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A Network Perspective of Economic Relations and Markets

Abstract: A review of the research literature applying social network analysis to different aspects of economics (markets, firms and economic organizations, policies and public administration) will be presented. The review will specifically explore the contributions that network analysis has made to the investigation of market relations and interactions between firms either at the level of whole economies or regional areas globalization (chapters 3 and 4), entrepreneurship and social development (chapter 4) and finally, contemporary transformation of economic relations and technological innovation (chapter 5). The introduction describes the methodological perspective of social network analysis and specifically its application to economic and historical sources.

Key Words: SNA, economic relations, markets, nodes

1. Social Network Analysis and Economics

The social perspective of network analysis, a branch of mathematics that deals with topological properties of elements, emerged at the beginning of the twentieth century from empirical observations of human and animal interactions. It was developed by sociologists as a specific methodological approach – the so-called structural or relational sociology.[1] In the following decades this approach was further refined both as a survey and analytical technique[2] and its use was successful for understanding determinants of processes of choice and diffusion,[3] impact of personal and informal resources in the labor market,[4] and in the formation of firms interlocks and social capital.[5]

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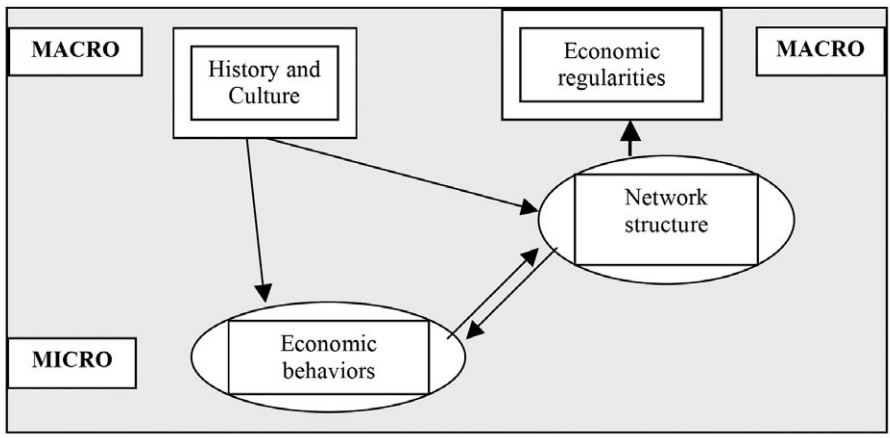
Social network analysis (also referred to as SNA for short) originated as two distinct areas of social research. On the one hand, the socio-metric approach developed by American sociologists[6] that used network analysis to describe configurations and properties of social relations, such as intensity of connections among members, leadership positions and flow of communication within social and work groups. On the other hand, the anthropological studies of the so-called Manchester Group that analyzed social and political changes in traditional European communities and in African and Asian countries during the fifties and sixties[7]. These two areas of study 'translated' the formal mathematics of networks to social concepts and provided the theoretical bases for elaborating structural theories to explain different social and economic phenomena (e.g., ethnic entrepreneurship, decisions on financial investment, social mobilization). Barnes's study of a small Norwegian fishing town, for example, highlighted the presence of personal links among the inhabitants that could not be summarized by localization (neighborhood) or economic relations. According to Barnes, informal relations among members of the small rural community, partially related by kinship or family, reproduce a class structure; a 'hidden' class structure that in an egalitarian culture like the Norwegian one would not have been visible on the basis of observations limited to economic or territorial relations.[8]

In the economic discipline the references to network society theory are more recent, resulting from changes in social implementation processes of information technology applications within firms, services, distribution and financial activities, as well as from the debate concerning the role that institutions were expected to have in the non-productive areas of the economy (education and knowledge transfer, social and government issues). The adoption of network analysis as a specific methodology is even more recent than in sociology, but has become increasingly widespread with research being carried out on firms' alliances, decision processes in the financial market, governance and industrial organization[9]. The application of SNA to economic phenomena, in particular, has brought forth several innovations in the theoretical approaches of decision theory, industrial and labor market studies and social learning areas[10]. The adoption of such a perspective in the study of economic activities from trade and commerce to banks, as well as of the evolution of specific forms of organizational structures in the globalized economies, is highly relevant because it is also associated with a shift in theoretical perspective.[11]

To situate the theoretical contribution of SNA to knowledge of economic issues, sociologist Steiner moves from the problem of interaction between explanatory dimensions of phenomena.[12] According to a sociological approach based on a individualistic and rational perspective of human action, social phenomena, including economic and political ones, can be described both at the micro and macro societal level. History and culture, in particular, influence economic relations of sub-

jects (individual, groups, organizations and institutions) which are associated with specific structures that can be traced at the macro level (Figure 1). Due to its specific methodology network analysis is a technique that lends itself particularly well to investigating these persistent connections between the macro level and the micro level; relations pertaining to network are in fact all those that can be described in terms of social and economic behavioral patterns, from job selection choices to industrial strategic decisions.

Figure 1 – Explanations of economic phenomena according to Network Analysis perspective (Steiner 2005)



According to scholars social network analysis should be primarily interested in describing relations (links) that connect subjects (nodes) in a significant structure (network) whose influence is found on the individual nodes' opportunities as well as on their collective output.[13] Some researchers thus underline the strength or multiplicity of relations between nodes as main factors of influence, others emphasize the topological position of nodes and put in evidence the structural properties of different networks. Despite their procedural differences these positions share a common perspective that conceives economic and social interactions at the basis of economic processes, whose outcomes may be evaluated in terms of their structural efficiency. Since subjects – be they individuals, firms or collective actors such as governments or countries – connect according to relative stable models of interaction that are not intentionally designed as a whole, some structure (e.g., the shape of the network, type of connections) are found to favor, or in some cases block the exchange of resources/information and group cohesiveness. The specific structure of a network or its 'internal architecture' enable resources/information to be passed on to those groups who can recognize them as profitable, and acquire advantageous posi-

tions; while other types of network structure may block or circumscribe the information flow – and hence innovation – only to circumscribed areas of the network, or specific actors.

A motive for using SNA is thus its capability to analyze economic phenomena from a multiple perspective, focusing either on the level of connections between institutions and organized groups, or on the level of individual and personal relations where resources and information circulate.[14] I will refer to cases in historical studies to illustrate this duality of perspective in observing economic processes. The study of Harreld, for example, describes the duality of collective and individual dimensions when he analyses individual personal networks – Antwerp cloth merchants – as entangled elements in the Renaissance structure of economic relations.[15] Connections of merchants travelling across sixteenth century Europe could indeed represent both individual specific encounters (personal network or individual contracts) and formalized contracts derived by guilds and city regulations or other institutionalized agreements. The structure of commercial relations that emerges from their combination is a synthesis of knowledge about localized economies (cities, neighborhoods and regions) and institutional structures that regulate production and exchange of goods (craftsmen, trade investors).

A second example, Van Doosselaere's study of the Genua Republic is another illustrative case of how SNA may allow a researcher to move from a micro level approach to macro level theories. Changes in the organization of trade and commercial activities over three hundred years of Genoese economy are expressed in individual merchants relations, that Van Doosselaere scrutinizes analyzing notarial documents of commercial and financial transactions among traders and other professional categories (contracts – the so-called *commendae* – between a merchant and investors, commercial credit relations, and marine insurance underwriting). The analysis of connections emerging from such contracts show that concentration of economic power and political authority was reached via crescent stages of cohesiveness and centralization of economic networks. Ties formed predominantly within particular social status groups and returns from trade investment were redistributed accordingly; such a combination of accumulative and closure processes favored the takeoff of early capitalism, while a group of people occupationally dedicated to mercantile activity became transformed in an oligarchic elite.[16]

In the following chapters a review of the research literature applying social network analysis to different aspects of economics (markets, firms and economic organizations, policies and public administration) will be presented. The review will specifically explore the contributions that network analysis has made to the investigation of market relations and firms interactions either at the level of whole economies or regional areas globalization (chapters 3 and 4), entrepreneurship and social devel-

opment (chapter 4) and finally, contemporary transformation of economic relations and technological innovation (chapter 5). To introduce the topics, the next paragraph describes the methodological perspective of social network analysis and specifically its application to economic and historical sources.

2. SNA Methodology, Economic Relations and Historical Data

Data about economic and social relations – either derived from secondary sources of freshly collected data – that are appropriate for network approach may refer to a variety of subject such as groups, organizations and individuals.[17] The core subject of analysis is considered the node in a set and different types of relations or connections between nodes – than can concern exchange of resources, as well as co-participation to events or companies – are interpreted according to specific methodological and theoretical requirements (e.g., as binary data could refer to associative affiliation, valued data to transfer of resources).

Flexibility in the choice of the subject of analyses, however, does not imply that all types of data that are available to social scientists allow one to analyze the structure of social interactions and exchanges.[18] According to SNA methodology, in fact, the first aspect to be considered is whether the data contain relational information or not. Potentially, any information which connects at least two units of observation providing details about their relation, such as the flow of messages between e-mail user, the exchange of products between firms, or the reception of benefits from governmental organization and citizens, can be synthesized in numbers or indices or other formalized measures to describe the social relation. Second, these pieces of information must frequently be re-organized, defining the boundaries of research observations (countries that belong to the WTO, firms located in the same district, social policies for specific social groups) and the type of dependent effects that the research is aimed at testing (efficacy of patents on the innovation system, social integration, e-learning or educational attainment). And third, there should be some form of measurement in relational terms for the relation between the two units of observation, such as the total number of messages or the density of communication exchanged between users of a social site, and the creation of specific sub-grouping in the network of all the firms located in a region. When a research project is designed with a specific purpose in mind, a situation that pertains more frequently to sociological and political sciences, all these requirements are easily fulfilled. The main task of researchers is to relate theoretical concepts with their operative counterpart (indices of network structure, models of flow and exchange for connections among nodes etc.). But this not always the case and relating secondary data that con-

tain some relational information may require to re-organize the data in a different matrix format than the usual case by variables of most quantitative analysis.

Social network data typically are organized according to adjacency matrices (cases by cases) and affiliation matrices (cases by events), or in the case of spatial data, the incidence matrix (subjects by links) is also adopted.[19] A specific area of study deals also with individual links (the so-called ego networks) and reconstructs patterns of similarity and dissimilarity in personal networks of individuals or groups.[20] Data that can be re-organized (re-coding or transposing data, or even extracting individual relations) according to these formats are suitable for social network analysis.[21] Some data, however, do not allow for two units of observation to be related even if they belong to the same category, while other data that connect units of observation on different dimensions can be rearranged and thus lend themselves to network analysis. Thus consumers and sellers (units that belong to different categories) can be related according to network analysis criteria (e.g., by means of details about the purchase); while gross data on the sales of specific producers (e.g., number of sold licenses for ADSL connections) and aggregate data on consumers spending for specific goods (e.g., Internet connections for domestic use) could not be linked according to those criteria because they lack a connection event (or affiliation). When re-coding is possible some measurement adjustment may have to be made and, if possible, the rate of errors due to incompleteness and recoding of information or other aspects related to standardization of data is estimated; techniques allowing these problems to be dealt with have been developed[22] and more recently, some algorithms adjusted to cope with these issues.[23]

Historical economic data, in particular, have been analyzed quite extensively in network research and according to some authors "social-network analysis represents a different modality of historical research because it demands a new way of approaching historical sources and of gathering data about the past"[24]. The adoption of this perspective, however, has become the task of sociologists, political scientists, and in particular historians, frequently skeptical concerning the application of quantitative methods. Archive reconstruction and the interpretation of data that is performed in the coding process from historical data to quantitative representation in matrices and indices is indeed a delicate operation and may require that researchers consult topic-specific literature in the interpretative process. The interpretative function of coding is well expressed in the work of Franzosi who analyzed on the basis of content analysis the evolution of the collective protest in Italy from the beginning of the twentieth century (the so-called 'red biennium') up to the rise of Fascism in Italy, using documents from the press archives.[25]

As pre-organized forms of information selection, documents and also other sources historians deal with (oral testimony, visual data and artifacts), may in fact

contain relevant as well as ambiguous information about relations between subjects. Knowledge of the sources (representativeness, stability and selectivity of information) is thus essential for establishing connections between nodes (e.g., control, resource exchange, sanctions, requests, etc.) Furthermore, documents can also be coded according to different techniques from simple binary relations to semantic categories (content of relations) to provide data on complex relational structures.[26] A clear description of these methodological implications is present in Hansen and McDonald fieldwork observations on their performing quantitative coding of personal diaries in nineteenth century rural United States (1820–1870). The researchers coded visits reported by 56 diarists of different gender and social class in order to analyze the changes in the diarists' personal networks: the goal was to provide insight into public life and private sphere separation in the pre-industrialization period and reconsider patterns of encounters as a consequence of the emergent industrial division of labor and geographical migration in the US. The task required not only recalling historical knowledge about the society of that period but also re-organizing the classification of 'visit' to take in account, for example, that families migrating for work frequently were hosted by distant family members living in another county or state.[27]

Despite all these difficulties, SNA has frequently made use of data from historical archives and these data are intentionally used by researchers as a strategy to develop or test new technical features. The most acknowledged examples are the studies of Padgett and colleagues on the Florentine Renaissance.[28] The analysis of the foundation of the Medicean political party was an opportunity to discuss political centralization theories and to scrutinize the interrelation of family and business strategies in Medici's oligarchic dominance.[29] The researchers selected the family elites in Renaissance Florence (1400–1434) and explored their marriage and business relations to depict social structure during a period of intense institutional changes in the governance of the city. Using the block-modelling technique, a type of approach that puts in evidence structural differences in data patterns, the study shows that the Medici party was characterized by a strong centralization with almost all relations directly connecting the Medici with their followers. Relations were based on marriage or business ties, both implying resource and information flows that could benefit the position of the Medici among the other elite families of Florence. The Medici clan activating these separate connections mobilized alliances and was able to assume a supremacy position in the political arena, and to establish an oligarchy that governed Florence for successive thirty years. In the subsequent study Padget and McLean combine several historical sources (official companies records and Florence city state archive, historian's studies on the Medici) to test hypothesis on the origins of the birth of a new form of business organization – the partnership sys-

tem.[30] The partnership system was an innovation in business because it introduced a new organizational form where 'a single controlling partner – or a small number of partners – made a set of legally separate partnership contracts with branch managers in different locations and industries'. According to Padget the adoption of the new system allowed the Medici clan to manage separately different business markets and to decentralize financial responsibility of new branches; an important step in the history of financial capitalism introducing limited liability risk and allowed diversification into multiple product markets.

The comprehensiveness of explanations that can be reached through network analysis is testimony of the relevance this approach can have for advancing theoretical debate, and to enhance comparative inquiry of institutions and culture in the economic domain. Acknowledging this potential the historian Wetherell suggests "SNA possess real potential for historical analysis and comes with a full complement of formal methods"[31] that can originate new hypothesis of causal relations and interdependence of events. The typical design of research in social network analysis combines indeed elements of formalization (e.g., gathering the data), with inductive and interpretative knowledge. In fact, the quantitative analysis performed on networks, rooted in mathematical algorithms and indices, requires that concepts and relations that are meaningful for the case under scrutiny be 'translated' in measures and indices. All these operations require clarification in the researchers' theoretical and interpretative perspective. In this sense, a singular illustration of explanatory potential of SNA is the analysis by Alexander and Danowsky who tested a hypothesis on the structure of the Roman society and in particular the position of the senators and of the knights classes, looking at the content of Cicero's letters. They identified persons cited in the letters of Cicero on the bases of social class and other indicators of social position (e.g., gender, citizenship) and perform a social network analysis of communication content that supported the functional, but not political, separation between the two classes of knights and of the senators in the ancient Roman Empire.[32]

Furthermore, the application of SNA to large theoretical issues (e.g., class structure, innovation diffusion, group cohesion and culture) can support existing theories and offer new insights into the structure and determinants of contemporary social phenomena.[33] In the study of collective movements, for example, several political scientists and sociologist applied network analysis to historical sources from formalized archives, integrating non-official documents and oral texts, to test contemporary theories concerning the causes of collective protests and mechanisms of group mobilization.[34] Limited to American history, Gould's analysis of anti-federal political protest,[35] Bearman and Everett's study of new social movements,[36] and finally Rosenthal's et al. study of nineteenth century women's rights movement,[37]

show the possibility of combining historical sources with contemporary theoretical debate on state and social change. Another singular case of SNA application that is rooted in a social history perspective is De Vooght's study of records of official dinners at the Belgian royal court (1865–1909). The theoretical intention is to reveal the interdependence of the monarchy and of the court, following Norbert Elias' theories on the public representation of kings' power and its legitimization and reproduction.[38] By mapping the 'food network' of dinner guests (position at the table, type of menu, meeting occasion and social role of the guests), the researcher highlights the power relations and the construction of the court's identity displayed in political and mundane events such as banquets and court dinners of the Belgian monarchy.

3. Economic Systems and Networks

Among the issues where SNA has been applied with continuity since its formalization and development in the social sciences is the study of economic systems. The internal organization on national economic systems, their articulation in production sectors and the relations between different countries' economic systems (trade, financial flows) is an area of research that first attracted economists, and apart from the availability of structured data (e.g., input-output tables, official records of companies and stock exchange registry) for analysis, these aspects favored the application of network analysis and testing of methodologies.[39] Specifically, the use of SNA to investigate macro relations that constitute and structure an economic system provide researchers an opportunity to obtain important results in terms of theoretical interpretation and model definition.[40] As example I will refer to two relevant research areas where the application of network analysis techniques is particularly pronounced: international trade and the study of interlocking directorates.

Historical advances in the study of international trade and financial exchanges between countries illustrate how the theoretical perspectives of scholars has moved from the description of exchange relations among countries to a more complex interpretation of the phenomena at hand. The classical study of world economies by Snyder and Kick in the period 1950–1970 revealed that the growth rates of individual countries are related to their presence in sub-groups of countries showing a similar set of factors in their economic systems.[41] Their sources were trade and exchange relations, political and military alliances, diplomatic and warfare actions involving 118 countries, which were subdivided into ten groups and classified according to three different positional relevancies (core, periphery and semi-periphery) in the world economy. Revised by Smith and White, the hypothesis on the structure of relations concerning international trade was supplemented by the analy-

sis of more detailed trade data and extended to 1980.[42] The authors proved that in the period from the 1965 to 1980 the world economic system had evolved towards a multicentre model with areas of similar homogeneity of conditions concerning commerce, but had also improved in competition with more countries connected in sub-networks characterized by dependent models of economy. In addition to association to a sub-group of countries, other factors such as the multiplicity of relations had increased the opportunity for a country to move from the periphery (or semi-periphery) to the center, but also the risk to be 'trapped' to peripheral sub-groups.

Recent studies on the same subject have moved further, analyzing possible models of wealth distribution in the world economic system and dynamic processes that influence the stability and evolution of network structure. The analysis of Dorogotsev and Mendez implemented the concept of 'preferential attachment' to the relations of countries, showing that there is a strong theoretical relation between degrading stages of the economy of a country and an unfair distribution of wealth, while economic systems that are characterized by developmental stages or stagflation are compatible both with fair or unfair conditions of wealth distribution.[43] The recent study by Mahutga also re-interprets the international trade system, analyzing the opportunity for countries to move upward in the core-periphery hierarchy or in other words to escape structural inequality.[44]

These examples show again that through the specific perspective of SNA it is possible to move from basic or micro economic relations, such as the presence of a connection between two nodes (traders or countries) to investigate the creation of a general or macro social outcome (prices formation or growth rates) and put in evidence the role played by structural elements of the network of relations such as positions, homogeneity and hierarchy of nodes. As for the subject matter the use of SNA can be expanded to analyze the impact of globalization on world trade and evaluate the effects of different national policies for commerce[45] or the historical evolution of the International Monetary System from 1890 to 1910, analyzed through exchange rate tables by Flandreau and Jobst, as well as to describe the structural changes that a single national system underwent in a specific period of time, as in the study on the Canadian economy by Berkowitz and Fitzgerald.[46]

Similarly, by applying SNA to national economies, researchers try to explain the structure of their aggregate relations in terms of networks and to evaluate the influence of exogenous (e.g., institutional regulation of firms, international agreements), and endogenous factors (financial system and banks, type of production). In their approach national economic systems are seen as constituted by economic agents – firms and consumers – that share a variety of connections (such as demand for products) which can be explored in both in terms of content as well as relational structure.[47] The analysis of firms in particular flourished with the large availability of

archives of stock companies and of associative archives of industrial organizations and economic institutions, as in the two examples described here. The first example is the study by Baccini and Vasta on Italian stock market companies in the period between 1911 and 1936.[48] The intention of the researchers was to test the contrasting theories in economics that interpret the presence of interlocking directorates among companies. The term interlocking directorates (or ID) indicates the presence of a link between two organizations (or groups) by co-presence of direct relations (as in the case of a representative of the company's board that is appointed to another company's board), or indirect connection (as the ownership of a company's stocks by a bank, investing in other economic activities). Analyzing the Italian economic system, the study by Baccini and Vasta reports a limited rate of association of companies with the financial institutions: only two large banks exercised control over groups of companies, while insurance companies – a type of enterprise that is frequently associated to financial elite's families – played a central role in interconnecting sectors and firms. This peculiarity, according to the researchers, was contingent to the lack of regulative assets for stock ownership in Italy and the persistence in its economic system of family-related parallel system of ID that connected several industrial groups via multiple directorships.

A second example is Windolf's comparative study of US and Germany economic structure in the first part of twentieth century (1896–1938).[49] Here the focus is on the role of banks as collective actors with an interest in controlling stock companies. The role of financial institutions in the economy and the strategies adopted by banks for increasing their control power over companies are described by means of analysis of ID (density of connections, presence of redundant and multiplicity links involving banks and companies) in the same productive sector, as well as looking at the inter-sectorial relations. In Germany after 1913 banks become more intertwined in the production system and acquired the role of co-entrepreneurs, participating in multiple economic partnerships. The German economy thus acquired a structure characterized by cartels (e.g., energy and utilities companies were controlled by the same banks). On the other hand,, the introduction of the Clayton Act in 1928 (known also as the first anti-trust law) modified the US economic system determining a reduction of the control power of banks. Institutional changes, however, did not prevent a process of vertical integration among US companies belonging to the same sector and the centralization of some sectors of the economy (in particular transport, utilities and energy). The author concludes the study by discussing two different interpretations of results – one centered on the concept of economic efficiency (favoring in national cases either vertical or horizontal integration of companies) and the other on the role of institutions in modifying economic structures according to specific goals (legitimacy of bank's control over the economy).

As previously mentioned, the increasing application of refined and technically advanced techniques of SNA was also favored by the progressive diffusion and availability of organizational and institutional archives concerning economic relations. In particular, technological instruments such as super and diffused computing and software tools made it possible to collect and to process a huge quantity of information concerning telecommunication, Internet links and other types of human-based connections, which rely on networks for coordinating goods and services distribution. The longitudinal qualitative study of McKenzie for example, scrutinizes the restructuring process of a large ITC company, putting in evidence the role that networks of clients and subcontractors had in facilitating the organizational change. The advent of the so-called 'contract regime' in Eircom organization (the major telecommunication company in Ireland) as observed by McKenzie led a progressive decentralization of the organization and an increase in networks and hence interdependencies among companies and their goals. The formal mechanism of connections created by joint ventures could give way to a common understanding of business visions and a shifting balance of collaborative and competitive relations between the main company, Eircom and its subcontractors. "Inter-organizational relations", as McKenzie remarks, "must be seen as dynamic, not static, and therefore despite their appearing at this advanced stage of development, the tensions inherent within the process would continue to herald change. The inter-organizational relationship witnessed at the end of the study represented a considerable development since the earliest stages of subcontracting. This incumbent contract regime, however, could not be viewed as an end state – but was supposed to be seen rather as the latest stage of a dynamic process that would continue to be driven by the emergent contradictions inherent within it"[50].

An interesting innovation in SNA methodology based on a dynamic perspective of networks is the application of simulation techniques to study the evolution of economic systems. Theoretical hypotheses concerning the evolution of the system (e.g., rate of the formation of new links among specific nodes or firms) are first formulated by researchers and then inserted into network algorithms based on the real data, providing comparable results for discussion. The simulation results subsequently offer the possibility of verifying previous theoretical assumptions, as well as to test the fit of the model in describing the real phenomena. This perspective can be used whenever a circumscribed economic theory is under scrutiny and high-quality data are provided, as in the case of the relations concerning firms' ownership in present-day Germany, investigated by Kogut and Walker.[51] To investigate the dynamic and the effects of company acquisition and merging, the two researchers tested the hypothesis of the control of the German economic system by comparing the real network of ownership among top 500 companies, to a theoretical small-world

model. Typically, small-world networks show a large number of nodes and a limited number of links: their efficiency in terms of information diffusion, however, can be very high (or to put it differently, they have high connectivity and low density). Economic networks that possess such properties are more robust, but also more interdependent in terms of its internal components (a phenomenon described as *clusterization*). The evaluation of structural indicators and other properties of networks such as the concentration of links between firms and owners, length of the chain of interrelating relations and the centrality of the nodes (owners) support the conjectures made by researchers about the relatively cohesive world of German firms in the period considered (mid-nineties). By using simulation the authors move further, now considering the possible effect of different rates of changes in ownership on the structure of the network and measure the robustness of the ownership network with regard to financial erosion.

4. Theories of Market and the Study of Industrial Networks

Another research area where SNA methodological approach has been extensively applied is the study of markets, where explanations of economic phenomena on the basis of efficient and rational choices are combined with structural analysis of information flow and organizational models. According to Goyal this focus is linked to the recent shift in economic theory from considering interaction as internalized and anonymous, as in standard theory, to approaches more capable of understanding the impact of technological change and informal aspects such as trust and cooperative behaviors in economic relations.[52]

Economists generally tend to consider firms that organize their activities in the form of network as something distinguished from vertically integrated firms; a manufacturer in this second case obtains specialized inputs from its own plants, while in a network organization external suppliers provide specialized inputs and this implies a certain rate of know how exchange. The situation on the anonymous market would be characterized, on the contrary, by manufactures and sellers that negotiate prize for standardized inputs, a situation which is very rarely found in reality. The intent of construct theories more respondent to factual economics has brought several scholars to SNA as a possible approach to represent the interdependence of social, organizational and economic relations in production and exchange.[53] Specifically, the districts of firms together with ethnic entrepreneurship, are viewed as a typical case of the effectiveness of network organization in the economy, a form of deep-rooted organizational structure, based on informal and trust relations, specialized applied knowledge and cohesiveness of social and economic activities that

can be traced back to the beginning of the industrialization process.[54] Empirical studies of different industrial districts in the Third Italy (Tuscany, Emilia, Veneto) showed that the system of small firms was not simply an organizational form which was purposely designed to enhance the production system of certain kinds of goods.[55] Relationships between firms often fostered increased specialization and division of labor among small firms and were rooted in economies of scale, external to the single units of production, but internal to the same portion of the territory where they were located. According to Trigilia, this phenomenon originated from the interaction of a specific subculture with economic rationality and the presence of firms' districts and associative networks is connected to institutions and collective associations (trade unions, employer's associations, local councils) as agents of informal regulation in the local economy. Local regulatory models compensate national regulations and the interference of the state in the social and economic sphere, improving efficiency in transactions and production.[56]

In particular, economic sociologists, geographers and economists applying the notion of *embeddedness* to Italian industrial districts showed the structural similarity of different forms of economic organizations from informal production activities, to the rise of new industries and the establishment of alliances and innovation patterns among firms.[57] In response to Putnam's thesis on an institutional path dependency between economic development, social capital and civic culture in Italy,[58] researchers in SNA gave a different interpretation of districts' economic success. According to their perspective the clustering of economic activities in local districts in Italy could be seen both as a means of organizing the social context of economic development, and operating specific social mechanisms, specifically, those that favored the diffusion of successful economic practices. For example, the research of Chiesi, carried on in six areas of small business, concentrated on two sectors ('old economy' and 'new economy') and surveyed the relational networks of a sample of entrepreneurs, measuring their social capital and the level of *embeddedness* of the firms in the local economy.[59] Results show that specific structural characteristics of the personal networks (stability and status of relations of the entrepreneurs) can serve to predict the position of the firm in the district and of the business opportunities of the company. The implications of having a certain number of connections and of being connected to certain players, however, produces economic advantages only in networks of limited size; any increase in dimensions of the network and its associated complexity also increase the costs of optimization of relations and exceed their benefits. Social capital is therefore associated to economic development but its efficiency is subject to specific limitations and time-related downsides (e.g., excessive costs of many relations, social closure of the entrepreneurs' relations).

The study of comparative cases in European and non-European countries has further contributed to distinguishing between the concepts of *networking*, a specific form of alliance and strategic cooperation, and the one of *network*, as the formalization of the relations (commercial, productive and knowledge-dependent) among firms belonging to a particular sector or region.[60] Empirical investigations of social and economic aspects involved in the organization of collaborative relations also developed a theoretical framework to interpret these variations in efficiency in relation to network structural features. The study of Uzzi in the garment industry in New York City, for example, describes the relations among contractors and firms as networks of knowledge.[61] Manufacturers design and market garments, hiring contractors to fabricate them and provide them some information about the product and thanks to this exchange of information the terms of the contract can vary and adapt to the market and the uncertainty of the fashion industry. Moreover, the manufacturers and contractors are linked by long-term, ongoing relationships which involve "fine-grained information" acquired over time about a manufacturer's particular style. This type of market is highly fashion-sensitive and firms face significant demand uncertainty. To help ensure production, manufacturers often have long-term relationships with multiple sellers and conversely, sellers have long-term relationships with multiple manufacturers to protect themselves against the difficulties of any one manufacturer. In a subsequent study on the same sector Uzzi also finds that contractors with long-term ongoing relationships with several manufacturers have a lower failure rate than those that primarily engage in arm's-length transactions with many manufacturers.[62] The effectiveness of the business is related to the efficiency of the networks in transmitting the right information from sellers to manufactures and from them to contractors and networks of the manufactures have thus evolved in adaptation with such market requirements.

The relation between firms' network organizations and innovation also appear to figure centrally in studies that investigate the role of endogenous link 'quality' or 'intensity' connections in a networks[63] proving that some network structures (such as a 'star' distribution with a central core node and several direct connections) despite their efficiency in distribution, tend to generate an unequal distribution of payoffs. The study of Talmud and Mesch, for example, explain the differences in survival opportunities of a sample of Israeli firms.[64] The researchers relate efficiency to control over the firms' transactions and evaluate the impact of the industrial sector on the individual firm in terms of network organization (number and density of contacts). The result of their survey showed that the efficiency of connections in providing effective and stable business relations is dependent on a series of factors that are external to the economy, such as strong links to institutional subjects. Moreover, some structural features of the firms' inter-organizational networks provide support

in competitive environments and this may stimulate firms to acquire specific organizational features (isomorphism of structures). Competitive pressure, the authors conclude, creates complex and dissimilar networks as a response to the need of firms to differentiate their strategy; social capital of the firms is not clearly identifiable under such conditions and may not be necessarily related with economic efficiency.

It is important to also stress that from the methodological point of view studies on firms' production networks represent a good illustration of the integration of different information sources on economic relations. Studies on industrial districts in many cases adopt a multidisciplinary perspective and are based on industrial and local councils' archives and historical sources, or supplemented by interviews and qualitative observations to highlight specifics of territorially based economic institutions. A combination of qualitative and quantitative research on social networks has been adopted for example, by Elfring and Hulsink, who analyzed the impact of ITs from the entrepreneurial point of view by looking at how firms identify their own strategy on the market and exploit their links to expand activity or survive competition.[65]

Elfring and Hulsink select three ideal type situations of a firms' network: firms which are based on the founders' personal network, those which have been established by the merging of personal and institutional connections (typically spin-off projects) and finally those firms which originate from a 'incubator' such as a larger company that benefit from the activities of the former and provides a certain number of links and services. The study involved 32 different IT companies in the Netherlands and surveyed the relationships of the founders with social network research techniques (in-depth interviews and reconstruction of the business history); the cross-comparison among cases was accurate and the authors compared three elements in the structure of the firms' network, weak and strong ties, 'resource *embeddedness*' and legitimacy. The networks in which an entrepreneur more or less actively participates can provide opportunities for new ideas and business options, for accessing resources and also, for obtaining information. Weak ties are assumed to lead to a more varied set of information and resources than strong ties can,[66] and consequently weak ties enhance the ability of entrepreneurs to spot opportunities. Furthermore, connections may offer the start-up further access to financial resources, production know-how and complementary technology, distribution channels, in other words a 'resource *embeddedness*' that is critical in start-up and consolidation phases as well as at the time of launching innovative projects. Finally, legitimacy is identified with the spread of knowledge regarding the new business and it is particularly relevant for the IT sector, where firms deal also with problems of conveying new ideas about technology use and culture. The ability of relationships to boost a company's reputation in terms of business or market position is not secondary

and can make the difference between firms with very short timelines of production and fast knowledge obsolescence. Concluding their inquiry, Elfring and Hulsink, describe the differences among the firms in terms of different network development patterns with an initial phase of tie formation process that is quite similar for all the cases, and a second stage of changes where weak and strong connections are renewed or confirmed according to the firms' strategy and identity. The process of development of ties and its transformation is complex and according to the authors, may involve a certain amount of risk such as the firm being locked in business connections that do not provide adequate support for a competitive market or overburdening the company with redundant connections that reduce the efficacy of radical innovations.

Finally, the investigation of firms' inter-organizational relations in districts and clusters with SNA has also had the effect of stimulating analysis of the labor market. Career paths, in particular, have been analyzed by economic sociologists and organization experts[67] and applications of social network theoretical modeling of social exchange have also provided an opportunity to investigate 'special market' where the transactions dealt with are marriage and elites links,[68] academic members' recruitment and intellectual dominance,[69] or support for specific political factions.[70] Studies on the labor market put in evidence that standard labor market models used by economic theory show a limit to interpreting patterns of unemployment in the market as well as the coexistence of organizational practices and recruitment effectiveness.[71] Better connections may allow individuals to receive more information on vacancies and better recommendations and job offers,[72] The market for jobs is in fact socially regulated, resembling more a 'chain' type of structure where vacancies are filled by organizations on the basis of criteria that may include legitimization and conformation of managerial culture, conformity or innovativeness of the worker to specific work roles and other elements difficult to describe in terms of economic exchange.[73] Specifically, organizational studies have analyzed the transformation of structure and content of personal networks as result of position and function of an employee inside an organization and the influences exercised by different recruitment and career policies.[74]

5. Digital Economy and Networks of Innovation

According to modern growth theory, investments in technology and the development and diffusion of technological knowledge are the main factors explaining growth. Innovation diffusion and spill-overs can be represented rather accurately in the form of networks, and it is possible to trace links among different individuals

as in case of urban economics and regional systems. Empirical studies that hold this perspective analyse and use techniques derived from the network analysis approach to interpret economic data (e.g., input-output tables) with the aim of highlighting differences among national economic systems or specific production sectors [75]Apart from this more descriptive use of SNA, there is also the tendency to adopt a relational perspective of economic phenomena, and thus to interpret innovation and information diffusion as dynamic social processes. Usually in network analysis the diffusion of information and the adoption of innovations have been approached from the perspective of 'social contagion': the proximity (either physical or social) of people facilitate the flow of information, including those concerning costs and benefits associated to a specific innovation.[76] Innovations can consist in ideas, practices, habits and modes of relations, which are at the heart of social change and social transformation. The transmission of innovations from one subject to another is regulated by imitation and contagion among members of proximate groups, and the piece of information is more or less unintentionally passed on through social interactions.

Coleman's much-cited piece of research on medical innovation[77] was one of the first empirical works employing network analysis that showed the dynamics of innovation and provided an explanation on the basis of social interactions. The study analysed the diffusion of prescriptions with a new type of antibiotics among a population of physicists and related the rates of adoption to social interaction opportunities among physicians (a proxy of social cohesion among group members) and their sources of advice on medical innovations (information flow). Specifically, the interpersonal environments in which individuals practiced their professional activity (structure of their personal networks) proved to be highly relevant for understanding the differences between adopters and non-adopters and the rate of penetration of the innovation. These findings inspired a series of studies on the dynamics of innovation and offered stimulus for clarifying the elements in a network structure (such as roles and positions) that may be relevant in more complex processes of information transmission[78] and may also have an influence on other types of social interactions. Studies on economic innovation expanded this interest in the structural elements and in the case of studies involving economic subjects paid more attention to information flow problems, showing how the flow of innovations among firms and inside an industrial system is subject to 'rules', which are not necessarily only the ones dictated by the market. Competition and industrial strategies may in fact play a role in blocking innovation adoption in the industry. Political international relations can also interfere with free circulation of knowledge, generating problems for technological advancement or knowledge transfer among countries.

An interesting example can be found in analysis of industrial patents and their impact on technological and economic systems, such as the study by Balconi et

al. which worked with data on patents and mobility of scientists.[79] The authors measured the flow of innovations inside Italian economic system in the period from 1985 to 1995 with the aim of capturing knowledge externalities generated by innovations. Deriving the concept of social proximity from SNA, their study interprets the networks of collaborations how they relate to the discovery of patents both in terms of research affiliation (citations) and location affiliation (location of laboratory or research institution). Affiliation to a research group as in co-location, in particular, is considered equivalent in economic terms to adhesion to a club, whose benefits – knowledge concerning the patent – are restricted to members, while simple participation in co-authorship is a signal of affiliation to a public club, equivalent to presence in the network of inventors. Results show that innovation flow and its "commercial" outputs (i.e., patents) is more productive in those geographical areas that can attract "technological stars", such as metropolitan areas. However, this productivity is not necessarily a benefit for local firms as mobile inventors tend to maintain old collaboration links with distant colleagues and fellow researchers working in other firms. Bounded inventors, by contrast, though less productive were able to generate more localized knowledge externalities. The analysis of the structure of the scientists' network (scientists' personal networks of collaborations as evidenced by co-authorship links) also showed that social connections are relevant for both types of inventors, but co-localization, which implies a propensity to mobility by researchers and the presence of newly and purposely formed research teams, seem to be the most effective element favouring innovation diffusion. Many public policies designed to attract R&D firms and high-tech companies in regional and urban areas, will be less effective, the authors advise, if they not consider that network effects may introduce a structural flaw in the process of creating local spillover. The ideal model for producing economic benefit by innovation at the regional level, they argue, is in fact that of a club good (specific knowledge and economic spill-over from patents), not of a public good (already represented at the national level by the network of inventors sharing general knowledge), requiring a simultaneous investment both in firms' incentives and the criteria applied to recruit researchers.

The study of information selection processes, and in particular innovation implementation, is thus becoming crucial to understanding socio-economic evolution and to designing policies that are effective in reducing diseconomies and promoting development. Moreover, with the increasing presence of mass media and professionals paid to disseminate and collect information on innovation, obtaining information in the ITC society is less problematic than in the past; nevertheless, the large availability of 'generalized' knowledge has shifted the target to the identification of trustworthy information and their reorganization into profitable knowledge.[80] One of the most influential theories to have addressed these issues is Burts' theory of

structural holes; his first proposal relies on an extensive study of economic market organization, which has been refined and tested with empirical work in several productive and non-productive sectors of society. According to Burt, some structural positions within a network (or an intersection of networks) are given advantage in terms of opportunity to manage the information flow and select that information which is more valuable. Brokerage across groups or organizations is therefore associated with 'social capital' and the structure of some networks (a formal representation of a real social or economic context) may favour or prevent transmission of innovations.[81]

By studying the dynamics of information flow along the supply chain it is possible to highlight the presence of several social mechanisms that positively and negatively influence the process of innovation adoption; for example, social convenience (measured as cohesion with other members of a group) was one aspect that prevents managers from mobilizing support for specific ideas, despite the presence of a specific organizational code that rewarded managers' creativity. Burt's conclusion suggests further more complex analysis of innovation to distinguish between information distribution networks and innovation creation networks.[82] As he underlined, economic constraints influence individual and organizational initiative in different ways within the two contexts and thus inhibit or support those positions which hold a structural advantage (such as being across the intersection of social and knowledge worlds). In particular, the presence of profit from a bridge of relations through which employees broker technology flow between industries may be a specific product of brokerage across organizations, where structural holes emerge from specific technological and production type dependencies, while in other social contexts, such as large corporations the brokerage effect may hold less validity for information flow dynamics.

The mechanism described by Burt is valid both for positive and negative returns such as positive performance in organizations and organized crime or corporate malgovernance,[83] and has been reported in diverse contexts from biotechnology and electronics firms[84] to the art and entertainment industry.[85] Specifically, the theory of structural holes has proven able to interpret how a firms' creation of value in inter-organizational networks, where the firm's brokerage ability is articulated in the creation of new commercial value from joint ventures, project and participation to commercial networks. Connections with other firms, in fact, may not be economically profitable per se, but the opportunity to access product know-how and exchange knowledge with other firms may generate occasions for the emergence of unrecognized opportunities or, as Burt defines them, good ideas. So Ahuja's study of how the international chemical industry applies Burt's theory of structural holes, puts in evidence how inter-firm collaborative networks influence the outcomes in terms of

innovation and productivity, but also the advance of scientific knowledge that result as unintended effects of their investment in applied research.

Ahuja's longitudinal study of the patents and formalized collaborative projects among 97 large international companies in Western Europe, the US and Japan reveals that links among firms could signify different types of relations, from the direct exchange of know-how and sharing of resources and infrastructures for research, to knowledge spill-over benefits that transmit information and innovative ways of approaching problems. Competition is co-existent with collaboration and the presence of strong or formalized links does not exclude the possibility of spill-overs; moreover, the benefits that a firm could derive from a direct (formalized sharing of resources) link with another firm, are much greater than the benefits that could be derived from indirect links which had a higher risk of being non-productive. Ahuja compared his findings with other studies on structural holes and innovation and concluded that "where developing a collaborative milieu and overcoming opportunism are essential to success, closed networks (e.g., a prevalence of strong links) are likely to be more beneficial. When speedy access to diverse information is essential, structural holes are likely to be advantageous."[86] The ideal network for a firm whose primary business is the brokerage of information or technology, as is the case of most ITC companies, for example, is the one which includes many non-overlapping ties and empowers brokerage positions in knowledge spill-over. In other types of industry, the greater benefits may be experienced if collaboration between competitors is based on cooperation norms, which are more frequently associated with interconnected and closed networks of relations.

Innovation networks, however, are not limited to firms; in the globalizing world economy individuals and their associations, including households, tend to adopt technologies and make use of them for a variety of reasons. Specifically, digital innovations or knowledge concerning the use of ITC, is expected to increase the proportion of population that is able to access the market of products and to become involved in large knowledge processes. Social network theories analysed the problem of information seeking and the processes of network formation in social groups either as a product of social homophily (social ties rise more frequently among people with similar socio-economic characteristics), or physical proximity (likelihood of communication increases with personal knowledge or vicinity among subjects, like colleagues or neighbours). The effect of rising mobility or serendipitous interactions, as in the case of exposure to cultural or lifestyle innovations, is also considered a possible determinant in social change and learning processes. The more recent tendency, however, is to interpret the process of formation of information networks as a dynamic choice process, where the subjects evaluate the expertise of acquaintances,

their accessibility and the potential costs in seeking information from each specific person.[87]

The empirical work carried out by Borgatti and Cross in two organizations, for example, shows that costs have a limited role in affecting the behaviour of the information seeker, while direct access to a person and personal knowledge increases the probability of including this person among the network of 'informants'. In problem-framing situations, social and individual costs such as trust, seem in fact, to be more relevant, while in simple information exchange (typically, price and economic transactions) it is easier for people to seek fast, easy instructions, giving priority to learning out of necessity. If these results are significant also in the area of technology appropriation, we see that the insistence on an economic perspective to limit its analyses of social innovation to integration and classification categories of ITCs consumption may generate problems in interpreting future tendencies in globalized and digitalized economies.[88]

First, knowledge flow is becoming more and more relevant for the diffusion of technology responsiveness in organizations and groups.[89] The studies of community by Hampton and Wellman on the evolution of communitarian relations in a neighbourhood that is digitally connected (Netville) show, for example, that Information Technology applied to personal communication merges with global social change factors (urban mobility) and as such can promote new expressions of civic participation and demands for inclusive policies.[90] These findings are confirmed by the research of Stern and Adams on rural communities in the US.[91] The researchers report that on-line communication in rural areas facilitated social participation. Despite the fact that only a fraction of the population in rural areas makes intensive use of the Internet (and finds it 'complex to use'), rural community members use their Internet connections to get involved at the local level and to maintain local social networks (social capital) as much as to connect and find information about global issues and shared interests (cultural capital).

Second, information flow networks are extremely relevant in social processes that favour or prevent the implementation of innovations in public policies.[92] Reconstructing the process of formation and diffusion of the UN convention on Climate Change in Switzerland as a series of interactions between actors (political actors) and events (decision-making process for implementing the convention), Serdült and Hirschi were able to represent in dynamic terms the structuring of relations between governmental agencies, federal councils and environmental organizations.[93] With an analogue approach Furst et al. investigate the pressure exerted by globalizing factors such as new technologies on the regional actor network of the Hanover area in the period preceding the organization of the Hannover Exposition (Expo2000).[94] The economic relevance of the event encouraged the formation

of new relations – much more flexible organizational configurations – and had great potential in terms of innovation diffusion among the different circles of actors. One of the most prominent factors in network creation was party affiliation, which structured informal communication and meetings among actors; differences between city and country actors were also relevant, with city actors being more active (frequency of contacts) and having denser relations (multiple links). The authors concluded that transformation of the regional economy, such as the creation of new supply networks, was influenced not so much by the social capital of the actors or their individual resources than by the collaborative links that endorse the creation of a collective social capital (a form of collective good). Social circles, in this case, would act as mobilizing agents for innovations and initiate positive responses to external pressure factors, as the case of the Expo2000 confirmed. On the contrary, expected administrative reforms, which were more dependent on individual social capital (and subject to the party's control), may have a limited role in transforming the economy and involve a higher risk when used to reproduce the present economic structure, with reduced innovativeness for all the regional system.

6. Forthcoming issues in research

Contemporary social network analysis is a quickly evolving area of research, with a growing number of scholars, in economics as well in the historical disciplines, becoming attracted to this methodology and its promising potential to formalize and test theoretical assumptions. Some areas of study, in particular, are evolving fast with important advances made in practice-oriented as well as in the speculative approaches. Among them is the application of social network analysis to micro relations, which is used to identify links in social and economic theorization.[95]

Specifically, the concept of network, and in particular the use of the term to describe interconnectivity between apparently unrelated phenomena, has become central in research on the ITC society. The complexity of the subject, however, has had a twofold impact: on one hand, empirical studies of ITC's impact has adopted network analysis models on specific sub-themes (such as studies on the social impact of telecommunications on social integration). On the other hand, the availability of data which are suitable for network analysis has become impressive (see the works dealing with evolution of the structure of the Internet by Gonzalez-Bailo),[96] and has created sub-disciplines of study where sociological analysis merge with social physics.[97]

This very recent methodological innovation reflects a shift in theoretical perspective, with considerable impacts in empirical research. While revising results of empirical networks analysis – both in social or natural contexts – mathematicians

and physicists realized that network models inspired by random or abstract criteria cannot describe the real dynamic of many natural and man-made phenomena. The discovery that in several large networks (protein domains, Internet routers, and computer virus diffusion) the distribution of the degrees follow a power law (or, put differently, that the network is scale-free) has thus inspired scientists to explore complex networks looking for systematic mechanisms or principles. The paradigmatic shift has also been favoured by the progressive diffusion in a society of organizing and communicative systems that are based on network forms, such as the WWW or that rely on networks for coordinating goods and services distribution (air transportation). Technological instruments such as super and diffused computing and software tools have made it possible to collect and process a huge amount of information concerning telecommunications, Internet links and other types of human-based connections, plus biological and biochemical data on animal species, genes and diseases. Moreover, the observation of real networks derived from empirical and historical studies and the comparison with theoretical results from simulations indicate that systematic patterns of connections may be related in some contexts (e.g., cooperation) to specific forms of relationships between actors (shared knowledge about economic processes or cognitive assonance from cultural models).

Still the prerequisites which may limit the use of secondary data or new information collection may preclude specific research objects or may not integrate with definite theoretical perspectives. However, technical innovations such as simulation or modelling have certainly contributed to raising the level of analysis from simple descriptivist.[98] A final example demonstrates this integration of multiple levels in empirical observations and theoretical explicatory power in network analysis applications in social process modelling. In the case of the work of Sindbæk, the use of historical data dates back to archaeological sources with the intent of analysing time-related differences in communication networks.[99] Relating the material documenting the travels of a Norwegian missionary (Anskar the Viking) in early medieval Europe to sites that are meaningful from a religious or political point of view, the researcher reconstructs a 'small world' network of Anskar personal contacts and compares its properties to theoretical small-world models. The comparison shows that some typical elements of communicative networks, such as the clustering of travellers (nodes) around specific sites and social groups or organizations (in this case, the Catholic Church) are not linked to the historical period, while other characteristics as the centrality of weak ties (e.g., a key actor in the chain of encounters) in connecting culturally and politically separate geographic areas, appear to be historically specific and highly context-dependent.

New interests in applied research have also stimulated network sociologists to differentiate their theoretical perspective and to move to innovative relational con-

texts. In particular, new forms of economic transactions, such as E-markets and virtual marketplaces have attracted the attention of economic scholars, providing a context of experimentation for communication and cooperation theories. The analysis of economic systems has also taken up the issue of integration with ITC as a competitiveness factor among cities and regions. The study by Malecki, for example, scrutinizes the urban economic systems of ten European cities, looking at interactions between enterprises that belong to the same urban environment.[100] To illustrate the role of different types of network structures the author distinguishes between 'hard networks', those related to the implementation of the Internet economy in production and infrastructures, and the 'soft networks' which represent the social connections that gather and distribute knowledge about the local economy at the regional, national and international level. Evaluating the level of integration in the ITC society of the ten cities and the opportunities for digital connectivity that are offered to the urban population and to the industry and service economy, Malecki relates the economic implications of E-economy (e-trade and production and logistic structures) to concerns for social integration. The conclusions of his study is that integration between the two types of networks is the best combination, because only 'hard networks' or 'soft networks' cannot efficiently promote innovations or develop the right use of the system in public infrastructures. Moreover, as the author notes, "digital divides between the computer-literate and the rest of the population is a risk for the ubiquitous e-commerce and even more so for e-government, because governments cannot choose to serve only selected customers", but are supposed to impact the majority of citizens.[101]

Besides, the new communicative forms of interaction based on networks, such as the ones explored in online and technology mediated communities are increasingly becoming objects of scientific inquiry. Their disciplinary impact is still to be evaluated, but is expected to stimulate innovation, not only on the technical side (sampling, collection and filtering of relational and social network data) but also theoretically. According to researchers new forms of social participation, differing from the usual one, will emerge with the gradual implementation of mobile technologies of communication from e-government to shopping and cultural life. Some of the methodological questions posed by SNA are to be addressed in future research agendas that will pay attention to basic social organization principles such as shared knowledge and the multiplicity of forms of communication.[102] Contemporary social network analysis moves along these complexity dimensions, focusing on evolution of social patterns with visual exploration of structural relations among sub-groups in tournaments and repeated interactions (Markov chain effects) and in cross-national contexts, such as financial markets and telecommunications.

Finally, the development of specific software and computer programs for visualizing and relating large amounts of data, can be expected to contribute to more refined knowledge about time-related processes in social life and collective phenomena. The availability of digital archives, specifically, is already stimulating multidisciplinary research and interpretative frameworks that support such empirical advances. The research perspective, especially in economics, however, has yet to implement a relational point of view in collecting, processing and interpreting data and information flows that are at the heart of the digital transformation, as well as ethical guidelines for collecting and processing online data.[103] In this connection sociological and historical perspectives may significantly contribute to the development of interpretative frameworks that are more receptive to these aspects and to knowledge integration goals.

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