Networks and Economic Life

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Introduction

Sociologists and anthropologists have long been concerned with how individuals are linked to one another and how these bonds of affiliation serve as both a lubricant for getting things done and a glue that provides order and meaning to social life. The attention to networks of association, which began in earnest in the 1970s, provided welcome texture and dynamism to portraits of social life. This work stood in stark contrast to the reigning approaches in the social sciences. In contrast to deterministic cultural (oversocialized) accounts, network analysis afforded room for human agency, and in contrast to individualist, atomized (undersocialized) approaches, networks emphasized structure and constraint (Granovetter, 1985). Network studies offered a middle ground, a third way, even if no one was quite sure whether networks were a metaphor, a method, or a theory (Barnes 1979). But the sociologists and anthropologists who initially studied networks did not pay sustained attention to economic activity, although some industrial sociologists (Roy, 1954; Dalton, 1959) had long stressed the role of informal networks as an antidote to formal organization practices and structures.

Over the past two decades, however, there has been an enormous upsurge of interest in the role of networks in the economy. This sea change has occurred in the worlds of both practice and theory. Across the social sciences, from anthropology to sociology to political science to economics, there is research on the role of networks in shaping such diverse phenomena as migration, entrepreneurship, the viability of communities, and international trade. In the world of business, an appreciation for the role of both informal and organized networks has grown markedly. The late Bennett Harrison (1994) nicely summarized this trend with his quip: "Networking among

companies is now in fashion all over the world." Networks provide three broad categories of benefits: access, timeliness, and referrals (Burt, 1992). Ties can facilitate access to parties that provide information and/or resources. Linkages that generate access in an expeditious manner afford advantage over those who lack comparable connections. Referrals offer the opportunity to bypass formal, impersonal channels. Thus, the cumulative effects of networks on economic outcomes can be considerable indeed.

Much of the literature on networks emphasizes that they are most salient in a domain between the flexibility of markets and the visible hand of organizational authority (Powell, 1990). Networks provide order to disconnected parts of organizations and markets (Burt, 2000). The challenge for research on networks is to explain their emergence, activation, and durability. Networks, as Mark Granovetter (1985: 491) emphasized, "penetrate irregularly and in different degrees." Thus some individuals are better placed than others, some groups are more isolated, some formal organizations have more informal cliques, and some communities have more associational life. There is wide variability in the presence of linkages across multiple levels, and in when these connections are mobilized. We know a good deal more about the effects of networks than we know about the factors that generate, sustain, and reproduce them.[1]

The empirical terrain covered in the economic sociology literature ranges widely, including the following analyses of how networks influence economic activity:

1.) Networks represent informal relationships in the workplace and labor market that shape work-related outcomes. Social ties and economic exchange can be

deeply interwoven, such that purposive activity becomes "entangled" with friendship, reputation and trust.

2.) Networks are formal exchanges, either in the form of asset pooling or resource provision, between two or more parties that entail ongoing interaction in order to derive value from the exchange. These more formal network relationships may be forged out of mutual need, but can also lead to interdependence and repeated interactions that reduce the need for formal control.

3.) Networks are a relational form of governance in which authority is broadly dispersed; such arrangements are more commonly associated with settings where both markets and environments change frequently and there is a premium on adaptability. Much of the literature has celebrated this flexibility, but it is important to recognize that this form of organizing can be found in an entrepreneurial firm, a terrorist cell, an organization with extensive use of cross-functional groups, an international company with many cross-border alliances, or an illegal drug cartel. The flexibility of networks can be tapped for good or detriment.

Studies of these diverse forms of economic activity commonly share several key assumptions. One, the analytical focus is more on the nature of the relationships rather than attributes of the actors. Two, attention is directed to location within the larger context in which information and resources flow. Three, there are increasing returns to "investments" in relationships and position, which can produce rapid mobilization, cumulative advantage, or "lock-in." Our goal in this chapter is to survey the rapidly

expanding empirical literature on networks and economic life, while emphasizing the conceptual and theoretical advances that this research draws on. To serve this dual aim, we begin first with a brief overview of key analytical tools used in network research.

A Conceptual Toolkit

In the first edition of this volume we argued that two branches of the network literature on economic activity - - one more focused on methods, a second more concerned with governance - - had developed rather separately (Powell and Smith-Doerr 1994). One branch utilized increasingly sophisticated tools to analyze networks of social actors, building on diverse theoretical perspectives, ranging from neo-Marxist to rational choice. A second literature, more united in its theoretical orientation but less so in its data and methods, employed a network metaphor to characterize a form of economic organization in which organizations have flatter job hierarchies, permeable boundaries, and numerous connections to other organizations.[2] While this division of academic labor still persists, the manner in which network ties are conceptualized can provide a common language that bridges multiple lines of research.

Network analysts use concepts of location, or nodes, and the relations among these positions - - termed ties, connections, or links - - to argue that the pattern of relationships shapes the behavior of the occupant of a post, as well as well as influences others (Marsden and Friedkin, 1993). As Knoke (1990, p. 9) tells us, "A position's power - - its ability to produce intended effects on the attitudes and behaviors of other actors - - emerges from its prominence in networks where valued information and scarce resources are transferred from one actor to another." Practically, a variety of images

depicting the relational structure of networks provide scholars with a toolkit of concepts to draw upon in both empirical and theoretical work.

The idea of a network invokes the image of connectedness between either individuals or organizations. The work of Georg Simmel provides the classic foundation in social theory for network analysis. Simmel argued for the importance of group composition to understand fundamental aspects of social life. For example, he contended that the differential roles of laborers and employers in the economy were explained by group size. Employers lack the sense of solidarity that workers have because of "the smaller number of employers as compared to the number of workers; the larger the number of a given kind are involved, the more readily a general concept is formed" (Simmel 1955 [1922]: 176). In addition to group size, Simmel pointed out the importance of considering the position of an individual actor within a group. He developed the idea of "tertius gaudens," or the third who benefits (Simmel 1950). In a triad, a third person can play off the other two against each other, benefiting from their conflict, for example, if the two are buyers and the tertius is the seller. Merton (1957) further elaborated Simmel's idea in his discussion of role-set theory, positing that there may be a downside to having multiple associates calling upon an individual's different roles at the same time (think of someone who is both a parent and an employee). One strategy that a tertius can use when two others make conflicting demands is to make that role conflict known to the other parties, thus recognition of incompatible demands may provide room for autonomy. Burt (1992) has also built on Simmel's idea of tertius gaudens in his discussion of how a third who connects two others who are previously unknown to each other bridges a structural hole.

The striking visual impact of network analysis accounts for some of its popularity. As Scott (2000: 10) observes, we now have difficulty imagining that Simmel wrote of "webs of affiliation," before Moreno (1934) had devised the familiar nodes and lines of the sociogram in the 1930s. Today we have sophisticated mathematical operations coded into software (e.g., UCINET, KrackPlot, Inflow, P-Star, Pajek) to analyze and depict features of relationships parsimoniously. While complex algorithms are necessary to analyze large-scale networks, the simple images of connection that underlie network measurement provide a key to understanding how various measures reflect substantively different configurations of social relationships. Take, for example, the contacts between a potential employee and an employer. If the employer is the friend of a friend, we can describe the relationship in terms of path length—two degrees of separation. Put colloquially, the job seeker is two handshakes away from an interview. We could also portray the relationship between a potential employee and employers in terms of the strength of their ties. Perhaps a job seeker is the best friend of one potential employer and a distant acquaintance of another. A strong tie binds the job seeker in the former relationship, while a weak tie provides the linkage to the latter. One might say the job seeker is either a handshake or a hug away from an interview. The measures of path length and tie strength can be combined to assess how many strong or weak ties separate a given individual from another in a network. These tools do not, however, explain whether an individual provided a bridge linking two disconnected networks. This example illustrates how the choice of a particular tool (or tools) facilitates predictions that can be made about network relationships.

Table 1 here

We introduce and illustrate eleven key network concepts that we have culled from the literature. In the figures in Table 1, the dots, or nodes, represent social actors—e.g., individuals, groups, or organizations. The lines in the figures represent ties, or social relationships between the actors.

The first row of Table 1 depicts the simple distinction between a group and a network. A group has some form of social boundary indicating who is in the group and who is not (illustrated by the ellipse around three dots). In contrast, a network is a set of actors, with specific types of connections to one another. For example, an industry consists of a group of companies, who may all be members of an industry trade association and listed in various industry publications. The industry affiliation network, however, would describe alliances between firms, interlocking directorates, or supply-chain relations among buyers and sellers. While data on the relationships among group members may be more difficult to gather than membership data, they can provide insight into how the actions of one member affect another member. The second row of Table 1 shows a basic sociometric configuration, as conceived by Moreno (1934). The node in the center of the figure is the "star" of the network. Zucker, Darby and Brewer (1998) have employed Moreno's language of network stars to analyze the scientist-entrepreneurs who combined academic and commercial science to start some of the first generation biotechnology firms.

The idea of structural equivalence, developed by Harrison White, occurs when two actors occupy similar positions in a social system by having structurally comparable network ties (White, Boorman and Breiger, 1974; Lorrain and White, 1971). The figure

in the third row of Table 1 shows a simple representation of structural equivalence in networks. In the figure, the circular nodes are equivalent in that they each possess a tie to a square, a triangle and a flattened circle. Consider two American universities, each with active ties to different corporate benefactors, student loan providers, and state governments. The universities are structurally equivalent, that is, they occupy a similar position by having the same kinds of relationships, even though their ties are not to the same organizational partners.

The idea of the strength of weak ties has become a foundational element of network research, thanks in large part to Mark Granovetter's (1973; 1974; 1995) pioneering work on the job search process. The fourth row of Table 1 represents strong and weak ties between nodes, the weaker connection demonstrated with a dashed line. One study that has looked at both kinds of relationships is Wellman and colleagues' (1996) analysis of the use of the internet in the workplace. They found that computer-supported weak ties were more helpful than strong ones for gaining access to useful information. Similarly, in another study of a large organization, Constant, Kiesler, and Sproull (1996) found that workers with diverse online weak ties received better technical advice.

Structural holes are the natural borders in social space. The fifth row of Table 1 depicts a bridge across a structural hole in network space. The two triangular networks are not connected to each other, except through the bridging node at the center of the figure. Managers who can create inter-divisional networks in large organizations provide bridges across structural holes, combining information from disparate groups that would not otherwise communicate (Burt 1992). Research shows that managers located in such

positions move more rapidly up the corporate ladder. Row six demonstrates the popular concept of "six degrees of separation." On the basis of his studies of the passage of correspondence among strangers, Milgram (1967) offered the provocative idea that U.S. citizens are connected by six degrees of separation or less. As the figure shows, between the node on the far left and the far right node, there are six lines, or degrees, and five other actors. Cultural industries often constitute small worlds as new entrants rarely work with other novices, but instead affiliate with veterans. In response to the uncertainty about the audience for new films, Hollywood filmmakers often use the same artists on film after film (Faulkner and Anderson 1987). Watts and Strogatz (1998) have shown that, on average, the network of film actors is linked by less than 4 degrees of separation.

The linkages between corporate executives and business policies are often scrutinized in research on interlocking directorates (Mizruchi, 1996). In the figure on row 7, the circles represent membership on corporate boards of directors. While the 1914 Clayton Act prohibits competing U.S. corporations from sharing members of their boards, companies can legally pursue interlocking directorates if each has an executive on a third board. In the 1960s, top managers joined exclusive social clubs in addition to seating outside members on their boards as a means to orchestrate acquisitions of other corporations (Palmer and Barber, 2001). Here, a simple interlock between board 1 and board 2 through common membership on board 3 is illustrated.

While direct network ties frequently shape economic outcomes, research has also demonstrated that second-order ties, or the affiliations of partners, are consequential as well (Freeman, 1979). The two networks depicted in the figure on row 8 demonstrate how local and global centrality differ. Consider the node in the center of the top network.

The four connections represent direct degree centrality. If the network is expanded, as in the lower graph, we see the centrality of this node in the overall network. In this case, centrality is weighted by the number of alters connected to the actor's partners. Shah's (2000) study of an electronics firm found that an employee's centrality in the overall network increased when the company laid-off a structurally equivalent co-worker. Although downsizing may have caused the individual's number of direct ties to decrease, survivors often became more central in information flows in the overall network.

Centrality, however, does not always correlate with power and influence (Bonacich, 1987). Row nine of the table illustrates how centrality differs from power in an exchange network. In this network, lines denote a zero sum exchange—so that if B deals with C it cannot deal with A. Point A is the most central in the network, but not the most powerful. Exchange theory defines power as the degree of dependency on others or a focal actor (Emerson, 1962; Cook, 1977). The figure shows that while A has four potential exchange partners, none is dependent solely on A. The B position occupies the most powerful location in the network because it monopolizes both C and D's trade for a substitutable resource (Yamaguchi, 1996). Haveman and Nonnemaker (2000) found that a savings and loan firm's social structural position in markets determines its pattern of competition and growth. Savings and loans with more local, single-market contact do not grow as quickly as firms with multi-market contacts. Savings and loans that compete in multiple domains tend to temper their rivalry to avoid future reprisals for cut-throat behavior. While these multi-market firms gain centrality by having more exchange partners, they also increase their dependence on rivals for mutual forbearance in markets. As Haveman and Nonnemaker show, the growth of multi-market firms eventually slows,

as their various dependencies eventually constrain their expansion and result in less market power.

The figures in row 10 depict density, a measure that captures structural properties of the network as a whole rather than of an individual node (Barnes, 1979; Marsden, 1993). A network that is maximally connected is dense—in the figure the network of four nodes on the left has higher density than the one on the right. Biggart's (2001) analysis of rotating credit associations demonstrates that stable communities with denser social relationships provide a necessary context for successful peer group lending. The last row of the table draws from Watts and Strogatz's (1998: 441) analyses of network topology, which show that it takes but a few small changes to tip from a random association configuration to a small world of closely connected actors. News travels quickly in small worlds, but they are also highly vulnerable to attack and perturbation, thus the removal of several highly connected hubs can destabilize an entire network (Albert, Jeong, and Barabási, 2000; Barabási, 2002).

This toolkit of images portraying different network configurations reveals how variation across networks can be conceptualized. These patterned differences in the shape of networks have potent effects on economic outcomes. Consider, for example, Mizruchi and Stearns' (2001) study of the effects of networks on bank decision-making. They analyze bankers' networks in terms of their tie strength and density. Bankers consult closely-linked colleagues in order to feel more certain about their financial information, but this strategy does not lead to the successful closure of deals. Close ties do not result in sufficiently candid or fresh assessments of information, but rather reinforce existing opinions. Now consider a comparable study to Mizruchi and Stearns'

analysis of decision-making networks, but focused on the exchange power of bankers. An assessment of how a banker utilizes colleagues for information or support to facilitate rapid promotion might find that close ties are critical for sponsorship. Thus, having a diverse intellectual tool kit affords the opportunity to understand the varied effects of different types of network configurations on economic outcomes.[3]

Progress is needed, however, in developing new tools, particularly measures that capture the kinds of information that passes through networks, as well as more macro-level measures of the cohesiveness of large networks (but see White and Harary, 2001; Moody and White, 2003). Measures that provide an account of network durability and experience would be useful, too. The sociology of the family, for example, has developed the study of the life course as a fruitful line of research incorporating chronology as a central feature. Studying the life course of economic relationships would allow the development of measures that capture the quality of ties, which could provide purchase across a range of organizational contexts. Longitudinal empirical studies that map regular patterns or phases in economic relationships can suggest when networks either become calcified or generate novelty, and predict the deepening or demise of ties (Powell, White, Koput, and Owen-Smith, 2003). We turn now to a discussion of some of the factors that foster the development of networks.

The Formation of Networks

The toolkit of network measures offers wide purchase, providing sociologists with "radiological" tools to examine the structure of social relations. Viewed from a structural perspective, networks are present in a broad range of circumstances, from markets to

formal organizations. Structural analysis, however, elides the crucial questions of what factors contribute to the formation of networks and why do some networks prove beneficial and others do not. To tackle these questions, we need to explore the relationship between formal and informal organization, and develop a more general definition of networks as a form of exchange or organization. We can then build on these ideas to explore the conditions that facilitate the formation of networks, and, in turn, analyze these networks with our array of measures.

Formal and informal foundations. Much of the writing in the economics and sociology of organization concerns the formal structure of authority, the incentive systems that ostensibly motivate employees, and the job ladders that employees climb throughout their careers. That there is considerable activity outside the formal channels of authority is obvious to anyone who has spent any time in organizations, but curiously there is little theory to guide us in understanding informal organization. The interplay between formal and informal structures - - the chain of authority represented in the organization chart versus the soft underbelly of friendship cliques and tacit workplace norms - - is not well understood.

In the much discussed Hawthorne study, Roethlisberger and Dickson (1939:457) argued that "employees had their own rules and their own logic which, more frequently than not, were opposed to those which were imposed on them." In contrast, Burawoy (1979), in his ethnography of a piecework machine shop, argued that the myriad games and rule-bending taking place on the shop floor were neither independent of nor in opposition to the interests of management. Research on communication networks, done in the early 1950s (Bavelas, 1950; Leavitt, 1951; Guetzkow and Simon, 1955), suggested

that hierarchical patterns inevitably emerged out of informal channels of communication. Hall (1991:116) made a more general claim that cliques, coalitions, or other forms of informal organization "obviously begin from the established organizational order and then become variations from that order." Empirical support for Hall's claim can be found in studies like Stevenson and Bartunek's (1996), in which informal interactions among small groups of teachers in a K-12 school did not lead the groups to agree, while teachers in similar structural positions—the grades they taught—did concur on the organizational order. Krackhardt and Porter (1985) illustrate the reverse effect, showing how friendship networks influence job satisfaction and employee retention. Mintzberg (1979) offered a more dynamic view, arguing that the formal structure and informal relations are interdependent: "The formal shapes the informal, while the informal greatly influences what works in the formal, and sometimes even reflects its shape to come."

When the camera is directed at formal aspects of organizations, networks appear as the informal connective tissue between the formal structures. Thus most work on intraorganizational networks focuses on informal relationships. (See Krackhardt and Brass, 1994; and Raider and Krackhardt, 2002 for useful reviews.) When the lens shifts to relationships among organizations, attention is directed much more at formal ties that connect organizations. (Note that there are two categories that are often neglected - - formal internal networks and informal external networks.) The external linkages that connect organizations take many forms: subcontracting relationships, research consortia, strategic alliances, joint ventures, and a wide array of activities that fall under the rubric of relational contracts. Podolny and Page (1998: 59) offer a useful definition that cuts across these diverse forms of external linkage: a network form of organization is "any

collection of actors that pursue repeated, enduring exchange relations with one another." These exchanges are not guided by a common central authority that can dictate the direction of the relationship or resolve disputes.

Under what circumstances are these more formal relational linkages likely to arise? What conditions promote the dominance of lateral as opposed to hierarchical relations inside organizations? And when do markets function less like the stylized spot market of isolated participants and more like a relationship of give and take, where participants exercise voice rather than exit (Hirschman, 1970)? These are difficult questions, not well addressed by the literature. In an early formulation of an answer, Powell (1990: 323) observed that the origins of networks are highly contingent: "In some cases, the formation of networks anticipates the need for this particular form of exchange; in other situations, there is a slow pattern of development which ultimately justifies the form; and in other cases, networks are a response to the demand for a mode of exchange that resolves exigencies that other forms are ill-equipped to handle." A full examination of the formation question would require a chapter-length treatment of its own. Here we attend to several key factors that are most relevant to economic outcomes, including the type of work performed and the wider context in which work is carried out.

Project-based work. A core insight of contingency theory is that the nature of the task that needs to be executed or the problem that demands resolution has a strong effect on the form of organization (Stinchcombe, 1990). Many kinds of work tend to be project-based, rather than involve the continuous production of a good or service. These temporary projects involve products that are relatively unique, hence the work process depends to a considerable degree on intuition and skill (Stinchcombe, 1959; Perrow,

1967). Organizations in craft-based industries have long eschewed formal organizational arrangements, opting instead for more flexible, short-term relationships. Industries such as construction (Stinchcombe, 1959; Eccles, 1981), book publishing (Coser, Kadushin, and Powell, 1982), architecture (Blau, 1984), women's clothing (Uzzi, 1996), the diamond trade (Ben-Porath, 1980), music (Faulkner, 1983) and the film industry (Faulkner and Anderson, 1987) rely, to a considerable extent, on stable and enduring personal networks based on loyalties and friendships cemented over time. In these settings, formal collaboration commonly emerges out of pre-existing informal relationships. As a consequence, these forms of repeated exchange are much more than a series of bilateral relationships, but are entangled with the concerns of friendship, status, and reputation.

Information access. Connections are also vital in high-velocity environments, but the forces fostering linkages are less driven by loyalty and association and more by a need to stay informed. In fast-paced fields, where knowledge is developing rapidly, the sources of expertise are widely dispersed, and there is uncertainty about the best approach to a problem, organizations forge connections to other parties to access relevant expertise. Access to centers of knowledge production is essential when knowledge is developing at an unprecedented pace. Moreover, much sophisticated technical knowledge is tacit in character - - an indissoluble mixture of design, process, and expertise; thus it is not effectively transferred by licensing or purchase. Under conditions of uncertainty, firms seek out partners with technological complementarities. Collaboration can shorten the time it takes to bring new ideas to market, while access to a broad network of cooperative R&D provides companies with a rich portfolio of diverse information sources.

Moreover, rather than simply enhancing the transfer of information between two or more parties, the relationship becomes an opportunity for novel syntheses that diverge from the stock of knowledge previously held by the individual parties (Powell, Koput, Smith-Doerr, 1996; Stuart and Podolny, 1999). In such circumstances, networks can become the locus of innovation.

Organizations involved in collaborative ventures often struggle to construct a framework in which they can learn from partners without becoming unduly dependent upon them. Formal strategic alliances may lack the relational glue that project-based networks possess, hence they must rely on contractual mechanisms to curb potential opportunism. At the outset of an alliance, monitoring may be formally negotiated, with prearranged progress reports and milestone dates. Many commentators stress the fragility of such relationships (Doz and Hamel, 1998); indeed there is considerable turnover in high-tech alliance partnerships (Hagedoorn, 2002). But a focus on impermanence misreads both the focus of alliances and their evolving dynamics. As a rule, strategic alliances are short-term agreements designed for specific purposes – to produce a prototype, to establish a joint venture, or to enter a new market. In such settings, trust is not readily established; fear or uncertainty must be overcome before information can be shared. But once a strategic alliance is successfully pursued, further cooperation with the same partner is easier should the need arise. Moreover, participants develop reputations as either reliable or unreliable partners, sending signals that either attract or repel possible collaborators. The process is iterative – the level of cooperation increases with each agreement among common partners; at the same time, individual participants become more skilled at learning through alliances. As parties learn to rely on one another and

develop reputations for effective collaboration, the amount of contractual detail that unites the parties is reduced (Lerner and Merges, 1998). Various forms of monitoring are lessened and control rights, such as an equity stake, are utilized less frequently by participants that are centrally located in an industry network (Lerner, Shane and Tsai, 2003; Robinson and Stuart, 2002).

In one case, project-based networks, informal personal ties lead to repeat contracting, while in networks generated by a response to uncertainty, successful repeat contracting leads to less formal controls and a more informal basis of peer monitoring. In both circumstances, groups of collaborators become involved in multiple forms of cooperation and competition. We argue that these new patterns of affiliation, with shifting rival alliances competing and recombining on a project-by-project basis, lead to new interpretations of the nature of competition. First, recognize how profoundly a competitive relationship is altered when two parties compete on one project, but collaborate on another. The goal of competition cannot be to vanquish your opponent lest you harm your collaborator on a different project.[5] Second, consider how the identity of the organization has changed: no longer a coherent totality, but a bundle of complex projects. Judging the likelihood of success also requires knowledge of the capabilities of a firm's partners. Finally, a reputation for successful cooperation has become a valued asset. The financial markets have learned how to evaluate the value of networks. In fields such as biotechnology and information technology, the industry business press, as well as the financial community, routinely assess the quality of a firm's networks.

Regional agglomeration. Perhaps the most extensive use of interorganizational linkages is found in spatially concentrated regions, sometimes referred to as industrial

districts (Marshall, 1920; Becattini, 1978). The region dubbed the third Italy is often regarded as an exemplar of flexible, decentralized production. Networks of loosely linked, but spatially clustered, firms create a distinctive "industrial atmosphere" where the "secrets of industry are in the air," (Marshall, 1920). The modus operandi of the industrial districts rests on a very different logic than that found in the vertically integrated, mass-production firm. Firms are commonly grouped in specific zones according to their products: knitwear in Modena; bicycles, motorcycles, and shoes in Bologna; food processing machinery in Parma; and woodworking machine tools in Capri (Brusco, 1982). Within the region, firms specializing in a product congregate in a specific area, serving to link industry and region closely. Work is carried out through extensive, collaborative subcontracting agreements. Only a portion of the firms market final products; the others execute operations commissioned by a group of firms that initiate production. The owners of small firms typically prefer subcontracting to expansion or integration (Lazerson, 1988). Though closely related and highly cooperative, the firms remain independent.

Saxenian (1994) contends that Silicon Valley evinces many of the same characteristics as the European industrial districts. She suggests that it represents an industrial order that promotes collective learning among specialist producers of related technologies. In this decentralized system, dense social networks and open labor markets encourage entrepreneurship and the ongoing mobilization of resources. Companies compete intensely, but they simultaneously learn about changing markets and technologies through informal communications, collaborative projects, and common ties to research associations and universities.

The logic of the industrial districts is self-reinforcing. The more distinctive each firm is, the more it depends on the success of other firms' skills or products to complement its own. Repetitive contracting, embedded in local social relationships, encourages reciprocity. Monitoring is facilitated by social ties and constant contact. Indeed, trust-based governance seems easy to sustain when it is spatially clustered. Proximity, as is found in north-central Italy or Silicon Valley, seems to be both too strong and too weak an explanation for trust. Too strong in that the apparent advantages of the industrial districts seem insurmountable: How could models of production that are not as spatially concentrated generate comparable levels of trust? But too weak in that other regions that combine similar skills and advantages cannot reproduce comparable norms of reciprocity and information exchange. The simple fact of proximity among companies provides insufficient purchase on their mode of organizing. The vibrancy of the districts is not due to their geography alone, but to their social practices. To understand why districts have formed in particular locales, an analysis of the institutional infrastructure that enables economic growth is necessary.

Studies of Silicon Valley stress the unusual combination of extensive university-industry relations, initially fueled by Stanford University's Engineering School (Sturgeon, 2000; Leslie, 2000; Gibbons, 2000), the creation and expansion of venture capital to fund startup companies (Kenney and Florida, 2000; Hellman, 2000), and law firms that stressed negotiation and dispute resolution over litigation (Suchman, 2000). As this region developed, professional service firms, such as consultants (McKenna, 2000), accountants (Atwell, 2000), and executive search firms (Friel, 2000) helped sustain an ecosystem (Bahrami and Evans, 2000) with highly fluid labor markets (Angel, 2000) and

high rates of a firm formation and recombination (Kenney and Von Burg, 2000). Herrigel's (1996) analysis of Baden-Württenberg in southwestern Germany also points to the wide availability of critical support services – excellent technical colleges and vocational training institutes, small banks willing to loan funds to local small businesses, specialized industry research programs – that encourage cooperative relations that attenuate the cut-throat aspects of competition. In the Third Italy, decentralized production also depends upon a combination of familial, legislative, political, and historical factors. The bonds of extended kinship create economic relations based on cooperation and aid the search for new employees through family and friendship networks (Lazerson, 1988).

Thus, while the particular configurations of institutions may differ across regions, the common elements that give rise to the formation of districts appear to be a host of supportive intermediary organizations that promote and support risk-taking, while curbing some of the destructive aspects of intense competition by sharing risk (Kenney, 2000). These supportive institutions serve as both conduits of resources and as monitoring agents that guide and structure inter-firm collaboration. In such settings, competition fosters knowledge creation, while 'news' circulates rapidly as participants are connected to one another through multiple pathways. As valuable knowledge percolates through networks, participants attend to their partners with more intensity. The enhanced flow of ideas and skills then becomes an attraction, rendering the regional economy more appealing to be a part of, and more vibrant than other locales where the generation of novelty occurs less frequently (Powell, 1990; Brown and Duguid, 2000).

There are many other circumstances that foster networks. Smaller organizations seem to rely on external forms of support more than larger organizations, while resource-constrained firms turn to networks more readily than established, successful organizations (Baker, 1990; Larson, 1992). Historical contingency and founding date loom large as well. Firms established during a period when relational contracting is widely used, more readily avail themselves of external linkages than do large vertically integrated firms founded during an earlier era when companies strove to be self-sufficient (Powell, 2001). Table 2 summarizes key elements of the research literature on the formation of networks. We now turn from our sketch of factors that account for the origins of networks to an assessment of the performance consequences of networks.

Table 2 here

The Consequences of Connectivity

The consequences that accrue from one's position in a network may be positive or negative, and the goals that networks serve may be put to socially beneficial or harmful uses. Research initially focused much more on positive effects of networks, stressing their advantages over other forms of governance, such as markets or hierarchies, in terms of speed and reliability of communication. At the core of networks, however, are questions about differential access; hence the advantages that ensue from a favorable position in a network may benefit some parties while limiting others. More recently attention has focused on the ubiquity of networks and the extent to which both legal and illegal economic activity may be orchestrated through networks. The growing presence of international terrorism is a powerful reminder that cells of operatives organized as a decomposable network can create widespread destruction (Arquilla and Ronfeldt 2001).

We review the literature on the consequences of membership and position in networks, attending first to issues of performance. We then turn to distributional concerns, and assess what is known about the preferential advantages and disadvantages of networks. We conclude with a discussion of the diffusion of ideas through networks, examining both the utility of networks for accessing novel or obsolescent information and when networks 'recycle' stale information.

Performance issues. Labor market opportunities have been a rich terrain for network analysts. In a now classic study of professional men seeking work in the Boston area in the 1970s, Granovetter (1973; 1995) found that weak ties (i.e., someone with whom you are acquainted but travels in different social circles, such as a classmate from college) lead to jobs more readily than did strong ties among friends and family. Acquaintances are valuable in finding employment because they provide non-redundant information that strong ties do not. Close friends and family members have access to the same contacts and information, whereas weak ties more often supply new contacts and information. On the other hand, strong ties may be more motivated to help when one is in great need for a job. More generally, most job-seekers find work through personal connections rather than formal channels (Granovetter 1995). Subsequent surveys report wide replication of Granovetter's findings. A majority of job seekers secure work through information gathered through their social network ties not only in the U.S. (Marsden and Campbell 1990), but also in the U.K. (Fevre 1989), the Netherlands (Boxman, DeGraaf and Flap 1991), Mexico (Rogers and Kincaid 1981) and China (Bian 1997). Lin (1999) provides a comprehensive review of this growing literature.

Employing organizations also benefit from hiring through networks. Employers have a strong motivation not to hire strangers; they prefer dependable employees who have been vouched for by others. Job offers made to acquaintances of current employees are more likely to be accepted, and those hired through these channels are less likely to quit (Licht 1992; Blau and Robins 1990). Fernandez, Castilla and Moore (2000) counted the significant economic returns that accrued to a phone center by hiring through referrals for a job with a high rate of turnover. By saving on the costs of screening applicants, the credit card phone center realized a 67% return rate on their investment in referral bonuses.

Besides getting a job, interpersonal networks afford individuals other career advantages. Burt (2000) argues that those who bridge unconnected groups through network ties receive more positive work evaluations, faster promotion, and greater compensation. Having a tie to a mentor with control over the fate of the organization is particularly helpful (Podolny and Baron 1997). Entrepreneurs often rely on networks to start businesses. Especially in ethnic communities, connections provide startups with both social and financial capital (Aldrich and Waldinger 1990).[4] Formerly wealthy Cubans who came to Miami in the 1960s with scant resources traded on their pre-immigrant social ties, especially connections to bank loan officers who knew of their trustworthiness in Cuba, to obtain the financial capital to start businesses (Portes and Sensenbrenner 1993). Jewish immigrants from Eastern Europe at the turn of the 19th century also shared support and know-how for entrepreneurship that took them from vaudeville troupes to the creation of Hollywood movie studios (Jones 2001). Korean immigrants to Southern California in the 1970s formed rotating credit associations,

pooling their limited financial capital so that each participant, in turn, had the means to start a small business (Light and Bonacich 1988). Network ties are a critical avenue through which individuals advance their careers - - getting a job, a raise, or startup capital.

At the organizational level, the performance of firms can benefit from network ties in the form of access to information and resources, more rapid product development, and enhanced innovation. Much research has suggested that close interaction among divergent organizations can produce novel recombinations of information leading to greater innovation and learning (Cohen and Levinthal 1990; Powell 1990; March 1991; McEvily and Zaheer 1999; Stuart and Podolny 1999; Ahuja, 2000). For example, the biotechnology industry is rife with a wide variety of interorganizational collaborations, and the firms more centrally located in the industry networks are more scientifically capable and the first to introduce new medicines (Powell et al, 1996; Stuart, Hoang and Hybels 1999; Baum, Calabrese and Silverman 2000).

Inter-organizational networks can also contribute to greater productivity in manufacturing, as well as facilitate the introduction of new production methods. In north-central Italy, small family-run artisanal firms generate output out of proportion to the scale of their operations. The decentralized production of knitwear permits small putting-out firms to specialize in machinery and skills that can be constantly reset after short production runs, as fashions change. Long-term relationships between manufacturers and artisanal producers have resulted in a viable strategy of making fashionable clothing at a competitive price (Lazerson 1995). Variants on this theme of rapid mobilization, such as the well-known "just in time" strategy employed by Japanese

manufacturers, are also based on close, long-term ties to subcontractors. Japanese lead firms rely on extensive interaction with suppliers in lieu of haggling for the lowest bid or conflicts over faulty parts. Repeated exchange permits a manufacturer to call up a long-time subcontractor and negotiate for better terms on prices should the market change, or request replacement parts, trusting that mistakes will be corrected quickly (Dore, 1983). Such give-and-take relationships enhance both speed and quality.

Connections to other organizations can also improve the likelihood of a firm's survival and ability to garner financing. Pennings and Lee (1999) demonstrate that professional service firms, such as accounting companies, with close ties to client sectors are less likely to dissolve. Pena's (2002) study of startup firms revealed the importance of relational capital as well as intellectual capital to the survival of new ventures. In New Zealand, pastoral networks of farmers and agents led to the development of trust and successful lending to those farms that were part of the network (Ville and Fleming 2000).

Much of the literature has stressed the positive contribution of networks to economic performance. Less attention has been devoted to the ways in which networks may hinder performance or retard progress. Surely not all networks function in a similar manner; moreover there may well be decreasing returns to connectivity. An important line of research has begun to analyze network portfolios, or the mix of different types of ties, and their relationship to performance. Uzzi (1997) found that in New York's garment industry, manufacturers with the best economic performance had networks that were neither overembedded in too many strong ties, nor underembedded in too many arm's length contracts. A mix of strong bonds of trust with some jobbers and short-term contracts with others proved most useful. Uzzi and Gillespie (1999) also found that firms

with a mix of strong and weak ties were able to obtain more advantageous terms from banks granting small business loans. In a study of the impact of university patents, as measured by citations, Owen-Smith and Powell (2003) found that research universities lacking ties to commercial partners had less consequential patents, while universities with diverse relations with multiple partners had more high-impact patents. But when universities had very close ties to a small handful of commercial firms, they ran the risk of "capture," where their research efforts became more wedded to an applied agenda, and, consequently, their patents had less impact.

Position in a network both empowers and constrains action. A prevalence of strong ties may result in information gathering being limited to local sources. Much attention has been directed at the success of high-tech regional economies, and these technology hotbeds in the U.S. are often held up as models for attracting the best and brightest in the world (Florida 2002). Yet the positive effects of geographic agglomeration can be tempered when access is restricted. Sorenson and Audia (2000) report that in footwear production in the U.S., spatial concentration tends to reinforce the status quo, as knowledge sharing leads to conformity. In her study of the closely knit Swiss watch industry, Glasmeier (1991) found that the densely distributed mode of production limited firms' ability to adapt new quartz technology. She argued that the decentralized network's biggest flaw was its inability to respond to the technological challenge posed by Japanese watchmakers.

Local search can result in mixed performance outcomes for individuals as well as organizations. Lee (1987) found that among employees laid off from the aerospace industry, those job searchers with low- density networks had a longer wait between jobs,

but lost less income in their next position. The employees who had more dense networks were able to find jobs quickly, but on average lost significant income in changing jobs. Local search provided information that lead to quick results, but meant that search for higher paying jobs was curtailed. A similar process of fast results with a less than optimal outcome was found in the job market studied by Morris (1987) in a Welsh steel mill town. Men were hired off the books through their pub-centered, close network of strong ties. Those workers who were not part of these community networks were unable to find short-term contract work, and waited for longer periods to be hired through formal channels. The lads who were hired through the pub networks, however, had no insurance protection against accidents, being paid off the books. In this case, strong local networks resulted in more work but under more hazardous conditions.

The structure of network ties can also shape the nature of conflict in organizations. In Morrill's (1995) study of corporate executives, he found that the emotional intensity and frequency of conflict was greater in a toy-making corporation with high informal network density because there was confusion about who held formal authority. Executives handled conflict through staged "battles" at meetings that were governed through informal norms of conflict resolution. At the more formal accounting firm that Morrill studied, senior executives settled conflicts more routinely through hierarchical fiat.

There are, obviously, tradeoffs across different forms of governance. Consider the case of fish markets. The strong ties that exist in some regions between fishing boat operators and those who buy their catches result in a dampened market where the forces of supply and demand are muted, and prices are volatile for consumers. On the other

hand, where markets with arms length contracts between buyers and sellers exist, over-fishing often results (Bestor, 2001; Rauch, 2001). Vertical integration of the process is not the answer either, as stability in fish supply and prices is best achieved only in the frozen fish market. Whether organized by networks, markets, or hierarchies, there are associated drawbacks - - price setting, depletion of natural resources, and low quality, respectively.

Networks can also have a dark side. Dalton's (1959) classic studies of four Midwestern firms in the 1950s portrayed organizations rife with cliques and rival coalitions: between staff and line and between those defending their turf and those trying to usurp it. His accounts of rivalry and revenge has parallels with studies of the organization of criminal activity. Densely knit networks are common in circumstances of danger and uncertainty. Such conditions facilitate both intense trust and bitter rivalry. Colombian drug cartels, for instance, were founded on relationships that developed between Medellín shipping partners in the gold mining industry (Rubio 1997). The Italian mafia is perhaps the most well-known example of how networks can produce honor among thieves. Connections among mafiosi provide the protection that they sell to others. Gambetta (1993: 15) quotes a Sicilian cattle rancher who describes how he vends meat with mafia protection, "When the butcher comes to me to buy an animal, he knows that I want to cheat him. But I know he wants to cheat me. Thus we need, say, Peppe [that is, a third party] to make us agree. And we both pay Peppe a percentage of the deal." But when Sicilians willingly pay protection, the price includes a society governed by violence rather than law.

Baker and Faulkner (1993) provide a rare analysis of how networks facilitate criminal activity among U.S. corporations. In the 1950's companies in the heavy electrical equipment industry colluded to fix prices on turbines, switchgear, and transformers. The collusive networks concealed their communication from outsiders with ingenious methods like the "phases of the moon"—a pre-calculated format for ensuring that the selected company had the low bid on a switchgear job. The colluders were, however, eventually caught. Baker and Faulkner showed that an executive's degree centrality predicted their fate in court. There is little benefit to holding a central network position, it turns out, when centrality means that more people can identify you to federal prosecutors.

Not all negative effects of networks are illegal, some are simply detrimental for performance. Long-term associations can lead to stagnation. When groups become too tightly knit and information passes only among a select few, networks can become competency traps. Organizations may develop routines around relationships and rules that have worked in the past, but exclude of new ideas (Levitt and March, 1988). Information that travels back and forth among the same participants can lead to lock in, group think, and redundancy. Powell (1985: 202-7) showed how the ossification of editors' network eventually led to a decline in the quality of a publishing house's list. Grabher (1993) described how cognitive lock-in contributed to the decline of steel-making in the tightly knit, homogeneous region of the Ruhr in Germany. Thus, the ties that bind can also become the ties that blind. Moreover, there are costs of trying to break out of strong affiliations. Portes and Sensenbrenner (1993) argue that individuals too tied into ethnic community networks can face leveling constraints. Successful ethnic

businesspeople they may be threatened with ostracism from the community if they become too economically successful.

Distributional issues. Whether the information, relational capital, and other resources made available through network connections are beneficial or not depends largely on one's position. Within networks, ties help people get a job, start ethnic enterprises, move upward in organizations, and generally have more options. But which people or organizations garner the greatest returns? When access to the resources that aid economic performance is contingent upon selective association, there are winners and losers. Burt (1992; 2000) argues that different types of network connectivity matter for managerial careers. He finds that managers in dense networks characterized by closure wait longer to be promoted and receive smaller bonuses. In contrast, managers who serve as bridges between disconnected networks are rewarded more generously and are on the promotion fast track. These results are conditioned by race and gender, however. Both female and minority managers, as well as white male managers in structurally similar "minority" positions, are not rewarded by bridging ties in the same fashion. Burt's (1998) study of managers' networks found that women were promoted faster if they borrowed from the social capital of mentors in the organization, while men were better off building independent networks.

Female and minority managers find that they need to utilize different strategies of sponsorship, relying more on strong ties and mentors (Ibarra, 1992; 1995). Typically, exclusion from dominant pathways results in less access to valued resources. But constraint has been turned into opportunity in the formation of alternative sponsorship networks by women and ethnic minorities. Discrimination against ethnic minorities can

be a force that creates an "us versus them" sentiment that can generate a strong basis for trust among immigrants who invest in each other's small businesses (Portes and Sensenbrenner 1993). Portes, Haller and Guarnizo's (2002) study of immigrant entrepreneurship shows the effects of different tie configurations for Latino businesspeople. Immigrants with mostly local ties in the U.S. were more likely to start domestic businesses, and less likely to start ventures that operated transnationally. Connections to their cultures of origin allowed Latinos to extend their businesses across borders. Strong local ties, however, seem to limit the scope of entrepreneurs, as well as job seekers.

When networks reinforce the perception that people can only trust those who are "one of us," access, power and resources remain concentrated (Marsden, 1993). In Russia, calculating who will repay credit cards is shrouded in uncertainty, thus relatively few people have such cards (Guseva and Rona-Tas 2001). Bank managers prefer to rely on their personal networks—no distance further than friends of friends—to decide when to issue credit cards. Although Guseva and Rona-Tas find that employment in an organization with connections to the issuing bank will also provide access to credit, the Russian system creates greater stratification in credit access than the U.S. system, which is reliant on centralized and routinized credit checks. Kadushin's (1995) study of the French financial elite, which combined quantitative and qualitative data on friendship and interlock ties, shows how close-tie networks generated through common social background and educational experiences, result in an exceptionally homogeneous upper class. In France, friendship cliques account for common board membership and create a

strong system of closed reproduction. In contrast, the U.S. corporate elite is rather open to new entrants, and interlocks are guided more by strategic considerations.

An important contribution of research on the distributional consequences is the insight that there is wide variability in the nature of networks and in membership in them. Common stereotypes about "old-boy" networks are tempered when faced with empirical evidence of the ubiquity of networks. The critical attributes are not simply race, class, and gender, but differential access to, and rates of formation of, networks. For example, Renzulli, Aldrich and Moody (2000) found that having a personal network characterized mainly by kinship and other homogeneous ties was more detrimental to entrepreneurs starting a small business than being female. Smith-Doerr's (1999) research reveals that female life science Ph.D.s employed in biotech firms—organizations enmeshed in multiple interorganizational networks—are nearly eight times more likely to move up into positions of authority than female scientists working in more hierarchically governed settings such as the academy and large pharmaceutical companies. These studies indicate that the relationship between gender inequality and networks is more complex than gender composition studies frequently imply. Often, studies of the race and gender composition of occupations assume that homosocial reproduction (bosses hiring and promoting from within their own social circles, see Kanter 1977) must be occurring in organizations, without looking at the structure of individual and organizational network ties (see Smith 2002 for a review).

Diffusion. New ideas spread more rapidly through interpersonal ties than through most other kinds of communication channels, save for the mass media. The earliest studies of the diffusion of innovations through networks looked at the adoption of

technological innovations. Rural sociologists found that Midwestern farmers who were more connected were the first to adopt new seed and pesticide technologies in the 1940s and '50s (Ryan and Gross, 1943; Rogers, 1958). Coleman, Katz and Menzel (1966) showed that the doctors who were first to prescribe tetracycline were those who were most central in friendship networks. Doctors isolated from friendship networks adopted much more slowly. This classic study has triggered much subsequent debate and attention. Burt (1987) and Strang and Tuma (1993) reanalyzed the original data and took issue with Coleman and colleagues' findings, pointing out that the structural equivalence of physicians—having the same kinds of ties—was a better predictor of their propensity to innovate than their direct ties. A more recent reanalysis (Van den Bulte and Lilien, 2001) stresses that receptivity to advertising determined adoption. Nevertheless, in these subsequent reanalyses, position in the network structure remains key in determining access to information that lead to adoption of the new technology.

Communication networks play a critical role in the spread of models of business strategy and structure (see Davis, this volume). But the transfer of knowledge, as well as fads and fashions, is a complex process involving multiple, overlapping, yet analytically separable channels of communication. Important knowledge often flows through professional networks. Linkages of this kind have grown and become more formalized as professional and trade associations promulgate standards about appropriate professional behavior. Universities, training institutes, professional journals, and the business press also transmit information about current best practices. One key network of communication, then, is the professional or trade network. A second channel of communication is the pattern of interorganizational relations in which an organization is

involved, including suppliers, key customers, members of relevant regulatory agencies, and the like. The interorganizational network is a critical source of news about administrative and technological innovations. Much of the behavior of organizations is also shaped by the activities of other organizations that are considered to be exemplars. Firms are not only embedded in an intricate network of relations with other organizations, they also attend to the actions of highly visible or prestigious organizations within their field. Early adopters of new practices are likely to be situated at the intersection of multiple networks, with links to diverse informational sources that expose them more quickly to new ideas and to critical evaluations of their merits. Research has documented that human resource management policies (Baron, Dobbin and Jennings, 1986), promotion and review procedures in law firms (Tolbert, 1988) and financial reporting methods in law firms (Mezias, 1990) all diffuse rapidly through interorganizational networks. Taken together, the information available through professional, resource, and status networks shapes the definition of what kinds of behavior are appropriate and sets standards that organizations seek to match.

The literature on interlocking directorates provides ample evidence that the diffusion of managerial ideas is shaped by social position. Useem (1984) showed that directors use interlocks to get information that enables them to scan their business environment. Davis (1991) found that firms were more likely to employ poison pills as a takeover defense when they shared directors with firms that were prior adopters. Davis and Greve's (1997) analysis of executive responses to hostile takeovers suggests that corporate interlocks afford more rapid diffusion of strategies than does geographic proximity. Further, information from similar corporate interlock partners seems to

influence organizational behavior more than information from dissimilar partners (Haunschild and Beckman 1998). Shared boards of directors also influence the decision to change stock market listings. Rao, Davis and Ward (2000) discovered that firms leaving the NASDAQ for the NYSE had strong prior ties to members of the New York Stock Exchange. These ties reinforced the view that a company's corporate identity did not match its NASDAQ affiliation. The opposite also obtained, companies that stayed on the NASDAQ had strong ties to core members of that exchange, and developed the perception that a NASDAQ listing matched their corporate identity.

A key feature of diffusion processes is that network position affects the social construction of identity and meaning (Strang and Soule 1998). In the development of new technologies in R&D laboratories, for example, the social networks of project members affect the interpretation of success. Smith-Doerr, Manev and Rizova (2003) find that project managers who are more central in organizational advice networks have more flexible interpretations of the meaning of success than those less connected or central only in technical advice networks.

Recent research on diffusion processes emphasizes both the sender and receiver of signals (Strang and Tuma, 1993; Strang and Soule, 1998). Drawing on epidemiological research, attention has been directed to differential rates of susceptibility to external influences. For example, younger firms may be especially attentive to the opinions of other organizations, particularly if they rely on them for key resources. And the diffusion of common practices is likely to occur more rapidly in the period before standardization sets in (Swedberg, 1997). We know less, however, about the circumstances under which diffusion slows, as either organizations build immunity to

network-wide practices or decreasing returns to connectivity occur. Table 3 summarizes our review of the key effects of networks on performance outcomes, equality issues, and diffusion processes.

Table 3 here

In sum, the impact of networks upon economic performance is profound, but also highly contingent upon context. No general theory has emerged that covers all situations, nor is there a single mechanism comparable to the price signal that regulates behavior. Networks are the relational structure of social and economic life. The institutional context in which network ties are formed and governed largely shapes the distribution of access to network resources. When that access is more broadly distributed and resources and information can be obtained through multiple pathways, connections can lead to entrepreneurial activities, opportunity, and learning. But when network access is restrictive and produces social closure, connections can lead to widening gaps between the haves and have-nots.

Limitations and Prospects

Any field of research that garners attention and generates a productive line of scholarship is bound to attract critics, and network analysis of the economy is no exception. We briefly sketch three of the main criticisms of network studies, as well as responses to them.

A persistent criticism of network analysis is its tendency to focus on the structure of relationships and neglect the content of ties (Goodwin and Emirbayer, 1994). An overemphasis on the structure of linkages can lead to treating all ties as comparable,

without regard to their content or context. Stinchcombe (1989; 1990), in his discussion of research on interlocking directorates, has voiced this criticism most forcefully:

> One has to build a dynamic and causal theory of a structure into the analysis of the links…We need to know what flows across the links, who decides on those flows in the light of what interests, and what collective or corporate action flows from the organization of links, in order to make sense of intercorporate relations. (Stinchcombe, 1990: 381)

There have been several responses to concerns about the sterility of structural analyses of networks. Researchers are pursuing quantitative analyses of large data sets analyzing the duration and depth of relationships. The length of a relationship is an indirect measure of quality, but it does suggest that the parties to a relationship remain committed to one another in some fashion. Longitudinal studies of network connections capture the length of relationships and the extent to which partners share relationships with other actors at specific points in time, offering considerable insight into which participants are central in a field (Powell et al, 2003). The depth of ties can be assessed by measures of how consequential a tie is to one party in contrast to the other. A focus on differing levels or stages of investment in a relationship, and the consequences of different types of uncertainty for disparate actors, offers purchase on how the content of relationships is perceived differently by participants (Podolny, 2001).

Much remains to be done to integrate quantitative and qualitative studies of networks. More process-oriented, case-based approaches provide rich accounts of why ties are created, how they are maintained, what resources flow across these linkages, and with what consequences. Two lines of research, prominent in Europe, focus more directly on the content of relationships. The markets-as-networks approach, developed largely by Swedish researchers, attends to the interdependence of companies in business

markets, and analyzes how these interconnections are managed (Hägg and Johanson, 1983; Håkansson, 1987; Håkansson and Snehota, 1989; Axelson and Easton, 1992; Ford et al., 1998). The virtue of this interaction-focused approach is in showing how a relationship between two companies evolves over time, and may assume an identity of its own, independent of the characteristics and resources of the participants. The limitation of such detailed cases is that they have been, almost necessarily, limited to dyadic relationships, or to a single focal organization. More recent work, however, looks at a large production network and its frictions and interdependencies. Håkansson and Walusziewski's (2002) study of the technological changes in the pulp and paper industry, initiated by important customers and environmental groups, and the ramifications of these new more environmental-friendly techniques for forest and chemical companies and equipment companies, is one example of how an entire circuit of production and consumption can be analyzed through network lenses.

Callon (1986; 1995; 1998), Latour (1987; 1988), and others (Law and Hassard, 1998) have developed an approach dubbed actor-network theory to explain when particular definitions or configurations of science and technology triumph over alternative conceptions. Actor-network theory is rather unique in including artifacts and technologies, as well as people and organizations, in its conception of network actors. In a masterful study of Pasteur's design for his sterilization process, Latour (1988) shows how Pasteur "enrolled" members of the European hygiene movement into his cause. In so doing, Pasteur gave his rivals a reason - - fighting microbes - - for having hospitals scrubbed and full of fresh air. Callon's (1986) study of how fisherman and scientists

became allies in preserving and "domesticating" the scallops of St. Brieuc Bay provides another example of network enrollment.

The actor-network approach stresses the process of translation, in which problems are redefined, supporters mobilized, and ideas and practices transformed in the process of interpretation. Rather than treat ideas or technologies as impervious to the context in which they are imported, this approach recognizes that knowledge and artifacts are interpreted, and utilized in divergent ways in different settings. The advantages of this approach are the attention to conflict and rivalry, both within and across networks. Drawing on a broader science studies perspective, Knorr Cetina and Bruegger (2002) argue that network researchers have thus far utilized a rather simplistic view of knowledge. They employ a more phenomenological approach to economic sociology to analyze new, computer mediated forms of interaction in global trading markets. Knorr Cetina and Bruegger apply the actor network approach to theorize how the computers become a focal node in the structure of markets.

A second common criticism of network studies is their static character. Obviously, the charge that most network studies are cross-sectional (Burt, 2000) applies primarily to North American quantitative research, and not to the markets-as-networks approach or actor-network theory, both of which look at the evolution of specific networks over time. The challenge is aimed more at scholars who are analyzing larger network structures, but do not take on the daunting task of collecting longitudinal data (McPherson, Smith-Lovin and Cook, 2001). Still, some progress has been made, both in analyzing the dynamics of dyads (Lincoln, Gerlach and Ahmadjian 1996; Gulati and Garguilo, 1999; Stuart, 1998) and the evolution of entire networks. Padgett's (2001)

analysis of early Renaissance Florence draws on two centuries of data to analyze the co-evolution of economics, politics, and family structure. He traces four regimes of career-organization mapping: family, guild, social class, and clientage. In each transition, perturbation in one network (e.g., politics) rebounded into another (e.g., banking), triggering unanticipated cleavages in the latter network. In turn, the actors in the first network clamored to save their status and preserve the old order by reconfiguring their positions. The innovations of the Renaissance, in Padgett's analysis, were not generated by Florentine efforts to produce novelty. Just the opposite occurred; Florentines were motivated to conserve their positions, but these attempts generated waves of unanticipated changes, which took place through turbulent cross-network rewirings of careers and organizations (Padgett and Ansell, 1993).

Powell and colleagues' (2003) research does not span as long a time period as Padgett's, focusing on the emergence of the field of biotechnology in the 1980s and 1990s. Still, they observe a transition as profoundly transformative in its domain as that observed by Padgett in early medieval banking. In their analysis of interorganizational collaborations among small and large firms, research universities, government institutes, and venture capitalists, they show how the roles of elite universities and smaller science-based firms assumed prominence. The growing involvement of universities in the commercialization of knowledge has altered the rules of competition among universities, remade academic careers and identities, and influenced economic growth and the fiscal health of communities where universities are located (Powell and Owen-Smith, 1998, Owen-Smith, 2003). One of the advantages of detailed time-series data on network evolution is the ability to show how organizational fields create tracks of career and

biography sequences, and how the reproduction of networks sustains these sequences. Most social science presumes goal-oriented actors, without investigating how actors acquire these identities and goals. Longitudinal network studies can shed light on the emergence of goals and identities.

A third line of critique of network research is that such studies focus on relationships at the expense of larger concerns with politics and institutions. Boltanski and Chiapello (1999) argue that network theory is a neoliberal project, suited to a U.S. culture that stresses flexibility, impermanence, and choice. Fligstein (2002) contends that network studies are "myopic" and that consequential action occurs within political and cultural institutions. We find these comments hard to square with the multi-level nature of network analysis. A starting point of network research is recognition that individuals and organizations are engaged in several domains of exchange. Following Simmel's core insight (1955 [1922]), networks are webs of cross-cutting affiliations; they are not segregated or layered into distinct spheres of the polity, economy, or family. Thus network research is fundamentally about differential capacities for action, based on the ability to mobilize connections from different domains of economic and social life. This architectural vision, sometimes referred to as heterarchy (Stark, 2001), affords insight into cross-realm influences as well as misalignments. In our view, the analysis of cross-network linkages and rewirings is central to understanding large-scale systemic transformations. Far from being divorced from the study of political institutions and culture, networks are the constitutive elements that sustain, rupture, and transform social and economic institutions.

ENDNOTES

[1] There is a burgeoning literature in both physics and sociology on network topology and dynamics (Watts and Strogatz, 1998, Albert and Barabási, 2002; Owen-Smith et al, 2002). Thus far however, economic outcomes are not the primary focus of this work.

[2] Castells (2000) provides an encyclopedic overview of this terrain in which networks become the heart of connectivity in the economy. Large organizations are internally decomposed as networks, while small and medium-sized organizations are connected through networks. These affiliations are activated in the context of projects, and reconfigure as projects are completed (Grabher, 2002). At the core of these networks is the transfer, sharing, and recombination of information.

[3] The above discussion and Table 2 introduce only a handful of the many measures available to network researchers. See Knoke and Kuklinski (1982), Wasserman and Faust (1994), Anderson, Wasserman, and Crouch (1999), Scott (2000), and de Nooy, Mrvar, and Batagelj (2003) for more detailed surveys of the tools of network analysis.

[4] See chapters in this volume by Portes and Haller, Light, and Aldrich for further elaboration on informal, ethnic, entrepreneurial networks.

[5] Wolfgang Streeck suggested to us that this feature of network competition can give rise to claims of collusion or cartel-like behavior. To be sure, networks entail a degree of social closure and restricted access. Just how closed and restrictive, and thus anti-competitive, is an empirical question. See the chapter by Granovetter (this volume) for a discussion of how the degree of closure among business groups either retards or enhances performance.

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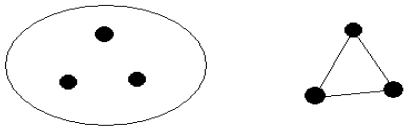
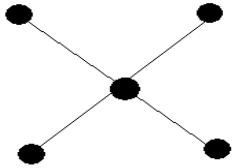
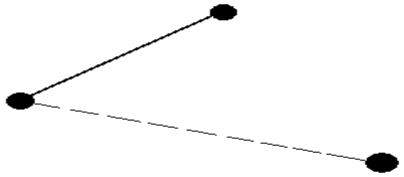
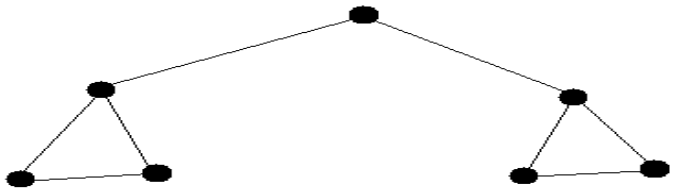
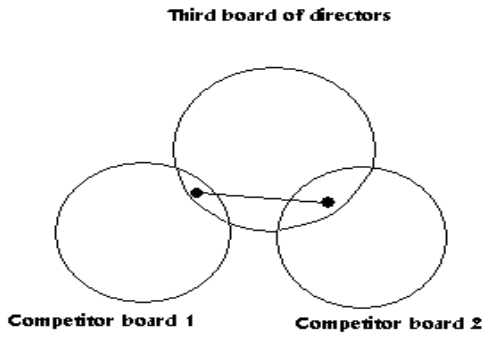
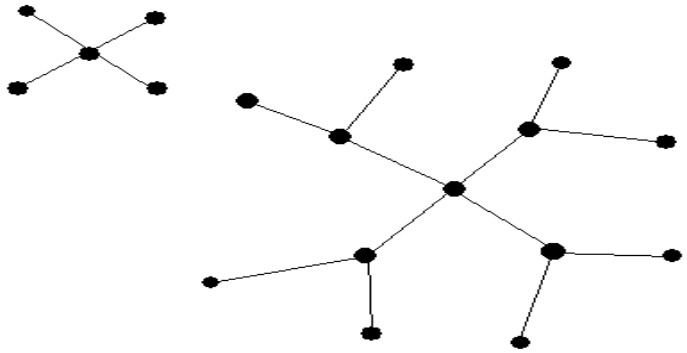
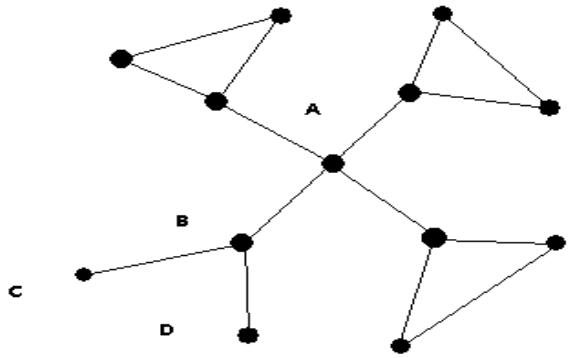
Table 1. Social Network Conceptual Toolkit

Metaphor/ Measure	*Relevant authors*	*Visual Representation*
1. Web of group affiliation, groups versus networks	Simmel, 1955 [1922]	
2. Sociograms, sociometric stars	Moreno, 1934	

3. Structural equivalence	White, Boorman, and Breiger, 1976; Burt, 1982	
4. Strength of ties, weak versus strong	Granovetter, 1973	

5. Bridges, structural holes, tertius gaudens	Burt, 1992	
6. Small world, degrees of separation, path length	Milgram, 1967	

7. Interlock centrality, sphere of influence	Mizruchi, 1996	
8. Local versus global network, closeness centrality	Freeman, 1979	

9. Exchange, centrality versus power (A is central, but B has power because both C and D depend on B)	Bonacich, 1987; Cook, 1977	
10. Density	Barnes, 1979; Marsden, 1993	

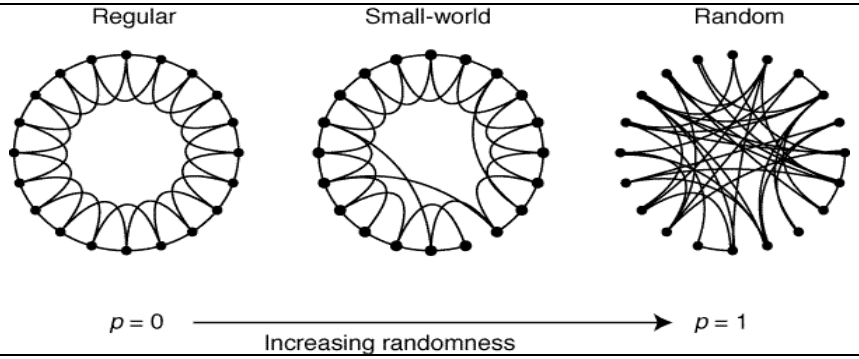
11. Small world, scale-free network, tipping point	Watts and Strogatz, 1998: 441	

Table 2: Formation of Networks

Enabling Condition	*Key Ideas*	*Relevant Authors*
Formal structure	Formal structure shapes informal coalitions.	Hall, 1991; Stevenson and Bartunek, 1996
Informal linkages	Informal relations serve as lubricant for economic exchange.	Larson, 1992; Gulati and Garguilo, 1999
Task-related contingencies	Tasks requiring coordination, sharing of information often lead to collaborative ties.	Eccles, 1981; Uzzi, 1996
Geographic propinquity	Regional agglomeration creates spillovers; the "secrets of industry are in the air".	Beccattini, 1978; Kenney, 2000
Institutional infrastructure	Historical, political, cultural context differentially affects capacity for collaboration.	Putnam, 1993; Herrigel, 1996; Powell, 2001

Table 3: Consequences of Networks in Economic Life

Issue	*Beneficial outcomes*	*Relevant authors*	*Detrimental or mixed outcomes*	*Relevant authors*
Economic performance	Individuals utilize networks to obtain jobs, promotions, start businesses; Organizations hire with lower turnover, innovate more, produce with speed and quality, and garner financing.	Granovetter, 1974; Burt, 2000; Fernandez, Castilla and Moore, 2000; Powell, Koput and Smith-Doerr, 1996; Dore, 1983; Baum, Calabrese and Silverman, 2000	Networks can generate local search, leading to lock-in and competency traps; Collusion, price setting and fixing; Small cells of multiply-linked agents use networks to attack hierarchical organizations (drug cartels, terrorist networks).	Grabher, 1993; Glasmeier, 1991; Baker and Faulkner, 1993; Arquilla and Ronfeldt, 2001
Resource distribution	Exclusion from larger economy because of discrimination can lead to ethnic entrepreneurship; When entrepreneurial organizations rely on networks, women have more access than in hierarchical organizations.	Portes and Haller, this volume; Light, this volume; Aldrich, this volume; Smith-Doerr, 1999	Restricted access, social closure, exclusivity, all exacerbate unequal distribution of resources.	Kanter, 1977; Ibarra, 1992; Kadushin, 1995
Diffusion of ideas	Centrality in network leads to more rapid transmission of info and faster adoption of new technologies (be they beneficial or harmful); More effective transfer of tacit knowledge.	Davis, this volume; Rogers, 1995; Strang and Soule, 1998	Corporate interlocks afford elites more power to coordinate the economy; Elite networks promote strategies for garnering greater influence.	Mizruchi, 1996; Useem, 1984; Palmer and Barber, 2001