of sociomatrices of relational count data. A generalized bilinear autoregression model for Y is that $E[y_{i,j,t}] = g(\mu_{i,j,t})$ with: $\{\mu_{i,j,t}\} = M_t = AX_tB^T$, where $x_{i,j,t}$ is a function of $y_{i,j,t}$, such as $x_{i,j,t} = \log(y_{i,j,t} + 1)$.

A and B are $n \times n$ "influence parameters," where n represents the number of actors in the system. The value of $a_{ii'}$ captures how predictive the actions of country i' at time $t-1$ are of the actions of country i at time t, while the value of $b_{jj'}$ captures how predictive the actions directed at country j' at time $t-1$ are of the actions directed towards country j at time t. Next, to determine the characteristics of i or i' that are related to the influence $a_{ii'}$, we consider a linear regression model for $a_{ii'}$ and $b_{jj'}$, given by $a_{ii'} = \alpha^T w_{ii't}$ and $b_{jj't} = \beta^T w_{jj'}$, where $w_{ii'}$ is a vector of nodal and dyadic time varying covariates specific to pair ii'. The network autoregression model then becomes:

$$\mu_{i,j,t} = \sum_{i'j'} a_{ii'} x_{i'j't} b_{jj'} \; = \; \sum_{i'j'} \alpha^T w_{ii'} x_{i'j't} w_{jj'}^T \beta \; = \; \alpha^T \tilde{X}_{ijt} \beta$$

The model presented above provides us with a novel way to determine whether and how actors within the material conflict network influence one another. The latter component of this framework enables us to explore the channels through which influence may be exerted in this system. We specifically reexamine a debate within the political science literature that has investigated what role alliance relationships play in influencing others to join into an existing conflict (e.g., Waltz 1979; Smith 1995; Leeds 2003; Fang, Johnson and Leeds 2014). Typically, we also want to predict $y_{i,j,t}$ with additional variables that capture features of the political institutions, economies, trading relationships, and geographic distance of i and j. We accommodate the testing of these types of propositions with a model of the form: $\mu_{i,j,t} = \theta^T Z_{i,j,t} + \alpha^T \tilde{X}_{ijt} \beta$.

Finally, we show that this network-based approach to understanding the evolution of the material conflict network has significantly better out-of-sample performance than extant dyadic approaches employed in the literature. In sum, our contribution here is in providing a novel network model that enables the estimation of parameters of significant theoretical interest, and we illustrate the utility of this approach using monthly level ICEWS event data.

[1]This model is an extension of our earlier work: Hoff (2015); Minhas, Hoff and Ward (2016).

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