Summary of the research

Social networks play a crucial role in economics and other social sciences. Applications include friendship networks at work, interactions on social media, and alliances between countries. Standard social networks are binary. They only capture whether two agents interact (coded as 1) or not (coded as 0), without distinguishing between positive and negative relations. This binary coding misses important differences of interactions in many applications. For instance, when a user on a social media platform has commented another user's post, this interaction may express consent, but it could also express the opposite, dissent between the two users. Ignoring this may lead to a wrong assessment of polarization in this example. More generally, standard social networks suppress negative ties, which leads to an incomplete assessment of costs and benefits of social networks and to distorted predictions about their evolution.

In this project, we explicitly introduce negative ties to re-assess costs and benefits of social networks and their evolution. For this purpose, we use the toolbox from economics of social networks and extend it to signed networks. Signed networks code relations as +1 if positive, −1 if negative, and 0 if neutral. This is a drastic innovation because the underlying logic changes. For instance, Closeness and Betweenness centrality, which are two prominent measures of network benefits, do not extend to signed networks. Likewise, there is no general framework on how to analyze strategic network formation in signed networks. Hence, there is need for more research on signed networks, in general, and with an economic approach in particular. Our work is organized into two fundamental research directions:

↑ UP: How does individual behavior affect the structure of the signed network?

↓ DOWN: How does the structure of the signed network affect individual positions and behavior?

In research direction UP ↑, we first develop a framework to study how agents strategically form and dissolve positive and negative ties. By analytical derivations and by computational methods, we characterize which networks are stable, and hence likely to emerge, and how they differ from the efficient, i.e., welfare-maximizing, networks. This enables us to show how incentives shape the evolution of signed networks. The results can differ dramatically from network formation in standard (unsigned) networks. For instance, in the presence of possible military conflict, alliance formation between countries will take a different shape.

In research direction DOWN ↓, we analyze the costs and benefits of network positions in signed networks. From basic assumptions on incentives, we derive utility functions and characterize their properties. In particular, we conduct a comparison of different measures of centrality, including a novel index based on Katz-Bonacich centrality. We compare centrality measures by basic properties and by their correlation in signed network data sets. Including standard centrality indices of unsigned networks enables us to estimate the measurement error of ignoring negative ties. In this research direction we also expect that results are significantly affected by allowing for negative ties. Obviously, costs and benefits of an employee can change dramatically when confronted with fights between colleagues. Such aspects shall be reflected by our utility functions.

Overall, bringing the toolbox from economics of social networks into the study of signed networks, we advance the economics of networks and network theory in other disciplines. Our concepts and results are readily usable for more applied research. Understanding the structural conditions for conflicts and showing how conflicts change due to incentives ultimately builds a network-theoretic foundation for conflict resolution – be it at work, on social media, or between countries.