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EMBEDDED BROKERAGE: HUBS VERSUS LOCALS

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Over the last two decades, two robust concepts have emerged in research on network advantage: status (Podolny, 1993, 2005) and structural holes (Burt, 1992, 2005). Subject to a few contingencies, research typically shows a competitive advantage associated with high status and more access to structural holes.

The two concepts emerged from the same research community, but they are rarely discussed together. There are exceptions — Podolny (2001), then recently Rider (2009), Shipilov, Li and Greve (2011), Phillips (2011), Smith, Menon and Thompson (2012) and Ferrin, Parker, Cross and Dirks (2012) — but for the most part research papers report on one or the other concept. For example, this year's Annual Review of Sociology contains a chapter on brokerage and a chapter on status. In the chapter on status, there is no mention of brokers, brokerage, or structural holes (Sauder, Lynn, and Podolny, 2012). Status is mentioned several times in the chapter on brokerage, but as a qualitative attribute, not as a network correlate (Stovel and Shaw, 2012).¹ Saying that the two chapters are independent says nothing negative about either chapter. The point is simply that network status and access to structural holes are rarely discussed together.

The separation is unfortunate because structural holes and network status in theory describe aspects of the same behavior: the structural holes to which a person is connected are embedded in a broader organization or market in which would-be brokers are more or less reputable. High status in the broader context signals a reputation that can make a would-be broker more attractive, more likely to engage opportunities to broker, and allay audience concerns about proposed brokerage.

The implications are correlation and contingency. Reputable people are more likely to be accepted as brokers, so they should more often be brokers. Therefore, network status should be correlated strongly with access to structural holes, and the

¹Note that Stovel and Shaw speculate about brokers achieving status, anticipating the strong status-broker correlations presented in this essay (see pages 146, 148-149).

benefits associated with access to structural holes should be higher for people of higher status because status improves the odds of successfully brokering connections. Stated the other way around, benefits associated with status should be higher for people rich in access to structural holes because they have more opportunities to benefit from having high status.

We offer illustrative empirical evidence of both implications and conclude that the two variables — network status and access to structural holes — are closely related in concept and in fact, such that advantage is more clearly revealed when the two variables are analyzed together as complements defining network advantage.

Brokerage Embedded in Formal and Informal Organization

The competitive advantage traced to status and structural holes results from the information implications of social structure. Within clusters of densely connected people information becomes homogeneous, tacit, and therefore sticky such that clusters disconnect, buffered from one another by the structural holes between them. People whose networks span these structural holes gain advantages of information breadth, timing, and arbitrage. In essence, network structure is an indicator of manager access to, and control over, information. The story is anchored in the association established in the 1950s between opinion and social clusters (e.g., Festinger, Schachter and Back, 1950; Katz and Lazarsfeld, 1955), from which network concepts emerged in the 1970s on the advantages of bridge connections across clusters: Granovetter (1973, 1983) on weak ties as bridges, Freeman (1977, 1979) on network centrality as a function of being the connection between otherwise disconnected people, Cook and Emerson (1978; Cook, Emerson, Gillmore, and Yamagishi, 1983) on the advantage of having alternative exchange partners, Burt (1980) on the advantage of disconnected contacts, later discussed as access to structural holes (Burt, 1992), and Lin, Ensel and Vaughn (1981) on the advantage of distant, prestigious contacts, later elaborated in terms of having contacts in statuses diverse and prominent (Lin, 2002). Application of these models to predict performance differences in representative cross-sections of managers began in earnest in the

1980s and 1990s, encouraged by earlier images of boundary-spanning personnel (Allen and Cohen, 1969; Aldrich and Herker, 1977; Tushman, 1977; with Brass, 1984, a key transition showing the empirical importance of the more general network concept). Relative to peers, managers whose networks provide greater access to structural holes receive higher compensation, more positive evaluations, and faster promotion (for review, see Burt, 2005, and Aral and Van Alstyne, 2011; Aral and David, 2012, for results on the information flow responsible for the network effect).

Since access to structural holes provides information advantages of breadth, timing, and arbitrage, it is not surprising to see structural holes more valuable to individuals in more senior job ranks (Burt, 1997, 2005:156-162). Job rank is an indicator of two things: kind of work and bureaucratic authority. Kind of work refers to the strategic, more political, less routine nature of executive work relative to the more routine, task oriented, directed work of junior managers. Senior job rank also carries bureaucratic authority. The kind of work done by people in senior ranks makes it valuable to have access to structural holes. More, greater bureaucratic authority makes it more likely individuals will succeed in efforts to broker connections across the holes. Together, authority and less routine work mean that holding a position of senior rank makes brokerage more likely and more valuable. People in senior ranks are more likely to be accepted as brokers, so they are more like to be brokers. It is not surprising therefore to see that job rank is typically correlated with network measures of access to structural holes and that the average performance increase associated with brokerage is higher for people in more senior job ranks.

As a structural hole is embedded in the formal organization of job ranks, it can be embedded in the informal organization of social standing. As brokerage is facilitated for senior executives, it can be facilitated for would-be brokers who have higher social standing in the surrounding informal organization.

Social standing is a network concept older than brokerage. In the early days, when network analysis was known as sociometry, social standing was measured by choice status (Moreno, 1936:102). The more people who cited ego as a preferred contact, relative to the number who could have cited the person, the higher ego's

choice status — indicating ego's popularity and social influence. Choice status evolved into more sophisticated concepts of network centrality in which choices were weighted by the social standing of the source, a condition ultimately captured by the left-hand eigenvector of a network (e.g., Katz, 1953; Hubbel, 1965; Bonacich, 1972): The more ego is cited by people who are themselves widely cited, the more central, or more powerful, ego is in the network. The eigenvector model was used extensively in the 1970s and 1980s to measure centrality and power within elite networks (e.g., Mizruchi, Mariolis, Schwartz, and Mintz, 1986). Podolny (1993) renovated the model with a new interpretation: in addition to measuring centrality and power, the eigenvector measures network status (cf. Katz, 1953). Podolny (1993) argued that network status is valuable as an indicator of quality. When the quality of work by a person or organization is difficult to determine, network status can be used as a signal of quality: a person or organization widely sought out by experts, who themselves are widely sought out, must be of high quality. When in doubt, look for the expert to whom experts turn.

Network status as a measure of quality is related to reputation, legitimacy, and other concepts of audience reaction. Reputation is what the audience expects of the person — she is known to be trustworthy, he is aggressive, she is an expert in her field. Legitimacy is about audience expectations, but focused on the boundary between who is deemed appropriate to take action versus who is not — he is board-certified to do this kind of operation, she is out of her element here. Similarly, network status when interpreted as a measure of quality is about audience expectations. As a network metric, status is merely an index of prominence in social structure, but its interpretation in terms of quality is grounded in an audience observing the structure. The audience sees the structure and draws inference about the higher quality of elements toward the top of the structure. Podolny (2005:13-21) is careful to distinguish status as a network concept from reputation as a behavioral concept, but the interpretation of status as an indicator of quality is no less an expectation of behavior than is reputation or legitimacy. You are known for your reputation. Network status is a visible characteristic of your position in a network, from which inferences about you can be drawn. In short, network status is at once a visible result of, and a source of,

inference about reputation. Status is no more than a measure of prominence in social structure, but that prominence is correlated with various audience reactions discussed as quality, reputation, legitimacy, and other concepts (allowing too that the audience is simultaneously reading other signals in addition to network status, Podolny, 1993:834).

This means that network status should be a contingency factor for brokerage just as job rank is a contingency factor. High-status people are visible, reputable, known for their ability and integrity. Because of past trustworthy behavior responsible for high status today, or the risk of high status being lost tomorrow following untrustworthy behavior, a would-be broker's high status can allay stakeholder concerns about him, and allay concerns about a broker's proposal. In contrast, low status makes a person an unattractive, perhaps illegitimate, source of brokerage.

In a sense, reputation is intrinsic to brokerage. Consider Nee and Opper (2012:211) on Chinese entrepreneurs building reputation in the course of brokering connections: "Through personal introductions and fine-grained information passed through social networks, the 'broker' typically signals trustworthiness and reputation of the prospective business partners. Moreover, it is in the broker's interest to make good recommendations, as most business partners will tend to reward their networking contacts in one way or another. Such introductions can span the social gaps, or 'structural holes' between groups. The owner of a Ningbo-based automotive company, for example, found her new business partner through a close friend working in the local highway construction business. The friend introduced her to a firm in Beijing that was looking for a reliable production partner in the Ningbo area." Rider (2009) offers quantitative evidence in his study of placement agents, the people who broker connections between investors and venture funds. Across a thousand venture funds from 2001 to 2006, higher status brokers have preferred access to higher status funds (Rider, 2009:593-595). Rider (2009:578-579) goes on to infer the contingency proposed in this essay: "a broker's reputation for consistently representing actors of high quality is a valuable, intangible asset that enables a broker to realize future rents on the brokerage position. . . . If a positive reputation reduces the costs of assuaging

potential exchange partners' concerns, then the returns to brokerage should be positively related to a broker's reputation."

A familiar illustration is provided by Merton's (1968) discussion of a "Matthew Effect" in science. Status autocorrelation can be traced to more than one social mechanism (Podolny and Phillips, 1996; Podolny, 2005: Chp. 4; Burt, 2005: Chp. 4, 2010: Chp. 6; Bothner, Podolny, and Smith, 2011; Bothner, Kim and Smith, 2012), but Merton's focus on status and new ideas in science is particularly relevant to this essay: prominent scientists are more likely to have their new ideas recognized and acted upon, which subsequently enhances prominence (cf. Podolny, 2005:Chp. 2). Merton (1968:60) argues that ideas proposed by prominent scientists receive disproportionate attention: "a single discovery introduced by a scientist of established reputation may have as good a chance of achieving high visibility as a multiple discovery variously introduced by several scientists no one of whom has yet achieved a substantial reputation." Disproportionate attention increases the likelihood of productive result (p. 62): "since it is probably important, it should be read with special care; and the more attention one gives it, the more one is apt to get out of it." Couple Merton's discussion with the fact that people whose networks bridge structural holes are disproportionately the source of good ideas (Hargadon and Sutton, 1997; Burt, 2004, 2005: Ch. 2), and you have the conclusion that network status should be a contingency factor for brokerage just as job rank is a contingency factor.

Thus, network status is associated with network brokerage in concept, in fact, and in effects. As job rank indicates high social standing in the formal organization embedding a structural hole, network status indicates high social standing in the informal organization in which a structural hole is embedded. As job rank is associated with more access to structural holes and higher returns to brokering across holes, network status should be associated with more access to structural holes and higher returns.²

²We reason from the perspective of an audience reacting to a broker. One could instead reason from the broker's perspective: Are the kinds of people drawn to brokerage also people likely to achieve high status? For example, self-monitoring, a psychological concept of adapting one's behavior to the

Evidence of Close Association between Status and Holes

Figure 1 illustrates close association between status and access to structural holes. We draw on four management populations: two with a center-periphery structure and two balkanized into variably-connected clusters. Details on the populations are available elsewhere (Burt, 2010, especially page 111 on network differences across the populations).

The sociogram to the left in Figure 1 describes one of the center-periphery structures: work discussion relations among HR officers in a large American commercial bank. A network survey was used to obtain sociometric data on relations among the 283 HR officers snowballed into the surrounding broader network of 542 employees (Burt, 2010:80-85). The HR organization has a center-periphery structure in that relations do not cluster so much as they show a dense center of interaction that fades in all directions toward a social periphery. Another of the four management populations has a similar center-periphery structure: a global network of 177 investment bankers observed for three years within a broader network of several hundred additional employees in the US, Europe, and Asia (described in Burt, 2010:85-93).

———— Figure 1 About Here ————

The sociogram to the right in Figure 1 is one of the clustered structures. These are 258 people managing the launch of a new software product in Asia-Pacific markets. A network survey was used to obtain sociometric data on relations among the 258 people and snowballed into the surrounding organization of 331 people (Burt, 2010:59-72; Merluzzi, 2013). There is a senior executive coordinating group at the hub of the network, with regional clusters of managers spinning off the hub like spokes on a wheel. One cluster is China, another is Korea, then India, Australia, and so on. The

social situation, is correlated with access to structural holes (Mehra, Kilduff, and Brass, 2001; see Burt et al., 2013, for review). Given personality and status correlated with access to structural holes, status should be correlated with the personality. However, the lack of an achievement effect from the interaction between network and personality (Mehra, Kilduff, and Brass, 2001; Burt, 2012), means that personality-induced correlation between status and access to holes cannot explain the contingent returns to network advantage illustrated below in Figure 2. Therefore, we focus on status and access to structural holes directly affecting the advantage that each provides.

fourth of the four management populations is similarly balkanized into clusters. Clusters in the fourth population distinguish people by geography, technology, and legacy organizations for 455 supply-chain managers snowballed into the surrounding network of 673 employees in a large American electronics firm (Burt, 2010:72-78).

Networks “balkanized” into multiple clusters are useful for estimating returns to network status and structural holes. Stronger boundaries between clusters mean that people are more likely to have within-cluster understandings difficult to communicate across clusters, which increases the advantage of having a network that bridges across clusters. Strong boundaries also increase the facilitating potential of high status across the clusters -- but local cluster status need not mean global status across clusters. A person can be well respected in one cluster and little known in other clusters. In contrast, status and access to structural holes vary together within a center-periphery network, such as the one to the left in Figure 1. Individuals vary in the extent to which they have social standing in the center-periphery population, but the structural holes to be bridged are less across different understandings of the business than across separate groups working with similar understandings.

Graphs below each sociogram in Figure 1 show status in both kinds of structures closely associated with access to structural holes. The graph to the left shows that 82% of the variance in an HR officer’s network status can be predicted from his or her access to structural holes; the lower an officer’s network constraint (measuring lack of access to structural holes), the higher the officer’s status. Network constraint is measured in the usual way (as described in Burt, 2010:Ch. 4, for the HR officers) to vary from zero to 100 with the lack of structural holes in an officer’s discussion network. Network status is measured in the usual way by the eigenvector model in Podolny (1993). Status scores are normalized here to be a multiple of average status; a score of 1.0 indicates an officer whose status is equal to the mean across officers, a score of 2.0 indicates an officer with status twice the mean, and so on. Network measures, and the sociograms in Figure 1, were obtained using the network analysis software NetDraw (Borgatti, 2002). There is a similarly strong association between status and holes in the other center-periphery population: 86% of the status variance

between investment bankers can be predicted from differences in their access to structural holes. The graph to the right in Figure 1 shows a weaker, but still strong, association between status and holes in the product-launch network: 74% of status variance can be predicted from employee differences in access to structural holes. The association is similar in the other balkanized management population: 56% of the status variance between supply-chain manager can be predicted from differences in their access to structural holes.³

Evidence of Complementary Advantage from Status and Holes

Figure 2 illustrates complementarity between status and access to structural holes. Each augments returns to the other. For the graphs to the left in Figure 2, individuals are dichotomized by network status: above-median status versus less. For people in each status category, data were averaged within five-point intervals of network constraint to define the dots in Figure 2. Thin lines through hollow dots show the association between compensation and network constraint for low-status people. Bold lines through the solid dots show the association for high-status people. The difference is striking. For high-status people, compensation has a strong negative correlation with network constraint: $-.98$ for the American HR officers and $-.96$ in the Asia-Pacific product launch. For low-status people, compensation has no correlation with network constraint (correlations of $-.11$ and $-.03$ respectively for the two populations). Status is more than corporate authority here. A positive reputation can substitute for status. Brokers do not have to be widely known so much as respected. Reputation as a good colleague is measured directly in the population of bankers. The strong compensation association with structural holes for high-status bankers in Figure 2 is strong for

³In this paragraph, percent variance explained is the R^2 for status predicted by a sixth-order polynomial of constraint. We are not proposing that status and constraint are isomorphic, just that one can be predicted from the other. Linear and squared terms do not produce a sharp enough bend in the association (R^2 of $.60$ and $.63$ for the left and right graphs respectively), but four- through seventh-order polynomials do. Replacing constraint with number of non-redundant contacts produces similar results (R^2 of $.85$ and $.89$ respectively for the HR officers to the left in Figure 1 and the bankers; $.66$ and $.61$ respectively for the product-launch network to the right in Figure 1 and the supply-chain managers).

bankers with positive reputations, regardless of status (-.74 correlation with constraint, -3.08 t-test holding network status constant, Burt, 2013:Fig. 2.8). The Figure 2 negligible compensation association with structural holes for low-status bankers is negligible for bankers with poor reputations (-.27 correlation with constraint, -0.36 t-test holding status constant).

———— Figure 2 About Here ————

For the graphs to the right in Figure 2, people are dichotomized by network constraint: median constraint or higher is a person with little access to structural holes, below median constraint is a person rich in access to structural holes. Data were averaged for each structural-hole category within intervals of network status to define the dots in the graphs to the right in Figure 2. The complementarity between status and holes is again evident. For people rich in access to structural holes, bold lines show a strong association between compensation and network status: squared correlations of .97 across the HR officers, and .94 across the product-launch network. For people in the product launch, compensation has no association with status without access to structural holes (.19 compensation correlation with status).

Complementarity is illustrated in Figure 2, but we inferred complementarity from results with continuous network measures and controls for job rank, function, demographics, and location. The regression models are given in an Appendix to this essay (available online at the URL in the acknowledgement note).

Conclusion: Hubs versus Locals

Our summary conclusion is that network status and access to structural holes are in fact complementary assets closely related in concept and fact, such that advantage is more clearly revealed when the two variables are analyzed together as complements defining network advantage. Future work should distinguish what can be termed hubs versus locals. As illustrated in Figure 3, hubs have both access to structural holes and social standing. The two forms of advantage are complementary: Access to structural holes provides advantage in detecting and developing opportunities, while social standing — network status or reputation more generally — provides advantage in the

form of more likely acceptance by a target audience. Local advantage involves social standing or access to holes, but not both. Local brokers have the production advantage of access to structural holes, but the audience does not accept the local would-be brokers as a source. People with local-status advantage would be accepted as brokers, but their lack of access to structural holes leaves such would-be brokers with little of value to deliver.

————— Figure 3 About Here —————

Hubs are population specific. In this population, Sam is above the rest of us in status and access to structural holes, which makes him a hub. In a broader population, Sam could easily be a local. Non-relative definitions are arbitrary because of porous boundaries around our study populations (Laumann, Marsden, and Prensky, 1989). There are always network contacts beyond a study population who affect behavior within the population. Drawing broad distinctions between place, organization, community, and time, the people in this department are affected by contacts outside the department. The people in this university are affected by contacts in other universities. The people in this discipline are affected by contacts in other communities. The people living today are affected by relations real and imagined with contacts deceased. The ways that hub advantage results from local social standing mixed with local access to structural holes promises interesting future research.

Meanwhile, an empirical cut on hubs is to define them relative to a reasonable criterion within a study population. For example, high status in Figure 2 is anyone with a status score higher than the population median, and high access to structural holes is anyone with a network constraint score below the median. To illustrate the distinctions in Figure 3, we used within-population medians to sort into the four cells of Figure 3 the senior people summarized in Figure 2: 258 managers in an Asia-Pacific software launch and 293 HR officers in a large commercial bank.

The diagonal cells of Figure 3 repeat familiar evidence of network advantage. Most people end up in the diagonal cells. Status and access to structural holes are closely correlated (Figure 1), so most people end up either as hubs with both forms of advantage (205 people) or as relatively disadvantaged by their lack of both forms (206

people). Z-score compensation is lowest for the people with neither form of advantage (-.29 mean), highest for the network hubs, who have both forms of advantage (.40 mean), and increases significantly for network hubs with increases in either form of advantage: Holding constant the positive compensation association with job rank, there is a -3.59 t-test for the negative association between hub compensation and decreasing access to structural holes, and a 3.89 t-test for the positive association between hub compensation and increasing status.

———— Figure 3 About Here ————

The contingency point is that either form of network advantage alone is anemic relative to the two forms combined. Z-score compensation is no more than average for managers with high status but low access to structural holes, and for managers with high access to structural holes but relatively low status (z-score compensation means of -.06 and -.18 respectively). More, compensation does not increase with increasing status or access to structural holes. Holding job rank constant, compensation for local brokers and managers with local status has negligible associations with network constraint (-1.12 and 1.42 t-tests respectively), and network status (1.73 and 1.55 t-tests respectively).

In sum, network advantage is most consequential when it combines in network hubs the production advantage of access to structural holes with the audience advantage of social standing.

Our conclusion is inconsistent with Podolny's (2001, 2005:Chp. 9) argument for distinct effects from status versus structural holes. Podolny argues that status and access to structural holes resolve market uncertainty for different people, which can produce correlates for status different from the correlates for holes. Access to structural holes provides ego with an information advantage in dealing with uncertainty about others — what ideas should I pursue and how should I pursue them — while network status helps others resolve uncertainty about ego. Podolny illustrates his argument with themes in academic recruitment: holes favor departments hiring junior faculty, where the key uncertainty is about candidates, while status favors departments hiring senior faculty, where the key uncertainty is about employers. Podolny supports

this argument with data on the investment stage at which venture funds specialize. Investors rich in access to structural holes tend to invest early (where the key uncertainty is about candidate investments), while investors rich in network status tend to invest late (where the key uncertainty is about candidate investors).

However, the fact that status and holes can have different correlates does not mean they often do have different correlates. The two kinds of uncertainty distinguished in Podolny's argument overlap in the process of brokering connections across structural holes: network brokers have an advantage in dealing with uncertainty about which ideas to pursue and how to pursue them, and the network status of the broker assuages audience uncertainty about the broker and the broker's proposal. In fact, Podolny (2001:44, 2005:233) expected to see the strong status-holes correlation reported in this essay: "It seems reasonable to anticipate a high correlation between an actor's status and the presence of structural holes in the actor's network. An actor with many structural holes in his or her network of exchange relations is, by definition, an actor that is quite prominent in the larger network of relationships — serving as a bridge and boundary spanner across numerous diverse cliques within the larger structure."

The argument and evidence here also reinforce the importance of local-structure cues to global structure. Kleinberg (2000) distinguishes the existence of bridge relations from their detection. Bridge relations are likely to exist under fairly general conditions, and are easily identified by people who have a bird's eye view across a network. But how do people limited to local knowledge find the bridge relations that link beyond their immediate social circle? The problem can be solved if local structure contains cues to global structure. Kleinberg's (2000) analysis implies that bridges should be most readily detected in networks of small, linked clusters, but does not go into the details of what constitutes a local-structure cue.⁶

⁶These are not Kleinberg's words, so here is a quick link to Kleinberg's model. Kleinberg locates individuals in a lattice; everyone is connected to their left-right and up-down neighbors. The probability that a bridge connects ego to some person k selected at random is set to $r^{-\alpha}$, where r is the lattice distance between ego and k (1 to nearest neighbors, 2 to diagonal neighbors, etc.), and α is a clustering

The graphs in Figure 1 display for network advantage a local-structure cue to global-structure: seeing a person behave locally as a network broker is a cue that the person has status in the broader network (which could be one reason why we resent people behaving like a broker locally when we know in fact that they do not have status in the broader network). In a related vein, Everett and Borgatti (2005) link local and global access to structural holes. They measure access with Freeman's (1977) betweenness index, which is a count of the structural holes to which ego has exclusive access. Everett and Borgatti compute a local-structure betweenness score for a person's direct contacts and a global-structure betweenness score for the person's direct and indirect contacts across the broader network. The status measure in this chapter is the network eigenvector, which is often discussed with global betweenness as a measure of network centrality (e.g., network status for the HR officers in Figure 1 is correlated .77 with global betweenness scores). Everett and Borgatti report correlations of .88 to 1.00 between local and global betweenness scores for several small networks taken from prior research. They report correlations of .86 to .99 for random networks of 200 to 500 nodes. Most management study populations contain a few hundred people with ego networks varying to a few dozen contacts, so strong correlation in most management populations should exist between advantage indices computed from local versus global network structure.

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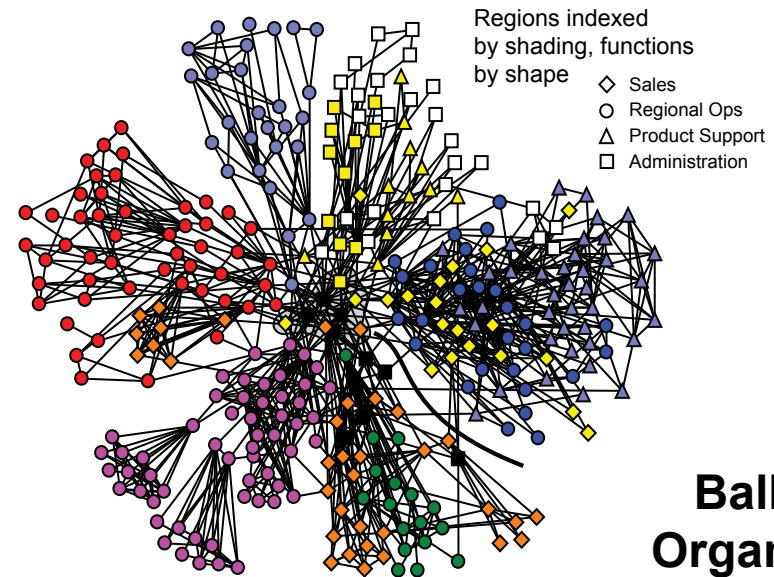
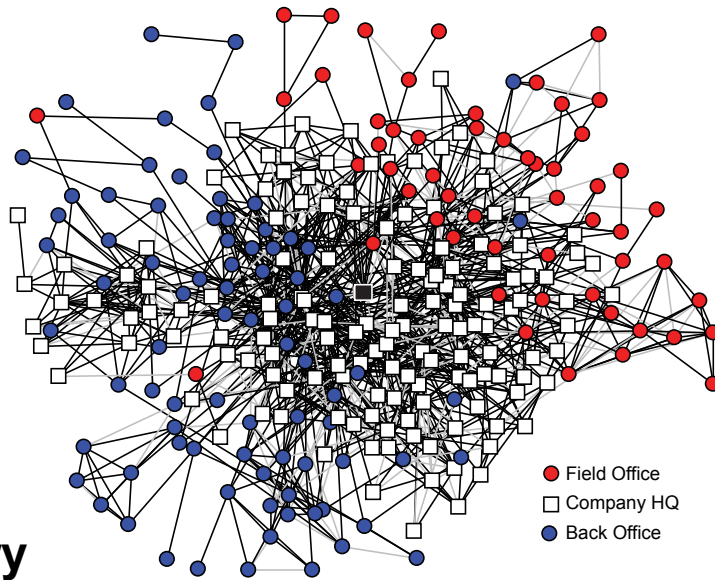
coefficient ($\alpha \geq 0$). Fractional values of the clustering exponent mean that local structure is a poor indicator of global structure; near and distant contacts are likely to be long or short bridges. As the clustering exponent increases, shorter bridges are concentrated in closer neighbors, so the network is a system of small clusters with near neighbors providing bridges to near-by clusters. Kleinberg (2000) shows that the quickest distribution of information occurs when the clustering exponent equals two, which concentrates useful bridges in close neighbors. Therefore we say in the text that Kleinberg's model implies that bridges should be most readily detected in networks of small, linked clusters.

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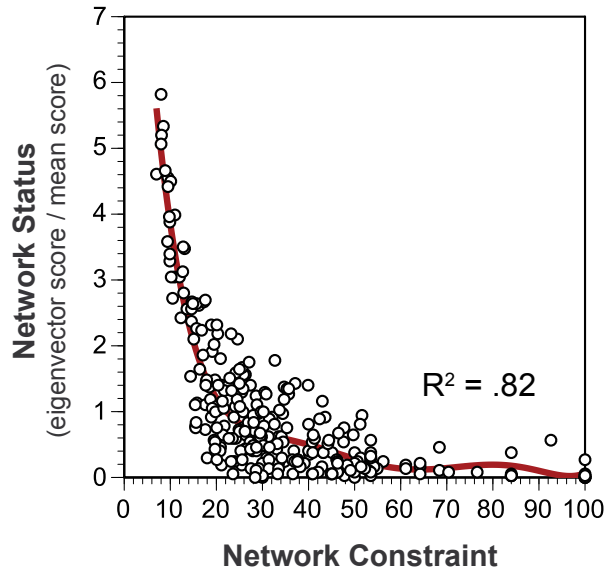
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Figure 1. Status and Access to Structural Holes Are Closely Related Sources of Network Advantage



Center-Periphery Organization

(HR in North American commercial bank; 283 people in a network of 542)



Balkanized Organization

(software product launch in Asia-Pacific; 258 people in a network of 331)

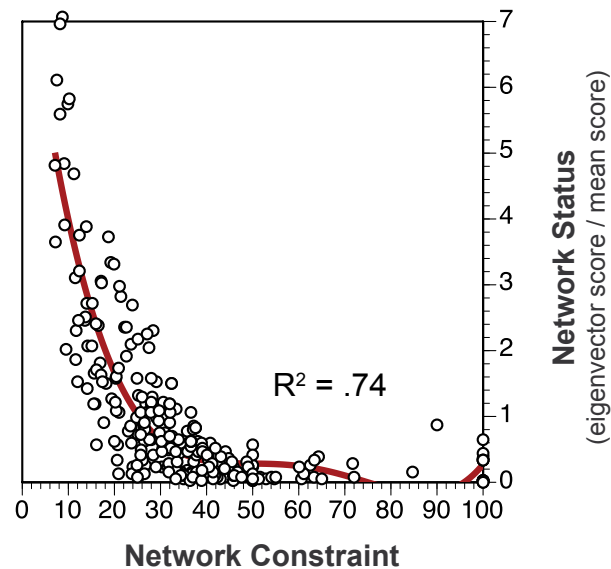
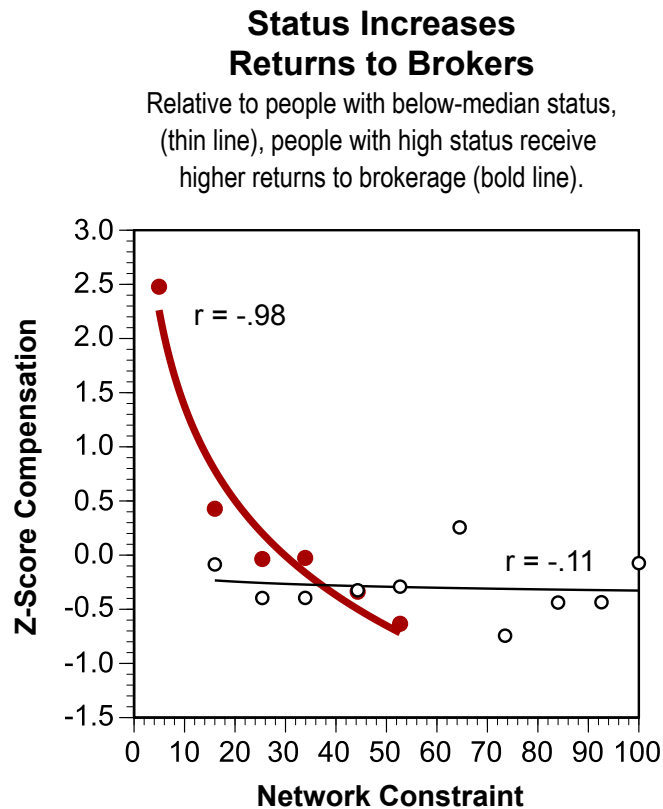
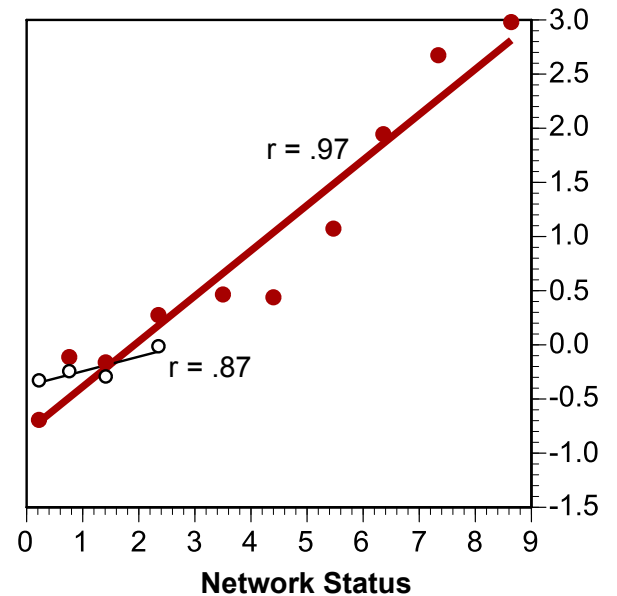


Figure 2. And They Are Complements in that Each Increases Returns to the Other

Predicting Z-Score
Compensation
for HR officers in the
Commercial Bank



Brokers Receive Higher Returns to Status
Relative to people in closed networks (above-median constraint, thin line), brokers receive higher returns to status (bold line).



Predicting Z-Score
Compensation
for Managers in
the Asia-Pacific
Software Product
Launch

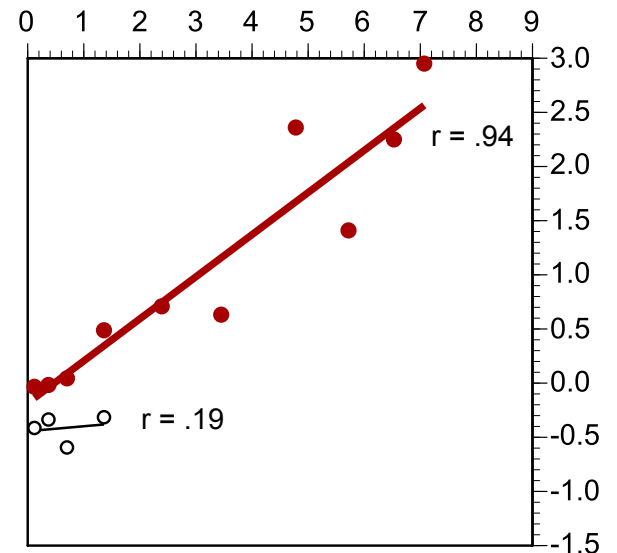
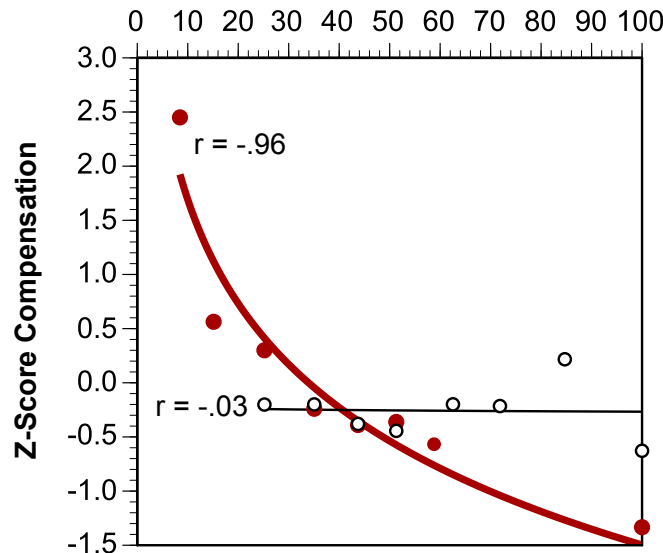


Figure 3. Hubs versus Locals

Access to Structural Holes

		More (lower constraint)	Less (higher constraint)
		More (higher status)	HUBS (achievement and return on advantage)
Social Standing	Less (lower status)	LOCAL BROKERS (less achievement and lower return on advantage)	Relatively Disadvantaged

Online Appendix

Embedded Brokerage

Figure 2 in the essay illustrates the complementarity between categories of network status and access to structural holes, but we inferred complementarity from results with continuous network measures and controls for job rank, function, demographics, and location. The regression models are reported in this Appendix.

Table A.1 reports on the HR officers described by the graphs at the top of Figure 2. With controls for job rank, annual evaluation, tenure at the organization, minority status, office location and job function, compensation decreases sharply with the network constraint for the high status officers (-2.96 t-test), but is irrelevant to compensation for low-status officers (0.37 t-test). Under the same controls, compensation increases sharply with network status for officers rich in access to structural holes (4.89 t-test), but increases not at all for officers with little access to structural holes (0.66 t-test). Putting the two results together, regressing compensation across network status and network constraint shows no association for the individual network metrics but a statistically significant association with their interaction (4.70 t-test). In short, network advantage is apparent only for HR officers with high-status and rich in access to structural holes.

Table A.2 shows a similar result for the investment bankers when compensation next year is predicted from the banker's network this year — holding constant job rank, annual peer evaluation, tenure at the organization, minority status, and office location. Network advantage is apparent when a banker has both status and access to structural holes (2.59 t-test). Status alone has no association with compensation (0.21 t-test). Network constraint alone is associated with compensation (-2.36 t-test) but the association is much weaker than reported when status was not held constant (-4.22 t-test for network constraint with same controls in Burt, 2010:92). The banker results are corroborated by Gargiulo, Ertug, and Galunic's (2009) analysis of a much larger population of investment bankers (Gargiulo et al. citation is in the essay references). Gargiulo et al. (2009:319) report that banker bonus decreases with the density of connections between colleagues citing the banker in the annual review. More, Gargiulo et al. show in the same table that the bonus-network association is stronger for bankers in more senior job ranks. Since these results are for networks defined by received citations, which would be the basis for defining network status, it seems safe to infer that the higher job ranks were on average of higher network

status, so Gargiulo et al.'s bonus-network association increasing with job rank probably reflects a bonus-constraint association increasing with network status.

Table A.3 reports on the product-launch network described by the graphs at the bottom of Figure 2 and Table A.4 reports on the supply-chain managers (the other population balkanized into social clusters). For the product-launch network in Figure 2, Table A.3 shows that compensation decreases sharply with network constraint for high-status employees (-4.41 t-test), and not at all for low-status employees (-0.35 t-test), holding constant job rank, gender, function, years with the company and location. Under the same controls, compensation increases with network status for employees rich in access to structural holes (2.27 t-test), but not at all for employees with little access to structural holes (-0.85 t-test). Not surprisingly, there is a statistically significant interaction effect in which compensation increases with status and access to structural holes (2.21 t-test).

Table A.3 also reports a strong compensation association with constraint after the interaction with status is held constant (-3.08 t-test), however, the effect is dependent on zero-points on the network variables. Median values define the zero points (see table notes), so the compensation association with constraint is evaluated at the median level of status, and the compensation association with status is evaluated at the median level of network constraint. If the status-constraint interaction is defined by raw scores (log network constraint times status) and the results in Table A.3 are re-estimated, the direct compensation association with network constraint weakens because the association is evaluated for employees with zero status. The -.43 coefficient in Table A.3 (with a -3.08 t-test) weakens to a -.34 coefficient (with a -2.50 t-test). The -2.50 t-test shows that there is still a compensation association with network constraint even for employees with zero status. Returns to holes are zero in the other three management populations for people with zero status, but it is worth mentioning that Ferrin et al. (2012) also report a direct performance association with network constraint when status is held constant for a population of almost two thousand engineers in the IT department of a large technology company (Ferrin et al. citation is in the essay references).

Table A.4 shows no direct compensation associations with either network status or holes, but a strong interaction effect: compensation rises sharply as network status increases along with greater access to structural holes (4.29 t-test, subject to controls for job rank, age, education, kind of business, and location).

Table A.1
HR Officer Compensation Returns to Network Advantage

	Network Constraint Prediction		Network Status Prediction		Total
	Low Status	High Status	High Constraint	Low Constraint	
Network Advantage					
Network Constraint	.03 (.07)	-.49 (.16)**			-.03 (.10)
Network Status			.03 (.05)	.19 (.05)**	.02 (.05)
Low Constraint x High Status					.18 (.04)**
Controls					
Job Rank (Ind. Contributor)	-.02 (.03)	.16 (.09)	-.01 (.03)	.09 (.08)	.03 (.04)
Job Rank (Managers)	.38 (.03)**	.64 (.08)**	.38 (.03)**	.48 (.08)**	.43 (.04)**
Positive Job Evaluation	.18 (.09)*	-.15 (.24)	.09 (.09)	-.02 (.22)	.07 (.10)
Average Job Evaluation	.14 (.08)	-.23 (.23)	.08 (.09)	-.06 (.20)	.04 (.09)
Years with Company	.015 (.006)*	.03 (.01)**	.01 (.01)	.03 (.01)**	.02 (.005)**
Minority (female or nonwhite)	-.12 (.09)	-.47 (.15)**	-.10 (.09)	-.48 (.14)**	-.36 (.08)**
Company Headquarters	.06 (.08)	.21 (.15)	.04 (.08)	.13 (.14)	.15 (.08)
Field Office	.24 (.08)*	.27 (.29)	.25 (.08)*	.52 (.23)*	.37 (.10)**
Intercept	-1.08	.43	-.94	-1.27	-1.07
R ²	.71	.66	.71	.70	.73
N	146	137	143	140	283

NOTE — Regression coefficients predict compensation from row variables for 283 HR officers snowballed into the surrounding broader network of 542 employees (standard errors in parentheses). Network constraint is the log of constraint. Network status is ratio of network eigenvector score to mean score. High-Low distinctions are defined by medians. Interaction advantage variable is (median log constraint – constraint score) times (status score minus median status). Compensation is measured as a z-score to indicate relative annual compensation. Variables other than status are taken from Burt (2010:Table 4.1).

* $p < .05$ ** $p \leq .01$

Table A.2
Investment Banker
Compensation Returns to Network Advantage

Network Advantage	
Network Constraint	-.37 (.16)*
Network Status	.03 (.13)
Low Constraint x High Status	.32 (.12)**
Controls	
Senior Job Rank	.77 (.10)**
Peer Evaluation	.53 (.10)**
Seniority (years with organization)	.01 (.01)
Minority (female or nonwhite)	-.01 (.18)
US Headquarters	.12 (.09)
Intercept	-1.46
R ²	.40
N	469

NOTE — Regression coefficients predict compensation next year from row variables this year for about 160 senior investment bankers (three years of data with some bankers entering and leaving the population, standard errors adjusted for autocorrelation in parentheses). Relations are work discussion reported in annual 360 evaluations. Network constraint is the log of constraint. Network status is ratio of network eigenvector score to mean score. High-Low distinctions are defined by medians. Constraint-status interaction variable measures is (median log constraint - constraint score) times (status score - median status). Compensation (salary & bonus) is measured as a z-score to indicate relative annual compensation. Variables other than status are taken from Burt (2010:Table 4.2).

* $p < .05$ ** $p \leq .01$

Table A.3
Compensation Associated with Advantage in the Product-Launch Network

	Network Constraint Prediction			Network Status Prediction			Total
	Low Status	High Status	High Constraint	Low Constraint	High Constraint	Low Constraint	
Network Advantage							
Network Constraint	-.04 (.11)	-.91 (.21)**					-.43 (.14)**
Network Status			-.15 (.17)	.15 (.06)*			-.12 (.11)
Low Constraint x High Status							.17 (.08)*
Controls							
Job Rank (Ind. Contributor)	.21 (.06)**	.59 (.14)**	.26 (.06)**	.47 (.15)**			.37 (.07)**
Job Rank (Managers)	.71 (.10)**	1.15 (.23)**	.72 (.11)**	1.10 (.23)**			.87 (.12)**
Female	-.11 (.09)	-.05 (.19)	-.22 (.09)*	-.01 (.21)			-.19 (.11)
Sales Function	.60 (.09)**	.84 (.16)**	.66 (.09)**	.80 (.17)**			.80 (.10)**
Years with Company	-.02 (.01)	-.05 (.02)*	-.01 (.01)	-.05 (.02)*			-.03 (.01)*
Regional Headquarters	1.05 (.31)**	.71 (.22)**	.57 (.20)**	.74 (.25)**			.68 (.17)**
Targeted for Study	-.34 (.13)*	.01 (.22)	-.29 (.15)	.05 (.21)			.05 (.14)
Intercept	-.96	1.15	-1.25	-1.65			.19
R ²	.54	.58	.49	.50			.58
N	126	132	126	132			258

NOTE — Regression coefficients predict compensation from row variables for 258 employees snowballed into the surrounding broader network of 331 employees (standard errors in parentheses). Network constraint is the log of constraint. Network status is ratio of network eigenvector score to average score. High-Low distinctions are defined by medians. Interaction variable is (median log constraint – constraint score) times (status score minus median status). Compensation is measured as a z-score to indicate relative annual compensation. Variables other than status are taken from Burt (2010:Table 3.1).

* p < .05 ** p ≤ .01

Table A.4
Supply-Chain Manager
Compensation Returns to Network Advantage

Network Advantage	
Network Constraint	-.04 (.05)
Network Status	-.01 (.03)
Low Constraint x High Status	.11 (.03)**
Controls	
Job Rank	.53 (.02)**
Age	.01 (.002)**
College Degree	.06 (.05)
Graduate Degree	.01 (.04)
Minority (female or nonwhite)	-.05 (.04)
High-Tech Businesses	.11 (.04)**
Low-Tech Business	-.22 (.07)**
Regional Headquarters	.15 (.06)*
Corporate Headquarters	.28 (.05)**
Intercept	-1.54
R ²	.86
N	455

NOTE — Regression coefficients predict compensation from row variables for 455 supply-chain managers snowballed into a broader network of 673 managers (standard errors in parentheses). Network constraint is the log of constraint. Network status is ratio of network eigenvector score to mean score. High-Low distinctions are defined by medians. Constraint-status interaction variable measures is (median log constraint - constraint score) times (status score - median status). Compensation (salary & bonus) is measured as a z-score to indicate relative annual compensation. Variables other than status are taken from Burt (2010:Table 3.2).

* $p < .05$ ** $p \leq .01$