Chapter 12
Network Analysis for Economics and Management Studies

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ABSTRACT

Sociology and other social sciences have employed network analysis earlier than management and organization sciences, and much earlier than economics, which has been the last one to systematically adopt it. Nevertheless, the development of network economics during last 15 years has been massive, alongside three main research streams: strategic formation network modeling, (mostly descriptive) analysis of real economic networks, and optimization methods of economic networks. The main reason why this enthusiastic and rapidly diffused interest of economists came so late is that the most essential network properties, like externalities, endogenous change processes, and nonlinear propagation processes, definitely prevent the possibility to build a general – and indeed even partial – competitive equilibrium theory. For this paradigm has dominated economics in the last century, this incompatibility operated as a hard brake, and presented network analysis as an inappropriate epistemology. Further, being intrinsically (and often, until recent times, also radically) structuralist, social network analysis was also antithetic to radical methodological individualism, which was – and still is – economics dominant methodology. Though culturally and scientifically influenced by economists in some fields, like finance, banking and industry studies, scholars in management and organization sciences were free from "neoclassical economics chains", and therefore more ready and open to adopt the methodology and epistemology of social network analysis. The main and early field through which its methods were channeled was the sociology of organizations, and in particular group structure and communication, because this is a research area largely overlapped between sociology and management studies. Currently, network analysis is becoming more and more diffused within management and organization sciences. Mostly descriptive until 15 years ago, all the fields of social network analysis have a great opportunity of enriching and developing its methods of investigation through statistical network modeling, which offers the possibility to develop, respectively, network formation and network dynamics models. They are a good compromise between the much more powerful agent-based simulation models and the usually descriptive (or poorly analytical) methods.

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INTRODUCTION: DIFFERENT DISCIPLINARY PERSPECTIVES

Network analysis research has become so vast that it is almost impossible to give a synthesis of its developments and scope of applications. This impossibility holds also if restricting the review to Social Network Analysis (SNA), under which we can include network-based approaches in anthropology, psychology, sociology (SOC), and economic sciences in a broad sense, which can be further distinguished into economics (ECON), and management and organization sciences (MOS). The first three have been matter of many studies, even (to a less extent) from a historical perspective, while the latter two, which are the specific subject of this volume, have been not yet well reviewed, especially from a historical perspective. Moreover, the few existing contributions are very recent, in particular those concerning network economics, and while some contrasts SOC and ECON (Jackson, 2010a, 2010b) - with the partial exception of Knoke (2012), who restricts the view of network economics only to few themes - no one contrasts ECON and MOS. As it often happens, even though two scientific areas are largely overlapped[1], they remain encapsulated into the respective disciplinary boundaries, so hindering a fruitful cross-fertilization. Most researchers in one area do not know the works in the other area. Therefore, the main aim of this chapter is to fill in this gap by directly contrasting ECON and MOS perspectives on network analysis.

There are various accounts of the history of network analysis in general, and SNA in particular. Among the former there is Barabasi's (2002) fortunate and popular book, and the classic Biggs *et al.* (1976). Among the latter there are many contributions (Berkowitz, 1982; Leinhardt, 1977; Marsden & Lin, 1982; Scott, 1992), some of which quite recent (Freeman, 2004; Prell, 2011). Leaving aside books dedicated to specific methodological or real topics, there is a certain number of handbooks (Borgatti *et al.*, 2013; Hanneman & Riddle, 2005; Knoke & Kuklinski, 1982; Scott, 1992; Wasserman & Faust, 1994; and the more recent Borgatti *et al.*, 2013; Knoke & Yang, 2008; Robins, 2015; Scott & Carrington, 2011). And of course a lot of readings (Carrington *et al.*, 2005; Wasserman & Galaskiewicz, 1994; Wellman & Berkowitz, 1988; among the many). There are also many books and papers dealing with both fields of social and natural sciences (Barabasi, 2002; Biggiero, 2011; Bornholdt & Schuster, 2003; Caldarelli, 2007; Dehmer & Emmert-Streib, 2009; Lewis, 2009; Newman, 2010; Newman *et al.*, 2006), but with few exceptions they are written by mathematicians or physicists.

Although the mathematical base of network analysis is graph theory, and so even developments outside mathematics and physics (MAPH) must be based on this ground, substantially different stories took place in the development of SNA and graph theory[2] during the 80 years between the thirties of last century and these last years. An appropriate treatment of this subject would deserve an accurate and extensive research far beyond this section and also beyond a full dedicated paper, but in extreme synthesis we can say that the story told by mathematicians and physicists, like Barabasi (2002), Watts (2003) and Newman 2010), describe a network analysis which, besides the pioneering work by Euler and some early studies in the thirties, was systematized by Erdős and Rényi during the fifties. Their work – and that of their followers - focused mostly on random or regular graphs, until in the nineties Barabasi (2002), Barabasi & Albert (1999) on one side, and Watts (2003, 2004a, 2004b) and colleagues (Watts & Strogatz, 1998; Newman, 2001, 2005) on the other side discover the peculiarity and wide diffusion in social and natural networks of, respectively, the scale-free and the small-world topology. Indeed, scale-free topologies had been discovered already in the fifties by the economist Nobel Prize Simon (1955; Simon & Bonini, 1958), who indeed exploited previous studies from economics (Gibrat, 1931; Pareto, 1896) and linguistics (Zipf, 1932)[3]. And the small-world structure was baptized as such by the sociologist Milgram (1967; Travers & Milgram, 1969) in his studies in the sixties, which were