Pp. 118-133 in **Corporate Social Capital and Liability,** edited by Roger Th.A.J. Leenders and Shaul M. Gabbay. Boston: Kluwer, 1999.

Dimensions of Corporate Social Capital: Toward Models and Measures

6

Shin-Kap Han
Ronald L. Breiger

ABSTRACT

Despite an emerging consensus on the importance of corporate social capital, little work has been done on the analytical problem of which aspects, precisely, of a corporate network might be identified as manifesting the concept. Where in a specific configuration of network ties is the corporate social capital located? Is network capital a unitary phenomenon or are there various ways to conceptualize it? In addressing these questions, we formulate models for corporate networks that produce counts for the expected number of ties between each pair of actors on the basis of sets of parameters *which are themselves measures of network capital.* The model we prefer decomposes a network into separable dimensions comprising status, volume, and proximity. We apply the models to a network of 'doing deals' in which billions of dollars of finance capital was raised by syndicates of major U.S. investment banks, data of Eccles and Crane (1988). We show that the model performs well with respect to empirical validity. The modeling framework can be applied and extended to other corporate network settings, and provides measures appropriate for theoretical analyses of markets and corporate relations conceptualized as embedded within social fields.

INTRODUCTION

Analysts as diverse as Coleman and Bourdieu put forward virtually identical definitions of 'social capital' as denoting the resources for social attainment that individuals acquire through networks of mutual acquaintance, obligation, and information channeling. Bourdieu defines social capital as the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition (Bourdieu and Wacquant 1992: 119).

Coleman (1990: 302) too emphasizes that, unlike physical capital and human capital, social capital 'inheres in the structure of relations between persons and among persons.' Relevant here is the considerable body of cross-national research on the impact of social networks and the transmission of job information on income and occupational attainment (reviewed in Coleman 1990: 302; Lin 1990: 250-52; Burt 1992: 11-13), productivity (Bulder, Leeuw, and Flap 1996), and the organi-zational side of job searches (Marsden and Campbell 1990). Studies such as these illuminate concrete mechanisms by which individuals are linked to larger structures through organizations and labor markets (see the review in Breiger 1995).

Much of the recent excitement generated by research on corporate networks results from a focus on how the structure of their ties both affects and results from the interests, resources, and positions of firms in the network—i.e., their social capital. Galaskiewicz (1985) studies business philanthropy as relations among corporations creating 'a grants economy.' Baker (1990) examines the interface between corporations and investment banks with relation to power-dependence concepts. Leifer (1990) seeks to explain authority and market relations among organizations as embedded within the multiplex relations among key actors. White (1992) emphasizes the mutual relations of corporate identity and intercorporate structures and processes of control. Focusing on profit and a typology of markets, Burt (1992: 82-114) shows how firms in production markets can use gaps in social structure—'structural holes'—to their advantage in negotiating transactions with suppliers and customers. Podolny (1993, 1994) theorizes and studies how status orders arise from market and network relations among firms. Haunschild (1994) investigates the effects of interorganizational relationships on the decision of how much to pay when acquiring another company. Han (1994) shows how the interplay between inclusion and exclusion among firms in a market yields a status dimension affecting networks of imitation leading to isomorphism in the selection of audit services. Many chapters in this volume also deal with the issue in a variety of contexts.

NETWORKS AND DEALS

The new work on corporate social capital, such as the studies cited above, has resulted in an explosion of new thinking and new knowledge about social networks. Nonetheless, little work has been done on the analytical problem of which aspects, precisely, of a corporate network might be identified as manifesting the concept. Where in a specific configuration of network ties is the corporate social capital located? Is network capital a unitary phenomenon or are there various ways to conceptualize it? If multiple meanings exist, how might each of them be measured? These are the questions concerning which we seek to contribute clarification and analysis.

To illustrate the scope of our contribution, including its limitations, consider the network of co-management relations among the major investment banks in the U.S. in the 1984-86 period. Eccles and Crane (1988) show that, in order to do their job effectively, investment banks create a complex network of ties to other banks, in the form of syndicates containing 'lead manager banks' and 'co-manager banks' with a separate syndicate organized around each specific 'deal' that is successfully put together. Within the syndicates, lead managers and co-managers do the bulk of the distribution, and work most closely together in the underwriting. In the aggregate these 'deals' generated billions of dollars of financial capital in the mid-1980s in the U.S.

The data in our Table 1 are taken from Eccles and Crane's appendix (1988: 230-31). Rows and columns list the major investment banks in the identical order. Rows index each bank in its role as 'lead manager' of a 'deal' in the capital market, that is, as a bank that works with a group of co-managers to form a syndicate to underwrite a security issue. A lead manager normally 'runs the books' (manages the underwriting and determines distribution allocation) and is usually the investment bank that originated the 'deal' (Eccles and Crane 1988: 237). Columns index the same banks in their role of 'co-manager': banks that work with the lead manager and often a group of other co-managers in the syndicate. These are the top investment banks in the country.[1] Entries off the diagonal in the Table are frequency counts of joint participation in deals. For example, during the study period Salomon Brothers served as the lead bank in 161 deals in which First Boston was a co-manager (see [row 1, column 2] of Table 1), whereas First Boston served as lead manager in 118 deals in which Salomon Brothers was a co-manager in a syndicate ([row 2, column 1]). Entries on the diagonal report the number of times that each bank served as lead manager without any other top bank serving as a co-manager (either because it was sole lead manager or because no co-managers were among the nineteen top firms). For example, during the study period Salomon Brothers led 609 deals without participation of other banks listed in the Table (see [row 1, column 1] of Table 1).[2]

THE SIMMELIAN PROBLEM OF ORDER

Table 1 is a network of ties among corporations. These network ties are at once collaborative and adversarial. The ties are adversarial in that a fixed number of securities must be allocated among the members of a syndicate, and also due to the struggle among banks for recognition and position. The ties are collaborative in that the offering must be distributed to desirable investors in a timely manner (Eccles and Crane 1988: 93-94). This world of 'doing deals' is not a Hobbesian war of all against all, which necessitates external control, but rather an instance of what we might term the Simmelian problem of order. Georg Simmel, a theorist of sociology's classical period, identified within certain forms of conflict a 'fight of all *for* all' entailing the internal social control of an intrinsically ordered interweaving of relations based on 'the possibilities of gaining favor and connection' (1955: 62). The Hobbesian problem of order, as it is described critically by Markovsky and Chaffee (1995: 255; Macy and Flache 1995) portrays the structure as seeking to extract from its components something that they would not otherwise provide. We believe that recent work on solidarity, with a new focus on reachability and relative unity of a structure (Markovsky and Lawler 1994; Markovsky and Chaffee 1995) and on models of macro-structure (Breiger and Roberts 1997), enables contemporary

Table 1

Table 1. Data of Eccles and Crane (1988, pp. 230-31) on ties among investment banks, 1984–1986

Co-Managers:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Lead Managers:																			
1 Salomon Brothers	609	161	123	23	86	243	34	73	36	19	23	20	17	15	7	4	4	7	18
2 First Boston	118	331	159	15	100	111	20	122	35	19	6	11	27	2	7	2	4	2	3
3 Goldman, Sachs	98	64	441	11	46	57	10	49	30	4	5	10	1	18	4	15	1	3	7
4 Drexel	9	12	7	699	17	21	7	1	17	5	5	12	23	10	0	5	8	2	2
5 Shearson Lehman	78	99	75	8	309	59	17	28	15	24	25	33	8	21	5	10	8	2	2
6 Merrill Lynch	123	98	47	16	63	249	15	32	24	27	17	11	20	13	2	14	9	5	7
7 Paine Webber	28	18	6	8	30	19	420	2	10	8	11	6	4	2	1	1	0	3	0
8 Morgan Stanley	93	65	57	32	21	56	6	92	28	12	16	15	18	8	4	7	9	9	3
9 Kidder, Peabody	22	11	22	16	13	31	3	7	322	7	17	19	2	4	3	1	7	2	0
10 Pru-Bache	2	7	2	2	5	3	1	0	3	274	4	4	5	5	0	0	4	4	0
11 E.F. Hutton	4	2	4	5	2	1	1	0	1	3	227	6	5	11	1	1	2	1	2
12 Smith Barney	9	2	3	3	8	4	7	4	4	1	9	120	6	9	0	3	2	0	0
13 Bear, Stearns	2	8	2	4	4	6	5	3	1	1	1	1	131	1	1	1	1	1	1
14 Dean Witter	3	9	6	3	8	7	3	0	6	5	12	9	5	86	2	0	4	1	5
15 Dillon, Read	3	9	4	0	3	2	0	1	2	0	2	2	1	2	86	1	2	0	0
16 Alex. Brown	3	2	2	4	3	3	1	2	5	0	2	1	0	0	0	80	1	3	3
17 DLJ	1	1	0	1	2	0	2	2	0	1	7	0	0	0	0	1	83	0	0
18 L.F. Rothschild	2	0	0	0	6	1	1	0	1	0	1	2	2	4	0	3	2	71	0
19 Lazard Frères	1	3	5	0	4	7	1	0	3	3	1	0	1	0	1	0	1	1	14

researchers to address the alternative, Simmelian, problem of order: that 'the structural membership of the individual in his group always means some mixture of enforced limitation and personal freedom' (Simmel 1959: 47; for further exposition see Breiger 1990). We seek formal models and quantitative measures that allow us to tease apart the subtle intermixture of various kinds of organizing principles (hierarchy, reciprocity, and so forth) that constitute the intercorporate network.

The technical infrastructure for our modeling project is already in place. Within the class of multiplicative and related models for contingency tables of frequency data, we focus on quasi-symmetry and its special cases and generalizations. Maximum likelihood techniques for estimating parameters are well known and widely available (see Sobel, Hout, Duncan 1985; Goodman 1984; Clogg and Shihadeh 1994). Thus freed from the necessity of creating new models, we concentrate instead on the call of Sobel, Hout, and Duncan (1985: 371) for researchers to 'attach new meanings to already existing models of this type and to generate new models for the square table.' Related work of ours includes Breiger and Roberts (1998), Breiger and Ennis (1997), and Han and Breiger (1996); see note 6 below.

MODELS AND MEASURES

To establish notation, we will use f_{ij} to refer to an observed count in Table 1. For example, f_{12} is the count in Table 1 at the intersection of row 1 and column 2; as we noted earlier, this entry reports that, during the period studied by Eccles and Crane, the first-listed bank, Salomon Brothers, was the lead manager in 161 deals for which the second-listed bank, First Boston, served as a co-manager. The set of f_{ij} defines a quantitative network of ties among these investment banks. We seek to model this network so as to bring out aspects of social capital. We will use F_{ij} to refer to the expected count that we derive for cell (i,j) on the basis of a model. We assume the table is square and of size $g \times g$, with the same entities (in our case, a set of investment banks) indexed by rows and columns.

We consider several models, all of which satisfy or are special cases of quasi-symmetry, a model which we will explicate. Other kinds of models might also be considered for these data, but we have found quasi-symmetry models to be particularly helpful in studying corporate social capital (cf. Friedkin 1998). These models are distinctive in that they decompose a network of counts into separable aspects comprising *status*, *volume*, and *proximity*, as we will demonstrate. The existing literature on corporate relations is rather vague on whether these aspects are conceptually separate, and their meanings have often been blurred. In fact, they might be strongly related to one another; however, this should be an empirical question. We seek explicit definitions of these concepts as features of networks, thus enabling us to jointly model and measure the concepts in relational terms.

Following the path-breaking work of Sobel, Hout, and Duncan (1985), we parameterize the quasi-symmetry model as follows:

$$F_{ij} = \alpha_j \beta_i \beta_j \delta_{ij} \qquad (1)$$

Terms on the right-hand side are parameters to be estimated. Several stipulations are imposed. An α is estimated for each of the *g* actors indexed in the table, and the product of the α_j is 1. It is understood that $\beta_i = \beta_j$ if i = j. The δ's are symmetric, $\delta_{ij} = \delta_{ji}$. Maximum-likelihood procedures for estimation of the parameters and expected cell frequencies under this log-linear model of quasi-symmetry are well-known; interested readers are referred to Bishop et al. (1975), Goodman and Clogg (1984), Agresti (1990), Clogg and Shihadeh (1994).

It will be useful to consider the pair of cells F_{ij} and F_{ji}. For example, Figure 1 indicates expected frequencies among three pairs of banks.[3] We see for example that, according to the model, Goldman Sachs is the lead manager in an estimated 45.618 deals in which Shearson Lehman is a co-manager. In the opposite direction, Shearson Lehman is lead manager in a larger number of deals, estimated at 59.245, in which Goldman Sachs is co-manager.

The ratio between the two, then, indicates and measures the extent to which the pairing between the two actors is asymmetric. In pairing Shearson Lehman (*i*) and Goldman, Sachs (*j*), for example, it is the former who is more likely to be the lead manager, as shown in the first panel of Figure 1 (59.245 versus 45.618). The ratio between the two, R_{ij}, then, is 1.299, showing that Shearson Lehman (*i*) is 1.299 times more likely to be the dominant partner (i.e., lead manager) vis-à-vis Goldman, Sachs (*j*). In other words, R_{ij} is a measure of the dominance of *i* over *j*.

We may form an entire *g* × g matrix, **R**, of such ratios, with

$$R_{ij} \equiv \frac{F_{ij}}{F_{ji}} \tag{2}$$

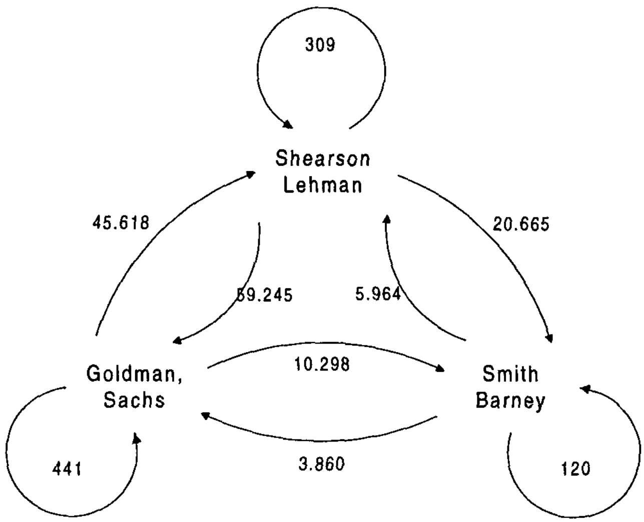
Although the equation above is definitional of dominance, we now turn to a result. The matrix of **R** is a function of one dimension: the α parameters in our model. As may be seen by substitution of equation 1 into this definition of **R**:

$$R_{ij} \equiv \frac{F_{ij}}{F_{ji}} = \frac{\alpha_j}{\alpha_i} \tag{3}$$

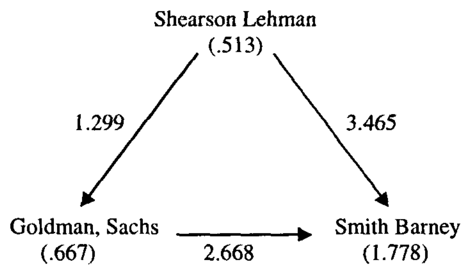
Each actor in the network thus has a unique value of alpha, and the asymmetry in any pairing between two actors can be described in terms of the ratio between the two alphas. With respect to the tie in network **R** from Shearson Lehman to Goldman, Sachs, for example, the ratio of the alphas (shown in panel **b** of Figure 1) is .667/.513, which equals 1.299, the value of R_{ij} given previously in the text. The vector of alphas forms a linear ordering and in this sense captures the dominance hierarchy among all the actors in the network.[4]

Furthermore, if we define a column vector **a** to have $1/\alpha_j$ as its j-th element, we can trace the relationship between our alpha and a conventional measure of centrality in the social networks literature (Bonacich 1972, 1987; Wasserman and Faust 1994).

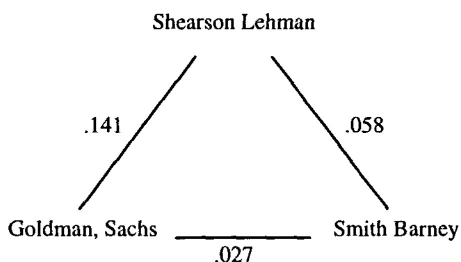
The centrality of an actor is very often operationalized as the sum of an actor's social connections, weighted by the centrality of the others to whom the focal actor is tied. A natural implementation of this concept of centrality is that centrality is an eigenvector of the matrix representation of the social network (see also the applications of eigenvector centrality measures in studies of corporate interlocks



Panel a: Expected frequencies (F_{ij}) from Model 3 in Table 2.



Panel b: Ties between firms ($R_{ij} = F_{ij} / F_{ji}$). Values in parentheses are α_j.



Panel c: δ_{ij}; see equation 5.

Figure 1. Modeling the network of investment banks: a three bank example

such as those referenced in Mizruchi et al. 1986).

With respect to the network **R** defined above, we have

$$\mathbf{R}\, a = \lambda\, a \tag{4}$$

with $\lambda = g$, the number of actors in the network. This equation establishes that the α_j parameters of the quasi-symmetry model define an eigenvector of matrix **R** and thus, in our modeling context, represent the dimension of networks that is typically captured by the family of centrality measures including prestige, status, and popularity.[5]

This interpretation of the α_j parameters illustrates the most fundamental feature of our modeling approach: We formulate models for the network that produce expected cell counts for the number of ties between any two actors on the basis of parameters (α, β, δ) which themselves are measures of network capital.

The models and measures are duals to each other, as roles and positions are duals to the structure. The models themselves (such as quasi-symmetry) are well-known. Our distinctive contribution is to develop their relevance to the analysis of network data on counts, such as the co-manager ties of Table 1. From a statistical point of view, the fit of the models to observed networks may be assessed by means of standard maximum-likelihood chi-square procedures, making them feasible to apply to square tables of frequency data in many different substantive contexts.[6]

In models of quasi-symmetry for network data, β_i is the average volume of ties sent and received by actor *i*, controlling for the other parameters in the model. In the present context, this parameter indexes a bank's total involvement in deals (whether as a lead- or as a co-manager, without distinguishing between these two roles but focusing only on the extensiveness of its ties). In this sense, β_i indexes the (relational) volume of an actor.

The third set of parameters, the δ_{ij}, measures how strongly or closely *i* and *j* are related to each other, net of α and β. The raw expected count, F_{ij}, is by postulation a function of all three parameters and thus is not a proximity measure. The geometric mean of F_{ij} and F_{ji} could be a proximity measure but it also suffers from a built-in dependence on all three parameters. However, if we norm this product appropriately, then the following is a measure of proximity between the two actors that is net of the asymmetric status (α) and relational volume (β) effects, as may be seen by substitution of equation 1 (see also Sobel et al. 1985: 364):

$$\sqrt{\left(\frac{F_{ij}}{F_{ii}}\right)\left(\frac{F_{ji}}{F_{jj}}\right)} = \delta_{ij} \tag{5}$$

Although it is usual to interpret the δ_{ij} parameters with reference to the social process of reciprocity (e.g., Sobel et al. 1985), in the context of our corporate data we prefer the more direct interpretation given by the equation above: δ is a measure of the social proximity of two actors. The relations themselves may not be symmetric, whereas δ is an average of their intensities, the degree to which two investment banks are likely to encounter each other in a syndicate formed to put together a deal. In Figure 1, panel **c** reports the estimated δ parameters (computed as in the equation above) for three illustrative banks. It is seen that Goldman Sachs and Shearson Lehman are much closer to one another (on the basis of the average net intensity of their relations) than either bank is to Smith Barney. The δ parameters give us a network of proximity coefficients. The δ_{ij} might well be related to differences in status (α_j / α_i) and in volume (β_i / β_j), as they indeed appear to be in the illustrative example of Figure 1. Such relations among the parameters can be investigated on the basis of a model that decomposes the expected cell counts into just these three components.

A variety of models simpler than quasi-symmetry may be postulated; see Table 2. The simplest model we consider consists solely of the β parameters for volume; that is to say, the model imposes that all $\alpha_j = 1$ and all $\delta_{ij} = 1$. This model is taken as the baseline model for analysis of square tables by Hope (1982), who terms it the 'halfway' model, and it is discussed by Goodman (1985) and by Hout, Duncan, and Sobel (1987: 152), who note that the model imposes both independence and marginal homogeneity.

The conventional model of statistical independence for rows and columns of a square contingency table may be obtained from the 'halfway' model by adding to the halfway model estimates of the α_j parameters measuring dissimilarity among the average counts in column *j* and in row *j*; see Table 2. In the independence model no pairwise interactions are allowed (all $\delta_{ij} = 1$). An alternative generalization of the 'halfway' model is to allow symmetric pairwise interactions (δ_{ij}) but to preserve marginal homogeneity ($\alpha_j = 1$); this alternative defines the usual model of (full) symmetry. Putting together, so to speak, the model of independence and the model of full symmetry yields the model of quasi-symmetry that we have been discussing in this chapter (see Table 2). In other words, we relax the marginal homogeneity condition, specified in the full symmetry model ($\alpha_j = 1$), while allowing the pairwise interactions, prevented in the independence model (all $\delta_{ij} = 1$), with some constraints.

The remaining models of Table 2 provide more parsimonious representation of the symmetric interaction parameters (the δ_{ij}), portraying these pairwise terms as one or more dimensions of interaction, rather than requiring one parameter for each pair of actors. Notice for example that the 'homogeneous RC(1) model' requires estimation of only ($g-1$) parameters more than the model of independence (the difference in degrees of freedom is 305 − 287 = 18; see Model 3 in Table 2) in order to represent all the pairwise proximities in terms of a single dimension (μ). The 'RC(2)' model uses two dimensions in preference to estimating a parameter for each pair of actors. All the models in Table 2 are well known and are discussed in detail by Goodman (1984, 1985) and others (Sobel et al. 1985; Hout et al. 1987; Agresti 1990). As shown by the parameter specification in Table 2, all these models are models of quasi-symmetry.

The fit of any of these models to data on frequency counts may be assessed in the usual way by means of a comparison of the chi-square and the degrees of freedom left by the model (see columns labeled G^2 and df in Table 2). Or, one may measure improvement in fit relative to a baseline model. The last column in the

Table 2

Table 2. Models of quasi-symmetry*

Parameter Specification	α_j	β_i	δ_{ij}	df	G_k^2	*bic*	$1-\{G_k^2/G_l^2\}$
k Model:							
1 Halfway	1	β_i	1	323	1624.4	−1099	0.0%
2 Independence	α_j	β_i	1	305	1248.0	−1324	23.2%
3 Homogeneous RC(1)	α_j	β_i	$\exp\left\{-\frac{1}{2}\phi(\mu_i-\mu_j)^2\right\}$	287	779.1	−1641	52.0%
4 Homogeneous RC(2)	α_j	β_i	$\exp\left\{-\frac{1}{2}\sum_{k=1}^{2}\phi_k(\mu_{ki}-\mu_{kj})^2\right\}$	270	644.6	−1632	60.3%
5 Full Symmetry	1	β_i	δ_{ij}	171	777.3	−664	52.1%
6 Full Quasi-Symmetry	α_j	β_i	δ_{ij}	153	330.9	−959	79.6%

* As implemented in this paper, all models fit the diagonal cells exactly. Models are ordered by their degrees of freedom.

Table provides such a measure relative to Model 1, the 'halfway' model. Alternatively, because the number of deals indexed in Table 1 is large, and to avoid overfitting (that is, the inclusion of terms in a model for which we have little or no substantive interpretation) we may apply the Bayesian information criterion (*BIC*) of Raftery (1986; see also Raftery 1995); values of this criterion are given in Table 2 for each of our models. In applying *BIC* one chooses the model with the lowest *BIC* value.

In fact, all the models of Table 2 are relatively more or less parsimonious efforts to represent quasi-symmetry. For example, the δ_{ij} values estimated from the one-dimensional model of Table 2, RC(1), correlate .82 with the δ_{ij} parameters estimated for the full quasi-symmetry model, and the single dimension estimated for the one-dimensional model in Table 2 correlates .98 with the first dimension of the two-dimensional model, RC(2).

According to the *BIC* criterion the best balance of parsimony and substance is attained by the one-dimensional model, RC(1), with a single dimension characterizing scores for both the row and (identically) the column categories of our data (see Model 3 in Table 2). This one-dimensional model differs from (full) quasi-symmetry only and precisely by modeling the pair-wise δ_{ij} parameters by means of a single dimension of proximity, as specified by the μ_i parameters in the column of Table 2 labeled 'δ_{ij}'. The illustrative example of Figure 1 above is based on expected counts and estimated parameters from this RC(1) model.

NETWORKS AND OUTCOMES

In this section, using the model discussed earlier, we examine the social structure of investment banking industry by analyzing the data on the ties between investment banks. Our preferred model (Model 3 of Table 2) fits the data with three dimensions: status (α), volume (β), and proximity (μ). The estimated parameters are reported in Table 3 for each of the nineteen investment banks in the dataset.

The model decomposes the relational structure among the investment banks into three components. The first one, α, captures the disparity between playing the role of the lead manager and the role of the co-manager. In other words, it measures the propensity of an actor to be on one side of this asymmetric relationship versus the other. In particular, the reciprocal of α measures the propensity to be the lead manager in a deal rather than a co-manager, and indicates each actor's position in the linear ordering of the dominance hierarchy among all the actors in the network.

The estimated α's closely reproduce the well-known 'bracket' structure in the industry, the strong and elaborate status hierarchy among the investment banks, typically shown in the 'tombstone' advertisements (Hayes 1979; Eccles and Crane 1988; Podolny 1993). All of the six special (or bulge) bracket firms—First Boston (#2); Goldman, Sachs (#3); Morgan Stanley (#8); Salomon Brothers (#1); Merrill Lynch (#6); and Shearson Lehman Brothers (#5)—are found at the top of the list of estimated α's, with Paine Webber (#7) being an exception in the ordering. Drexel (#4) and Dillon, Read (#15), follow closely after these six.

Table 3. Estimated parameters for Model 3 of Table 2

ID No.	Investment Bank Name	Special Bracket	Parameters ln(1/α)	ln(β)	*l*n(μ)
1	Salomon Brothers	Yes	0.9099	3.6608	1.4346
2	First Boston	Yes	0.8301	3.3161	1.7183
3	Goldman, Sachs	Yes	0.4056	3.2473	1.4390
4	Drexel	No	0.3369	3.4433	−0.5509
5	Shearson Lehman	Yes	0.6670	3.2002	0.6637
6	Merrill Lynch	Yes	0.4041	2.9608	1.0601
7	Paine Webber	No	0.5593	3.2998	0.1743
8	Morgan Stanley	Yes	0.8607	2.6913	1.1855
9	Kidder, Peabody	No	0.2063	2.9904	−0.0587
10	Pru-Bache Securities	No	−0.6952	2.4590	−0.4910
11	E. F. Hutton	No	−0.9994	2.2128	−1.5178
12	Smith Barney	No	−0.5757	2.1059	−1.0161
13	Bear, Stearns	No	−0.8767	1.9993	−0.4697
14	Dean Witter	No	−0.2102	2.1221	−1.2014
15	Dillon, Read	No	0.3217	2.3880	0.3272
16	Alex. Brown	No	−0.3679	2.0071	−0.3828
17	DLJ	No	−1.2533	1.5828	−1.4986
18	L. F. Rothschild	No	−0.4190	1.9218	−0.9267
19	Lazard Frères	No	−0.1043	1.2674	0.1109

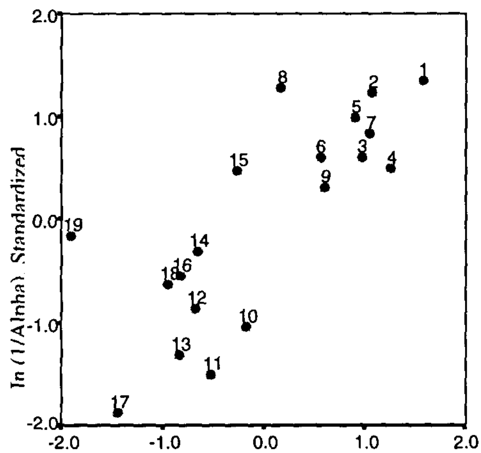


Figure 2a. Status (1/α) by Volume (β)*

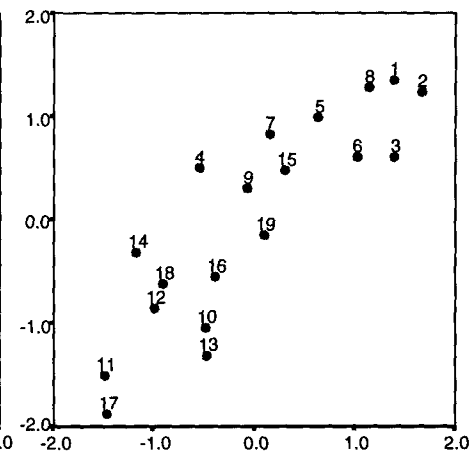


Figure 2b. Status (1/α) by Proximity (μ)*

* ID numbers in the Figure are keyed to the name of the investment banks in Tables 1 and 3. Parameters are standardized by taking *Z*-scores.

The second parameter, β, taps into the volume effect, the extensiveness of a firm's involvement in deals either as the lead manager or the co-manager. Salomon Brothers (#1) is on top, followed by Drexel (#4). These two parameters, α and β, are highly correlated with each other. Eccles and Crane (1988) observed that a firm's hierarchical position is based partly on its volume, and the volume of securities it gets to underwrite and sell is based in turn on its hierarchical position.

Consider, however, the joint distribution of the two. The scatterplot in Figure 2a shows a pattern of deviation from the expected association between the two sets of parameters, $1/\alpha$ and β. Although most of the firms are along or near the regression line describing the expected linear relationship between status and volume, there are two groups of firms that fall far outside the expected range.

1. On the one hand, there is a group of firms—Morgan Stanley (#8); Dillon, Read (#15); and Lazard Frères (#19)—known to be Establishment firms that enjoy high status relative to their volume (Podolny 1994; cf. Stuart in this volume). Morgan Stanley is known to be 'the bluest of the blue-chip investment bankers' (Hayes 1971: 139; Eccles and Crane 1988); Dillon, Read used to belong to the special bracket (Hayes 1979); and Lazard Frères represents the old Wall Street (Stewart 1991). This provides an example of how the inertia of the status hierarchy (α) mitigates the raw influence of the market as indexed by overall volume (β).

2. On the other hand, another group suffers low status despite high volume. Drexel (#4) is the most prominent case among the latter group of outliers, which also includes Prudential-Bache (#10) and E. F. Hutton (#11). Drexel's reputation as an aggressive newcomer and its strong association with 'junk bonds' provide partial explanations for this discrepancy,[7] with Eccles and Crane (1988: 115-16) noting in some detail that 'during our project the firm was described to us ... in the most unflattering ways' (see also Stewart 1991). This is an example of how the hierarchy, defined and legitimized by the participants themselves, acts as a conservative mobility barrier to firms trying to shift their position.

Volume is important, and it is highly correlated with status, yet the two are separate dimensions, and one does not necessarily translate into the other. The contrast between Lazard Frères (#19) and Drexel (#4) clearly illustrates this point (also see the more recent case of DLJ—Donaldson, Lufkin and Jenrette, #17—in Doherty 1997). The model we propose is precisely suited to such a setting, for it allows the two conceptually independent components to be separated out from each other. Although the two are rather highly correlated in this case, for instance, the underlying structural dimensions they tap are distinct. As shown in Table 4, it is β that best captures the overall volume effect, as in total market share and number of issues. By contrast, $1/\alpha$ does better at explaining the dimension that is associated

Table 4. Correlations between $1/\alpha$ and β and other select variables*

Variable	ln(1/α)	ln(β)
Total Market Share, 1984-1986	.689	.857
Number of Corporate Securities Issued, 1986	.775	.843
Market Share in Investment Grade Bonds	.687	.684
Market Share in Non-Investment Grade Bonds	.274	.478
Status Score (Podolny 1993)	.621	.535

* The sources for the other variables are Eccles and Crane (1988, Tables 5.4 and A.6) and Podolny (1993).

with prestige or status, an excellent example being the status scores computed by Podolny (1993, 1994) applying a widely used measure of centrality to the placement pattern of investment banks in the tombstone advertisements. Also revealing is the way they correlate with the market shares of two different financial products, investment grade bonds and non-investment grade bonds (see note 7). With the former both α and β are correlated to the same degree, while for the latter, a high risk product (Podolny 1994), the correlation with α is not statistically significant.

The third dimension, μ, is about how close or distant the firms are from each other net of α and β. The more deals a pair of firms do together, the closer they are to each other vis-à-vis the others. The vector of μ's thus forms a one-dimensional space along which each firm can be located, and the proximity between any pair of firms can be obtained from the distance between the two. The smaller the difference between μ_i and μ_j, the closer firm *i* and firm *j* are, and vice versa. For example, Salomon Brothers (#1; $\mu_i = 1.4346$) and Merrill Lynch (#6; $\mu_j = 1.0601$) are relatively close to each other ($\mu_i - \mu_j = 0.3745$), and they frequently serve as partners.[8] In contrast, Morgan Stanley (#8; $\mu_i = 1.1855$) and Dean Witter (#14; $\mu_j = -1.2024$) are relatively far apart ($\mu_i - \mu_j = 2.3869$), and they rarely do deals together.

Plotting relational proximity (μ) against status ($1/\alpha$) reveals a very important social dynamic that occurs among the investment banks, that of status homophily. The firms that are close to each other on μ are likely to be near to each other on α as well. The smaller ($\mu_i - \mu_j$), the smaller ($\alpha_i - \alpha_j$). Or, to put it otherwise, the investment banks that put together the deals tend to be status equals, which is the central finding in Podolny (1993) based on somewhat different data for these same firms.

This result also precisely matches what Eccles and Crane observed. The top six firms, those in the special bracket, are clustered to the right in Figure 2b. They are close to one another as a result of the security issues they do together. Yet they can be broken down into two groups. The first one consists of Goldman, Sachs (#3), Salomon Brothers (#1), and First Boston (#2). These three rely most heavily on other special bracket firms as co-managers. The second group—Shearson Lehman (#5), Merrill Lynch (#6), and Morgan Stanley (#8)—do so less often, bridging instead to banks further down the status ordering. The relative location of the two groups on μ, i.e., the second group being closer to the rest of the banks to the left, bears out Eccles and Crane's account. In particular, these authors report that 'a partial explanation of the difference between the two groups is that a larger share of the deals led by the second group, particularly Merrill Lynch and Shearson Lehman, were security issues in which regional firms were used as co-managers to get more retail distribution' (Eccles and Crane 1988: 94).[9]

IMPLICATIONS FOR RESEARCH AND THEORY

An emerging consensus on the importance of corporate social capital spans a broad spectrum of theorists and researchers, as aptly illustrated in this volume. Although the core ideas seem to be shared by many and have been shown to be operative in a variety of settings, little work has been done to parse out analytically the multiple and conceptually distinct aspects of social capital. In examining a network of 'doing deals' constructed among the major U.S. investment banks (Eccles and Crane 1988) from the analytic perspective of log-linear models, we rely on a set of well-established techniques. Yet at the same time we heed the call to 'attach new meanings' (Sobel et al. 1985: 371) to the models, and we expand their interpretive horizon by means of our novel application.

We formulate models for the networks that produce counts for the expected number of ties between each ordered pair of actors on the basis of a set of parameters which themselves are measures of network capital. More specifically, the model we prefer decomposes a network into separable dimensions comprising status, volume, and proximity. We show that the model and its associated estimated parameters, which situate the actors within a social space in relation to one another, performs well with respect to empirical validity.

'Something about the structure of the player's network and the location of the player's contacts in the social structure of the arena,' Burt argues, 'create a competitive advantage in getting higher rates of return on investment' (1992: 57). That 'something' is social capital, upon which economic constraints and opportunities that confront a producer are very much contingent (Podolny 1993). The approach proposed in this chapter makes it possible to formulate this intuitive notion in a more explicit and structural manner. Providing measures appropriate to analyze the intercorporate relations, competitive or otherwise, and a way to map the configuration of the market as a whole, the model can easily be applied and extended to other corporate network settings, such as joint ventures, strategic alliances, or R&D collaboration (e.g., Freeman, Pennings and Lee, Smith-Doerr et al., and Stuart in this volume). The model thus should allow better informed strategic deliberations in a variety of management settings (e.g., Porter 1980).

Furthermore, the model and its parameters offer a way to portray a social field in general, beyond this specific framework. Consider, for instance, different configurations of actors in α–β space, as in Figure 2a. For the investment banking industry, there is a high correlation between a firm's volume of underwriting business and its place in the industry's hierarchy. The two, however, are conceptually distinct. The model we propose is precisely suited to such a setting, for it allows each dimension to be separated out from the other. It should be possible, nonetheless, to find a case completely opposite to ours, one in which the two are correlated negatively—as in luxury goods. Or, one might be able to find a setting in which the mid-sized firms are the most prestigious (cf. White 1988, 1992). In α–μ space, shown in Figure 2b, we showed precisely a pattern of status homophily. And yet, other configurations are plausible as well. There are settings that exhibit social proximity between status unequals, as for example between managers and secretaries (Kanter 1977). Curvilinear relationships are also possible, as for example among U.S. Supreme Court justices, where we have argued that those justices 'in between' the coalitions of liberal and conservative ideologies are highest in the status hierarchy (Han and Breiger 1996). Such an inverse-U shape is itself in contrast to the U-shape for plotting status against social proximity that is often postulated in the cases of the middleman minority (Bonacich 1973).

In sum, the theoretical and research work that is necessary to further develop the concept of corporate social capital requires structural and systematic measures on networks. In this chapter we have introduced relationally based measures which appear to be most promising for future work.

For comments on an earlier draft we are grateful to the editors and to Robert Faulkner, Noah Friedkin, Joseph Galaskiewicz, Philippa Pattison, and John M. Roberts, Jr.

NOTES

1. That these nineteen investment banks are the major players seems to be a robust finding. Eccles and Crane (1988: 228) report that, 'since nineteen is not a round number, we attempted to chose a twentieth but could not. All the candidates were firms strong in narrow product categories, purely regional firms, or varied in the strength of their performance through the three-year period' of 1984-86.
2. Of these, 488 were deals in which Salomon Brothers was the sole lead manager, and 121 others involved deals with banks other than those listed in Table 1.
3. The expected frequencies in Figure 1 are derived from Model 3 in Table 2 of this chapter. This model is a special case of quasi-symmetry, to be discussed below.
4. This discussion of R_{ij} is somewhat analogous to related formulations, including those of R. D. Luce (who developed implications of the choice axiom for the scaling of preferences) and of S. E. Fienberg and K. Larntz (who showed that the Luce model implies a linear preference model in the logit scale, and who formulated aspects of Luce's model as well as other models for paired comparison experiments in terms of the quasi-symmetry model). See Agresti (1990: 370-74) and the brief review that appears in Breiger and Roberts (1998).
5. Equation 4 may be obtained by substituting equation 1 into the definition of R_{ij}.
6. For example, Breiger and Roberts (1998) and Han and Breiger (1996) examine networks of joining in one another's opinions on the part of members of the U.S. Supreme Court. Breiger and Ennis (1997) examine as a social network a cultural field of relations among writers in Köln, Germany, data of Anheier et al. (1995).
7. A 'junk bond' or noninvestment-grade bond is a certificate of debt promising a high rate of return on investment but carrying a high risk; these securities are often used to finance corporate takeovers.
8. Eccles and Crane (1988: 96) note that 'the tie between Merrill Lynch and Salomon Brothers was particularly strong.'
9. See Doherty (1997) for a detailed account of DLJ's (#17) relative location vis-à-vis the others and its recent movement in the parameter space.

References

Agresti, Alan. 1990. *Categorical Data Analysis*. New York: John Wiley & Sons.

Anheier, Helmut K., Jurgen Gerhards, and Frank P. Romo. 1995. "Forms of Capital and Social Structure in Cultural Fields: Examining Bourdieu's Social Topography," *American Journal of Sociology* 100:859-903.

Baker, Wayne E. 1990. "Market Networks and Corporate Behavior," *American Journal of Sociology* 96:589-625.

Bishop, Yvonne M.M., Stephen E. Fienberg, and Paul W. Holland. 1975. *Discrete Multivariate Analysis: Theory and Practice*. Cambridge, MA: Harvard University Press.

Bonacich, Edna. 1973. "A Theory of Middleman Minorities," *American Sociological Review* 38:583-594.

Bonacich, Phillip. 1972. "Technique for Analyzing Overlapping Memberships," Pp. 176-185 in Herbert Costner (ed.), *Sociological Methodology 1972*. San Francisco: Jossey-Bass.

Bonacich, Phillip. 1987. "Power and Centrality: A Family of Measures," *American Journal of Sociology* 92:1170-1182.

Bourdieu, Pierre, and Loïc J. D. Wacquant. 1992. *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.

Breiger, Ronald L. 1990. "Social Control and Social Networks: A Model from Georg Simmel," Pp. 453-476 in Craig Calhoun, Marshall W. Meyer, and W. Richard Scott (eds.), *Structures of Power and Constraint: Papers in Honor of Peter M. Blau*. New York: Cambridge University Press.

Breiger, Ronald L. 1995. "Social Structure and the Phenomenology of Attainment," *Annual Review of Sociology* 21:115-136.

Breiger, Ronald L., and James G. Ennis. 1997. "Generalized Exchange in Social Networks: Statistics and Structure," *L'Année sociologique* 47:73-88.

Breiger, Ronald L., and John M. Roberts, Jr. 1997. "Solidarity and Social Networks," Ch. 8 in Patrick Doreian and Thomas J. Fararo (eds.), *The Problem of Solidarity: Theories and Models*. New York: Gordon and Breach. In Press.

Bulder, Bert, Frans Leeuw, and Henk Flap. 1996. "Networks and Evaluating Public-Sector Reforms," *Evaluation* 2:261-276.

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

Clogg, Clifford C., and Edward S. Shihadeh. 1994. *Statistical Models for Ordinal Variables*. Thousand Oaks, CA: Sage Publications.

Coleman, James S. 1990. *Foundations of Social Theory*. Cambridge, MA: Belknap Press.

Doherty, Jacqueline. 1997. "The New Drexel," *Barron's* (September 8):17-21.

Eccles, Robert G., and Dwight B. Crane. 1988. *Doing Deals : Investment Banks at Work.* Boston: Harvard Business School Press.

Friedkin, Noah E. 1998. *A Structural Theory of Social Influence*. New York: Cambridge University Press.

Galaskiewicz, Joseph. 1985. *Social Organization of an Urban Grants Economy*. New York: Academic Press.

Goodman, Leo A. 1984. *The Analysis of Cross-Classified Data Having Ordered Categories.* Cambridge, MA: Harvard University Press.

Goodman, Leo A. 1985. "The Analysis of Cross-Classified Data Having Ordered And/Or Unordered Categories: Association Models, Correlation Models, and Asymmetry Models for Contingency Tables With or Without Missing Entries," *Annals of Statistics* 13:10-69.

Han, Shin-Kap. 1994. "Mimetic Isomorphism and Its Effect on the Audit Services Market," *Social Forces* 73:637-664.

Han, Shin-Kap, and Ronald L. Breiger. 1996. "Switching and Stacking: Network Multiplexity in the Supreme Court," Paper presented at the 16th Sunbelt International Social Network Conference, Charleston, SC.

Haunschild, Pamela R. 1994. "How Much Is That Company Worth?: Interorganizational Relationships, Uncertainty, and Acquisition Premiums," *Administrative Science Quarterly* 39:391-411.

Hayes, Samuel L., III. 1971. "Investment banking Power Structure in Flux," *Harvard Business Review* (March/April):136-152.

Hayes, Samuel L., III. 1979. "The Transformation of Investment Banking," *Harvard Business Review* (January/February):153-170.

Hope, Keith. 1982. "Vertical and Non-Vertical Class Mobility in Three Countries," *American Sociological Review* 47:99-113.

Hout, Michael, Otis Dudley Duncan, and Michael E. Sobel. 1987. "Association and Heterogeneity: Structural Models of Similarities and Differences," Pp. 145-184 in Clifford C. Clogg (ed.), *Sociological Methodology 1987*. Washington, DC: American Sociological Association.

Kanter, Rosabeth M. 1977. *Men and Women of the Corporation*. New York: Basic Books.

Leifer, Eric M. 1990. "Market and Authority in League Sports," *American Journal of Sociology* 96:655-683.

Lin, Nan. 1990. "Social Resources and Social Mobility: A Structural Theory of Status Attainment," Pp. 247-271 in Ronald L. Breiger (ed.), *Social Mobility and Social Structure*. New York: Cambridge University Press.

Macy, Michael W., and Andreas Flache. 1995. "Beyond Rationality in Models of Choice," *Annual Review of Sociology* 21:73-91.

Markovsky, Barry, and Mark V. Chaffee. 1995. "Social Identification and Solidarity: A Revised Formulation," Pp. 249-270 in Barry Markovsky, Jodi O'Brien and Karen Heimer (eds.), *Advances in Group Processes* 12. Greenwich, CT: JAI Press.

Markovsky, Barry, and Edward J. Lawler. 1994. "A New Theory of Group Solidarity," Pp. 113-137 in Barry Markovsky, Jodi O'Brien and Karen Heimer (eds.), *Advances in Group Processes* 11. Greenwich, CT: JAI Press.

Marsden, Peter V., and Karen E. Campbell. 1990. "Recruitment and Selection Processes: The Organizational Side of Job Searches," Pp. 59-79 in Ronald L. Breiger (ed.), *Social Mobility and Social Structure*. New York: Cambridge University Press.

Mizruchi, Mark S., Peter Mariolis, Michael Schwartz, and Beth Mintz. 1986. "Techniques for Disaggregating Centrality Scores in Social Networks," Pp. 26-48 in Nancy B. Tuma (ed.), *Sociological Methodology 1986*. Washington, DC: American Sociological Association.

Podolny, Joel M. 1993. "A Status-Based Model of Market Competition," *American Journal of Sociology* 98:829-872.

Podolny, Joel M. 1994. "Market Uncertainty and the Social Character of Economic Exchange," *Administrative Science Quarterly* 39:458-483.

Porter, Michael E. 1980. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.

Raftery, Adrian E. 1986. "Choosing Models for Cross-Classifications," *American Sociological Review* 51:145-46.

Raftery, Adrian E. 1995. "Bayesian Model Selection in Social Research," Pp. 111-163 in Peter V. Marsden (ed.), *Sociological Methodology 1995*. Washington, DC: American Sociological Association.

Simmel, Georg. 1905. *Sociology of Religion*. Tr. Curt Rosenthal. New York: Philosophical Library, 1959.

Simmel, Georg. 1908. *Conflict and the Web of Group-Affiliations*. Tr. Kurt H. Wolff and Reinhard Bendix. New York: Free Press, 1955.

Sobel, Michael E., Michael Hout, and Otis Dudley Duncan. 1985. “Exchange, Structure, and Symmetry in Occupational Mobility,” *American Journal of Sociology* 91:359-372.

Stewart, James B. 1991. *Den of Thieves*. New York: Simon & Schuster.

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

White, Harrison C. 1988. “Varieties of Markets,” Pp. 226-260 in Barry Wellman and S. D. Berkowitz (eds.), *Social Structure: A Network Approach*. New York: Cambridge University Press.

White, Harrison C. 1992. *Identity and Control: A Structural Theory of Social Action*. Princeton, NJ: Princeton University Press.