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THE SOCIAL ORGANIZATION OF CONSPIRACY: ILLEGAL NETWORKS IN THE HEAVY ELECTRICAL EQUIPMENT INDUSTRY*

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We analyze the social organization of three well-known price-fixing conspiracies in the heavy electrical equipment industry. Although aspects of collusion have been studied by industrial organization economists and organizational criminologists, the organization of conspiracies has remained virtually unexplored. Using archival data, we reconstruct the actual communication networks involved in conspiracies in switchgear, transformers, and turbines. We find that the structure of illegal networks is driven primarily by the need to maximize concealment, rather than the need to maximize efficiency. However, network structure is also contingent on information-processing requirements imposed by product and market characteristics. Our individual-level model predicts verdict (guilt or innocence), sentence, and fine as functions of personal centrality in the illegal network, network structure, management level, and company size.

"People of the same trade seldom meet together but the conversation ends in a conspiracy against the public, or in some diversion to raise prices."

—Adam Smith, *Wealth of Nations*

"The fact that secrets do not remain guarded forever is the weakness of the secret society."

—Georg Simmel, *The Secret Society*

Free enterprise," "open markets," and similar expressions are standard business rhetoric, but in practice economic organizations strive to limit, curtail, and restrict the operation of competitive markets. Their tactics include planning (Galbraith 1967), entry barriers (Baker 1984; Porter 1980c), joint ventures, mergers, director interlocks, political activity

(Pfeffer 1987; Pfeffer and Salancik 1978; Burt 1983), direct manipulation of market ties (Baker 1990), and embedding business decisions in social relationships (Granovetter 1985). These market-restricting tactics are legal, but business organizations also indulge in practices proscribed by law that flagrantly subvert the market mechanism.

We analyze the social organization of a prevalent illegal corporate practice—price-fixing. Aspects of price-fixing conspiracies have been studied extensively by industrial organization economists and organizational criminologists, but the constituent features of the conspiracies are virtually unexplored. For example, the conspiracies in the heavy electrical equipment industry have been called "the most carefully studied corporate offenses in the history of the United States" (Geis and Meier 1977, p. 68), yet insights into the social structure of these conspiracies are limited to anecdotes and journalis-

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tic descriptions. Even researchers who had access to confidential data about these conspiracies concluded “we have little specific evidence concerning the *organization of conspiracies* in our eight electrical-equipment industries” (Lean, Ogur, and Rogers 1982, p. 57 [emphasis added]; Hay and Kelley 1974).

Using archival data, we reconstruct the communication networks involved in three major conspiracies (switchgear, transformers, and turbines). We find that the structure of illegal networks is driven primarily by the need to maximize concealment, rather than the need to maximize efficiency. Network structure, however, is contingent on information-processing requirements imposed by characteristics of a product and its market. At the individual level, we show that the structure of illegal networks influences important and highly visible outcomes. Our model predicts verdict (guilt or innocence), sentence, and fine as functions of personal centrality in the network, network structure, management level, and company size.

The study of the organization of conspiracy is important for both theory and policy. We contribute to research on organizations by studying *illegal* networks involving companies and their agents (employees). Most knowledge about interorganizational networks is based on studies of *legal* practices. Interorganizational conspiracies, however, are a perduring feature of capitalist societies. Our study explores the extent to which theories based on legal networks can be generalized to illegal networks. Most sociological knowledge about organizational crime is based on studies of corporate offenders and their offenses (Shapiro 1980, p. 29). We move beyond this focus by analyzing the *organization* of criminal activity, as well as its effect on outcomes.

Studies of the social organization of conspiracy also provide new insights relevant to public policy, especially regarding the investigation of antitrust violations and the enforcement of antitrust laws. The anticompetitive activity we study here is so common that uncovering it is a chief purpose of major “guardians of trust” (Shapiro 1987) like the U.S. Department of Justice. Price-fixing and other anticompetitive practices reduce consumer and societal welfare (Scherer 1980). Successful conspiracies artificially raise prices above the competitive norm (Lean et al. 1982; Scherer

1980; Ohio Valley Electric Corp. v. General Electric Co. and Westinghouse 1965, p. 915 [henceforward Ohio Valley 1965]).

BACKGROUND

Collusive agreements in the heavy electrical equipment industry go back to the 1880s, but the price-fixing “schemes of the 1950s were given special impetus when repeated episodes of price warfare proved incompatible with top management demands for higher profits” (Scherer 1980, p. 170). Top executives imposed unrealistic profit objectives in an industry characterized by chronic overcapacity, increasing foreign competition, and stagnating demand (Ohio Valley 1965, p. 939). To cope, managers decided to conspire rather than compete. Their elaborate conspiracy involved as many as 40 manufacturers and included more than 20 product lines, with total annual sales over \$2 billion. The conspiracy was pervasive and long-lasting; it became, insiders said, a “way of life” (U.S. Senate Committee on the Judiciary 1961, pp. 16879–84 [henceforward Kefauver Committee]).

The Tennessee Valley Authority’s (TVA) planning in 1958 for the Colbert Steam Plant exposed the conspiracy. The TVA complained about possible bid rigging to the U.S. Justice Department because it had received identical or nearly identical bids for electrical equipment, ranging from \$3 for insulators to \$17,402,300 for a 500,000 kilowatt steam turbine generator (Walton and Cleveland 1964, pp. 24–29). The Justice Department’s investigation in 1959 revealed extensive collusion and grand jury indictments followed in 1960. The U.S. Senate Committee on the Judiciary, Subcommittee on Antitrust and Monopoly (the Kefauver Committee), held hearings on administered prices in April, May, and June 1961.

Conspirators were prosecuted under Section I of the Sherman Antitrust Act, which forbids “every contract, combination . . . or conspiracy in restraint of trade or commerce among the several states.” The courts have interpreted Section I to mean that price fixing is *per se* illegal (Lean et al. 1982, p. 1; Scherer 1980, p. 497), an interpretation that stands to this day (Holmes 1993, p. 1). Companies and individuals were fined in excess of \$1 million and many high-ranking executives received jail sentences. These remedies are among the

strongest ever levied for violations of the Sherman Antitrust Act (Lean et al. 1982, p. 4). Private utilities and state and local governments then sued the electrical equipment manufacturers for damages resulting from inflated prices and received refunds that reduced corporate after-tax incomes by more than \$150 million (Lean et al. 1982, p. 1).¹

Although the manufacture of heavy electrical equipment is considered a single "industry"—and the "conspiracy" is often referred to in the singular—the electrical equipment industry is actually diverse and the conspiracy involved at least 20 products (Herling 1962, p. 94; Lean et al. 1982, p. 5). We consider the three major conspiracies, which involved switchgear, transformers, and steam turbine generators. These product lines accounted for the largest annual sales in the industry, and the actions brought in these cases were considered among the most serious (*Business Week* 1960a, p. 27). These three product lines correspond to General Electric's three divisions (Walton and Cleveland 1964, p. 62).

Switchgear

Switchgear are devices used to control and protect electric apparatus that generate, convert, transmit, and distribute electrical energy. They operate in combination with control and metering equipment to interrupt and switch the flow of electrical current (Herling 1962, p. 353). Annual sales of switchgear in the late 1950s amounted to \$75 million (Smith 1961).

According to our informants (who worked at General Electric during the late 1950s), most types of switchgear are built according to "standard design" and bought "off the shelf" using catalog prices (Walton and Cleveland 1964, p. 24). The lag time from date of order to date of delivery and installation is relatively short. These standardized, prefabricated units arrive complete and can be installed for imme-

diately use (*Electrical World* 1950, 1954). Switchgear vary in size and are produced for low, medium, and high voltages. Although high-voltage switchgear may be built according to customer specifications, switchgear are generally considered to be commodity products, particularly when compared to steam turbine generators. They are smaller and less complex to manufacture than are turbine generators. Orders are frequent and regular, which produces a fairly predictable and steady flow of business (Kefauver Committee 1961, p. 16690).

The switchgear conspiracy was organized in a decentralized fashion. Frank Stehlik, General Electric's general manager of low-voltage switchgear, testified that he and other general managers set price-fixing policy and delegated execution of the details to a "working-level" group of subordinates (Kefauver Committee 1961, p. 16807). The working-level group devised the famous "phases-of-the-moon" pricing formula, which Stehlik testified he never even heard about until long after it was in operation. This formula included a schedule of numbers that established the bidding order of the various switchgear manufacturers (who were assigned code numbers). A different company was "phased" into priority position every two weeks and this company used another schedule to determine how much it would knock off book price to be low bidder. The remaining companies used the same schedule to determine how much they would bid *above* the low bidder (Smith 1961; Herling 1962). This simple yet effective scheme produced a pattern of prices that baffled Justice Department investigators; the code sheets could not be deciphered, even with the help of a professional cryptographer. The enigma was solved only when Nye Spencer, ITE's sales manager for switchgear, came forward and explained the phases-of-the-moon schedules (Smith 1961).

The phases-of-the-moon system illustrates the proposition that simple, routine tasks can be performed acceptably by using impersonal rules and schedules (Scott 1987, pp. 215–16). Such rules and schedules could be used in sales of switchgear because switchgear are standardized products and the flow of orders is predictable. Complex products with irregular and unpredictable orders, like turbines, preclude the use of similar systems.

¹ The conspiracy proved difficult to eradicate. The electrical equipment makers signed consent decrees in 1962, but General Electric and Westinghouse found sophisticated ways to coordinate pricing of large turbine generators until 1975 (Porter 1980a, 1980b). Though the U.S. Justice Department investigators found no evidence of direct communication, they concluded that the companies colluded tacitly by using similar pricing books and policies.

Transformers

Transformers are “voltage-changing devices that permit more efficient transmission of electricity over long distances” (Lean et al. 1982, p. 5). Transformers have no moving parts, but use electromagnetic induction to change voltages between points of generation and distribution (Herling 1962, p. 355). The huge transformer market, which includes power, network, and distribution transformers, totaled annual sales of about half a billion dollars in the late 1950s (Herling 1962, p. 90).

Transformers and switchgear have similar product and market characteristics. Most transformers are commodity products made for and sold from inventory (Lean et al. 1982, p. 5). “Buying transformers may not be too different from buying household appliances: the customer starts with the price in Sears Roebuck and looks around for a neighborhood store that will give him a better price” (Walton and Cleveland 1964, p. 27). In the 1950s, demand was growing for standardized transformers, and General Electric responded by building a new plant in Rome, Georgia, using mass-production instead of job-shop principles (*General Electric World* 1955, p. 21). The time lag between date of order and date of delivery and installation is short, about one month to four months (*Electrical World* 1957).

The transformer conspiracy was organized in the same decentralized fashion as the switchgear conspiracy. “There were two groups or levels of the industry that operated here,” said Antitrust Trial Division Chief Baddi Rashid, “a *high-level group* and a *working-level group*” (quoted in Herling 1962, p. 91). The high-level group, composed of top executives and general managers, met several times a year to establish price-fixing policies. The working-level group of assistant general managers, marketing managers, and sales managers executed the agreements struck by the high-level group, working out operational rules, routines, and details (Herling 1962, p. 91).

Steam Turbine Generators

A steam turbine generator combines a turbine and a generator to produce electrical energy on land, using steam (Ohio Valley 1965, p. 919). Annual revenues for turbine generators ex-

ceeded \$400 million in the late 1950s (*Business Week* 1960b, pp. 28–30).

The product and market characteristics of turbine generators differ from those of switchgear and transformers. Turbine generators are complicated, massive, multi-million dollar devices. Turbine generators take much longer to manufacture—from 18 months to three years between the date of order and the date of delivery and installation (Ohio Valley 1965, p. 919; Porter and Ghemawat 1980, p. 3). Manufacture requires highly skilled labor, large and sophisticated machine tools, and a lot of space; job-shop (rather than mass production) principles must be used, and even small generators cannot be fully standardized (Porter and Ghemawat 1980, p. 5). Generators are custom-made to detailed and extensive specifications. For example, the TVA’s invitation to bid for its 500,000 kilowatt turbine generator required 80 pages and 7 drawings (Walton and Cleveland 1964, p. 27).

The size distribution of orders for turbine generators is extremely “lumpy” (i.e., orders are large, indivisible, and irregular), which makes it difficult to predict demand (Scherer 1980, p. 220). In 1958, for example, only 33 turbine generators were ordered from U.S. manufacturers; 80 units were ordered just two years later (Scherer 1980, p. 222). Economists attribute the lack of “discipline” in the turbine generator conspiracy—a tendency to break agreements and cheat—to the lumpiness and infrequency of orders (Scherer 1980, p. 222).

Pricing turbines is complicated. Each order is unique, making it almost impossible to compare orders, and multiple interpretations of customer specifications are possible (Scherer 1980, p. 202). Sellers disagree about costs, demand, entry of rivals, and other factors (Jacquemin and Slade 1989, p. 420). Even without a conspiracy, pricing is subject to “prolonged negotiation” between buyer and seller (Walton and Cleveland 1964, p. 24). With a conspiracy, sellers must also cope with the added complexity of secret price negotiations with each other as well.

The turbine industry has high information-processing requirements. Conspirators had to discuss and agree on many subjects, including interpretation of customer specifications, prices, “position” (who would be lowest bidder), terms and conditions of each sale, escalation and progress payments, stabilization of or-

der prices and market levels, and so on (Ohio Valley 1965, p. 925). Frequent and regular meetings were required, consistent with Eisenhardt's (1990) argument that managers use frequent meetings to quickly process large amounts of data, as well as the economic argument that frequent negotiations among colluders are necessary when market conditions are unstable and uncertain (Jacquemin and Slade 1989, p. 420).

THEORIES OF COLLUSION

Prevailing economic and sociological theories of collusion fall into two main categories—industrial organization economics and organizational crime theory. The objectives of each theory differ, but both have contributed substantially to understanding price-fixing conspiracies. Like many theories in economics and sociology, however, they relate structure to outcomes without a theory of the causal links between them (Coleman, J. S. 1986; Coleman, J. S. 1990, chap. 1). Our network approach redresses this problem by incorporating work on interorganizational relations and network analysis (Baker 1990; Knoke and Pappi 1991; Laumann and Knoke 1987).

Industrial Organization Economics

Industrial organization economics examines the effect of variations and imperfections in the market system on the behavior of producers and the extent to which producers satisfy society's economic needs (Scherer 1980). The structure-conduct-performance model is the principal paradigm in industrial organization economics (Scherer 1980; Porter 1980c). While sociologists define structure as a durable pattern of roles and relationships (Laumann 1966; White, Boorman, and Breiger 1976), the industrial organization economists' definition of structure means the number of buyers and sellers, degree of product differentiation, entry barriers, cost structures, and degree of vertical integration in a particular industry. *Conduct* includes legal pricing behavior, various "nonprice instruments of rivalry" like advertising, product strategy, research and innovation, joint ventures, and mergers (Jacquemin and Slade 1989, p. 420). Conduct also includes *illegal* activities like price-fixing, bid rigging, allocation of markets, etc. Finally, *performance*

refers to productive and allocative efficiency at the societal level and profitability at the firm level.

The empirical evidence suggests that particular industry structures facilitate collusion. For example, Hay and Kelley (1974) found that antitrust violations were more likely in industries with few sellers, high or intermediate concentration (few sellers account for most sales), and homogenous products (Jacquemin, Nambu, and Dewez 1981; Asch and Seneca 1975). Most price-fixing cases involve 10 or fewer firms; when more than 10 firms are involved, trade associations may play a coordinating role (Hay and Kelley 1974).

Economists argue that conspiracies tend to form under these conditions because of the "low costs of planning and enforcing a conspiracy and the smaller likelihood of being caught" (Hay and Kelley 1974, p. 24). Large numbers and low concentration are "natural barriers to coordination" (Hay and Kelley 1974, p. 25). Scherer (1980, pp. 199–200) noted that the difficulty of coordination increases almost exponentially with the number of sellers, citing the well-known network principle that the number of possible two-way communication flows is given by the expression $N(N - 1) / 2$. Product heterogeneity is also a natural barrier because "the terms of rivalry become multidimensional and the coordination problem grows in complexity by leaps and bounds" (Scherer 1980, p. 200).

Although the relationship between industry structure and collusion has been extensively documented in industrial organization economics, the internal social organization of conspiracies is treated as a "black box." Scherer (1980) concluded, for example, that "the relationship between an industry's informal and formal social structure and its ability to coordinate pricing behavior . . . lies beyond the reach of conventional economic analysis, and its effects would be difficult to predict even with a very rich multidisciplinary theory. Consequently the economist is forced, without denying their importance, to view variations in industry conduct and performance owing to differences in social structure as an unexplained residual or 'noise'" (p. 225). Hay and Kelley (1974) had access to the U.S. Justice Department's fact memoranda, which reveal the full conduct of the individuals involved, but they claimed that social structure "cannot be quantified" (p. 25).

Given the lack of direct analysis of social structure, industrial organization economists are forced to make assumptions that oversimplify the social organization of price-fixing conspiracies. For example, coordinated action is thought to be possible only in industries with few sellers (e.g., Hay and Kelley 1974, p. 14; Scherer 1980, pp. 199–200). When conspiracies involving many sellers are successful, coordination is attributed to “a dominant individual,” a unifying “*esprit de corps*,” or a trade association (Scherer 1980, p. 225; Hay and Kelley 1974, p. 25). Successful conspiracies involving many firms and low concentration, such as the famous folding box industry conspiracy that involved over 450 firms of which the largest captured less than 10 percent of the market, are puzzling anomalies (Sonnenfeld and Lawrence 1978). Yet recent research on networks reveals that coordination among many organizations often occurs in the real world (Laumann, Knoke, and Kim 1985; Laumann and Knoke 1987; Knoke and Pappi 1991).

Organizational Crime

Organizational crime is a type of white-collar crime (Clinard and Yeager 1980, p. 17) that is “enacted by collectivities or aggregates of discrete individuals” (Shapiro 1976, p. 14) in the context of “complex relationships and expectations among boards of directors, executives, and managers . . . and among parent corporations, corporate divisions, and subsidiaries” (Clinard and Yeager 1980, p. 17). Most important, organizational crimes are committed by individuals acting as *agents*; these crimes take place primarily for the benefit of the organization, rather than the private gain of individuals. Examples include deceptive advertising and violations of environmental laws and antitrust laws.

An agent may be motivated to fix prices to obtain financial and socioemotional rewards, such as bonuses awarded for meeting sales and profit targets, pay raises, promotions, the goodwill and approbation of fellow conspirators, and so on, or to avoid punishments, such as social ostracism, denial of promotions, demotions, or even firing. Or the agent may simply identify with the company and seek to enhance its position. Both sources of motivation—collective and personal—appear in the conspira-

cies in the electrical equipment industry (Smith 1961; Herling 1962). Without both motivations, the conspiracy could not have persisted for so long: If conspirators had resigned or blown the whistle, the conspiracy would have fallen apart. But this “secret society” remained undetected for years. The 1950s was the era of the “organization man,” the employee known for slavish loyalty to the corporation and overconformity to organizational norms (Whyte 1956), even “deviant” norms like price fixing. The conspiracy was a “way of life” in which price-fixing crimes served organizational and personal ends.

The concerns of organizational criminologists and industrial organization economists are similar. For example, organizational crime theory emphasizes the economic structure of an industry (Simpson 1986; Coleman, J. W. 1987; Clinard, Yeager, Brissette, Petrashek, and Harries 1979). The main objective is to describe how macro-level forces (state of the economy, industry structure, market conditions, business cycle) influence the legal and illegal behaviors of firms, especially in the face of languishing financial performance (Shapiro 1980; Clinard et al. 1979; Clinard and Yeager 1980, Finney and Lesieur 1982; Geis and Stotland 1980). For example, Simpson (1986) analyzed how macroeconomic variables and industry structure induce various violations of antitrust laws, and Staw and Szwejkowski (1975) analyzed the effects of overcapacity, declining market share, and the shift from environmental munificence to scarcity.

Organizational crime sociologists who study antitrust activities recognize the necessity of intervening social mechanisms (Simpson 1986, p. 872) but, like industrial organization economists, they tend to relate structure to outcomes without a theory of the intervening link (Coleman, J. S. 1986). They, too, make oversimplified assumptions about the social organization of conspiracy. For example, Siegel (1989) argued that “close coordination among bidders is essential; therefore, these schemes usually involve only a few large firms” (p. 324; also see Gross 1980; Maltz and Pollack 1980).

Shapiro’s (1980) conclusion about criminology still applies to the study of price-fixing conspiracies: “The study of crime and deviant behavior has been negligent, particularly in recent years, in its lack of attention to the form and social organization of criminal activity. We

know a great deal about criminals . . . but very little about the activity itself" (p. 29; also see Wheeler 1976).

A Network Approach to Price-Fixing Conspiracies

An organization is an incomplete social system; it must obtain inputs and dispose of outputs (Aldrich and Marsden 1988). Therefore, an organization is involved in numerous dependent relationships, each of which is a potential source of constraint (Baker 1990; Burt 1992). For example, firms are engaged in interdependent relationships with customers and suppliers; when two or more rival companies compete for the same customers and suppliers, the rivals are interdependent.

Business managers use various strategies and tactics to reduce their dependencies (Baker 1990, 1994; Baker and Faulkner 1991; Burt 1992; Pfeffer 1987; Pfeffer and Salancik 1978). Cooperation among competitors is a common strategy (Baker 1994, chap. 14). Rivals may join forces via joint ventures, technology sharing, marketing and distribution arrangements, joint manufacturing, equity investments, and so on. Such interorganizational relationships are legal, but "within a network operating on the basis of competitive norms, linkages between [competing] units tend to be viewed with suspicion. Should interorganizational relations take on a more perduring nature . . . the units involved may be seen as conspirators seeking unfair advantage and subverting the market mechanism" (Laumann, Galaskiewicz, and Marsden 1978, p. 467). This describes the heavy electrical equipment industry of the 1950s.

The illegal interorganizational networks studied here are known as organizational action sets. An action set is a coalition of organizations assembled for the purpose of carrying out specific activities (Aldrich 1979, p. 280; Knoke and Pappi 1991, p. 510; Knoke and Burleigh 1989). Some action sets are long-lived and operate with formalized agreements, an established division of labor, norms regulating behavior internally and externally, and clearly defined principles for recruiting new members (Aldrich 1979, p. 281; Knoke and Pappi 1991, p. 510). Other action sets may be short-lived and informal; some are disbanded after success or failure (Knoke and Pappi 1991, p. 510).

Most organizational action sets carry out legal activities; all network research on action sets has studied legal interorganizational networks. Some action sets, however, are created to engage in illegal activities (Aldrich 1979; Blok 1975, p. 110; Schneider 1969, p. 112). Our organizational action sets engaged in explicit price-fixing—horizontal collusion in violation of Section I of the Sherman Antitrust Act.

The structure of illegal networks. Illegal networks differ from legal networks in important ways. Unlike participants in legal networks, conspirators must conduct their activities in secret. They must conceal the conspiracy from outside "guardians of trust" (Shapiro 1987), from their customers, from nonparticipants inside their own companies, and from internal company watchdogs (corporate legal staff). In general, the "secret society" is organized to conceal itself and protect its members from detection (Simmel 1950, pp. 345–76). When a secret society works properly, the larger society remains unaware of its existence. If a secret society is discovered and investigated, its organizational structure should offer protection by making it difficult to unravel the conspiracy.

Various practices and organizational devices are used to protect a secret society. Members may conceal the secret society and their involvement in it by limiting face-to-face interaction. Leaders, for example, may be unknown to ordinary members (Simmel 1950, pp. 371–72). Members can increase protection by minimizing the channels of communication (Goffman 1970, p. 78; Fitzgerald 1973, p. 260). Impersonal communication procedures and decision rules (e.g., the phases-of-the-moon system in the switchgear conspiracy) may be used as a substitute for direct personal communication and negotiation. Organizational buffers can seal off different levels or groups. For example, a graduated division of labor—hierarchy—may separate members of a secret society (Simmel 1950, pp. 356–58; Goffman 1970, p. 78; Shapiro 1984, pp. 84–85). Top managers may approve or direct activities, but delegate implementation to lower-level operatives. Decentralization or "compartmental insulation" (Goffman 1970, p. 78) limits exposure, making it difficult to uncover an entire network, particularly its leaders. Subversive political movements, for example, are organized into decentralized cells (Selznick

1952; Fitzgerald 1973, pp. 235–63; Simmel 1950, p. 357).

Secrecy was a paramount consideration in our three price-fixing conspiracies. These illegal networks involved high stakes, major corporations, government buyers, and the careers and reputations of dozens of corporate managers and executives, many of whom were pillars of their local communities and members of the elite class. The conspirators knew their activities were illegal, yet continued them despite repeated written directives from the chief executive's office to refrain from meeting with competitors. Given the importance of secrecy, we expect to observe illegal networks that use buffers and other means to maximize concealment. In particular, the need for secrecy should lead conspirators to conceal their activities by creating *sparse* and *decentralized* networks. If secrecy were the only consideration, we would expect sparse and decentralized communication networks in each of our three conspiracies.

But secrecy is not the only consideration. Like participants in legal networks, conspirators have tasks to accomplish, and these tasks must be performed effectively and efficiently. Information must be exchanged quickly and accurately. Problems and disputes must be worked out quickly and smoothly. Most of all, acceptable agreements must be hammered out in time to meet deadlines (e.g., due dates for proposals). Secrecy is critical, but if price-fixing tasks are not performed well, the conspiracy will be a vain and needlessly risky endeavor.

Given the need for efficient task performance, what type of communication network is required? The social psychology of small groups and organizational theory agree that the answer depends on information-processing requirements—the amounts and types of data, knowledge, and intelligence that must be handled to execute a task sequence (Scott 1987, p. 215). Experimental research on small groups has found that simple, routine, unambiguous tasks are performed more efficiently in centralized structures, while difficult, complex, ambiguous tasks are performed more efficiently in decentralized structures (Collins and Raven 1969, p. 155; Shaw 1964).² Organi-

² Findings from small-group research may not be generalizable to interorganizational price-fixing conspiracies. However, price-fixing tasks share some important characteristics with the tasks assigned in the classic Bavelas-Leavitt small-group

zational theorists make similar arguments. High information-processing requirements, caused by greater complexity, uncertainty, and interdependence of work flows, lead to decentralized organizational structures (Galbraith 1973, 1977; Scott 1987, pp. 214–17; Stinchcombe 1990, chap. 4; Thompson 1967; Armour and Teece 1978; Chandler 1977; Williamson 1975).

If illegal networks were created to maximize efficient task performance only, we would expect substantial differences in the configurations of our three conspiracies. The conspiracies with low information-processing requirements—switchgear and transformers—should exhibit centralized communication networks. The conspiracy with high information-processing requirements—turbines—should exhibit decentralized communication networks. Of course, these expectations are based on the presumption common to both social psychology and organizational theory that communication structures are created to maximize efficiency (coordination). The theory of secret societies, in contrast, assumes that conspiracies are designed to maximize concealment. In this view, all illegal networks should be decentralized, regardless of information-processing requirements.

Conspirators face a difficult dilemma if they attempt to design communication networks that maximize *both* concealment and efficiency (Figure 1). Buffers are required to maintain secrecy, “but these devices, in turn, reduce coordination of action and dangerously impede corroboration of information” (Goffman 1970, p. 78). For conspiracies with low information-processing requirements, the need to conceal and the need to coordinate drive them in opposite directions: Secrecy requires decentralized communication networks, but task efficiency requires centralized networks. This dilemma vanishes in a conspiracy with high information-processing requirements. In this case, both the need to conceal and the need to coordinate push for decentralized networks. Of course, the dilemma of con-

experiments: “All members of the group are necessary—both in the sense that each and every group member possesses information without which the task cannot be solved, and in the sense that each and every member of the group must know and agree with the correct answer” (Collins and Raven 1969, p. 138).

Organization Objective	Information-Processing Requirement	
	High	Low
Concealment	Decentralized networks	Decentralized networks
Coordination	Decentralized networks	Centralized networks

Figure 1. Concealment Versus Coordination: Theoretical Expectations

cealment versus coordination may exist only in theory. By analyzing three related conspiracies with different information-processing requirements, we can discover empirically how the demands for concealment and efficiency are resolved in practice.

Verdict, sentence, and fine. If a conspiracy is detected and conspirators are prosecuted, how does the structure of the illegal network influence outcomes like verdicts, sentences, and fines? If conspiracies are organized to maximize concealment, then it should be difficult for investigators to identify participants, especially high-level conspirators. And it should be difficult to successfully prosecute alleged conspirators and impose severe sentences and fines. According to theory, decentralized and sparse networks should provide better protection against the investigation and sanctioning of a secret society, compared with centralized and dense networks (Simmel 1950, pp. 345–76; Goffman 1970, p. 78; Shapiro 1984, pp. 84–85; Selznick 1952). If so, then the more decentralized and sparse illegal networks should yield a *low* percentage of conspirators who are found guilty or who plead *nolo contendere*. (For brevity, we use “guilty” to denote individuals found guilty or who pleaded *nolo*.) Further, if decentralized and sparse networks provide more protection, those found guilty in such illegal networks should receive shorter sentences, on average, and pay lower fines, on average, than do their counterparts in centralized and dense illegal networks.

At the individual level, an actor’s location in an illegal network should influence the likelihood of a guilty verdict and the severity of the penalty. Location is the result, at least in part, of how each conspirator resolves the dilemma of concealment versus coordination. As an

agent of a company, an individual conspirator wants to be a *central player* in the illegal network. As a central player, the agent can ensure fair treatment of the company, and monitor competitors to prevent them from cheating. Personally, however, an actor wants to be a *peripheral player* (if a player at all) to avoid detection, prosecution, and sanctioning. A conspirator desires to reduce individual vulnerability by using buffers to conceal personal involvement.

Conspirators are not equally able to buffer themselves. Organizations are authority structures in which subordinates serve under the command of superiors. Top executives, for example, may be better able to buffer themselves because they can delegate operation of the conspiracy to subordinates. If top executives successfully shield their involvement, lower-level operatives would end up “taking the fall” and protecting their bosses. If so, top executives should be less likely to be found guilty, compared with junior managers or middle managers. If top executives are found guilty, they should receive lighter sentences and fines than their subordinates. However, the ability of top executives to protect themselves by delegation may be constrained by the overall structure of the network. In a decentralized network, top executives can separate themselves from the actual operation of the conspiracy. In a centralized network, however, they may have to be involved in the day-to-day running of the conspiracy. If so, top executives in a centralized illegal network should be more likely to be found guilty and to receive harsher sentences and fines.

Middle managers may be at the greatest risk. Although they enjoy authority over junior managers, middle managers occupy a conflictual, difficult, and often vulnerable position between junior managers and top executives (Clinard 1983). Indeed, Shorris (1980) calls them the “oppressed middle.” Middle managers must carry out policy directives issued from the top, and they are often subjected to “excessive pressures” exerted by top executives (Clinard 1983, p. 22). For example, “undue corporate pressures upon middle management may lead to their becoming engaged in illegal or unethical behaviors” (Clinard 1983, p. 22). This appears to be the case in the heavy electrical equipment conspiracies. A chief reason companies participated in the conspiracies was that top execu-

tives insisted on unrealistic profit performance in a mature and stagnant industry (Ohio Valley 1965, p. 939).

Personal (or point) centrality in an illegal network should influence outcomes. Point centrality has several meanings and can be measured in at least three ways (Freeman 1979) *Degree* refers to the number of direct contacts a person has and is customarily interpreted as an index of communication activity. For illegal networks, degree is critical because it indicates legal vulnerability: *direct eyewitnessing of a person's participation in price-fixing events*. For example, a degree of 2 indicates a person was observed in price-fixing activities by two witnesses. Therefore, we expect that degree centrality is positively associated with the likelihood of a guilty verdict, longer sentences, and stiffer fines.

For completeness, we also include two other widely used indicators of point centrality—*betweenness* (the extent to which an actor is strategically located as a bridge between different actors) and *closeness* (the sum of shortest paths to all other actors) (Freeman 1979). These two measures represent important aspects of a person's location in a communication network, but they are not valid indicators of legal vulnerability. Betweenness and closeness are tantamount to hearsay evidence because they do not measure direct eyewitnessing of events—the only legally admissible evidence.

DATA AND MEASURES

Archival Data

Our data on networks are based on archival documents—sworn testimony before the U.S. Senate Committee on the Judiciary, Subcommittee on Antitrust and Monopoly (Kefauver Committee 1961). This information was supplemented with other sources, including Ohio Valley (1965), *Business Week* (1960a, 1960b), Herling (1962), Scherer (1980), Smith (1961), and Lean et al. (1982). The data from the Kefauver Committee hearings are a type of data that Perrow (1986) correctly saw as access to powerful and dominant organizations: “There is a large body of valuable data on the powerful governmental and economic organizations in our society . . . but it is scarcely tapped by organizational theorists. [This in-

cludes] the massive amount of information to be found in the records of committee hearings of congressional groups and in the reports of governmental regulatory agencies and governmental agencies in general” (Perrow 1986, p. 172–73).

The Kefauver Committee report is a verbatim transcript of the Committee's three-month hearings on price fixing in the heavy electrical equipment industry.³ Each witness testified about his and others' participation in price-fixing activities, including interpersonal contacts, direct communications, and dates of and attendance at conspiratorial meetings. The Kefauver Committee focused on significant, relevant interactions among conspirators; our data do not include trivial or irrelevant communications. The Committee had complete access to verbatim transcripts from the grand jury proceedings, bills of particulars, U.S. Justice Department fact memoranda, and other key sources of confidential information about the conspiracies. One of Senator Kefauver's objectives was to read into the public record specific information about price-fixing activities from these sources. The Kefauver Committee interrogators used their prior knowledge to direct and corroborate testimony.

We reviewed the entire Kefauver Committee transcript to identify all participants and ties. A “participant” is defined as any manager or executive employed by an electrical equipment manufacturer who (1) was a witness before the Kefauver Committee, or (2) was cited by such a witness, under oath, as directly involved in price-fixing activities. (We also refer to these participants as “conspirators.”) We located 78 individuals from 13 companies who participated directly in the three conspiracies. Thirty-two of the 78 testified before the Kefauver Committee; 18 of these 32 had been previously indicted by the grand jury.

³ Fifty-three witnesses testified before the Kefauver Committee. Fifty-one of the 53 witnesses were current or past employees of the companies involved (the other two were the Secretary of the Department of Commerce and the President of United Shareholders of America). Of these 51 witnesses, 32 participated in the three conspiracies studied here. Eighteen of the 32 were indicted by the Philadelphia grand jury. Twenty-three participants in the three conspiracies were indicted by the grand jury but were not called to testify.

Forty-six of the 78 were "fingering" by witnesses but did not testify before the Kefauver Committee; 23 of the 46 "fingering" individuals had been previously indicted by the grand jury. None of the 78 participants was an isolate; each is connected directly or indirectly to one or more guilty parties. In total, 37 of our 78 participants were found guilty or pleaded *nolo*.

A "tie" between two participants refers to the explicit citation of another's direct participation in price-fixing activities, such as a conversation between the two parties on price fixing, or joint attendance at a price-fixing meeting. We coded all direct ties among the 78 participants. (Only three individuals were involved in two of the conspiracies; none participated in all three.) Dyadic ties were combined into a binary (0,1) adjacency matrix for each of the three illegal networks. All data were made symmetrical such that $A \rightarrow B$ implies $B \rightarrow A$.

Our data are actors' self reports of their relationships (called "cognitive" data). Some analysts have questioned the extent to which cognitive data accurately reflect actual behavioral relationships (Bernard and Killworth 1977; Bernard, Killworth, and Sailer 1979). Recollections, however, can be *more accurate* representations of enduring patterns of interaction than individual observations of relationships (Freeman and Romney 1987; Anderson 1980; Krackhardt 1987). Moreover, our data were actively "collected" in ways that maximize accuracy, rather than collected passively via sociometric questionnaires. First, our data are based on testimony given under oath and in public before a U.S. Senate Committee. Second, witnesses were subject to severe penalties for perjury. Third, many of the witnesses had already been indicted by the grand jury. Fourth, testimony was obtained via interrogation by multiple parties and was thoroughly cross-checked (e.g., compared to grand jury transcripts and U.S. Justice Department fact memoranda).

Measures of Organizational Rank

The organizational rank of each participant was determined by examining official titles and company organization charts. We classified participants into three categories: top executives (35.9 percent), middle managers (20.5

percent), and low-level managers (32.1 percent). (We could not reliably determine the rank of 9 of our 78 participants.)

Top executives have titles like president, executive vice president, and vice president/general manager. Some top executives in our illegal networks are Westinghouse executive vice president John K. Hodnette, General Electric vice president/group executive Arthur F. Vinson (number two executive at General Electric), and William S. Ginn and Lewis J. Burger, two of the three vice presidents/general managers who reported directly to Vinson.⁴

Middle managers have titles like general manager (at General Electric) and manager (at Westinghouse). Some middle managers in our illegal networks include Clarence E. Burke, general manager of General Electric's high-voltage switchgear department, and L. M. Eikner, manager of Westinghouse's large and medium turbine department.

Low-level or junior managers have titles like sales manager, marketing manager, and marketing secretary. Some low-level managers in our data include W. R. Swoish, sales manager in the transformer division of Moloney Electric, and F. M. Noland, sales manager in the switchgear department at Allis-Chalmers.

⁴ Both Ginn and Burger were found guilty, paid fines, and served time. Vinson's role in the conspiracy was the subject of intense investigation. Federal investigators were sure he had approved the price-fixing conspiracy, and several witnesses testified about his direct involvement (he was "fingering" by several conspirators in our data). To make its case, the Justice Department had to prove that Vinson had participated in the infamous price-fixing meeting in Dining Room B at General Electric. Several attendees testified that he was there, but Vinson escaped indictment owing to a technical error committed by the Justice Department. In his January 1993 obituary for Ginn, Thomas O. Morton of the *Berkshire Eagle* reported on his interview with Ginn in 1961, just after Ginn was released from prison. In response to Morton's question about why federal investigators were unable to successfully indict Ginn's former boss, Vinson, Ginn replied, "Tom, the feds raided the `hohouse on the wrong day." This meant, says Morton, that the feds "had made an error in drawing up the indictment and got the date of the meeting wrong. And Vinson could prove he was elsewhere that day" (Morton 1993, p. B2).

Measures of Point Centrality

Many measures of point centrality have been proposed, each capturing a different characteristic of centrality. These measures can be divided into two types: power/influence and communication. Friedkin (1991), for example, proposed power/influence measures "derived from an elementary process model of social influence" (p. 1478).⁵ For communication networks, Freeman (1979) presented three classic centrality measures based on his synthesis of prior research on communication and group processes.

Centrality measures should be chosen on theoretical grounds. Because our data represent communication patterns, Freeman's (1979) measures are appropriate. His family of measures—degree, betweenness, closeness—tap different dimensions of centrality in communication networks. However, only degree is clearly relevant from a legal standpoint. For completeness, we include all three measures in our analysis.⁶

Degree is defined by Freeman (1979, p. 220) as the number of direct contacts (or adjacencies) for a point, p_k :

$$C_D(p_k) = \sum_{i=1}^n a(p_i, p_k). \quad (1)$$

⁵ Other measures that index power/influence include Bonacich's measures of sociometric status (Bonacich 1972) and influence (Bonacich 1987), Coleman's (Coleman, J. S. 1973) measure of power, and Burt's (1980) measure of prestige.

⁶ Stephenson and Zelen (1989) proposed a new measure of point centrality in communication networks that appears to be appropriate for the analysis of illegal networks. Unlike Freeman's measures of betweenness and closeness, their "information" measure reflects the information contained in all possible paths in a network, not just the shortest or geodesic path. "It is possible," they argued, "that information will take a more circuitous route either by random communication or may be intentionally channeled through many intermediaries in order to 'hide' or 'shield' information in a way not captured by geodesic paths" (Stephenson and Zelen 1989, p. 3). By avoiding the shortest paths, for example, a conspirator could create buffers and reduce the chances of detection. Despite the potential appropriateness of their measure, however, in our data it is so highly correlated with degree ($r = .818$) and closeness ($r = -.823$) that it does not add explanatory power. Including it in the regression analysis introduces problems of multicollinearity.

For example, the degree of the "hub" of the wheel network in Figure 2 is 5; the degree of each of the other points is 1.

Betweenness measures the extent to which a point is a strategically located as a bridge between other points. Freeman (1979, p. 223) defined the betweenness of p_k as:

$$C_B(p_k) = \sum_{i < j}^n \sum_{j}^n b_{ij}(p_k), \quad (2)$$

where

$$b_{ij}(p_k) = \frac{1}{g_{ij}} \times g_{ij}(p_k),$$

and $g_{ij}(p_k)$ = the number of geodesics linking p_i and p_j that contain p_k .

Closeness measures the extent to which a point is connected by short paths to other points. It is the sum of all the geodesics (shortest paths) between a given point and all other points. Because the measure *increases* as a point is connected by *longer* paths, it is more appropriately named *farness*.⁷ Freeman (1979, p. 225) defined the farness of p_k as:

$$C_C(p_k) = \sum_{i=1}^n d(p_i, p_k), \quad (3)$$

where $d(p_i, p_k)$ = the number of edges in the geodesic linking p_i and p_k .

Measures of Graph Density and Centralization

Both graph density and centralization are important concepts in network theory in general (Freeman 1979), as well as key features of organizational action sets in particular (Laumann and Knoke 1987, p. 35). Density and centralization characterize an entire network, not an individual. Centralization, for example, should not be confused with point centrality, which is an individual characteristic.

Density indicates the volume of ties in a network and is defined as the observed number of ties as a percentage of maximum number of ties possible for a network of size n . The maximum number of ties possible is $n^2 - n$, where n

⁷ The fact that "closeness" increases the farther away a given point is from all others is confusing. One way to clarify this issue is to take the reciprocal of closeness; this, of course, is not a linear transformation. We prefer to solve the problem by giving the measure a more intuitive name—farness.

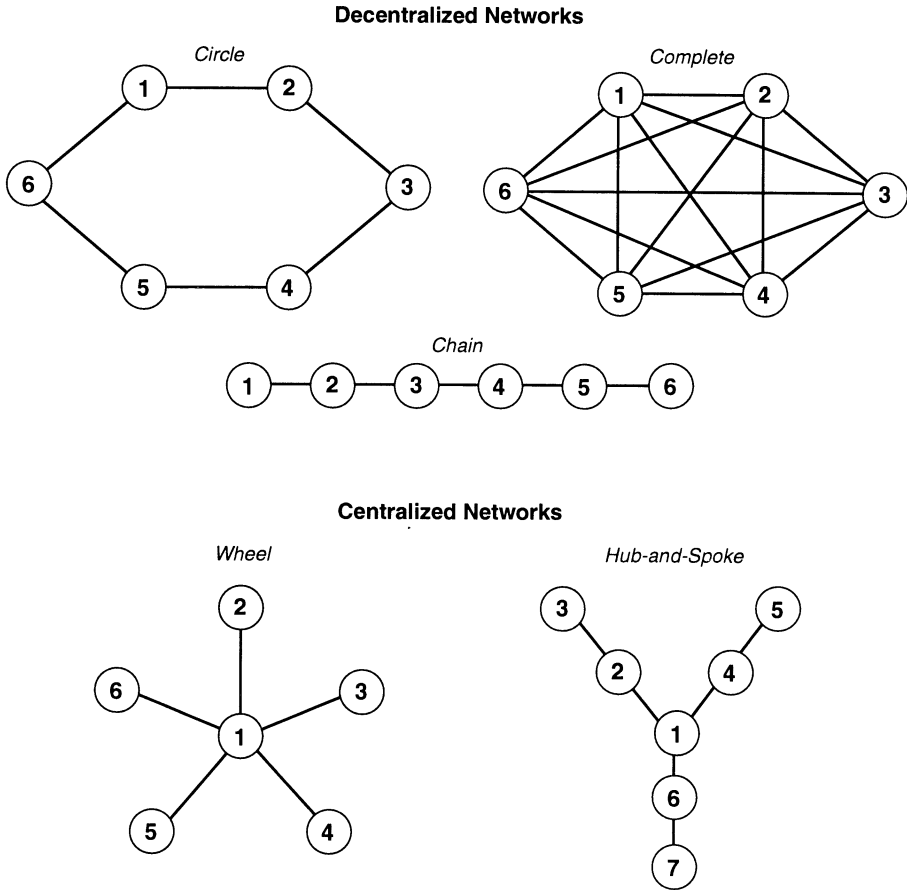


Figure 2. Five Examples of Communication Networks

is the number of nodes in the network. When ties are symmetricized, this denominator is divided by 2.

Density does not reveal much about the arrangement of ties in a network.⁸ Centralization provides more information about the overall pattern of ties. It refers to “the tendency of a single point to be more central than all other points in the network” (Freeman 1979, p. 227). Consider, for illustration, the five classic com-

munication networks presented in Figure 2. A “star” or “hub-and-spoke” network is the most centralized because a single point (the “hub”) completely dominates all others; the “circle” network and “complete” network are the least centralized because no point is more central than any other (Freeman 1979).

Graph centralization measures “the degree to which the centrality of the most central point exceeds the centrality of all other points,” and is “expressed as a ratio of that excess to its maximum possible value for a graph contain-

⁸ Density and centralization are closely related only at the extreme. The centralization of a network with a density of 100 percent must be 0. The “complete” network in Figure 2 is an example. Because all possible ties exist, all points are “equally central” and no single point dominates. Most real social networks, however, are quite sparse; density is much less than 100 percent. When density is less than 100 percent, density and centralization are virtually unrelated. Compare the “chain” and “wheel” networks in Figure 2. Both have the same density—

33 percent of all possible ties exist. But the “chain” is much less centralized than the “wheel.” The “wheel” is the most centralized network possible because all three measures of graph centralization—Nieminen (degree), Freeman (betweenness), and Sabidussi (farness)—equal 100 percent. The “chain” is relatively decentralized, with centralization measures of only 32 percent, 29 percent, and 10 percent, respectively.

ing the observed number of points” (Freeman 1979, p. 227). Freeman developed centralization measures based on the three measures of point centrality; all follow the general form (Freeman 1979, p. 228):

$$C_X = \frac{\sum_{i=1}^n |C_X(p^*) - C_X(p_i)|}{\max \sum_{i=1}^n |C_X(p^*) - C_X(p_i)|}, \quad (4)$$

where n = number of points, $C_X(p_i)$ = one of the point centralities (degree, farness, betweenness), and $C_X(p^*)$ = largest value of $C_X(p_i)$ for any point in the network. The maximum possible sum of differences in point centrality for a network of n points is:

$$\max \sum_{i=1}^n |C_X(p^*) - C_X(p_i)|. \quad (5)$$

Each measure of graph centralization varies between 0 and 1 and may be expressed as a percent of its maximum. A wheel network is the most centralized network structure (i.e., each measure of graph centralization is 100 percent). The circle and complete networks are the “least centralized” or most decentralized; i.e., each measure of centralization is 0 percent.

Measures of Outcomes

We consider three outcomes: verdict, sentence, and fine. *Verdict* is the formal decision rendered in these cases by a Federal judge: guilty or not guilty. Ordinarily, defendants may plead *nolo contendere* (literally, “I will not contest it”). Prior to the heavy electrical equipment conspiracy cases, “a plea of *nolo contendere* was often accepted by Federal judges as a simple way of disposing of many antitrust cases” (Herling 1962, p. 75). A *nolo* plea would satisfy the Justice Department’s need to show sufficient cause, and would allow the conspirators to pay token fines and escape trials and future legal consequences (Herling 1962, pp. 75–76). This tradition was broken here. Both the Federal judge and the Justice Department resisted *nolo* pleas, forcing defendants to plead guilty or face trial.⁹ (Eventually,

the judge relented and accepted several *nolo* pleas for minor offenses.) For our analysis, we treat guilty and *nolo* as equivalent. In the law, *nolo* is considered equivalent to a guilty plea; one who pleads *nolo* can still be fined and sentenced (as happened in our data).

Once a defendant is found guilty (or pleads *nolo*), he or she can be sentenced and/or fined. We distinguish three types of sentences. *Recommended sentence* is the jail term proposed by the prosecutors (e.g., the U.S. Justice Department). *Imposed sentence* is the term as ruled by the judge. In some cases, the imposed sentence is more severe than the recommended sentence. *Time served* is the actual time spent in jail. (Differences between imposed sentence and time served occur because sentences may be suspended.) We distinguish two types of fines. *Recommended fine* is the cash payment proposed by the prosecutors. *Imposed fine* is the cash payment made, as ruled by the judge.

RESULTS

The Network Structure of Three Price-Fixing Conspiracies

Both the theory of secret societies and small-group/organizational theory offer the same hypothesis about the structure of the turbines conspiracy network: This illegal network should be sparse and decentralized. This expectation is not supported by the data. The turbines conspiracy network exhibits the *highest density* and is the *most centralized* (Table 1).

The theory of secret societies and small-group/organizational theory offer competing hypotheses about the structure of the two illegal networks with low information-processing requirements—the switchgear and transformers networks. The data suggest that the need to conceal overrides the need for efficiency in each of these conspiracies: Both networks are relatively sparse and decentralized, compared with the turbines network. According to testimony, both the switchgear and transformers conspiracies were organized in a decentralized two-tier structure, each divided into a high-

⁹Their resistance to *nolo* pleas was based, in part, on (1) the seriousness of the crimes, (2) the sheer magnitude and scale of the conspiracies, and (3) the fact that *nolo* pleas would force potential damage claimants to build their cases from the ground up.

“The testimony of witnesses who had appeared before the grand jury which indicted the companies does not become available for use by the agencies or the persons bringing suit for damages” (Herling 1962, p. 76).

level policy group and a low-level working group. There is no evidence from testimony or other sources that the turbines conspiracy was decentralized.

Verdict, Sentence, Fine

Verdict, we hypothesized, should be a function of company size (used as a control), conspirator’s organizational rank, the network structure of the conspiracy in which a person participates, and personal centrality in the network. To test hypotheses, we used logistic regression, which directly estimates the probability that an individual conspirator is found guilty.¹⁰ Table 2 presents the results of our analysis. The predictive accuracy of this model is quite good. It correctly classifies 87 percent of those found guilty, and 78 percent of those found not guilty.¹¹

The control variables for large companies (General Electric and Westinghouse) are not significant, indicating that company size does not influence verdict. Conspirators from General Electric and Westinghouse were not more likely to be found guilty than conspirators from small companies.

In general, network decentralization did not protect against successful prosecution. In fact, participants in the centralized turbines network were *much less likely* to be found guilty, compared with those in the two decentralized networks. Indeed, only 16.7 percent of participants in the turbines conspiracy were found guilty, whereas the majority of conspirators in the switchgear and transformers conspiracies was found guilty (Table 1).

¹⁰ The logistic model can be written in terms of the log of the odds (called a logit) as follows:

$$\log\left(\frac{\text{Prob}(\text{guilty})}{\text{Prob}(\text{innocent})}\right) = \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p.$$

¹¹ This model is based on N = 69 because we could not determine rank for nine conspirators. The dummy variables for rank use junior managers as the baseline. Other analysis (not shown) demonstrates that there is no statistically significant difference between top executives and middle managers. The dummy variable for the centralized conspiracy (turbines) uses the two decentralized conspiracies (switchgear and transformers) as the baseline. Other analysis (not shown) demonstrates that there is no statistically significant difference between the switchgear and transformers conspiracies.

Table 1. Network Characteristics and Outcomes for Three Price-Fixing Conspiracies

Network Characteristic and Outcome	Conspiracy		
	Switchgear	Transformers	Turbines
<i>Network Characteristic</i>			
Size (number of participants)	33	21	24
Density	23.3	32.4	35.5
Nieminen graph centralization (degree)	41.7	36.1	51.4
Freeman graph centralization (betweenness)	21.3	17.6	24.2
Sabidussi graph centralization (farness)	39.0	37.4	60.8
<i>Outcome</i>			
Percent guilty	66.7	52.4	16.7***
Recommended sentence (in months)	1.43	2.64	1.25
Imposed sentence (in months)	.57	.82	.75
Time served (in months)	.10	.18	.25
Recommended fine (in dollars)	\$2.33	\$2.95	\$5.25***
Imposed fine (in dollars)	\$2.17	\$2.91	\$4.50*

* $p < .05$ *** $p < .001$ (one-way ANOVA)

Note: All outcomes except verdict are averages based on guilty verdicts.

Top executives in the two decentralized conspiracies were able to shield themselves from prosecution; they were not more likely to be found guilty than junior managers. Top executives involved in the turbines conspiracy did not fare as well. The coefficient for the interaction of top-executive rank and involvement in the turbines conspiracy is large, positive, and significant. Top executives involved in the turbines conspiracy were much more likely to receive a guilty verdict.

Middle managers were much more likely to be found guilty than were junior managers. The odds of a guilty verdict increase by a factor of 5.2 for middle managers.¹² The two-tailed test

¹² To make it easier to interpret the results, the logistic equation can be rewritten in terms of the odds (rather than the log odds):

Table 2. Logistic Coefficients for Regression of Verdict on Personal Attributes and Network Variables: Participants in Three Price-Fixing Conspiracies

Independent Variable	Model 1
Constant	-3.834* (1.890)
General Electric (1 = GE; 0 = otherwise)	-.561 (.769)
Westinghouse (1 = Westinghouse; 0 = otherwise)	-.060 (.875)
Turbines conspiracy (1 = turbines; 0 = switchgear or transformers)	-3.416* (1.471)
Top executive (1 = top executive; 0 = otherwise)	.281 (.753)
Middle manager (1 = middle manager; 0 = otherwise)	1.643† (.927)
Turbines conspiracy × top executive	4.020* (2.019)
Degree centrality	.381** (.138)
Betweenness centrality	.002 (.021)
Farness centrality	.020 (.019)
Number of participants	69

† $p < .05$ (one-tailed test)

* $p < .05$ ** $p < .01$ (two-tailed test)

Note: Numbers in parentheses are standard errors. This model correctly classifies 86.5 percent of those found guilty and 78.1 percent of those found not guilty. Overall, the model correctly classifies 82.6 percent.

of significance assumes the null hypothesis is that middle managers are neither more *nor less* likely than junior managers to be found guilty. Our hypothesis, however, is strongly directional, given the well-known precarious organizational position of middle managers (Clinard 1983; Shorris 1980); i.e., middle managers are no more likely than junior managers

$$\log\left(\frac{\text{Prob}(\text{guilty})}{\text{Prob}(\text{innocent})}\right) = e^{\beta_0 + \beta_1 X_1 + \dots + \beta_p X_p}$$

$$= e^{\beta_0} e^{\beta_1 X_1} \dots e^{\beta_p X_p}$$

Each regression coefficient can then be thought of as a power, such that e raised to the power β_i is the factor by which the odds change when the independent variable is increased by one unit.

to be found guilty. A one-tailed test suggests that we should reject the null hypothesis.¹³

Personal centrality is strongly related to verdict. Degree increases vulnerability: The more direct contacts a conspirator has, the greater the likelihood of a guilty verdict. Although the logit coefficient of .381 seems small, it means that the odds of conviction increase by almost 50 percent for each additional direct tie to another conspirator. Neither betweenness nor farness significantly influence verdict. As discussed, these are ambiguous measures of legal vulnerability, given the discounting of hearsay evidence.

We expected that sentence and fine would be systematically related to company size, conspirator's rank, the structure of the network, and personal centrality. To test hypotheses, we regressed sentence and fine on the nine dependent variables. This analysis is based on 36 guilty parties (one of the 37 guilty participants was dropped owing to missing data). Results are summarized in Table 3.

In general, guilty participants from the big companies—General Electric and Westinghouse—did not face higher sentences or fines, compared with guilty participants from small companies. Although conspirators from General Electric faced average recommended fines of about \$1,000 more than did small-company conspirators (Model 4), they did not actually pay significantly higher fines (Model 5).

Overall, network centralization did not influence the severity of sentence or fine. Sentences and fines in the centralized conspiracy (turbines) were not significantly different from than those in the two decentralized conspiracies (switchgear and transformers). For top executives, however, decentralization *increased* the severity of sentences and fines. For example, a top executive in the switchgear or transformers conspiracies served about one week longer, on average, and paid about \$1,240 more, on average, than a low-level manager. Top executives in the centralized conspiracy, however, served slightly *less* time than

¹³ Another reason for rejecting the null hypothesis is that our sample is a very large fraction (perhaps 100 percent) of a finite population. A large sample fraction means the calculated standard errors are too large and probabilities too high, which could cause one to fail to reject the null hypothesis when it should be rejected.

Table 3. OLS Coefficients for Regression of Sentence and Fine on Personal and Network Variables: Guilty Participants in Three Price-Fixing Conspiracies

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Recommended Sentence (months)	Imposed Sentence (months)	Time Served (months)	Recommended Fine (in dollars)	Imposed Fine (in dollars)
Constant	.820 (.994)	-.090 (.354)	-.157 (.275)	3.191** (1.016)	3.332* (1.338)
General Electric	.528 (.456)	-.085 (.162)	.210 (.126)	.995* (.467)	.174 (.615)
Westinghouse	.515 (.512)	.094 (.182)	.229 (.142)	-.080 (.524)	-1.125 (.690)
Turbines conspiracy	-.226 (.813)	.387 (.289)	.335 (.225)	1.082 (.831)	1.127 (1.094)
Top executive	2.222** (.467)	.700** (.166)	.265* (.129)	.976* (.478)	1.240 (.630)
Middle manager	1.507** (.481)	.768** (.172)	-.093 (.133)	.133 (.492)	.656 (.648)
Turbines conspiracy × top executive	-2.614* (1.142)	-.763 (.407)	-.754* (.317)	2.458* (1.168)	1.550 (1.538)
Degree centrality	.123* (.059)	.021 (.021)	.022 (.016)	-.089 (.060)	-.082 (.080)
Betweenness centrality	-.003 (.008)	-.001 (.003)	-.001 (.002)	.006 (.008)	.014 (.011)
Farness centrality	-.031** (.011)	-.002 (.004)	.002 (.003)	.015 (.012)	-.018 (.014)
Adjusted R ²	.594	.381	.303	.528	.288
Number of guilty participants	36	36	36	36	36

* $p < .05$ ** $p < .01$ (two-tailed test)

Note: Numbers in parentheses are standard errors.

did junior managers (determined by adding the coefficients in Table 3 for turbines conspiracy, top executive, and their interaction). Nonetheless, top executives in the turbines conspiracy faced much higher recommended fines than their counterparts in the decentralized conspiracies, an average of \$4,516.

Middle managers, as expected, faced significantly longer recommended and imposed sentences. However, they did not serve more time, compared with low-level managers. Further, fines for middle managers were not significantly different from those for junior managers.

While personal centrality (degree) strongly influenced the likelihood of a guilty verdict, it has little effect on penalties. Degree increases the recommended sentence, but is not significantly related to the other variables.

DISCUSSION

Price-fixing conspiracies face a fundamental problem: the dilemma of concealment versus coordination. The theory of secret societies argues that conspirators desire to conceal illegal activities from internal and external observers. If the structure of a secret society is driven only by the need to maximize concealment, then all three price-fixing conspiracies should exhibit sparse and decentralized communication networks. But conspirators must coordinate their activities and operate the conspiracy efficiently and effectively. The need to coordinate, unlike the need to conceal, does not suggest a single hypothesis for all conspiracies. Rather, the structure of a network is contingent on information-processing requirements. If an organi-

zation is designed to maximize coordination (efficiency), then high information-processing requirements should result in decentralized networks, while low information-processing requirements should result in centralized networks.

The theory of secret societies and small-group/organizational theory offer *competing expectations* for networks with low information-processing needs. Because we observed decentralized networks in the two conspiracies with low information-processing needs, we conclude that the need to conceal overrides the need for efficient coordination. Simply put, a secret society with low information-processing needs *can* be decentralized because it can operate reasonably well through a decentralized network, even though this structure does not maximize coordination.

The theory of secret societies and small-group/organizational theory offer *consistent expectations* for networks with high information-processing needs. However, the network structure of the conspiracy with high information-processing needs—the turbines conspiracy—does not conform to theoretical expectations. The turbines conspiracy is denser and more centralized than the two conspiracies with low information-processing needs. Participants in the turbines conspiracy had to create a centralized communication network because technical complexity, multiple interpretations of customer specifications, disagreements about costs, uncertainty of entry of rivals, and other complicating factors made this conspiracy difficult to operate. Top executives had to be more involved in daily affairs; they could not delegate operation of the conspiracy to lower-level employees. The conspirators could not rely on impersonal communication devices but were forced to communicate and negotiate directly. Consensus was fragile and hard to achieve. This conspiracy, in fact, suffered from a tendency to break down, and could only be patched up through face-to-face interaction (Scherer 1980).

Information-processing needs and centralization are *positively* related in our illegal networks, contrary to findings from small-group experiments and organizational studies. How can we explain this apparent anomaly? Prior experiments and studies have focused on *legal* business organizations and activities. Although some degree of secrecy is required in legal busi-

nesses (e.g., protection of trade secrets), concealment is not a paramount and compelling concern. For illegal activities, however, secrecy is vital. The added element of secrecy means that the structure of intercorporate secret societies does not follow the same underlying efficiency logic as the organization of legal business activities. Efficiency is important, but the need to maintain secrecy is even more important.

Previous research on legal networks and our study of illegal networks suggest the following propositions. (1) Low information-processing needs without secrecy yield centralized networks; high information-processing needs without secrecy yield decentralized networks. These propositions apply to legal business activities, where efficiency is the primary consideration. (2) Secrecy without high information-processing needs yields decentralized networks, e.g., the switchgear and transformers conspiracies. Low information-processing requirements meant that these conspiracies could be run acceptably (though not optimally) from an efficiency standpoint. (3) But secrecy with high information-processing needs requires centralized networks, e.g., the turbines conspiracy. Centralized communication is required because difficult, complex, and ambiguous tasks and decisions must be conducted *in secret*. Operating a high-information conspiracy in a decentralized manner is infeasible because face-to-face interaction and involvement of top executives are necessary to make complex decisions in secret.

Personal attributes and network variables influence outcomes—verdict, sentence, and fine. Four of nine variables significantly increase the probability of a guilty verdict. In descending order of contribution to explained variance, these are: (1) Being in the thick of a conspiracy, or degree centrality; (2) participating in a decentralized conspiracy (switchgear or transformers); (3) occupying a top-executive position and participating in a centralized conspiracy (turbines); and (4) occupying the oppressed middle-manager position.

Degree centrality makes a person vulnerable. The more eyewitnesses to a conspirator's participation in price-fixing activities, the more likely the conspirator was to be found guilty. Degree means being "in the thick of things" (Freeman 1979, p. 219), and the results show that being in the thick of a conspiracy means one is likely to be found guilty.

Network decentralization should be a shield against detection and prosecution, but we found that the opposite is true: The turbines conspiracy—the most centralized conspiracy—had the lowest percentage of guilty conspirators. Why were higher proportions of conspirators convicted in the decentralized conspiracies? It was not because federal investigators pursued these two conspiracies more vigorously than they did the turbines conspiracy. Price fixing in the turbines industry was a major focus of the investigation. Turbines were big business. The crimes in the turbines industry were considered among the most egregious offenses in the heavy electrical equipment industry; indeed, the turbines case was one of the so-called “serious seven” cases, along with transformers and switchgear (*Business Week* 1960a, 1960b; Smith 1961). The highest ranking General Electric official indicted by the grand jury, vice president/general manager William Ginn, was found guilty in the turbines conspiracy.

This paradox may be explained as follows. A centralized network is divided into a small core (“ringleaders”) and a large periphery. The core participants are densely interconnected *and* connected to the peripheral participants. The peripheral participants, in contrast, have few connections. This pattern of ties makes the core a vulnerable position while protecting the large periphery. We found that degree is significantly related to a guilty verdict. Those in the core have more direct ties than those in the periphery. An investigator has many pathways available to penetrate the core, and many eyewitnesses can testify against a member of the core. Participants on the periphery, however, are much less vulnerable. It is difficult, if not impossible, to secure eyewitnesses to a peripheral conspirator’s involvement.¹⁴ Therefore, a

lower conviction rate is found in a centralized network because only the core “ringleaders” can be successfully prosecuted. In a decentralized network, however, there is no periphery. Many eyewitnesses to activities of numerous conspirators can be obtained, resulting in a much higher conviction rate, as in the switchgear and transformers conspiracies.

This explanation is supported by the finding that top executives in the centralized turbines network were more likely to be found guilty, while their top-level peers in the decentralized conspiracies (switchgear and transformers) were not, compared to junior managers. Top executives cannot hide in a centralized conspiracy. They cannot distance themselves from illegal operations; they are forced by high information-processing requirements to remain close to day-to-day operations. And closer involvement increases vulnerability. In contrast, decentralization affords protection for top executives. In a decentralized illegal network, top executives can shield their involvement by delegating operations to their hapless subordinates who “take the fall.” And subordinates do indeed take the fall—middle managers are five times more likely than junior managers to be found guilty. Further, once convicted, middle managers face significantly higher recommended and imposed sentences. In the conspiracies in the heavy electrical equipment industry, they are indeed the “oppressed middle” (Shorris 1980; Clinard 1983).

Network decentralization protected top executives, but once convicted, they were punished more harshly than junior managers. Top executives in the switchgear and transformers conspiracies received higher recommended and imposed sentences, served more time, and received higher recommended and imposed fines, compared with junior managers. Top executives in the turbines conspiracy did not enjoy the protection of decentralization, but if they were convicted, they did not face stiffer penalties than did junior managers.

In general, sentences and fines were light.¹⁵ Penalties were symbolic, despite the publicity,

“wheel” network; each member of a circle network can be “fingered” by two eyewitnesses.

¹⁵ In general, the legal system is much kinder to white-collar criminals, compared with other types of criminals (Sutherland [1949] 1983; Clinard and Yeager 1980), and it is much softer on antitrust offenders, compared with other types of white-collar

¹⁴ Consider, for illustration, the “wheel” network in Figure 2, which is a very centralized network. The core is the central node and the periphery is composed of the five nodes connected to the core. Five eyewitnesses can testify against the core member. The peripheral members cannot “finger” each other. Each peripheral member can be “fingered” by only one node, the core, but this testimony cannot be corroborated. In contrast, consider the patterns of “fingering” possible in the “complete” or “circle” networks. In the “complete” network, each node is vulnerable: Each can be “fingered” by five eyewitnesses. In the “circle” network, each node is more vulnerable than those in the periphery of the

public outrage, and official condemnation of the great electrical equipment conspiracy. The longest recommended sentence was only six months (for General Electric vice president/general manager William Ginn in the switchgear conspiracy). But many sentences were suspended and no one served more than 30 days in jail. The biggest single fine paid was only \$7,500, which Schwager-Wood vice president/assistant secretary W. M. Wood paid for his role in the switchgear conspiracy, and which Ginn paid for his involvement in the turbines conspiracy. Ginn paid an additional fine of \$5,000 for his role in the switchgear conspiracy.¹⁶

The symbolism of punishment can be seen by comparing the three types of sentences. For middle managers and top executives, time served is shorter than the sentence imposed, and the imposed sentence is shorter than the recommended sentence. However, this descending order is not true for fines. Fines imposed by the judge on top executives in the decentralized conspiracies were higher than fines recommended by the prosecution. There also was an added penalty for top executives in the centralized turbines conspiracy: They faced an average recommended fine of \$2,458 *in addition* to the fine recommended for all top executives (and for all participants in the turbines conspiracy). Finally, the symbolism of punishment is implied by differences in the proportion of variance explained by our models. We explain over 50 percent of the variation in recommended sentences and recommended fines, but we explain only about 30 percent of the variation in time served and fines paid.

CONCLUSION

In this study, we reconstruct and analyze three illegal networks in the biggest and most famous price-fixing cases, the heavy electrical equipment conspiracy. This study makes four contributions. First, it opens and inspects what has been treated as a “black box” by the two predominant perspectives on antitrust activi-

offenders like tax evaders, forgers, or embezzlers (Wheeler, Weisburd, and Bode 1982, pp. 654–55).

¹⁶ Ginn’s conviction and prison term did not end his career. He became president of Baldwin-Lime-Hamilton Corporation in Philadelphia, and he later became vice president of the electrical and machinery division of Reynolds Metals (Morton 1993).

ties—industrial organization economics and organizational crime. Unlike past research, we analyze the internal structure of price-fixing conspiracies. We show how particular conspiracies are organized and how their network structures are driven by the need to maximize concealment, contingent on information-processing needs imposed by characteristics of a product and its market. We also demonstrate that systematic variations in social structure influence important outcomes like verdict and penalties at the network level and individual level.

Second, this study is the first quantitative network analysis of intercorporate conspiracies. Most empirical research on organizational action sets has focused on *legal* activities. Sociologists acknowledge that action sets can conduct illegal acts (Aldrich 1979, pp. 317, 320), but this promising line of research has remained virtually unexplored. Our research shows that the study of illegal networks can yield important theoretical and substantive insights into interorganizational behavior. One of our key conclusions is that the structure of intercorporate secret societies does not follow the same underlying efficiency logic as does the organization of legal business activities. Efficiency drives the structure of legal networks, but secrecy drives the structure of illegal networks. For illegal networks with low information-processing needs, secrecy results in decentralized structures, even though centralized structures should be more task-efficient. This decentralization protects top executives from legal vulnerability. Illegal networks with high information-processing needs, however, require top executives to be more involved in illegal operations, creating centralized networks, even though decentralized networks would be more task efficient. Centralization is the only way to operate a high-information conspiracy because face-to-face interaction is required to make complex decisions in secret. But this structure comes at a cost: Centralization increases the legal vulnerability of top executives.

Third, our analysis suggests future directions for both industrial organization economics and organizational crime theories. Industrial organization economists recognize that social structure exists but admit that they lack the tools to analyze it (e.g., Scherer 1980, p. 225). We demonstrate the utility of social net-

work theory and methods for analyzing the social structure of conspiracy. Our results suggest that the industrial organization perspective can profit from incorporating a network approach. Our study is a response to Shapiro's (1980, p. 29) lament that organizational crime research has not revealed much about the organization of criminal activity. Not only do we show *how* collusive activities are organized, we also demonstrate the *effect* of social structure on critical outcomes (verdict, sentence, fine). By doing so, we begin to redress Coleman's (Coleman, J. S. 1986) general criticism that social and economic theories do not take into account the causal links between structure and outcomes.

Finally, our study contributes to the development of network theory. Network analysis is a popular and accepted approach in sociology, but many argue that it suffers from a gap between theory and technique (Granovetter 1979; Burt 1980, p. 134; Turner 1991, pp. 571–72). We have tried to close this gap by developing grounded propositions that relate network antecedents (the need for secrecy and information-processing needs) to the structure of illegal networks and the effect of network structure on important and highly visible outcomes.¹⁷

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¹⁷ There may be practical applications of our network approach to criminal intelligence systems. Sparrow (1991) argued that the law-enforcement and investigative communities could make use of the concepts and methods of modern network analysis, but the art has not progressed beyond using network metaphors and primitive sociometric techniques. Any such applications, however, would have to guard against the potential abuses of network analysis noted by Boorman and Levitt (1983).

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