# THE SMALL WORLD OF GERMANY AND THE DURABILITY OF NATIONAL NETWORKS

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*The globalization of financial markets and the concomitant restructuring decisions of firms challenge the historical legacy of national systems of governance. German corporate ownership patterns and restructuring events in the 1990's are examined here in this light. The results show that ownership links among German firms constitute a "small world" that has consequences for understanding mergers and acquisitions. Ownership links form closely-knit clusters of firms that are nonetheless highly connected across the network as a whole. Restructuring events fall squarely in the center of this structure. Despite increasing global competition, the German small world tends to replicate itself. To illustrate this robustness, potential disruptions to the observed German network are simulated. This simulation shows that the properties of the small world remain intact even when ownership ties are changed. These findings suggest that a more global economy in Germany need not lead to the dissolution of the ownership structure, but rather may be associated with a deepening of network ties.*

THE internationalization of capital poses a significant challenge to national systems that structure the financing and governance of large corporations. Countries have historically developed dramatically different means of raising capital for economic enterprises. Systems of governance in a country reflect the historical bargains struck by labor, the state and holders of capital regarding who gets to own and control the economic assets.

These national systems are challenged by the globalization of capital and the related restructuring strategies of domestic firms.[1] If one departs, as we do in this article, from the view that these systems are static reflections of institutional pressures or cognitive beliefs, the immediate question is how can national ownership patterns endure in the face of strategizing economic actors. The vulnerability of these systems is highlighted when they are understood as networks in which firms, financial intermediaries, and other economic institutional actors are embedded. A striking feature of national ownership networks—as we show for the case of Germany—is that they are very sparse. In sparse

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[1] As recently as the 1980s, the great proportion of capital was derived from national savings, even for developing countries. Increasingly, however, international capital flows augment national sources for investment (see Feldstein and Bacchetta 1991).

networks, observed ties between firms represent only a small proportion of all possible links. Surely, with such low network densities, these national systems should be fragile structures subject to rapid erosion.

We argue here that the opposite is true—that a few ownership ties can still generate substantial structure in a network and have a powerful effect in creating an enduring national structure for the coordination of economic behavior. This argument derives from the notion of a "small world" that presents far more order and stability than that suggested intuitively by network sparseness. A small world is a network in which many dense clusters of actors are spanned by relationships that act as conduits of control and information (Milgram 1967; White 1970). Thus, despite the overall low density of ties, the members of a network are linked with each other across clusters through a relatively small number of intermediaries. It is possible, to paraphrase an old quip, to get "there from here" in only few steps: The number of paths between any two randomly chosen actors is rather small. Indeed, this observation is central to a wide range of sociological models, such as Coleman's (1990) association of social capital with "closed" networks, Granovetter's (1973) theory of weak ties, Burt's (1992) structural holes, and studies of social class (e.g., see Domhoff 1967).

The dynamic properties of small worlds provide insight into the durability of national structures of firm ownership as sparse networks. These properties are best understood by comparing the observed network with a randomized network (i.e., a random graph) that has the same number of nodes and same number of relationships per actor as the observed. Simulations by Watts (1999), for fairly general families of networks, show that as an increasing proportion of existing ties are replaced with randomly generated links, the global connectivity among actors increases much more rapidly than the degree of clustering is reduced. The network becomes more globally connected, but the clusters of densely interconnected members persevere. There is, in other words, structural stability in small worlds despite the low density, even when a substantial number of paths are changed.

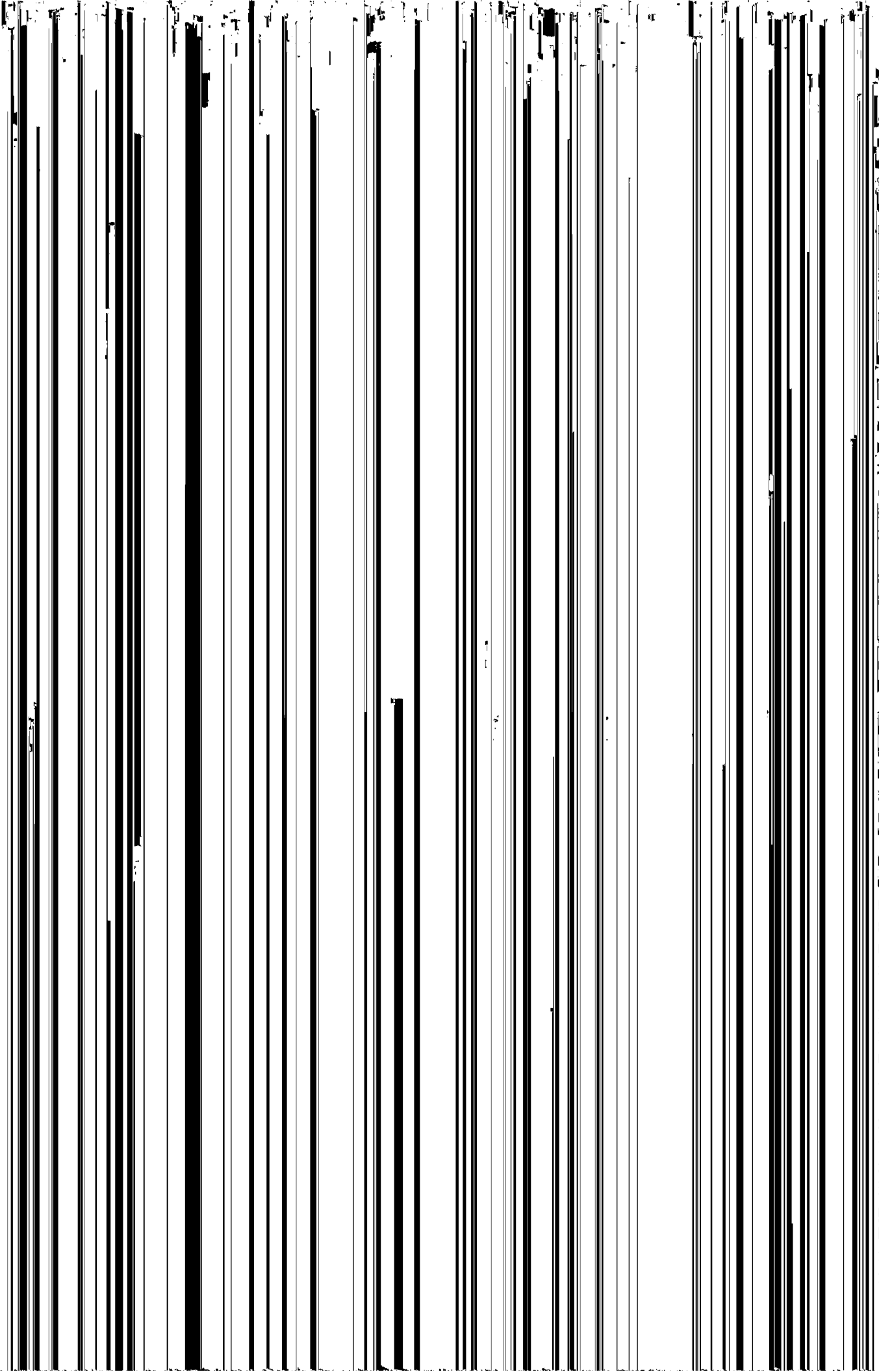
Thus, the dynamics of a small world permit economic actors to strategize, and yet the small-world structure still tends to be replicated. This duality of action and structure (Giddens 1984) in the process of structuration contradicts the intuition that strategizing actors will disrupt social structure. In fact, the inherent durability of the network structure itself may have a strong stabilizing property, as actors may intuit the structural constraints on their actions.

The conservative properties of a small world caution us from inferring too much from the globalization of capital and the restructuring of equity ownership. In the context of small-world structures, the persistence of national systems of power is not inconsistent with the growing penetration of global capital markets. Networks are composed of entrepreneurs whose probable intents are to preserve their structural autonomy and cohesion. Globalization, we claim, is always a localized affair. National networks not only mediate global and local forces but also provide specific actors with the resources and opportunities to preserve the national structure of ownership.

We argue that ownership networks are prevalent in national economies and, although typically quite low in density, are nonetheless important influences on acquisition events. We adopt the small-world model of Watts and Strogatz (1998; Watts 1999) as a way of understanding how sparse networks can have a surprising degree of structure. The ownership patterns and globalization trends in Germany provide the background to our analysis—with a special focus on the 1990's.

## BACKGROUND

Over the past decade, there has been increasing interest in national models of corporate governance (for representative studies, see Berger and Dore 1996; Boyer and Freysennet 2000; Hamilton and Biggart 1988; Kogut 1993; Soskice 1990). These systems are often presented as static descriptions that determine the behavior of firms. This observation, however, is only half the story; these systems emerged from specific national conditions and were shaped by strategies of economic actors who created institutions to



rise in foreign-owned equity, the short-term incentive to restructure along the lines of American capitalism is believed by many to cause fundamental changes in these economies.

The argument that national structures of ownership matter for economic choices is complicated by the observation that these networks have very low densities. It is not obvious how such networks can produce stable national patterns that are able to endure over time. In this regard, it is instructive to look at the many studies that have focused on interlocking directorates.[3] The studies of interlocking ownership present anything but clear evidence for the effects of network structure on economic behavior. The most striking statistic is that these networks are characterized by low density. Scott (1997:122, 149) reports the density among the largest 250 firms to be .038 for Germany, .034 for the United States, and .017 for the United Kingdom. For his sample, Gerlach (1992:158) found density to be .041 for Japan. These densities are so low as to suggest that any pattern of relationships might be more random than conducive for any kind of network-wide coordination.

Because they failed to find dense networks, many authors (e.g., Useem 1984) have backed away from arguing that ties among firms lead to coordinated action. Rather, they suggest that action is related to the generalized context of a managerial class that adheres to a common ideology. Further, Palmer (1993) finds that interlock ties that are broken through accidental events are only infrequently reconstituted, suggesting that motivation for coordinated action is unlikely to be primary. Some studies show that structural impediments to action can be overcome ("money talks"), although these studies are still sensitive to the roles played by institutional contexts and owners (Davis and Stout 1992). There are also numerous studies showing that interlocks matter for the diffusion of ideas (e.g., Haunschild 1993), even if financial motives remain important (Palmer et al. 1995).

It therefore seems inconsistent to claim that markets are politically and socially constructed, and at the same time to note that network structures among market participants appear to be sparse and thus fragile. One way to resolve this inconsistency is to appeal to law and to the state as active political influences on market formation (Fligstein 1996; Roe 1994). Clearly, the historical record of many countries, Germany included, shows the strong hand of state regulation on markets. Changes in governmental institutions and regulatory environments are often the product of negotiations between the state, capital, labor, and other interests. Firms, like other actors, seek to acquire institutional changes that favor their strategies. As Zey and Swenson (1999) have shown for the United States, alterations in tax laws that were desired by corporations subsequently led to restructuring.

Regardless, shifts in legal and fiscal policies, even if designed under the influence of corporations, only establish a framing by which paths are rendered feasible or infeasible; they rarely dictate who gets to own whom. We can view the preservation and evolution of markets as arising out of these institutional framings *and* the structural conditions that permit economic actors to exercise control. Once institutional changes are made, the structural opportunities are altered as well. Firms jockey to implement their strategies, such as restructuring and acquisition. But who buys and who is bought depend upon differential ownership claims and access to financial resources embedded in on-going structural relationships.

Restructuring decisions involving acquisitions require the joint decisions of the current owners to sell and the new owners to purchase. To a great degree, acquisitions are a matching process between sellers and buyers who are located in a network of ownership relations. A firm's location in such a network indicates the constraints on and resources available for restructuring. In this sense, different locations in the ownership network imply that firms differ in their access to social resources (Lin 2000). Network structure is thus a critical force that

[3] This focus partly reflects the restriction on ownership holdings by corporate and financial firms in the United States, a restriction that is generally absent in most other countries. For a recent review, see Mizruchi (1996).

rges (Watts and Strogatz 1998:441). In-
stingly, even when 10 percent of the
is are rewired, clustering remains strong.
; result implies that when connectivity
eases, as ties within clusters are replaced
ties that span them, clustering can still
ain strong, even in large, highly dis-
ed networks.

## E NATIONAL SETTING

ownership network in Germany pro-
s a useful and important setting for ex-
ning the small-world model. The Ger-
ownership structure has its origins in
great wave of entrepreneurship that
pt Western Europe in the later half of the
Os. Germany was one of the first coun-
; to develop large diversified firms. Al-
igh German firms did not experience a
ger wave with the intensity of that in the
ted States, acquisitions among German
is were frequent even prior to World War
loreover, because of investments in re-
ch and development, German firms di-
ified through internal growth and the de-
pment of new products. As a result, at
turn of the century, large German com-
ies were more diversified than their
erican counterparts (Kocka and Siegrist
9).

is impossible to understand the patterns
erman ownership of large corporations
out focusing on the powerful role played
inancial institutions. The rapid industri-
ation of Germany required immense fi-
cial resources. The state and banks coop-
ed on this front to finance these large in-
ments. It was the German example of
k financing that gave rise to
schenkron's (1962) thesis of late capital-
levelopment. The power of the bank was
ngthened by the convention of issuing
k as bearer's shares. Since possession,
er than registration, marked ownership
hese shares, individuals deposited them
banks. In doing so, they often gave the
ks the rights to vote on their behalf (the
alled *Depotstimmrecht*). Thus, banks of-
voted their own shares, *plus* those of
r customers.

hough the power of the banks fluctuated
ughout the twentieth century (with par-
lar weakness after the great inflation of

ners held on average 41.5 percent of eq-
. Moreover, 25 percent of the largest 310
financial firms had a majority owner in
1.[5]

his structure did not change through the
l-1990s. Beyer (1999) concludes that
nagement-controlled firms with dispersed
ners were not prevalent in the German
nership network even as recently as 1993.
network analysis among large German
ns shows a structure in which firms are
ated in hierarchical pyramids under a
minant firm or in long ownership chains.
ecent report of the Monopoly Commis-
n in Germany shows that of the largest
firms, a controlling interest in the eq-
of 51 was held by 39 large firms. To
nplicate the picture, of these 39 firms, 28
were recipients of controlling interests
epner 2000:9).

lowever, cracks appeared in the banks'
l the insurance company Allianz's) con-
over German companies in the 1980s
1990s. Gorton and Schmid (1996) found
affiliation with a bank improved the
fitability of firms in the 1970s. However,
e was no effect on profits in the 1980s.
letailed study by Edwards and Fischer
93) found that the influence of German
ks was overstated, that the debt/equity
os of German banks was not higher than
se among comparable countries. Still,
er studies have shown that banks own the
ncial intermediaries in Germany and that
e has been only a modest increase of eq-
-derived financing compared with bank
ns (Schmidt, Hackethal, and Tyrell 1999).
ending weight to the arguments that
nership networks in Germany are shifting
ne claim that global pressures have been
ding to force Germany to change, largely
ugh the accumulation of German shares
American institutional investors. Thus, a
6 report by the California state pension
l, CalPERS, reports that:

> ermany has recently been experiencing an
> conomic slowdown causing many people to
> assess the old ways of doing business.
> . [T]he growth and liquidity of the inter-

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This statistic might well be an artifact of the
alence of the holding company in Germany,
hich a parent company is listed as an owner
ndependently-incorporated affiliates.

s, individual shareholders, nizations, families, state German national govern- rman firms.

on a company's owners is porting practices. In some furter handbook simply imate number of anony- s. We did not include these alysis as they appeared to , of course, could not be important is the treatment nies, a relatively common nal ownership which is far Germany than in other in- s, including France (see coming). Holding compa- blem of how to treat affili- e listed as companies but a holding-company struc- the practice used in the ook of recording a firm as lding company, along with t was a joint venture or a ned entity.

### EVENTS

ucturing events come from ta Corporation archive on quisitions. From 1994 to 101 acquisitions, including transaction, involving the orporations, banks, and in- s. There were obviously a ber of transactions involv- nd smaller firms, however, erned with such events in quisitions we examine are of an entire corporation poration's subsidiary (N = t venture in which a large (N = 15). We do not differ- se types of acquisition, be- entail the same questions e of ownership chains.

### THE NETWORK

### TIES

is a tie between two firms n owner. These links for all

the firms in our sample compose an affiliation network (for a discussion and listing of previous studies of this kind, see Wasserman and Faust [1994, chap. 8]). Analyzing such networks has a broad tradition and differs slightly from the more commonly studied relational networks that focus on *direct* ties between actors. The ownership network among the 550 German firms is simply their affiliation matrix. In many ownership networks such as this not all firms will be connected. It should also be clear that firms can be linked by more than one owner. In our method, multiple common owners between firms result in only one tie.

Using the affiliation network, we constructed a distance matrix among the firms. The distance between two firms is the smallest number of owners linking them. Thus if companies A and B share an owner and companies B and C share an owner, the distance between A and C equals two (see Appendix A).

### IDENTIFYING SMALL WORLDS

To be a small world in the sense of Watts and Strogatz (1998), a network must exhibit a short average distance, or path length, between actors and a high degree of clustering. The average path length, called $L$, is simply the average of all geodesics (shortest path length between two actors in the network) taken from the distance matrix. The degree of clustering is indicated by a clustering coefficient, called $C$. This coefficient represents the extent to which firms that are directly connected to a focal firm are also directly connected to each other. It is calculated by observing, for each firm, how many of the firms that are tied to it are also tied to each other and dividing this number by the number of possible ties in the set. For example, if Daimler Benz is connected to 10 other firms by 1 ownership link and 8 of these firms are also directly tied to each other, then $C_i$ for Daimler would be 28 (the number of pairwise ties between the 8 firms) divided by 45 (the number of possible ties among all 10 firms in Daimler's set) or .62. The network clustering coefficient is then the average $C_i$ for all the firms.

Intuitively, one might assume that clustered graphs would be characterized by long average path lengths. But this assumption can be wrong, as Watts and Strogatz (1998) show. Their method, already discussed briefly, is to start with a connected network with high degree of clustering and a high average path length and, in a simulation, to rewire a proportion of the ties. When the proportion of ties rewired in this fashion equals 1, a new network is created. Watts and Strogatz call this new network a "random network" for purposes of comparison with the highly structured original. In contrast to the original network, the random network has a low degree of clustering and a small average path length. Notably, as the network moves from a structured to a random graph, changes in path length and clustering are not linearly related. The average path length decreases much faster than clustering does. In other words, both the clustering coefficient and path length converge to the random values, but at different rates. This difference explains why assuming a negative linear relationship between global connectivity and the degree of clustering can be incorrect in many cases. These cases are small worlds; they demonstrate high clustering and short distances among actors network-wide, even though the network is sparse.

The concept of the random network is useful in that it provides a basis for identifying whether empirical networks demonstrate small-world properties. Watts and Strogatz (1998) provide limiting values for the average path length and the clustering coefficients of random networks with $n$ actors and an average of $k$ relationships per actor. These limiting values are $\ln(n)/\ln(k)$ for the average path length and $k/n$ for the clustering coefficient. For a network to be a small world, its average path length is close to $\ln(n)/\ln(k)$, but its clustering coefficient is substantially greater than $k/n$.

## RESULTS OF THE SMALL-WORLD ANALYSIS

Table 1 shows how much the firm ownership structure in Germany resembles a small world. The table presents the parameter values for the ownership network connecting firms and the values for the network of owners themselves, as they are linked through their equity holdings in the firms. In each

**Table 1. The Small World of Firms and Their Owners: Germany, 1993 to 1997**

| Variable | Firms | Owners |
|---|---|---|
| *Density* | | |
| Density for all firms [a] | .01 | .01 |
| Average number of links for all firms | 3.56 | 2.02 |
| Density for network of connected firms [b] | .02 | .01 |
| Average number of links for connected firms | 6.59 | 3.23 |
| *Clustering* | | |
| Clustering coefficient of connected firms | .84 | .83 |
| Clustering coefficient of a random graph with same size and number of links per firm for connected firms | .022 | .008 |
| *Path Length* | | |
| Average path length among connected firms | 5.64 | 6.09 |
| Expected average path length in a random graph of firms with same size and number of links as connected firms | 3.01 | 5.16 |

[a] Total number of firms = 538.

[b] Number of connected firms = 291; number of owners = 429.

case we distinguish between parameters calculated for the overall network, which includes unconnected firms or owners, and parameters calculated for the connected firms or connected owners only. We focus primarily on the latter. The results reveal a small-world pattern for both firms and their owners. Both firm and owner networks are highly clustered and at the same time are connected through relatively short average path lengths globally, compared with the random graph benchmarks.

Table 2 compares these results to three other networks analyzed by Watts and Strogatz (1998). The film actors network is an affiliation network of actors connected by participation in the same films; the power grid network represents links between generators, transformers, and substations in the western United States; and *C. Elegans* is the completely mapped neural network of a worm. The first four columns for German firms repeat the statistics of Table 1. The next 2 columns provide critical statistics, showing for all five networks that the actual and random average path lengths are quite similar, while the ratios of clustering coefficients are considerably different. The last column shows this most clearly: The small-world effect is evident and strong for German networks connecting firms through owners and connecting owners through firms.

## MERGERS AND ACQUISITIONS

Table 3 presents the results on buyers and targets. There are two central observations. First, buyers and targets are clustered to about the same degree as firms on average (shown in Table 1). Because the clustering coefficient is high (approaching 1.0) among the buyer and target firms, it is tempting to claim that their "cliques" must be filling in.

**Table 2. How Small Is Germany's Small World: A Comparison**

| | Path Length | | Clustering | | Actual-to-Random Ratio for: | | |
|---|---|---|---|---|---|---|---|
| Network | Actual | Random | Actual | Random | Length | Clustering | Length/ Clustering |
| Film actors network [a] | 3.65 | 2.99 | .79 | .001 | 1.22 | 2,925.93 | 2,396.90 |
| Power grid network [a] | 18.70 | 12.40 | .08 | .005 | 1.51 | 16.00 | 10.61 |
| *C. Elegans* network [a] | 2.65 | 2.25 | .28 | .05 | 1.18 | 5.60 | 4.75 |
| German firms, connected | 5.64 | 3.01 | .84 | .022 | 1.87 | 38.18 | 22.46 |
| German owners, connected | 6.09 | 5.16 | .83 | .008 | 1.18 | 118.57 | 100.48 |

[a] Data come from Watts and Strogatz (1998). See text above for descriptions of these networks.

**Table 3. The Small World of Buyers and Their Targets: Firms in Germany, 1993 to 1997**

| Variables | Buyers | Targets | Overall Firms (Connected) |
|---|---|---|---|
| Average number of links per firm | 5.15 | 3.82 | 3.56 |
| Clustering coefficient | .89 | .84 | .84 |
| Average shortest path to another firm (for connected firms) | 5.39 | 5.49 | 5.64 |

But this need not be the case. Buyers and their targets need not belong to the same cluster. Second, there are on average slightly fewer links connecting buyers and targets to other firms in the network than there are links connecting the other firms to each other (5.39 or 5.41 compared to 5.64 for connected firms). This finding indicates that the firms involved in the restructuring events are more likely to be brokers in the overall network.

There is another way to address the issue of who is doing the acquiring and how acquisitions relate to cluster membership. We ask: Are there owners who frequently act as brokers? And if so, are they more centrally located in the network of owners than the average owner is? In other words, do the more central owners in the network increase the centrality of their positions by brokering acquisition events? To calculate owner centrality, we calculated the point centrality for each owner (see Freeman 1979). We then simply compared the average point centrality of the owners who link acquisition events to the average centrality of owners in the overall network.

Table 4 presents statistics for the sample of pairs of firms in the network that are involved in acquisition events and the full sample of firm pairs. First, these results show that the average number of links in the network tying buyer and target together is lower than the average number of links tying firms in the overall population of connected firms. So the firms involved in the acquisition events are clearly tied more closely in the network. This finding is consistent with the results in Table 3 and indicates either more direct facilitation of the acquisition event through the ownership chain or a shorter search path.

Second, it is apparent that acquisitions reinforce the existing network structure of ownership. The evidence lies in comparing the average centrality of the owners in the chains linking buyers and targets and the average centrality of the "more central" firms in general. By "more central" here, we mean owners in the general population that are located on at least one path between two firms. The brokering owners have almost double the centrality of the general owner population (.038 vs. .020). So acquisition events are in a sense making the network more centralized. But they are not reducing the extent to which clustering occurs.

## SMALL WORLDS AND ACQUISITION BROKERS

The evidence on centrality shows that brokering owners facilitate the restructuring and replication of the German network. This result is not surprising when we recall that ownership ties provide directly the power to decide who buys what. To investigate these brokering owners in greater detail, we present them with some of their characteris-

**Table 4. Path Length and Owner Centrality for Acquisition Events and the Overall Population of Connected Pairs: Firms in Germany, 1993 to 1997**

| Variable | Acquisition Event Subsample | Overall Population of Connected Pairs |
|---|---|---|
| Average number of links in each chain | 3.29 (for buyer/target pairs) | 5.64 (for all connected firms) |
| Average centrality of owners | .038 (for owners brokering acquisition events) | .020 (for all connected owners) |

**Table 5. Descriptive Statistics of Owners in Chains Linking Buyers and Targets: Firms in Germany, 1993 to 1997**

| Owners | Industry | Number of Chains with an Event | Mean Level of Connection | Owner Centrality |
|---|---|---|---|---|
| Allianz | Insurance | 2 | 1.5 | .028 |
| Bayerische Hypotheken und Weschelbank | Banking | 1 | 2.0 | .005 |
| Brigitta Erdgas und Erdoel | Oil and Gas | 2 | 4.0 | .042 |
| Commerzbank | Banking | 1 | 2.0 | .017 |
| Deutsche Bank | Banking | 4 | 2.0 | .089 |
| Dresdner Bank | Banking | 2 | 2.0 | .073 |
| Dyckerhoff | Glass | 8 | 4.0 | .040 |
| E. Schwenk Baustoffwerke | Construction | 9 | 4.0 | .034 |
| Esso | Oil and Gas | 1 | 3.0 | .007 |
| Federal Republic of Germany | Government | 1 | 1.0 | .056 |
| Kaufhof Holding | Retail | 1 | 2.0 | .003 |
| Münchener Rückversicherung | Insurance | 1 | 1.0 | .005 |
| Ruhrgas | Oil and Gas | 3 | 4.0 | .064 |
| Siemens | Electronics | 2 | 4.0 | .018 |
| Veba | Oil and Gas | 2 | 4.0 | .099 |
| Vermoegensverwaltung | Holding company | 3 | 3.6 | .008 |
| WestLB Girozentrale | Banking | 3 | 3.0 | .022 |
| Wintershall | Oil and Gas | 2 | 4.0 | .095 |

tics in Table 5. We report the number of chains each firm belongs to, the average distance of the owner from the acquisition event, and the centrality of each owner. Using these data, we can confirm or deny our claim at the micro-level that brokers can be characterized as located on short path lengths and within dense clusters.

It is clear that most of these brokers fall generally into two industries: financial services (seven banks and insurance companies) and oil and gas (five companies) with the remainder in other categories (one glass firm, a construction firm, a retail firm, an electronics firm, a holding company, and the Federal Republic of Germany). Starting with the remainder, two of these owners—Dyckerhoff and E. Schwenk Baustoffwerke—are by far the most prevalent in the ownership chains, with eight and nine chains, respectively. However, these are clearly outliers given their industries and high levels of connectivity (four links for each). Vermoegensverwaltung is a holding company with an average number of chains of 3.6 and an average distance from the events of three links. The FRG and Kaufhoff Holdings have only one chain each but are quite close to the acquisition events they broker (one and two links away, respectively).

The financial services group, composed of some of the largest and most powerful banks and insurance companies in Germany, has an average point centrality of about half that of the oil and gas group (.034 compared to .061) but is much closer to the acquisition events (about two links as opposed to four links away). The groups are involved in about the same number of chains (13 for financial services and 10 for oil and gas). One might ask whether these two groups broker different types of events. For example, it is logical to assume that the oil and gas firms are involved in oil and gas acquisitions. Yet an examination of the data shows that this is not the case. The businesses of targets whose acquisitions are brokered by oil and gas firm

owners range from internet services and software companies to firms involved in manufacturing and shipping. Likewise, owners of financial services broker acquisition events involving companies in machinery, insurance, coal mining, real estate, and interestingly, oil and gas, among others.

To relate these findings to broader debates in network studies, consider two opposing definitions of network structure (each labeled "social capital") that have been proposed by Coleman (1990) and Burt (1992). Coleman's measure is based on the relative density of relationships within groups of actors, which leads to analyzing a network as blocks of similarly positioned actors that are more or less "inbred." In this view, higher density means greater social capital in the sense that actors have multiple channels for information transmission and the exercise of control. In an alternative view, Burt (1992) argues that brokering positions in a network, which he characterizes as filling structural holes, represent a kind of social capital. The hole is a structural opportunity for the broker who facilitates the flow of resources and information between otherwise disconnected actors.

The concept of networks as small worlds integrates these two views of social capital. Watt's (1999) definition of a clustering coefficient technically incorporates both the ideas of structural holes and of cohesion. A structural hole is often defined as $\Sigma_k(1-\Sigma_j P_{vj}P_{vk})$, where $j$ and $k$ are actors that are both directly tied to the firm. Thus, a structural hole implies that the clustering coefficient for a specific firm equals 0, since there are no ties among the firms that are tied to it. On the contrary, a high clustering coefficient indicates a high degree of cohesion.

Our findings suggest that the two types of social capital—cohesion and brokering opportunities—are not structurally inconsistent. Their coincidence can be illustrated by imagining the logic behind the spanning of new relationships across clusters as the network develops, consistent with the arguments of Watts (1999). In Watts's models, the network begins with clusters that then become connected over time. Small worlds in Watts's models are developed through the establishment of bridging ties chosen randomly. It is very likely that ties bridging clusters in real networks are highly motivated, probably by the potential for financial control. A bias toward replicating structure, which would surely be expected in any setting where norms and sanctions are prevalent, would further strengthen our results. We have therefore a result that reflects the importance of a broker, as in Burt's (1992) theory, that acts to preserve ownership clusters, as in the sense of Coleman's (1990) emphasis on dense cliques. As a result, the network changes but along the lines of its historical structure. Walker, Kogut, and Shan (1997) find exactly this result that biotechnology networks evolve to reinforce Coleman-like cliques.

### *The Durability of Ownership Networks*

We began with the claims that (1) a firm's or owner's position in a network influences acquisition patterns by conditioning structural opportunities for acquiring resources, and (2) that the small world is an important way to understand the network of resources: sparsely populated with ties, and yet both clustered and globally connected. This claim is especially appropriate for Germany in the 1990s as it adjusts to global economic pressures and the opening of its capital markets to foreign firms. Germany underwent a wave of restructuring in the late 1980s and 1990s, partly in reaction to the European Union initiatives, partly as a consequence of Germany's reunification, and partly in response to a changing world economy. Yet, despite this restructuring, the pattern of acquisitions is associated with existing ownership chains. This trend indicates not the fragmentation of but the persistence of the historical ownership structure.

In a period of rapid turbulence, the role of ideology clearly is a tool for influencing changes in the structure of markets. Here, we see the pivotal importance of how politics shapes markets (Fligstein 1996). Indeed, there are current signs that major changes are underway, even though German firms still display extensive interfirm ownership links. In particular, there have been serious attempts to change the ownership holdings in Germany (Ziegler 2000). In part, German

banks themselves desire these changes. They face inherent problems of conflicts of interest in their evolution into investment banks because they still hold considerable shares in potential buyers and targets. In this regard, German banks are following a change in strategy that was made by American banks (with important institutional differences) in the 1980s and 1990s (Davis and Mizruchi 1999).

Not surprisingly, strategizing actors use the ideology of the imperative of globalization. For example, Deustche Bank incurred a conflict of interest in advising Krupp, a steel company, (via their subsidiary, Morgan Grenfell, located in London) regarding its hostile takeover attempt of Thyssen, another metals company, in which Deutsche Bank held shares. Subsequently, Deutsche Bank tried to merge with Dresdner Bank, its historic rival, partly to consolidate its overseas investment bank activities. Rolf Breuer, head of Deutsche Bank, noted that:

> Rhineland capitalism, which . . . has assured the success of the German economy for 50 years, has reached its limits and should be reformed. The principal reason for this change is globalization that imposes on all national structures to change in order to remain competitive in the world environment.[6]

This ideological representation of market forces is not simply posturing, for restructuring requires alterations in the political and fiscal regulation of German financial markets. One of the major issues for the banks is to avoid massive taxation if they choose to sell their holdings. Indeed, there appears to be "money on the table," as many of the firms dependent upon central owners are underperforming in the market, thus suggesting their vulnerability to divestment (Hoepner 2000). The recent legislation of the Schroeder government to provide tax relief for corporate restructuring (called the Eichel-Plan after the Minister of Finance) promises to repeat the 1990's American experience changing tax laws to facilitate the massive corporate restructuring (see Hoepner [2000] for an analysis of the German case, and Zey and Swenson [1999] for the American case).

Amidst these challenges to the current structure of cross-holdings in ownership, it would be instructive to know if the German national system, as reflected in its small-world structure, should easily collapse.[7] As a simple baseline, consider the case where ties are reassigned randomly without sensitivity to issues of power and control. We want to test the durability of the national pattern of ownership in Germany. Thus, if we deprive owners of specific strategies, a proportion of which would certainly reinforce the existing structure, is the current network structure vulnerable to rapid erosion, or can a bit of that structure still endure? This is a pivotal question because in the coming years, as global forces impinge more strongly on the German economy, owners will clearly sell their stakes, firms will be acquired, and new ownership links will be forged.

To explore the robustness of the German ownership structure, we simulated degrees of change to the network. The simulations were performed for 20 levels of network change. The levels of change were chosen to reflect the logarithmic scale of Watts and Strogatz (1998) and ranged from altering 1 path to altering 192 paths in the affiliation matrix. At each level of change, we ran 100 simulations, randomly choosing ties to alter, and calculating the new clustering coefficient and average path length between connected firms. We then averaged these statistics across the 100 runs for that level of network change to create average statistics.

Thus, at the lowest level of change—one path—each simulation run identified at random an existing relationship between two firms, broke that tie, and added a tie between two other firms, also chosen at random. The clustering coefficient and average path length were then calculated. This process was repeated 100 times, and the mean

[6] Interview, "Rolf Breuer estime que la Deutsche Bank peut s'imposer sans fusionner," (Rolf Breuer believes that Deutsche Bank can succeed without a merger) *Le Monde*, May 31, 2000 (translated by the author).

[7] Again, recall that the national system is also anchored in other institutions, such as the representation of labor in work councils and supervisory boards. See Jurgens, Naumann, and Rupp (2000) on this point.

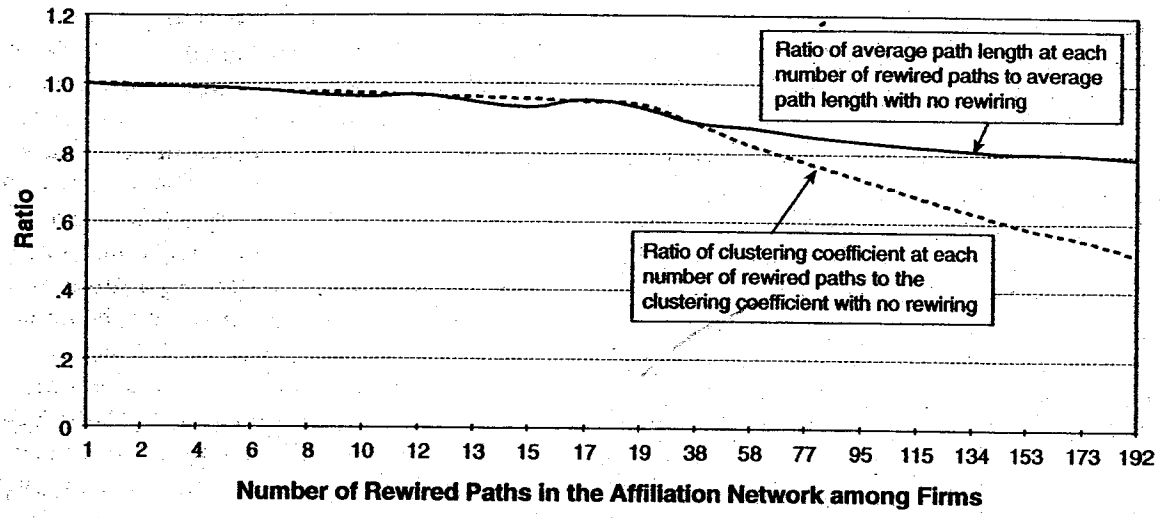


**Figure 1. Results of Simulated Changes in Firm Ownership through the "Rewiring" of Ties in the Affiliation Network: Firms in Germany, 1993 to 1997**

clustering coefficient and average path length were computed across all 100 simulations.

Figure 1 summarizes the results. As the amount of network change increases, both the average path length and the clustering coefficient drop, consistent with Watts's (1999) small-world concept. However, the extent of this drop differs between the two network characteristics. The average path length decreases slowly, so that even with 192 paths rearranged, the path length has dropped less than 20 percent from its original value. The clustering coefficient exhibits a different pattern. The clustering coefficient shows the same smooth decline as the average path length until roughly 19 paths are altered. After this point, the coefficient's rate of decline increases. As shown in Figure 1, even with 192 paths altered, the clustering coefficient equals about .42, roughly one half its value of .84 in the original network. However, the coefficient still remains quite high compared with the random value of .022 (see Table 2).

The simulation results suggest that a massive reallocation of ties would be necessary to significantly erode the small world of German firm ownership as this structure is substantially preserved even after 192 rewirings of owner relationships. This is a little less than twice the number (101) of acquisition events we observe between 1994 and 1997, roughly one-quarter of which were structure-preserving in the sense of involving two firms that were already connected.

Moreover, these simulations understate the self-preserving characteristics of networks. The relative stability of small worlds implies that a structure of connected cliques can persist even as a fairly sizeable number of ownership links occur randomly. *The obvious strategies of exploiting brokering opportunities and of developing cliques are both consistent with the small-world structure and are not excluded from the randomized approach.* In fact, randomization is perhaps the least favorable general rule for preserving the small world, certainly as Watts (1999) represents it, because randomization includes both those new links that reinforce the small world and those that degrade it. Of course, it is possible, for example, that Allianz might disappear as a node should its holdings be randomly distributed. This would clearly have an effect. But then we should ask by what logic can we foresee such an event *given* Allianz's position in the existing structure of relationships? Even if it decided to sell all holdings, it is likely that some would be sold to related partners. Hence, a randomization of ties is a strong test of network durability. For this reason, we are reasonably confident that the simulation results provide conservative evidence for the robustness of the small world of ownership in Germany.

The initial structure of an ownership network may vary widely across countries depending on a range of factors that limit or promote the connectedness of firms through shared ownership.[8] As capitalist institutions are realized in a country with a growing economy, the small world of firm ownership should appear. If the initial network structure is fragmented based on sectoral, financial, regional, or family clusters, the small world emerges when brokers enter to exploit restructuring opportunities as capital becomes available. If the initial structure is more centralized, as in a relatively small economy dominated by powerful brokers, the small world is developed as the economy expands and ownership becomes more widely distributed.

How small worlds are developed as market and regulatory institutions change is a question strongly related to understanding the capitalist model. Although the question is clearly beyond the scope of this paper, our simulation results suggest that, absent regulation that destroys the network itself (e.g., through prohibiting the co-ownership of firms), the small world should be robust to shifts in the policies and structures of supporting institutions. The plasticity of these institutions in response to political and economic forces, such as globalization, may therefore alter specific ownership ties, as for example industries are de- or re-regulated. But these changes should not eliminate the small-world structure and the role of powerful firms in brokering restructuring events.

National networks also reflect cognitive templates that influence the strategic action of economic actors who heed the distributional consequences of power and control. Networks are composed of clusters in the first place because they reflect the preferences of actors and the distribution of power in a historically given economic and social structure. In some capitalist economies, for example, network formation may reflect certain technological beliefs (such as the convergence of technologies) or adherence to status rules (Podolny 1993). Thus, we expect that new links form through the application of unobservable rules that influence network structures in dynamic ways. Also, investor understandings are undoubtedly influenced by financial and governmental institutions as well as by shifts in markets and technologies.

For these reasons, globalization itself may be a less powerful force than currently thought. Globalization may have the observed impact of fostering restructuring, yet it may not significantly disturb the historical structure of the domestic ownership network. Hence, the small-world effect acts as a powerful focal point of convergence for economic action. Power, very much in the sense of Giddens (1984), is self-preserving because actors sense that structure is fairly robust, even in the face of random disturbances. Certainly, national networks can decay, as Davis and Misruchi (1999) observed for the United States; yet certain nodes remain more critical than others. As Padgett and Ansell (1993 ) noticed in their study of Florence and the Medici family, the potential for robust action by well-positioned actors does not require extensive cross-holdings or a high density of relationships.

## CONCLUSION

It is ironic that globalization is experienced and manifested as a national phenomenon. Global economic forces—the mobility of capital, trends in trade and direct investment, the diffusion of capitalist ideas—impinge on individual countries through their institutions of ownership and power. Given differences among countries in these institutions, each country should respond differently to the same external pressures. But this hypothesis is not consistent with the evidence on the low densities of firm ownership networks in the major developed nations. Low density implies a lack of connectivity and therefore the impossibility of organized action at the country level. Without organized action in a country, the network of ownership and power loses its meaning as a national filter of global pressures.

[8] These factors may include the early presence of large firms with capital to invest, the availability of regional as opposed to central sources of capital, regulatory sanction of cross-holdings, the distribution of investment across the sectors of production, as well as political forces for or against the concentration of ownership (e.g., see Khanna and Palepu [2000] on group structures in emerging markets).

Thinking about networks in terms of small worlds resolves this conundrum. The small-world effect implies that a high level of connectivity can exist across a low-density network. And the persistence of closure in links around each firm, shown by our simulation, revitalizes the notion that clusters of ownership do matter. The analysis of ownership ties in Germany not only reveals a structure that guides acquisition decisions but also identifies brokers associated with the reinforcement and replication of national systems.

Our results linking restructuring events to the network of owners in Germany is an example of how the importance of the small-world concept can be demonstrated empirically. We found little evidence of sectoral influence in relating the ownership network to acquisition events. Nor did we find a predominance of financial organizations at the center of the network. Owners that were central in restructuring events came from a variety of industries, indicating that the repeated use of network position may be mostly related to specific strategic interests.

Networks of corporate control in other countries are likely to have similar structural characteristics as well as well-positioned firms. Seen in this light, the global economy consists of many national small worlds composed of country-specific institutions responding to the economic forces of global integration. Globalization is a force that impinges on all countries, but its effects are mediated by these small worlds of ownership within national economies that demonstrate surprising perseverance.

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## APPENDIX A: CONSTRUCTING THE NETWORKS AND THE DISTANCE MATRICES

Ties between firms based on common owners compose an affiliation network. Its obverse is the network among owners connected by firms. Here we discuss the construction of the distance matrix among firms below.

The ownership network among the 550 German firms we studied can be used to create the distance matrix for the network in which distance represents the shortest number of owners linking any two companies. For example, consider a network that has four firms and five owners. We want to create a distance matrix that indicates how many owners link each pair of firms. We start with the matrix A, which lists the four firms in the rows and the five owners in the columns. The number 1 indicates that the owner owns this firm; a 0 indicates no ownership:

$$\mathbf{A}=\begin{bmatrix}1&0&0&1&1\\0&0&1&1&0\\0&1&1&0&0\\1&1&0&0&1\end{bmatrix}.$$

In matrix A, the firm in the first row shares an owner with the firms in rows two and four. We see this by (Boolean) post-multiplying the matrix by its transpose. The matrix multiplication creates matrix B that now lists the four firms along the rows and along the columns:

$$\mathbf{B}=\begin{bmatrix}1&1&0&1\\1&1&1&0\\0&1&1&1\\1&0&1&1\end{bmatrix}.$$

To calculate indirect links, we post-multiply this matrix by its transpose to arrive at matrix C:

$$\mathbf{C}=\begin{bmatrix}1&1&1&1\\1&1&1&1\\1&1&1&1\\1&1&1&1\end{bmatrix}.$$

To capture the history of these calculations, we create a symmetrical distance matrix, matrix D, that has the following properties: $d_{ii} = 0$, since firms have zero distance to themselves; $d_{ij} = 1$, if $b_{ij} = 1$, since 1 indicates a common owner; $d_{ij} = 2$, if $b_{ij} = 0$ and $c_{ij} = 1$, since it takes another firm to link firms $i$ and $j$ in the ownership chain.

$$\mathbf{D}=\begin{bmatrix}0&1&2&1\\1&0&1&2\\2&1&0&1\\1&2&1&0\end{bmatrix}.$$

*(Continued on next page)*

*(Appendix A continued)*

This process is continued until all firms are connected.

A network and distance matrix was constructed in the same way for our German sample of owners connected by firms. In many empirical cases such as ours, not all firms will be connected. If two firms are not connected through any other firms, then $d_{ij}$ is set to a nominal value to indicate this fact. It should also be clear that firms could be linked in chains of more than one owner.

## REFERENCES


Albert, Michel. 1993. *Capitalism versus Capitalism. How America's Obsession with Individual Achievement and Short-Term Profit Has Led It to the Brink of Collapse*. New York: Four Walls Eight Windows.

Berger, Suzanne and Ronald Dore, eds. 1996. *National Diversity and Global Capitalism*. Ithaca, NY: Cornell University Press.

Beyer, Juergen. 1999. "Unternehmensverflechtungen und Managerherrschaft in Deutschland" (Enterprise networks and managerial authority in Germany). *Leviathan* 27:518–36.

Boyer, Robert and Michel Freyssenet. 2000. *The World that Changed the Machine*. Oxford, England: Oxford University Press.

Brady, Robert. 1933. *The Rationalization Movement in German Industry: A Study in the Evolution of Economic Planning*. Berkeley, CA: University of California Press.

Burt, Ronald S. 1983. *Corporate Profits and Cooptation: Networks of Market Constraints and Directorate Ties in the American Economy*. New York: Academic.

———. 1992. *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

CalPERS. 1996. "International Corporate Governance: A Study of the Corporate Governance Systems of the United Kingdom, France, Germany and Japan." California Public Employees' Retirement System (attachment), Sacramento, CA.

Coleman, James. 1990. *Foundations of Social Theory*. Chicago, IL: University of Chicago Press.

Davis, Gerald and Mark Mizruchi. 1999. "The Money Center Cannot Hold: Commercial Banks in the U.S. System of Corporate Governance." *Administrative Science Quarterly* 44: 215–39.

Davis, Gerald and Suzanne Stout. 1992. "Organization Theory and the Market for Corporate Control: A Dynamic Analysis of the Characteristics of Large Takeover Targets, 1980–1990." *Administrative Science Quarterly* 37: 605–33.

Deeg, Richard. 1999. *Finance Capital Unveiled: Banks and the German Political Economy*. Ann Arbor, MI: University of Michigan.

Domhoff, G. William. 1967. *Who Rules America?* Englewood Cliffs, NJ: Prentice-Hall.

Edwards, Jeremy and Klaus Fischer. 1993. *Banks, Finance and Investment in Germany*. Cambridge, MA: Cambridge University Press.

Feldstein, Martin and P. Bacchetta. 1991. "National Savings and International Investment." Pp. 201–20 in *National Savings and Economic Performance*, edited by D. Bernheim and J. Shoven. Chicago, IL: University of Chicago Press.

Fligstein, Neil. 1990. *The Transformation of Corporate Control*. Cambridge, MA: Harvard University Press.

———. 1996. "Markets as Politics—A Political-Cultural Approach to Market Institutions." *American Sociological Review* 61:656–73.

Frankfurter Allgemeine. 1995. *Germany's Top 500. A Handbook of Germany's Largest Corporations*. Frankfurt, Germany: Frankfurter Allgemeine Zeitung GmbH.

Freeman, Linton. 1979. "Centrality in Social Networks: Conceptual Clarification." *Social Networks* 1:215–39.

Gerlach, Michael. 1992. *Alliance Capitalism*. Berkeley, CA: University of California.

Gerschenkron, Alexander. 1962. *Economic Backwardness in Historical Perspective: A Book of Essays*. Cambridge, MA: Belknap Press of Harvard University Press.

Giddens, Anthony. 1984. *The Constitution of Society*. Berkeley, CA: University of California Press.

Gorton, Gary and Frank Schmid. 1996. "Universal Banking and the Performance of German Firms." Working Paper No. 5453, National Bureau of Economic Research, Cambridge, MA.

Granovetter, Mark. 1973. "The Strength of Weak Ties." *American Journal of Sociology* 78: 1360–80.

Hamilton, G. and N. Biggart. 1988. "Market Culture and Authority: A Comparative Analysis of Management and Organization in the Far East." *American Journal of Sociology* 94:52–94.

Haunschild, Pamela. 1993. "Interorganizational Imitation: The Impact of Interlocks on Corpo-

Activity." *Administrative Sci-*
38:564–92.
)96. *Industrial Constructions:*
*f German Industrial Power.*
: Cambridge University Press.
, 2000. "Unternehmentsver-
vielicht: Hans Eichel Plan zur
Deutschland AG" (Enterprise
twilight: The Hans Eichel Plan
on of Germany AG). Report,
nstitut fuer Gesellschafts-
gne, Germany.
s. 1957. *Le Pouvoir de Mono-*
· of monopoly). Paris, France:

Katrin Naumann, and Joachim
areholder Value in an Adverse
he German Case." *Economy*
4–79.
ınd Krishna Palepu. 2000.
cet Business Groups, Foreign
rporate Governance." Chap. 9
*Corporate Ownership,* edited
hicago, IL and London, En-
y of Chicago Press.
1 Horst Siegrist. 1979. "Die
en deutschen Industrieunter-
aeten 19. und fruehen 20.
e hundred biggest German in-
the late 19th and early 20th
133 in *Recht und Entwicklung*
*ehmen im 19. und fruehen 20.*
d by N. Horn and J. Kocka.
ermany: Vandehoeck and

1993. *Country Competition.*
*the Organizing of Work.* New
iversity Press.
ordon Walker, and Jaideep
ming. "Agency and Institu-
Divergences in Corporate Di-
avior." *Organization Science.*
*cial Resources and Social Ac-*
Cambridge University Press.
., Michael L. Gerlach, and
. 1992. "Keiretsu Networks in
Analysis of Intercorporate
*Sociological Review* 57:561–

967. "The Small World Prob-
*Today* 2:60–67.
96. "What Do Interlocks Do?
tique and Assessment of Re-
cking Directorates." *Annual*
*gy* 22:271–98.
2000. *Contests for Corporate*
*rate Governance and Eco-*
*ce in the United States and*
, England: Oxford University

Pennings, Johannes. 1980. *The Interlocking Directorates.* San Francisco, CA: Jossey-Bass.

Padgett, John and Christopher Ansell. 1993. "Robust Action and the Rise of the Medici, 1400–1434." *American Journal of Sociology* 98: 1259–1320.

Palmer, Donald. 1993. "Late Adoption of the Multidivisional Form by Large U.S. Corporations: Institutional, Political, and Economic Accounts." *Administrative Science Quarterly* 38:100–31.

Palmer, Donald, Brad Barber, Xueguang Zhou, and Yasemin Soysal. 1995. "The Acquisition of Large U.S. Corporations in the 1960s." *American Sociological Review* 60:469–99.

Podolny, Joel. 1993. "A Status-Based Model of Market Competition." *American Journal of Sociology* 98:829–72.

Prowse, Stephen. 1995. "Corporate Governance in an International Perspective: A Survey of Corporate Control Mechanisms among Large Firms in the U.S., U.K., Japan, and Germany." *Financial Markets, Institutions, and Instruments* 4:1–63.

Rapoport, Anatol and W. J. Horvath. 1961. "A Study of a Large Sociogram." *Behavioral Science* 6:279–91.

Riesser, Jacob. 1910. *Die deutsche Grossbanken und ihre Konzentration* (German big banks and their concentration). Jena, Germany: G. Fischer.

Roe, Mark. 1994. *Strong Managers, Weak Owners: The Political Roots of American Corporate Finance.* Princeton, NJ: Princeton University Press.

Schmidt, Reinhard, Andreas Hackethal, and Marcel Tyrell. 1999. "Disintermediation and the Role of Banks in Europe: An International Comparison." *Journal of Financial Intermediation* 8:36–67.

Scott, John. [1979] 1997. *Corporations, Classes and Capitalism.* Oxford, England: Oxford University Press.

Soskice, David. 1990. "Wage Determination: The Changing Role of Institutions in Advanced Industrialized Countries." *Oxford Review of Economic Policy* 6:36–61.

Useem, Michael. 1984. *The Inner Circle: Large Corporations and the Rise of Business Political Activity in the U.S. and U.K.* New York: Oxford University Press.

———. 1996. *Investor Capitalism: How Money Managers are Changing the Face of Corporate America.* New York: Basic Books.

Van Wolferen, Karel. 1990. *The Enigma of Japanese Power.* New York: Vintage Books.

Walker, Gordon, Bruce Kogut, and Weijian Shan. 1997. "Social Capital, Structural Holes and the Formation of an Industry Network." *Organization Science* 8:109–25.

Wasserman, Stanley and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. New York: Cambridge University Press.

Watts, Duncan. 1999. "Networks, Dynamics, and the Small-World Phenomenon." *American Journal of Sociology* 105:493–527.

Watts, Duncan and Steven Strogatz. 1998. "Collective Dynamics of 'Small World' Dynamics." *Nature* 393:440–42.

Wellhoener, Volker. 1989. *Grossbanken und Grossindustrie im Kaisserreich*. Goettingen, Germany: Vandenhoeck and Ruprecht.

White, Harrison C. 1970. "Search Parameters for the Small World Problem." *Social Forces* 49:259–64.

Zey Mary and Tami Swenson. 1999. "The Transformation of the Dominant Corporate Form from Multidivisional to Multisubsidiary: The Role of the 1986 Tax Reform Act." *Sociological Quarterly* 40: 241–67.

Ziegler, Nicholas. 2000. "Corporate Governance and the Politics of Property Rights in Germany." *Politics and Society* 28: 195–221.