Note on Performance and Structural Holes at the Top of a Large Finance Organization

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This note describes manager performance increasing with access to structural holes in the network of directors and managing directors, at the top of a large finance organization, just after the turn of the century. The organization operated in a variety of financial service businesses, excluding insurance and banking, and was doing well expanding after the turbulence of the dot-com bubble in the late 1990s.

This work was an element in the organization's investment in its leadership. The goal of the work was to inform an executive education program, and to answer the usual questions asked of a management network: Who are the leaders holding the network together? What are their stories? Are they recognized and rewarded for their exertions? Are the resilience and innovation benefits of network brokerage inhibited by any particular individuals or groups? Who are the individuals/groups likely to do well with additional attention? Are leaders being developed where we need them?

The data show the usual broker-success association familiar in published studies, so I saw little value in publishing another paper that replicated the association. However, I include this study population in a current review of aggregate results across populations, so I wrote this note to describe the results within this population that are aggregated in the review. I have two tasks here: Describe the study population social structure, and describe the broker-success association.

Data

I have two years of data on the population of 542 individuals. From human resource files, I have data on performance (measured by annual salary and bonus) and some background variables such as job rank (director versus managing director [MD]), office location, age, gender, and ethnicity. Network data are taken from annual 360 evaluations. In the early autumn, employees in the bonus pool were asked to evaluate colleagues with whom the employee that year had frequent and substantial work contact. Evaluations were on a five-point scale: poor, adequate, good, very good, and outstanding (synonyms for the actual words used). Within the organization, "poor" and "adequate" were treated as negative evaluations, "good" a neutral evaluation, and "very good" and "outstanding" indicated positive work between rater and ratee. A person's average evaluation by colleagues was a factor determining his or her annual bonus, which was distributed at the end of the year.

Stable, Connected, and Growing

The population is stable, connected, and growing. Figure 1 shows two sociograms of the population network. Dots represent individuals and lines indicate a positive

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relationship (“very good” or “outstanding” between the connected individuals). In Figure 1A, a line is drawn between individuals connected by a positive relation in either of the two years. I take three points from Figure 1A. First, the population is densely connected. There are individuals around the periphery of the sociogram who received and made no positive evaluations, but the bulk of the population is densely connected as a single group.

Second, geography does not inhibit connections. The population is organized around two headquarters (HQ), one in the US and one in Europe: 293 individuals worked both years in the US HQ (yellow dots), 115 worked both years in the European HQ (white dots), and the remaining 134 individuals worked for one or both years away from either HQ (red dots). The sociogram shows dense connections among and across the three colors. Yellow dots are concentrated to the right, and white dots to the left, but they overlap with each other and there are no signs of empty space between right and left.

Third, job rank does not inhibit connections. Most in the population directors during the two years (326 triangles). Some were an MD in one of the two years (79 circles), and some held MD rank for both years (137 squares). The sociogram shows no clustering in which one rank prefers others of the same rank. Triangles, circles, and squares are distributed adjacent across the sociogram.

To the extent that there is network clustering, it is by customer. The sociogram in Figure 1B has individuals in the same spatial location they held in Figure 1A, but the connections in Figure 1B are stronger (lines only link people connected by a positive relationship in both years and at least one of those evaluations claimed the other person was “outstanding”). Three clusters are suggested in Figure 1B (indicated by dense connection within cluster and relatively empty space separating adjacent clusters): one cluster contains people who focused on retail customers, another focused on institutional customers, and a third focused on especially well-to-do customers. Employees have their focus, but the dense connections in Figure 1A show that they are readily connected to colleagues anywhere who could be helpful.

Table 1 shows population growth over the two years. The 542 individuals are ordered by their job rank in the first year (rows) and second year (columns). I take three points from the table. First, there is a slight expansion (81 people entered the organization in the second year, 63 exited). Second, the kinds of people entering and exiting are different. More MDs left than entered (20 versus 9) and more directors entered than left (73 versus 43). Third, the difference reflects a strong internal labor market. Sixty-three directors in the first year were promoted to MD in the second, which shifted the population a higher proportion MDs in the organization. In the first year, 31% of the population is MDs. With the numerous internal promotions, 41% of the population is MDs in the second year. There is more growth here than people alone. MDs receive higher compensation than directors. With more MDs in the second year, and business going well, the aggregate operational cost of directors and MDs in salaries and bonuses is 14% higher in year two. Increased bonuses and internal candidates favored for promotion to MD are concrete indicators of the organization’s investment in the directors and MDs as future senior management.

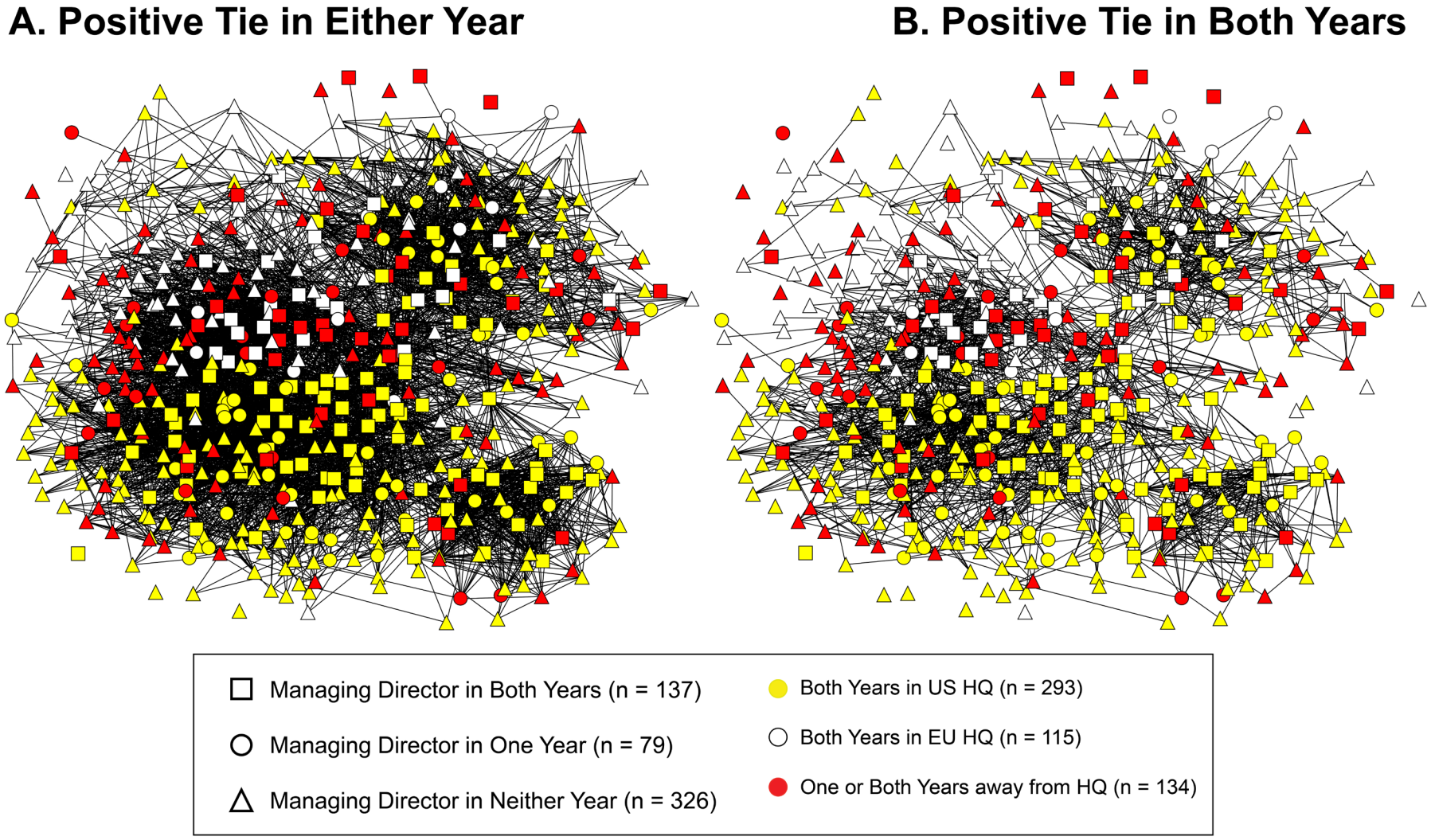

Figure 1. Sociograms of Senior Management Network

Beyond the above results, stability can be illustrated by comparing colleague evaluations in the two years. Table 2 shows stable relations among the continuing people. For the 398 individuals present in both the first and second years, the table shows how ratings made in the first year (rows) turn into ratings between the same individuals in the second year (columns). For example, there are 588 instances of a person rating work with a colleague as “good” in the first year. In the second year, 180 of those colleagues are not rated. Of the colleagues rated again, most receive the same rating (312 are again rated “good”), with 8 given a lower rating, and the other 88 given more positive ratings.

Table 1. Expanded Managing Directors

Job Rank in First Year	Job Rank in Second Year: Director	Managing Director	Exit	Total
Director	211	63	43	317
Managing Director	0	124	20	144
Enter	72	9	0	81
Total	283	196	63	542

NOTE — “Exit” refers to people present in the first year data, but absent in the second. “Enter” refers to people absent in the first year data but present in the second.

I take four points from Table 2. First, ratings tend to be positive. In the first year, 3% of ratings are negative (“poor” and “adequate”), and 84% are positive (“very good” and “outstanding”). Percentages are similar in year two (3% negative, 83% positive).

Second, when evaluations recur, they are most often replicated. Of 3,683 positive evaluations in the first year, 70% are positive in the second. Replication is less likely for weaker relations (53% for “good” and 42% for negative), but repeated evaluations are rarely more or less positive. Of 3,683 positive evaluations in the first year, for example, 107 (3%) are given a less positive evaluation in the second year.

Third, when relations change, it is most often by disruption. Of 4,396 evaluations made in the first year among the continuing managers (sum totals in rows 1 through 5 in Table 2), 1,221 (28%) are not present in the second year — which means either the initial evaluator worked on no projects with the evaluated colleague during the second year, or chose not to submit an evaluation of the colleague. Of 4,676 evaluations made in the second year among the continuing managers (sum totals in columns 1 through 5 in Table 2), 1,504 (32%) are not present in the first year. These disruptions seem likely to reflect work assignments rather than personal preferences because the probability of discontinuing a relationship is independent of whether it was strong or weak in the preceding year.[1]

Allowing for replication in recurring relations, and allowing for 30% churn from prior relations disappearing or new relations appearing, the dominant cell in Table

Table 2. Relationship Stability

Evaluation	Rating in First Year	Rating in Second Year: None	1	2	3	4	5	Total
None	None	152,109	6	46	262	705	482	153,610
Poor	1	8	5	0	1	2	0	16
Adequate	2	40	1	47	8	9	4	109
Good	3	180	0	8	312	74	14	588
Very Good	4	473	0	8	68	1,082	149	1,780
Outstanding	5	520	1	5	25	211	1,141	1,903
	Total	153,330	13	114	676	2,083	1,790	158,006

NOTE — Cell (i,j) is the frequency with with a person who gave rating i to a colleague in the first year, gave rating j to the colleague in the second. Tabulation is across the 398 employees present in both years.

2 is non-existent relations continuing to be non-existent. In the upper-left of the table, 152,109 relations were not rated in the first or second year. That is 96% of all 158,006 relations possible between the 398 continuing employees. Clearly, the dense connections evident in Figure 1 results from indirect connections; personal networks overlapping such that most colleagues are friends of friends.

The large number of missing connections is typical, and is, in its own way, another indicator of stability. Most of these directors and MDs work at a headquarters facility. They are surrounded by colleagues with whom they have not and do not work. In their vast numbers, the many not-worked-with colleagues are stable background noise that puts in perspective the relatively modest churn in individual networks.

Performance Advantage of Network Brokers

Which individuals are advantaged by their position in the Figure 1 network structure? Management research — drawing on psychology and sociology, rooted in the "Golden Age" of social psychology — has done well in connecting performance with the social network around a manager. Managers who coordinate across disconnected colleagues are, relative to peers, associated with proposing more valuable ideas, and receiving more positive evaluations, higher compensation, and faster promotion to leadership positions. The functional form of the association can vary with alternative network measures, but alternatives typically support the fact that success is lower for people in closed networks. I'll take a moment to make that statement more intuitive.[2]

Begin with sticky information. As people become more experienced in their work, they tire of repeating arguments and stories explaining why they believe and behave the way they do. They invent phrasing, opinions, symbols and behaviors that define what it means to be a member of their group, doing their work. Beneath familiar arguments and experiences are new, emerging arguments and experiences awaiting a label, the emerging items more understood than said. What was once explicit knowledge interpretable by anyone becomes tacit knowledge meaningful primarily to insiders. With continued time together, information in the group becomes "sticky" – nuanced, interconnected, implicit meanings difficult to understand in other groups. For reasons of a division of labor in which groups specialize on separate bits of work, or variation due to the independent evolution of separate social groups, holes tear open in the flow of information between groups. These holes in the social structure of communication, or more simply "structural holes," are missing relations indicating where information is likely to differ on each side of the hole and not flow easily across the hole. In short, clustering is a natural phenomenon in social networks, and serves as a proxy for the distribution of information in a population. Clusters indicate where information is relatively homogeneous (within group), and heterogeneous (between groups).

So called "network brokers" are people whose social networks bridge across structural holes. A bridge in graph theory is a link that connects two people who cannot otherwise be connected, but it is customary to discuss as bridges any connection between groups unlikely to otherwise coordinate with each other.

Network brokers have three information advantages over non-broker peers: breadth, timing, and arbitrage. With respect to breadth, bridge relations across groups offer access to more diverse information. With respect to timing, network brokers are positioned at crossroads in the flow of information between groups, so they are early to learn about activities in other groups, and are often the person who introduces to one group information from another. Brokers are more likely to know when it would be rewarding to bring together separate groups, which gives them disproportionate say in whose interests are served when the contacts come together, which brings in arbitrage: Due to their contact with different groups, network brokers have an advantage in translating opinion and behavior familiar in one group into the language of a target group. In short, network brokers are advantaged in detecting good ideas, developing those ideas, and making the ideas understood in target audiences.

The information advantages are less about getting novel information than they are about applying novel interpretations to existing information and combining previously disparate bits of information into novel interpretations. For one thing, technology continues to expand our exposure to information such that getting information is not as difficult as making sense of information. Second, the benefit of access to structural holes does not come from indirect access. It comes from direct access to disconnected people. It is one thing to hear about diverse knowledge and practice that defines an opportunity. It is quite another to recognize and develop the opportunity. Diverse information is readily available from professionals, social media, or word of mouth. It is easy to look up a business concept in Wikipedia and cite a reputable article on the concept. It is quite another to know the concept well enough

to transform it into terms appealing to a target audience. Experience coordinating people with different understandings develops one's talent for converting and synthesizing information between groups. People behaving as network brokers develop skills of analogy, metaphor, and simile. They develop tolerance for ambiguity, for conflict between contrasting colleague understandings, for seeing when the time is ripe to propose a new combination of knowledge or practice. In short, the social capital of brokering structural holes is a kind of forcing function for human capital. Relative to a person who has spent all their time in a single business function, a person connected to multiple business functions is more likely to see a novel solution that integrates or synthesizes knowledge and practice across functions — or industries, countries, products, or channels.

To summarize, structural holes are potentially valuable contexts for action, brokerage is the act of coordinating across a hole via bridges between people on opposite sides of the hole, and network brokers are the people who build the bridges and become more able brokers as they gain experience with diversity in their immediate social environment. Brokers operate somewhere between the force of corporate authority and the dexterity of markets, building bridges between disconnected parts of markets and organizations where it is valuable to do so, translating what is known here into what can be understood to be valuable over there. Brokers are a mechanism that clears their sticky-information market — and management is typically such a market.

Measurement and Example Networks

To use and test the advantage of network brokers, one needs a measure of access to structural holes, which are the opportunities for brokerage. A summary measure, network constraint, is often found associated with performance. Network constraint measures a person's lack of access to structural holes, and varies with three features of the network around a person: size, density, and hierarchy. Constraint is high when a person's contacts are few (size) and strongly connected to one another directly (dense network) or strongly connected indirectly through a central, mutual contact (hierarchical network). For most networks, constraint is a fraction that varies from 1.0 for networks that provide no access to structural holes, down toward zero for large, open networks. I multiply scores by 100 to discuss points of constraint.[3]

For example, Figure 2 is a sociogram of the relatively-open, year-one network around a director in the study population. Individuals and relations are coded as in Figure 1 — squares are MDs, triangles directors, yellow dots are in the US headquarters, etc. The focal manager is a director, age 38, working in Hong Kong. His compensation is about one standard deviation above the average for similar individuals in the population (not displayed). The network is well connected in the sense that everyone is connected directly or indirectly by positive relations. Those relations, however, connect the focal manager with colleagues in Hong Kong as well as in both the US and European headquarters. Given the geographic dispersion of the manager's contacts, it is not surprising to see relations missing between contacts in different locations. Of 36 symmetric connections possible among 9 contacts, only 17 are present (.47 density). The result is a network constraint score below average for directors: 36 points versus the director average of 46 points in year one. Given greater access to structural holes, indicated by his relatively low network constraint

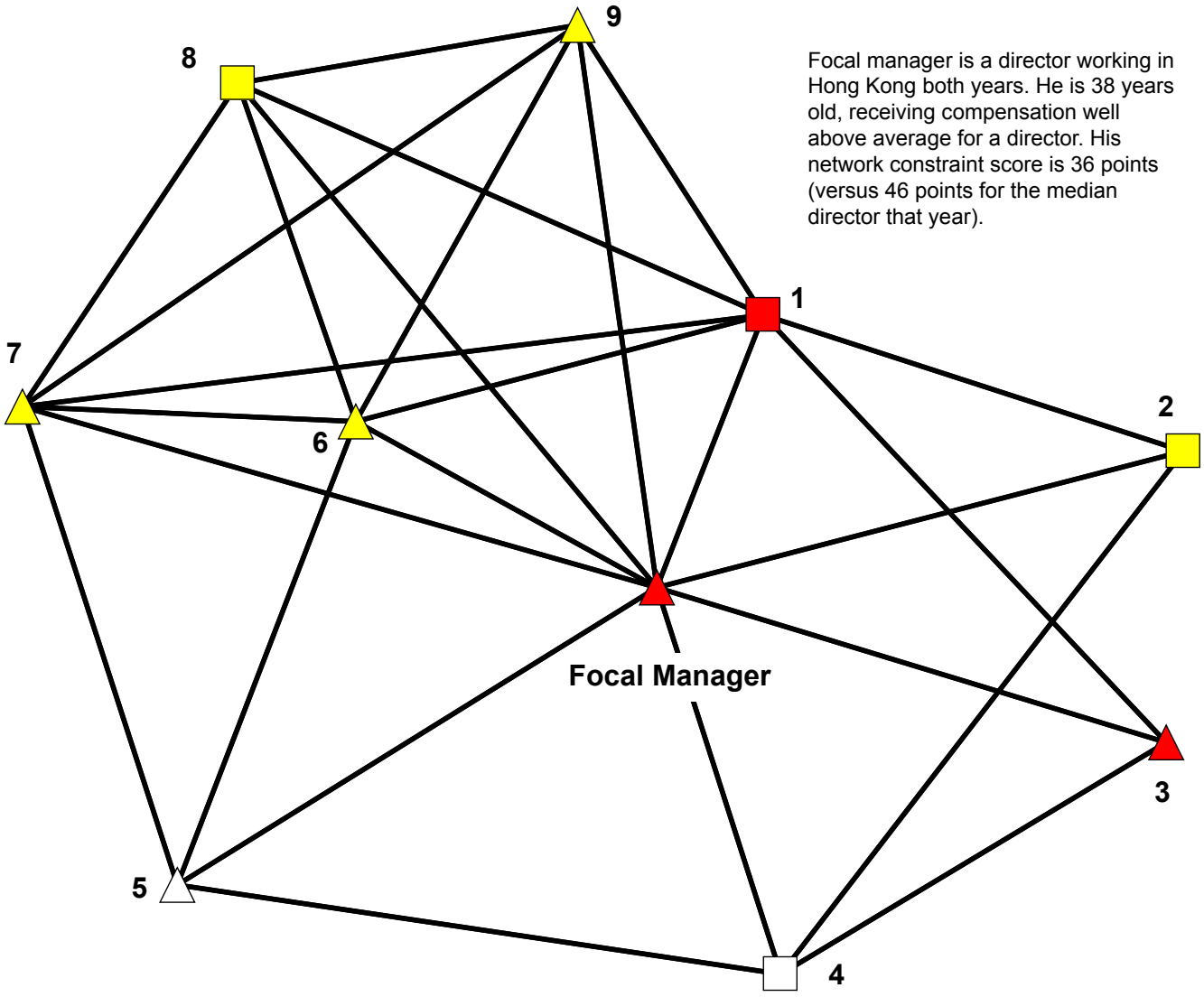

Figure 2. Director with Open Network

score, it is not surprising to learn that the director in Figure 2 received annual compensation that was about a standard deviation above the average for peer directors.

In contrast to the network in Figure 2, Figure 3 displays a closed network. Again, individuals and relations are coded as in Figure 1. Everyone in Figure 3 works in the US headquarters (yellow dots). There is one MD in the network (square) and four directors (triangles). No individual is marked as focal manager because it doesn't matter; all four directors are the same in the network. This is a completely closed network, everyone is connected to everyone else. The four directors work with each other and report to the same MD. Each has zero access to structural holes in the displayed network. It is unlikely that the directors offer valuable ideas, and unlikely that they are high performers. Indeed, the focal manager receives compensation that is about a standard deviation below what is typical for directors at US headquarters.

Table 3 shows there are many directors in the study population who have a network as closed as the one in Figure 3. Managers are sorted in the table into five-point

Table 3.
Network Constraint

Constraint	Directors	MDs
5	4	21
10	28	47
15	39	47
20	46	48
25	53	24
30	56	31
35	51	24
40	35	13
45	45	12
50	30	18
55	29	3
60	28	9
70	19	5
80	13	6
90	11	4
100	113	28
Total	600	340

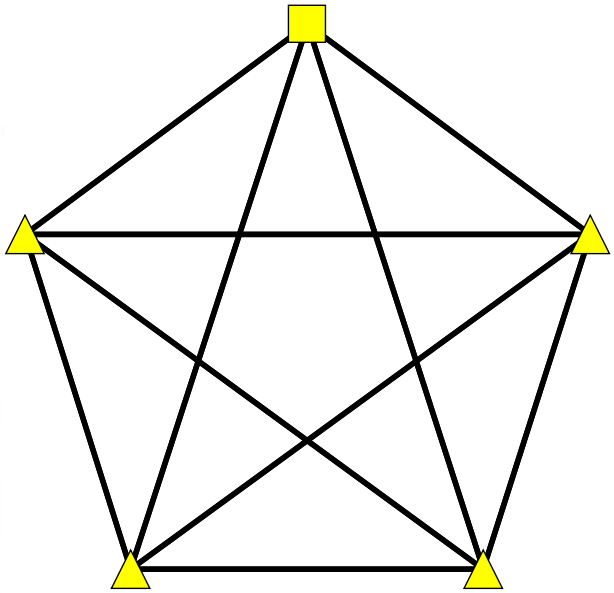

Figure 3.
A Closed Network

categories of network constraint down the rows. Some categories are combined where observations are few (e.g., the one person in the 65-69 point category is put in the 60-64 point category). Directors are reported separate from MDs. There are a total of 940 observations, 600 of directors and 340 of MDs.

Three points are illustrated in Table 3. First, directors and MDs are scattered across the full range of network constraint scores. Second, the larger, more open networks associated with senior rank are evident in the lower constraint scores for MDs (51.2 average constraint for directors, 35.6 average for MDs). Third — returning to the discussion of Figure 3 — a large number of directors live in closed networks (113 of 600 observations, or 19%). Of course, those directors in closed networks can have neutral or negative relations beyond their networks of positive relations. Those weaker relations are not included in Table 3. Also, there are colleagues below director rank. Relations to colleagues below director rank are not included in Table 3. Constraint scores in this note only refer to the network of positive working relations among colleagues at director or MD level (a level at which access to structural holes is especially consequential for performance).

Returns to Brokerage

There are so many ways that people can be successful that one can cite example individuals consistent with almost any explanation of performance. Here is an

example in which elite college mattered. Here is an example in which age or gender mattered. Here is an example in which experience mattered. Et cetera. Examples illustrate, but the critical test for a performance factor is consistent association across individuals representative of some population.

Figure 4 presents illustrative evidence of such association among the directors and MDs, and Table 4 presents critical test. The vertical axis in Figure 4 distinguishes directors and MDs by compensation. Annual compensation is converted to a z-score to preserve confidentiality.[4] To the left are the network brokers, people whose low-constraint networks bridge structural holes (illustrated by the sociogram of a person's network below the left side of the horizontal axis). To the right are people embedded in a closed network of interconnected colleagues (illustrated by the sociogram at the bottom right of the horizontal axis, also Figure 3). The data plotted in Figure 4 are average values of the horizontal and vertical axes within five-point intervals of network constraint (frequencies in Table 3). The regression lines in the figure are through the plotted data.

Figure 4 displays three familiar features of the broker-success association. First, the regression lines are downward sloping — compensation is lower for directors and MDs in more closed networks. The bold regression line is through all of the plotted data. The dashed lines are through the data on people holding the same job rank.

Second, the broker-success association is strongest for people to the left in the graph, the people who networks are richest in structural holes. The regression lines are most steep to the left in the graph and Table 3 shows that there are numerous directors and MDs to the left in the graph. The steeper slope to left in the graph reflects the fact that network advantage is no more than a "risk of productive accident." The value of brokerage across any particular structural hole depends on situational factors (external events, audience receptivity, preparation, etc.), so having access to more structural holes increases the odds that brokerage across one of them will be opportune.

Third, Figure 4 illustrates that job rank is important to hold constant. Two reasons. First, people in higher job ranks are more the author of their job. They have to do their work as well as decide what work would be productive for them to do. Broker information advantages in breadth, timing, and arbitrage can enhance the success of such authorship. Second, successful brokerage depends on the broker being accepted as such in target audiences. The authority associated with higher job rank facilitates that acceptance, which is displayed in Figure 4. The dashed regression line for MDs is higher, and steeper, than the dashed regression line for directors.

The results in Table 4 show that the three points illustrated in Figure 4 are statistically significant and robust to some key control variables. The estimates in Table 4 are OLS across the two years of observations (N = 940), with standard errors increased to correct for autocorrelation between the compensation of people observed in both years ("cluster" option in Stata). Z-score compensation (standardized within each of the two years) is predicted by variables in the rows.

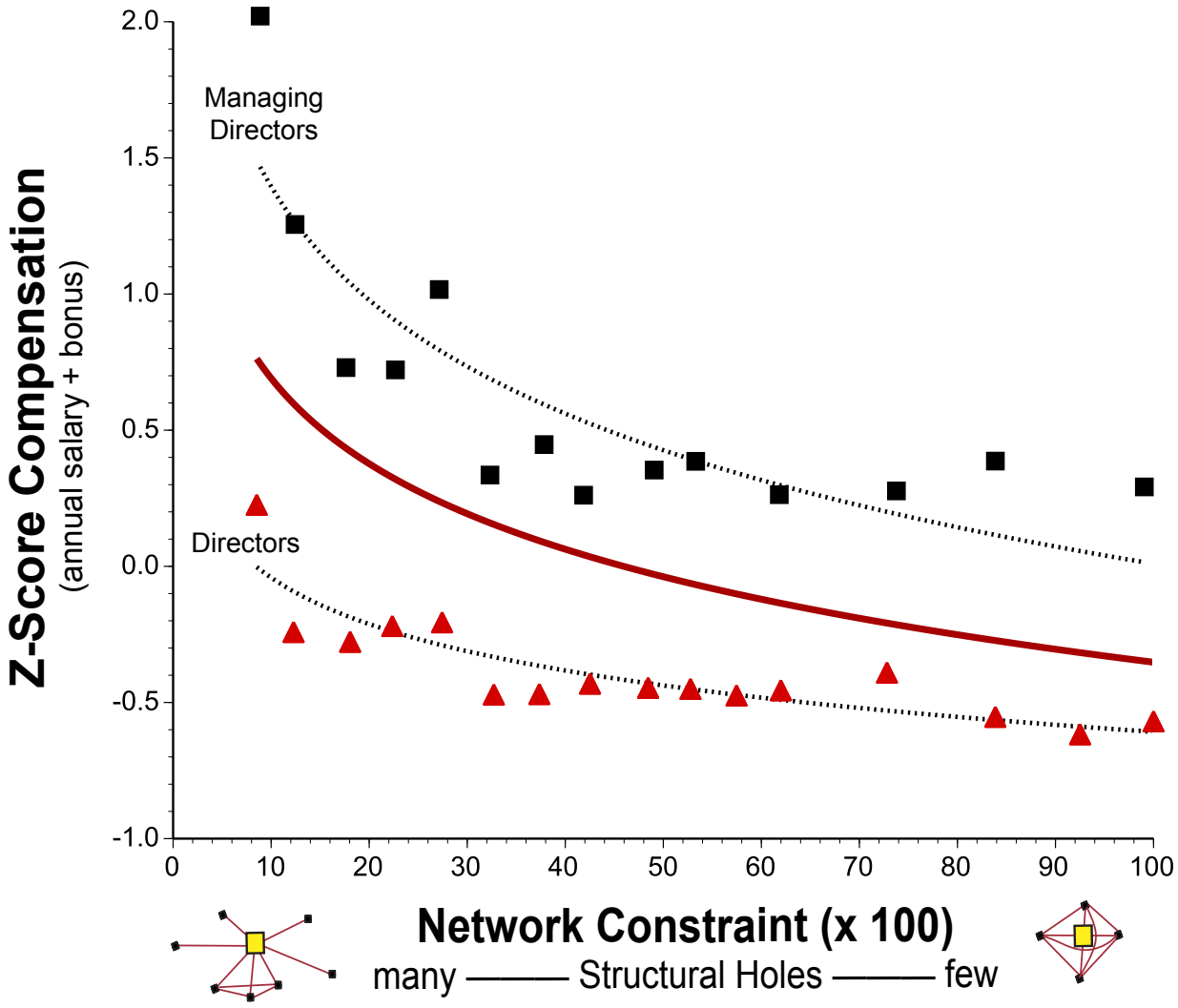

Figure 4. Returns to Brokerage

The first three rows of Table 4 capture the association illustrated in Figure 4. The first row shows returns to brokerage for managing directors: compensation decreases -.52 with a unit increase in log network constraint. That association corresponds to the upper dashed regression line in Figure 4. Given the -4.43 test statistic in the first row of Table 4, the association has a low probability of being zero in repeated samples (P < .001). The -.52 metric coefficient means that an MD who decreased her network constraint from 40 to 15 points (a unit decrease in log network constraint) could expect her compensation to increase by .52 of a standard deviation. Compensation had a standard deviation of a little less than a million dollars in this population, so the compensation increase associated with the broader network would be about half a million dollars.

The second row shows the lower compensation to directors versus MDs: -.92, almost a full standard deviation. This effect is the difference between the two dashed lines in Figure 4 (estimated at the mean level of network constraint). Clearly visible in Figure 4, the -12.21 test statistic shows that the difference is unlikely to disappear in repeated samples (P < .001).

Table 4. Predicting Compensation

Predictor	Coefficient	S.E.	t-test	P(no effect)
Log Constraint	-.52	.12	-4.43	.001
Director	-.92	.08	-12.21	.001
D*LogConst	.41	.12	3.52	.001
Peer Evaluation	.44	.08	5.57	.001
US Headquarters	-.16	.10	-1.67	.10
EU Headquarters	-.02	.09	-.22	.83
Age	-.01	.01	-1.22	.22
Minority	-.15	.09	-1.71	.09
Year	-.01	.03	-.35	.73

NOTE — Predicting z-score compensation, these are unstandardized OLS estimates with standard errors corrected for autocorrelation ("cluster" option in Stata). The regression intercept is 1.03 with a .40 R^2. Figure 4 plots z-score compensation across categories of network constraint. Log network constraint is the first predictor. Director is a dummy variable equal to 1 for directors. The third predictor is the interaction of the director dummy times (log constraint – mean log constraint), so the Director effect is estimated at the mean level of log constraint. Peer is the average five-point evaluation received from colleagues (see page 1). The two headquarters variables are dummy variables equal to 1 for people working that year in one of the headquarters. Age is in years. Minority is a dummy variable equal to 1 for men who are a minority race (African-American, Asian, Hispanic) and all women. Separate estimates for minority race and gender yield similar results. Year is a dummy variable equal to 1 for observations during the second year.

The dashed regression line for directors at the bottom of Figure 4 is less steep than the line for MDs, showing that returns to brokerage are lower for directors. That difference is captured in the third row of the table. The -.52 coefficient in the first row for MDs is lowered by .41 in the third row, so the regression coefficient for directors is -.11. Where an MD can expect compensation to increase half a million dollars by decreasing his network constraint from 40 to 15 points, a director making the same decrease in network constraint can expect his compensation to increase by about a hundred thousand dollars. Given the -3.52 test statistic in the third row of Table 4, the flatter slope for directors in Figure 4 has a low probability of being as high as the slope for MDs in repeated samples ($P < .001$).

The remaining predictors in Table 4 are factors held constant to ensure that the broker-success association is robust to them. The most consequential is reputation with colleagues. To measure reputation, the five-point colleague evaluations (page 1) are averaged for an individual, then distributed to the bonus committee. Given the dense connections among these directors and MDs (Figure 1), it is not surprising to see that people who receive more positive evaluations receive higher compensation (5.57 test statistic in Table 4, P < .001). The other factors are negligible predictors, although it is useful to know that they are negligible. With job rank, network, and reputation held constant, compensation is independent of whether a person works at the US headquarters or EU headquarters, the person's age, the person's minority status by gender or race, and the year in which the person is observed.

In sum, the usual broker-success association describes operations at the director and managing director levels in this organization

NOTES

[1]Let a "dead" connection be an evaluation present in the first year and not present in the second (first column of Table 2 versus the others). A logit model predicting the probability of a dead connection given the level of evaluation in year one shows no statistically significant differences between the levels of evaluation (6.43 chi-square, 4 d.f., N = 4,396, P ~ .17, controlling for autocorrelation between evaluations by the same individual using the "cluster" option in Stata).

[2]The next few paragraphs are abbreviated from a recent review of structural holes and network brokers (Burt, 2021). Related reviews of personality correlates and implications are given by Burt, Kilduff, and Tasselli (2013), Kwon et al. (2021); Tasselli and Kilduff (2021), and Brass (2022).

[3]The constraint index begins with the extent to which manager i's network is directly or indirectly invested in the manager's relationship with contact j (Burt 1992: Chap. 2): $c_{ij} = (p_{ij} + \sum_q p_{iq}p_{qj})^2$, for $q \neq i,j$, where p_{ij} is the proportion of i's network time and energy invested in contact j, $p_{ij} = z_{ij} / (\sum_q z_{iq})$, and variable z_{ij} measures the strength of connection between contacts i and j. Connection z_{ij} measures the lack of a structural hole so it is made symmetric before computing p_{ij} in that a hole between i and j is unlikely to the extent that either i or j feels that they have a relationship (strength of connection "between" i and j versus strength of connection "from" i to j; see Burt, 1992:51). In the study population for this note, z_{ij} is one if i or j rated work with the other as "very good" or "outstanding," else z_{ij} is zero. The total in parentheses is the proportion of i's relations that are directly or indirectly invested in connection with contact j. The sum of squared proportions, $\sum_j$ cij, is the network constraint index C (which is multiplied by 100 in the text so I discuss points of constraint).

[4]Z-scores are computed within each year of observations. The score for an individual is the individual's annual salary plus bonus for the year (compensation), minus average compensation across all observations for the year, quantity divided by the standard deviation of compensation across all observatons that year. A z-score of 0.0 indicates average compensation. Positive z-scores indicate above-average compensation. Negative z-scores indicate below-averge compensation.

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