

Review of
Sanjeev Goyal, “Connections. An Introduction to the Economics of Networks”,
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Economic interaction does not take place *in vacuo*; rather, it is embedded in social structures, as already pointed out, among others, by Granovetter (1985). This implies, first, that different social structures may determine different economic outcomes, *ceteris paribus*; and second that, since being in a certain social position may be economically attractive, social links are endogenously formed to exploit positional advantages. The economic approach to social networks, which has been an active field of research for the last ten-fifteen years, explores the relevance of these aspects for economic analysis.¹ Sanjeev Goyal, one of the pioneers of this approach, presents in “Connections” a state-of-the-art review of what we have learned so far, with particular attention to his own contributions, but also with a careful presentation and discussion of other scholars’ findings. The book is extremely clear and well organized, and it is structured as a continuous dialogue between empirical and theoretical research.

Empirical results indicate that systematic patterns of connections are present in different contexts and that many economic outcomes crucially depend upon them. In turn, theoretical results, presented with an intuitive discussion in the text and with rigorous proofs in appendix, show how economic theory is able to highlight some of the main forces driving network formation and interaction in networks. At the same time, the author also points out what remains to be explained and what the most promising open questions for further research are.

Concrete situations, in which social networks are economically relevant, include transmission of valuable information (e.g., about new ideas and technologies, the quality and price of goods, job opportunities or workers’ ability), social influence (e.g., peer or neighbourhood effects among youths, colleagues, acquaintances, criminals, and so on), coordination problems (e.g., adoption of new technologies and social norms) and cooperation problems (e.g., provision of public goods and of informal insurance, research collaborations among firms and co-authors, buyer-seller relations and free trade agreements). A fairly general empirical result is that real world networks in different contexts display a so called ‘small world’ structure. This means that the number of actual connections is low (compared with the number of potential links) and that there is substantial inequality in the degree of connectedness, in the sense that a few actors are highly connected, whereas most other ones have very few links, but are nevertheless close to one another, thanks to some connection to highly connected actors.

At the theoretical level, investigating the effects of network structure may be seen as an inquiry into the micro-foundations of externalities. The specificity of the economics of social networks is that nodes are treated as actors, who decide with whom to link and how to interact along their links, based on economic incentives.² Not surprisingly, given the presence of externalities, a general

¹ Several tools for social network analysis were previously developed by mathematicians and by sociologists (see, e.g., Mitchell, 1969, and Wassermann and Faust, 1994). The emphasis on economic incentives and on the relationship between equilibrium and efficiency is typical of the economic approach.

² It is worth distinguishing the social network approach from other leading paradigms in economics. To start with, the standard general equilibrium approach allows to study market dynamics without getting lost in the subtleties of social

theoretical result is that there is often a tension between efficiency and equilibrium. More importantly, the economics of social networks allows to investigate the implications of having a certain number of connections and of being connected to certain players, as well as the effect of the precise details in the structure of externalities on the gap between efficiency and equilibrium.

The book is organised in two main parts. The first part takes the network structure as exogenous and investigates how different networks induce different economic outcomes (both in terms of behaviour and welfare), i.e., it studies games on networks. The second part tackles strategic network formation.

The analysis of games on networks starts by formulating a rather general model, encompassing local and global interaction, positive and negative externalities, and strategic complementarity as well as strategic substitutability in players' actions. It is shown that behaviour and payoffs crucially depend on the details of the network, but in a complex way. This already highlights a major issue in the economics of social networks: on one side we definitely need a better understanding of the effects of social networks, but on the other side the generality of specific results is questionable. Further, while it is already difficult to obtain general results for the 'general model', the latter only serves as a basic setup and might be extended in several directions. While the analysis of these possibilities is just at the beginning, it seems that scholars will have to find a balance between the specificity in the description of certain features of social networks and the need to parsimoniously summarise other features.

The book proceeds by tackling the issues of coordination and cooperation on networks, as well as of social learning. A recurrent result in these different settings is that multiple equilibria are often possible, and it is not obvious which of them will be selected. A particularly relevant topic is the importance of social networks in labour markets, which are typically characterised by asymmetric information on job opportunities and workers' ability. Having more or better connections may allow individuals to receive more information on vacancies (see, e.g., Granovetter, 1973, and Calvó-Armengol and Jackson, 2004) and better recommendations and job offers (see, e.g., Montgomery, 1991). While this research sheds light on social, spatial and temporal patterns of unemployment, its integration with standard labour market models remains a task for future research. This holds not only for labour economics, but more generally for integration with the various fields of economic research.

The second part of the book deals with strategic network formation. Two main approaches have been investigated. In the non-cooperative approach, pioneered by Bala and Goyal (2000), each agent unilaterally chooses his or her links, and Nash equilibrium networks are studied. In turn, in the cooperative approach, pioneered by Jackson and Wolinsky (1996), link formation requires agreement by the two agents involved, whereas link severance may be unilateral. Here the relevant equilibrium concept is usually a variant of 'pairwise stability', i.e., stability against deviations by a pair of agents.³

As the number of players grows, networks become soon computationally difficult to manage. If this is a problem for theorists, it is an even more serious problem for individual actors in a network. In a

structure. Though, exactly because of this reason, it does not explain some relevant interaction patterns. Standard game theory, on the other side, provides deep insights into the strategic dimension of economic interaction, but it generally lets individuals interact in an abstract setting and match randomly with one another. Yet, real life matching processes are typically not random. Cooperative game theory investigates endogenous coalition formation, but each individual may belong to only one group at a time, whereas individuals in a social network may take part to different groups simultaneously, thanks to different links. Finally, operation research studies how to optimize a network from a 'central planner' or an individual firm's point of view, whereas in social networks each node is a decision maker.

³ The fact that more complex deviations are not allowed is restrictive compared with standard cooperative game theory.

very complicated environment, even if a full optimization were possible, its cost might exceed its benefits. So issues of bounded rationality and of local and incomplete information become relevant in the economics of social networks. Indeed, most dynamic analyses are based on myopic best response, whereas the investigation of incomplete information in network games is just at the beginning and seems to be a major and promising direction for future research. Another interesting research direction concerns the role of endogenous link ‘quality’ or ‘intensity’.

An important result in the non-cooperative approach is that ‘star’ networks are often efficient, but they generate an unequal distribution of payoffs and thus may not emerge in equilibrium. In related experiments individuals seem to trade off efficiency and inequality.⁴ In real world networks, stars and their variants are actually very common. While we have gained some understanding of the driving forces of inequality in the individual degree of connectedness, more research in this direction is needed.

Concerning the cooperative approach to network formation, the book shows how sharp theoretical predictions have been obtained for simple models and have been compared with empirical networks in a number of different applications. These include the connections and the co-authorship models, developed by Jackson and Wolinsky (1996), the role of transfers in supporting efficient networks (Bloch and Jackson, 2007), and various studies carried out by Goyal with different co-authors, on intermediation services, free trade agreements, the role of strategic complementarity and substitutability among links in driving inequality, and research collaboration among competing firms.

These different applications illustrate how the economics of social networks can be usefully integrated into the different fields of economic analysis, shedding new light on little understood but relevant questions. Given the pervasiveness of social networks, and notwithstanding the potential limitations of the network approach, this remains a very promising field for future research.

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⁴ In particular, in homogeneous experimental contexts efficient ‘star’ architectures are unlikely to emerge, whereas they are more likely to be formed in heterogeneous contexts.