DOES THE FORM OF NETWORK CLOSURE MATTER?
DENSITY, HIERARCHY, AND SUCCESS
IN CHINA AND THE WEST

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Business leaders embedded in small, closed networks tend to be paid less than peers, receive less positive work evaluations, and get promoted more slowly. A considerable literature has built up around that finding, but there is little attention to the specific form that closure takes. A network is closed to the extent that the people in it are interconnected, which can happen because everyone is tied to everyone else (clique), or because there is a strong central contact, other than ego, to whom other contacts in the network are strongly connected (hierarchy). The distinction turns out to reveal a substantive difference between network closure in China and network closure in the West. Poor performance in China is not associated with dense networks of connected colleagues so much as it is associated with loose networks anchored on a central contact. Often, the central person is family. Colloquial stories about business success can be accurately quite different in China and the West, hierarchy and family featuring more prominently in China. However, the results presented here show that network theory is consistent between China and the West: Closed networks erode success regardless of the observed differences in closure’s form and source.

START POINT: NETWORK ADVANTAGE IN CHINA AND THE WEST

The structural hole argument for advantage is that network brokers (people whose networks connect across the structural holes between groups) have information breadth, timing, and arbitrage advantages in detecting and developing good ideas, so brokers are more likely to be seen as creative, and enjoy greater success and achievement (Burt, 1992, 2005: Chaps. 1-2; Burt, Kilduff, and Tasselli, 2013, for review). Illustrative evidence on Chinese and Western business leaders is displayed in Figure 1. The vertical axis in each graph measures success. Across the horizontal axes, constraint is a network metric measuring the extent to which a person’s network is small and closed,
providing no access to structural holes between groups. The data plotted in Figure 1 are study-population average scores within five-point intervals on the horizontal axis. The large, open networks around network brokers are to the left. Small, closed networks are to the right. As predicted by network theory, the solid regression line through the dots in each graph shows success decreasing with the extent to a person is embedded in a small, closed network.

Begin with the similarity between the two graphs in Figure 1. That similarity is a core result in Burt and Burzynska’s (2017) analysis, from which Figure 1A is adapted: The network-success association in China (Figure 1A) is similar to the association in the U.S. and E.U. (Figure 1B). There are visible differences between the two graphs (noted by Sorenson, 2017): the networks in China are less open (data are less distributed to the left in Figure 1A), and success differences in the West are broader and concentrated among the most advantaged people (broader range of performance differences in Figure 1B, primarily to the left side of the graph) — but my start point for this paper is simply the displayed fact that success systematically decreases in China and the West with closure in the network around a business leader.

——— Figure 1 About Here ———

The data in Figure 1 are attractively heterogeneous. I am primarily interested here in the China data, which come from a 2012 survey of 700 CEOs, primarily founder entrepreneurs, selected as a stratified random sample of private enterprises in five manufacturing industries within three provinces around the Yangtze River Delta: China’s financial center, Shanghai, with Nanjing the capital of Jiangsu Province to the north, and Hangzhou the capital of Zhejiang Province to the south. The three provinces account in 2013 for 20.2% of China’s gross domestic product, and 31.9% of China’s imports and exports. The sample businesses were founded around the turn of the century on average, and are a 2012 continuation of samples surveyed in 2006 and 2009 by Nee and Opper (2012). As described in Burt and Burzynska (2017:Appendix), the network
around each entrepreneur is defined by responses to name generators concerning valued business contacts, and name interpreters concerning the strength of relations with and among contacts. Varying from three to 12 contacts around a median of six, each resulting network is a matrix of symmetric connections with and among contacts. Success is measured as a self-made man can be argued to experience it: (1) a lot of money passes through his hands, (2) jobs can be found for deserving friends, new contacts, or members of their families, and (3) the company signals technological sophistication by holding its own patents. Success in Figure 1A is a z-score defined by the principal component of all three indicators (Burt and Burzynska, 2017:229, report the network association with each success indicator). There is a -.83 correlation between success and network constraint in Figure 1A, an association that remains strong at the individual level with controls for various individual and business differences (Burt and Burzynska, 2017; Burt and Opper, 2017).

Consistent with the Figure 1A result, Batjargal offers a portfolio of studies reporting greater success for Chinese entrepreneurs who have larger networks richer in structural holes (Batjargal 2007a; 2007b; 2010; Batjargal et al., 2013). Merluzzi (2013) reports similar results on Chinese and other Asian managers in a large software company, and Bian and Wang (2016) report cross-sector relations being helpful for raising start-up capital by self-employed respondents in an area probability survey of eight large cities in China.

The Figure 1B baseline data on U.S. and E.U. business leaders come from six studies used in a review of network advantage (Burt, Kilduff, and Tasselli, 2013:535). All six of the organizations used in the review are American or European companies, but the data for one came primarily from managers in the company’s Asia-Pacific operations (Burt, 2010:Chp. 3; Merluzzi, 2013), so I removed that company from the baseline for this analysis. Two companies are added, making a total of seven study populations in the baseline for this paper. The two additions are senior managers in a large French engineering
organization (Burt, Hogarth, and Michaud, 2000), and senior bankers and managers in a large European financial services organization (Burt, 2017). I put aside senior people who have fewer than three contacts. Such people are important to describing the social environment within an organization, but are an aside to the analysis in this paper (all 700 Chinese have three or more contacts). The final total for the Western baseline is 2,193 Americans and Europeans, most in senior job ranks, in seven organizations.

Success for the Americans and Europeans is measured within companies by annual evaluations, compensation, or promotion — expressed in Figure 1B as a z-score adjusted for relevant background differences between senior employees. Positive scores indicate a person ahead of his or her peers within the company. Zero indicates a person just keeping up with peers. Negative scores indicate a person doing less well than peers. The data plotted in Figure 1B are average scores within each company within five-point intervals on the horizontal axis. The network data differ in richness from populations surveyed online with a single name generator eliciting “frequent and substantive contacts,” to populations surveyed with a printed instrument eliciting contacts for several kinds of relations (the online and printed name generators are listed in Burt, 2010:284-286). The resulting network around each person, varying from three to 66 contacts around a median of ten, is a matrix of symmetric connections with and among contacts. The Figure 1B association between success and large, open networks is a result replicated in several studies (Burt, Kilduff, and Tasselli, 2013), here based on a heterogeneous assembly of business leaders from American and European companies across industries, functions, and job ranks.

**CLIQUES VERSUS PARTNER NETWORKS**

Network constraint is an aggregate index combining three dimensions of closure: size, density, and hierarchy (or centralization). Intuitively, network constraint increases from zero to one with the proportion of person’s network time and
energy consumed by one group. Multiplied by 100, a constraint score of 100 indicates that a person’s contacts are all strongly connected with one another (no access to structural holes). Constraint decreases toward zero with the extent to which a person has many contacts (size or degree), increases with the extent to which the person’s network is closed by strong connections among contacts (density), and increases with the extent to which the person’s network is closed by a partner strongly connected with all contacts (hierarchy).

The mix of social conditions aggregated in network constraint is illustrated in Figure 2. Ego is the person whose network is being measured. Circles indicate ego’s contacts, lines indicate connections between contacts, and to keep the sociograms simple, ego’s connections with contacts are not presented. Network size increases down Figure 2, from networks of three contacts at the top to networks of ten at the bottom. Network density increases from left to right, from networks at the left in which none of ego’s contacts are connected (labeled “broker networks”), to the networks on the right in which all of ego’s contacts are connected (labeled “clique networks”). Network density is the average strength of connection between ego’s contacts. Density is zero for all networks in the left column, where no contact is connected with others, and 100 for all networks in the right column, where every contact is connected with every other.¹

--- Figure 2 About Here ---

¹Connection strength is binary in Figure 2 to keep the examples simple (zij = 0 or 1), but connection strength is continuous in the data to be analyzed. Specifically, relations in the data to be analyzed are symmetric fractions (0 ≤ zij = zji ≤ 1.0, zij = 0), the size, or degree, of ego i’s network is the number of people connected to ego (N), density is the average strength of relations between ego’s contacts (∑j ∑k zjk / (N*(N-1))), and constraint is the sum for ego i across contacts j of the extent to which ego cannot avoid each contact within his or her network: C = ∑j cij, where cij = (pijd + ∑k pijd pjk)², where pij is the proportion of k’s social ties allocated to j within ego’s network (pijd = zij / [∑j zij]). The sum of squared elements increases with the extent to which constraint is concentrated in one of ego’s contacts. That concentration is measured as a separate index in Figure 2 by the Coleman-Theil index (Burt 1992, pp. 70-71): ∑j (cijd/[C/N])²ln(cijd/[C/N]) / (N ln[N]). I multiply density, hierarchy, and constraint scores by 100 for integer presentation and discussion.
A second way contacts can be connected so as to close the network around ego, is by mutual connection with a central figure other than ego. This is illustrated by the “partner networks” in the middle column of Figure 2. The middle column networks in Figure 2 are characterized by no connections between contacts except for all being connected with contact A. The networks are centralized around A, making contact A ego’s “partner” in the network. This kind of network is revealed by constraint concentrated in one contact (e.g., .44, .20, and .20 constraint coefficients $c_{ij}$ for the three-contact network in the middle column of Figure 2), which can be detected with an inequality measure, such as the Coleman-Theil measure in the third row of each panel in Figure 2 (equation in footnote 1). Hierarchy varies with the extent to which network constraint comes primarily from one contact. There is zero hierarchy when contacts are all disconnected from one another (first column in Figure 2) or all connected with each other (third column). Hierarchy scores are only non-zero in the middle column of Figure 2. More, as ego’s network gets larger, the partner’s central role in the network becomes more obvious and hierarchy scores increase (from 7 for the three-contact network, to 25 for the five-contact network, then 50 for the ten-contact network). Hierarchy in a large network can create more constraint than complete connectivity in a comparable size clique (e.g., constraint is 41 points in the ten-contact network in Figure 2, but 36 points in the clique of ten contacts).

Across the networks in Figure 2, network constraint increases from left to right with closure by hierarchy or density (e.g., 20 points for the five-person disconnected network versus 65 points for the five-person clique network), and decreases from top to bottom with increasing network size (e.g., 93 points for the three-person clique network versus 10 points for the ten-person clique network).²

²For comparison, Figure 2 includes two additional metrics often used to distinguish network brokers. “Nonredundant contacts” is a count of ego’s contacts discounting contacts redundant with ego’s other contacts — in essence a count of the clusters to which ego is attached (Burt 1992, p. 52). For the networks of disconnected contacts in the first column of Figure 2, nonredundant contacts equal network size. Every contact is
THE CHINA DIFFERENCE

The graphs in Figure 2 show that high constraint is usually an either-or result of density and hierarchy, rather than a simultaneous result. The top graph shows levels of hierarchy in the Chinese networks across levels of density. The bottom graph shows the same plot for the American and European networks. The large, open networks of brokers are in the lower left of each graph, low in density and low in hierarchy. Closure can involve simultaneous hierarchy and density, but the extremes of either exclude the other. Extremely dense networks, marked in the top graph as “clique networks,” tend to have low hierarchy scores. They do not contain a disproportionately central person. Extremely hierarchical networks, marked in the top graph as “partner networks,” tend to have low nonredundant with the others. For the clique networks in the third column of Figure 2, ego has only one nonredundant contact regardless of increasing network size, because every contact is redundant with the others. The final metric in Figure 2 is Freeman’s (1977) betweenness index that measures the structural holes to which ego has monopoly access. Two disconnected contacts give you one opportunity to broker a connection. Four contacts disconnected from one another gives you six opportunities to broker connections. For the networks of disconnected contacts in the first column of Figure 2, betweenness equals the number of possible connections between contacts because all are disconnected (e.g., betweenness is 10.0 for the broker network of five contacts because none of the 10 possible connections between ego’s five contacts exist). For the clique networks in the third column of Figure 2, betweenness is zero because there are no holes between ego’s contacts. In the middle column of Figure 2, ego shares access to structural holes with her partner. For example, ego has access to a disconnect between contacts B and C in the three-person network, but so does contact A, so ego’s betweenness score is .5, half of one structural hole. Ego has access to six holes between contacts in the five-person partner network, but access is shared with the partner, so ego’s betweenness score is 3.0, half the number of holes to which ego has access. I use network constraint in this paper, but the usual high correlations among alternative measures also occur across the 700 Chinese entrepreneurs. Log network constraint measure used to predict Chinese success in Figure 1A is correlated -.89 with effective size, -.80 with betweenness, and the two alternatives are correlated .89 with one another.

To the extreme right in each graph, it might seem odd to see hierarchy greater than zero when density is 100, which means every contact has a maximum-strength connection with every other contact. Hierarchy in this case comes from the relative strength of ego’s connections with contacts. Constraint coefficients $c_{ij}$ will vary across completely interconnected contacts $j$ when ego is strongly connected with one contact, but not the others.
density scores. They contain disconnected contacts sharing strong connection to a central person in addition to ego.

Table 1 shows how the three components in China and the West aggregate on average into constraint. Levels of network constraint are predicted from levels of each component variable. Network size matters similarly in China and the West: constraint increases as the number of contacts decreases. Network density is a strong correlate in China and the West: constraint increases as colleagues become more densely interconnected.

——— Table 1 and Figure 3 About Here ———

Hierarchy is the component on which the Chinese networks differ most from the American and European. Among the Americans and Europeans, hierarchy is a statistically significant, but relatively minor constraint factor. The standardized regression coefficient for hierarchy predicting constraint is .10, relative to coefficients five times as large for size and density (−.50 and .53 respectively). In China, hierarchy and density make similar contributions to constraint (coefficients of .38 and .40 respectively).

Figure 3 shows that the hierarchy contribution to constraint in the Chinese networks is not uniform across levels of constraint — it dominates the high levels of constraint. People are partitioned in Figure 3 into brokers, clique networks, and partner networks (as in Burt, 1992:143). I distinguished two categories based on hierarchy scores: networks relatively evenly distributed across contacts (“flat networks,” median or lower hierarchy score), versus those anchored on a central contact (“partner networks,” hierarchy score above median). The Americans and Europeans are partitioned with respect to median hierarchy within each of the seven companies.4 Then, flat networks were partitioned at median

4Hierarchy scores differ significantly between the seven companies in the baseline data ($F_{(6,2186)} = 70.06, P < .001$), with the lowest scores in commercial banking and electronics, so flat networks are distinguished from partner networks within each company. There are no significant industry differences in hierarchy between the
constraint to distinguish “brokers” from “clique networks.” The three kinds of networks overlap in Figure 3B because the constraint criterion distinguishing a broker among engineers is different from the criterion distinguishing a broker among investment bankers. The distinction between partner and clique networks does not matter greatly among the Americans and Europeans: there are clique and partner networks at all levels of constraint in Figure 3B. The bold line of mean hierarchy scores continues flat across levels of constraint (-.02 correlation between hierarchy and constraint). In contrast, all of the Chinese networks posing more than 80 points of constraint are partner networks. Below 70 points of constraint, the bold line of mean hierarchy scores continues flat across levels of constraint below 70 points, but increases linearly with constraint at higher levels.

In sum, the network constraint associated with success in both China and the West has a foundation in the West different from its foundation in China. Constraint in American and European networks increases linearly with density, and high constraint is as likely to be based on density as hierarchy. In contrast, high constraint rarely occurs for the Chinese in the form of a dense network (empty space in the lower-right corner of Figure 3A). High levels of constraint occur when an entrepreneur anchors his or her network on a central contact (upper left corner of Figure 3A).

WHO ARE THE PARTNERS?
The central contacts on whom the Chinese high-constraint partner networks are anchored tend to be family. Table 2 shows how four kinds of Chinese networks differ in composition. The four kinds of networks in the tables are distinguished in Chinese entrepreneurs ($F_{(4,695)} = 1.33, P ~ .26$), so the entrepreneurs are partitioned with respect to median hierarchy for the whole sample.

Again constraint scores differ significantly between the seven companies ($F_{(6,2188)} = 61.23, P < .001$), so broker networks are distinguished from cliques using company specific median levels of constraint.
Figure 3A: brokers (hollow circles; low constraint, low hierarchy), cliques (solid circles; high constraint, low hierarchy), and two kinds of partner networks. The shaded triangles in Figure 3A are partner networks at the high end of constraint, where constraint and hierarchy scores increase together linearly. These are referenced in Table 2 as “extreme” partner networks. The hollow triangles in Figure 3A are partner networks at lower levels of constraint, levels corresponding to broker and clique networks. These are referenced in Table 2 as “moderate” partner networks.  

Table 2 and Table 3 About Here 

Family immediately stands out. The two rows in Table 2 show that of all contacts in extreme partner networks, 14.19% are nuclear family and 5.83% are extended family. The percentages in broker networks are much lower, and the percentages in clique and moderate partner networks is closer to brokers than to extreme partner networks. Not surprisingly, the family composition differences between kinds of networks are statistically significant (right-most column in Table 2). The bottom row of Table 2 shows that almost two thirds of extreme partner networks are around the CEO of a family firm (63.72%, using the common definition of family firms as owner-operated firms in which the respondent’s 

--- Table 2 and Table 3 About Here ---

There is a visible gap between the shaded and hollow triangles in Figure 3A that I used as a dividing line to distinguish “extreme” partner networks from “moderate” partner networks. The line could easily be moved to one side or the other, but not by a lot. Past 70 points of constraint, almost all networks are hierarchical. Those are a category of extreme partner networks. There are some hierarchical networks below 70 points of constraint that have very high levels of hierarchy (shaded triangles in the upper-middle of Figure 3A). Table 2 correlates of these high-hierarchy networks look more like extreme partner networks than moderate, so I put them in the extreme category. Similarly, Table 2 correlates of the hierarchical networks the median to 70 points of constraint (hollow triangles just above the cliques in Figure 3A) look more like the correlates for hierarchical networks at below-median levels of constraint, so I put them in the moderate category. I also checked the eight networks at low levels of constraint with hierarchy scores over 20 points. Hierarchy in these cases is largely due to the respondent’s different levels of attraction to his or her contacts. Correlates of these networks look more like the correlates of broker networks than the correlates of extreme partner networks, so I put the eight in the moderate category.
spouse or children are employees). Family firms are a quarter, to a third, of other networks.

Four out of five contacts cited by the Chinese entrepreneurs are not in the first eight rows of Table 2. The “None of the Above” contacts in the ninth row of Table 2 are neither family, nor childhood friends, nor classmates, nor contacts met in a business organization, nor contacts from the military, nor the Chinese Communist Party, nor the respondent’s neighborhood. These are colleagues from business pure and simple. They constitute four out of five contacts in broker, clique, and moderate partner networks. They are significantly less present in extreme partner networks, reaffirming the prominence of family at the highest levels of network constraint.

Contacts at the Top of the Hierarchy

Table 3 shows how the networks differ by the kind of contact most central in a network. That “most central” contact is the person at the top of the hierarchy of

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7 Many of the “None of the Above” contacts are, or were, co-workers. The network questionnaire included a role label of “colleague” defined as “you and the person have been employed in the same organization.” Most of the 3,645 “None of the Above” contacts are “colleagues” (79%). However, the questionnaire failed to distinguish between colleagues in the current organization versus colleagues from former organizations, so the label is ambiguous. Following prior analyses (Burt and Opper, 2017), I combine “colleague” in a residual category with the few contacts that are none of the eight unambiguous kinds listed in Table 2.

8 The network data include the gender of contacts, which is included in Table 2 to test for gender issues in the networks. Of the 700 Chinese entrepreneurs, 115 are women (14.16%). There is no difference in the kinds of networks associated with male versus female respondents (5.46 chi-square, 3 d.f., P ~ .14), but women are more likely to cite another woman as a business contact (77.39% cite a woman, versus 60.17% of men; 12.23 chi-square, 1 d.f., P < .001). Therefore, the second to the bottom row in Table 2 includes a control for female respondents. There is a statistically significant difference between the networks in their tendency to include female contacts. Broker networks are most likely (72.95%). Extreme partner networks are least likely (46.90%). However, women are similarly unlikely to be the most central contact in either kind of network (17.62% and 11.50%, respectively), and there are no statistically significant differences between the four kinds of networks on women as most central contact (6.78 chi-square, 3 d.f., P ~ .08).
contacts within a respondent’s network. The pattern in Table 3 is the same that was in Table 2 for composition: the most central contacts tend to be family, especially nuclear family, and the purely business “None of the Above” contacts (which are more likely in the other three kinds of networks, but still the most likely contact in an extreme partner network). When a contact from the military is most central, it is more often in extreme partner networks, but there are only six such networks in the data.

Illustrative Examples

An illustrative extreme partner network anchored on family is displayed in Figure 4. The respondent (square in the figure) founded his business 13 years ago, and grew it to 23 employees by the time of the survey. The business has survived these many years, but is less successful than others in the same industry and city (z-score business success, z-score return on assets).

The respondent named five contacts, largely interconnected by relations that are close (thin line) or especially close (bold lines). The respondent’s uncle is the most central contact in the network (c_{ij} = 36.8, see footnote 9). The respondent cited his uncle as the person most valuable in founding the business, and the person most valuable to the respondent in locating someone to replace

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9The most central contact in a network is the person j with the highest constraint coefficient c_{ij}. When there is more than one contact with maximum c_{ij}, which is typically a tie between two contacts, and more often than not in broker and clique networks, the most central contact is the contact with the stronger relationship to the respondent (z_{ij}). When two or more contacts in a network have the same maximum c_{ij} and z_{ij}, I use the founding contact as most central. The founding contact was always among the most central contacts when there are more than one in a network, and help with founding stands out as an especially close relationship (Burt and Burzynska, 2017:234; Burt and Opper, 2017:517-518).

10Residual measures of success are presented in Figures 4 and 5. Z-score return on assets is the studentized residual from 2012 return on assets regressed over 2011 company assets holding constant industry and city. Z-score business success is the studentized residual from regressing the success measure on the vertical axis of Figure 1A across firm age holding constant industry and city.
the operations manager, and the person most valuable in helping the respondent replace a major supplier. The respondent meets his uncle daily, and has known him all of his life (respondent is 41 years old, and says he has known his uncle for 41 years). The respondent’s two sons are the next most central contacts in the network. Both are valued current contacts met weekly, and each is cited for being the respondent’s most valued contact during a significant event in the history of the business. There is one further person cited as a current valued contact, and a fifth person cited as the respondent’s most difficult contact this year (friend of his uncle who left a job in the respondent’s organization and took some customers with him). This is a family firm in that it is a private enterprise run by the respondent and employing one or more of his children. It is also family focused in that the most central contacts in the network are relatives, and 60% of all cited contacts are relatives.

Figure 5 displays an illustrative extreme partner network containing only “None of the Above” contacts; no family, childhood friends, classmates, and so on down the list in Table 2. This is a purely business network. The respondent founded his business 10 years ago and now employs 21 people. The business continues, but it is not a striking success for its age, city, and industry (-1.25 z-score business success, -.62 z-score return on assets; see footnote 10).

Strong relations in the network are concentrated in the third contact, who is the most central contact (c_{ij} = 41.5, see footnote 9; contact 2 is next-most central with a much lower constraint coefficient of c_{ij} = 12.9). The respondent met the third contact three years ago, during a financial pinch, through which the contact provided most valued financial help. The respondent’s longest relationship is with contact one, who he met in the year he founded his business, but now meets less often than his other cited contacts. The first contact is cited as most valued to the respondent in founding the business, and during the first significant event (which was having to replace a key supplier). The line connecting contacts
one and three is thicker than the line connecting contact one with the respondent, which means the respondent feels that contact one is less close to the respondent than to the central finance person, contact three. The same is true for contact two, who is the respondent’s most valued employee, and sees daily, and has known for seven years. The same is especially true for contact 5, who the respondent cites as his most difficult contact this year: Contact 5 stole products when the respondent moved his plant, but response is limited because contact 5 has a strong connection with central contact three. In sum, the respondent is somewhat a visitor in his own network. The central person is the finance person; contact three, not the respondent.

**SO WHAT?**

The four kinds of networks have associations with success predicted by network theory. The first row of Table 4 shows the mean levels of z-score business success at the time of the survey (vertical axis in Figure 1A). Success is highest for the entrepreneurs with broker networks (.15), lower for cliques, and lowest for extreme partner networks (-.15). The second and third rows of Table 4 show similar results when success is measured in terms of return on assets: highest for broker networks (by a small margin) and clearly lowest for extreme partner networks.

The relative success of businesses run by entrepreneurs with the four kinds of networks is consistent with network theory, but also consistent with the Figure 1 prediction from relative levels of network constraint. In terms of business success and profit, Table 4 shows that respondents with broker networks are least constrained and run the most successful businesses. Respondents with extreme partner networks are the most constrained, and run the least successful businesses.

——— Table 4 and Table 5 About Here ———
Table 5 shows that success has a negative association with network closure, regardless of the form closure takes. In Model A, business success is predicted with industry and city fixed effects by log network constraint and correlates found significant in prior analysis (Burt and Opper, 2017:521). Model B adds three dummy variables to distinguish the four kinds of networks in Table 4 and Figure 3, plus a distinction for family firms since family firms so closely associated with extreme partner networks in Table 3. Test statistics for the added variables in Model B are all statistically negligible, and the summary test in the bottom row of Table 5 shows that Model B makes no improvement over Model A in predicting success ($F_{(4,680)} = 1.45$, $P \sim .21$). The same result comes from predicting the profit measures in Table 4. The association between return on assets in the year before the survey has a t-test of -3.12 for the association with network constraint in Model A, and prediction is no stronger in Model B when the four kinds of networks and family firms are distinguished ($F_{(4,680)} = 0.33$, $P \sim .86$). The association between average return on assets in the three years before the survey has a t-test of -2.70 for the association with network constraint in Model A, and negligible improvement in Model B ($F_{(4,680)} = .31$, $P \sim .87$).

**CONCLUSION**

In sum, business success has a negative association with network closure in China as in the West, but disadvantage in China occurs in a different form (hierarchy instead of density), and more often from a different source (family versus colleagues). Colloquial stories about business success can be accurately quite different in China and the West, hierarchy and family featuring more prominently in China. Nevertheless, the results presented here show that network theory is consistent between China and the West: Closed networks erode success regardless of the observed differences in closure’s form and source — at least with respect to the network structure and family distinctions considered here.
The same need not be true of closure’s many other correlates, but the analysis used here could be used to better understand other correlates. For example, closure in the form of a hierarchical network built around an insider sponsor can be beneficial to people who are distained outsiders (e.g., women in a sexist firm, people acquired from a distained legacy organization), but there is no benefit to such people from closure in the form of a dense clique (Burt, 1998, 2010:206). Creativity and innovation are another correlate: diverse evidence shows lower creativity and innovation in more closed networks (Gargiulo and Benassi, 2000; Burt, 2004, 2005:Chp. 2; Uzzi and Spiro, 2005; Fleming and Marx, 2006; Fleming, Mingo, and Chen, 2007; DeVaan, Vedres, and Stark, 2015; Jang, 2018; Soda, Mannucii, and Burt, 2018). The more closed the network around a person, the less exposed the person is to diverse opinion and practice, and the less experienced he or she is in blending previously distinct ideas into new combinations. Closure in general limits exposure to diverse thinking, and enforces conformity to our way, but density and hierarchy can be imagined to serve that function differently. Dense cliques expose members to shared understandings via connections to each other member. Those many faces can be welcome society, but a stifling impediment to creative thoughts. In contrast, social order in a hierarchy is enforced through member connection to the central contact. It is easier to deviate from the one central contact than to deviate from the omnipresent many. Indeed, the difference is familiar as oppressive control in self-managing teams in comparison to hierarchy (Barker, 1993). In short, network closure in the form of density might be more detrimental to creativity and innovation than is closure in the form of hierarchy.¹¹

¹¹I looked into this density-hierarchy contrast with data used in Burt (2004), which show a strong negative association between network constraint and the management perceived value of a person’s best idea for new business practice (Burt, 2004:381, Model 5; -4.81 t-test with various control variables). If I re-estimate the model with the same control variables, replacing network constraint with density and hierarchy as measured here, density has a strong negative association with idea value (-4.28 t-test, P
Looking beyond the network, Opper, Burt and Holm (2017) argue that the safety of interpersonal relations within a closed network amplifies feeling at risk in interpersonal relations beyond the network. They present evidence of people in closed networks tending not to cooperate with strangers (cf. Opper, Nee, and Holm, 2017, for evidence of risk-averse people finding guanxi activities unattractive beyond their network). Networks closed by hierarchy or density both coerce through reputation cost, but enforcement of reputation cost in a hierarchical network is concentrated in the central contact, versus distributed across the community of members in a clique. Relative to shared responsibility in a clique, might dependence on a strong central contact make people in a hierarchical network feel especially at risk in relations beyond their central contact’s purview?¹²

REFERENCES

¹²I looked into this density-hierarchy contrast with the data used in Opper, Burt, and Holm (2017). Half of their respondents cooperate with a stranger in the Prisoner’s Dilemma game (49.40%). That overall average is lower for people in partner networks: 55.10% for brokers, 50.54% for clique networks, 45.39% for moderate partner networks, and 38.98% for extreme partner networks. The differences are not statistically significant (6.16 chi-square, 3 d.f., P ~ .10), but cooperation is lower from people in partner networks, so appropriate controls might bring the hierarchy effect into sharper contrast.


Table 1. Network Constraint Components

<table>
<thead>
<tr>
<th></th>
<th>Beta</th>
<th>B</th>
<th>S.E.</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chinese Entrepreneurs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(R² = .87)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Size</td>
<td>-.61</td>
<td>-5.84</td>
<td>.16</td>
<td>-37.05</td>
</tr>
<tr>
<td>Network Density</td>
<td>.40</td>
<td>0.32</td>
<td>.01</td>
<td>23.79</td>
</tr>
<tr>
<td>Network Hierarchy</td>
<td>.38</td>
<td>0.93</td>
<td>.04</td>
<td>21.83</td>
</tr>
<tr>
<td><strong>Americans &amp; Europeans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(R² = .77)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Size</td>
<td>-.50</td>
<td>-1.15</td>
<td>.03</td>
<td>-41.94</td>
</tr>
<tr>
<td>Network Density</td>
<td>.53</td>
<td>0.51</td>
<td>.01</td>
<td>45.52</td>
</tr>
<tr>
<td>Network Hierarchy</td>
<td>.10</td>
<td>0.35</td>
<td>.04</td>
<td>8.83</td>
</tr>
</tbody>
</table>

NOTE — These are OLS regression results predicting network constraint from its three components. Estimates for the Chinese are across 700 respondents with city and industry fixed effects. Estimates for the Americans and Europeans are across 2,193 respondents with company fixed effects.
<table>
<thead>
<tr>
<th></th>
<th>Broker Networks</th>
<th>Clique Networks</th>
<th>Partner Networks</th>
<th>Row Test Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Family, Nuclear</td>
<td>2.94</td>
<td>6.66</td>
<td>5.84</td>
<td>14.19</td>
</tr>
<tr>
<td>Percent Family, Extended</td>
<td>1.59</td>
<td>1.57</td>
<td>3.41</td>
<td>5.83</td>
</tr>
<tr>
<td>Percent from Childhood</td>
<td>1.07</td>
<td>2.11</td>
<td>1.00</td>
<td>0.40</td>
</tr>
<tr>
<td>Percent Classmates</td>
<td>3.59</td>
<td>8.80</td>
<td>3.53</td>
<td>3.58</td>
</tr>
<tr>
<td>Percent Co-Members Business Organization</td>
<td>2.52</td>
<td>1.37</td>
<td>3.06</td>
<td>5.29</td>
</tr>
<tr>
<td>Percent from Military</td>
<td>0.16</td>
<td>0.78</td>
<td>0.39</td>
<td>2.04</td>
</tr>
<tr>
<td>Percent Neighbors</td>
<td>1.37</td>
<td>5.10</td>
<td>1.52</td>
<td>1.03</td>
</tr>
<tr>
<td>Percent from Party (CCP)</td>
<td>0.49</td>
<td>0.95</td>
<td>1.05</td>
<td>3.02</td>
</tr>
<tr>
<td>Percent None of the Above</td>
<td>87.32</td>
<td>79.08</td>
<td>81.63</td>
<td>65.02</td>
</tr>
<tr>
<td>Percent Naming a Woman</td>
<td>72.95</td>
<td>56.14</td>
<td>63.76</td>
<td>46.90</td>
</tr>
<tr>
<td>Percent Family Firms</td>
<td>29.09</td>
<td>26.32</td>
<td>35.37</td>
<td>63.72</td>
</tr>
</tbody>
</table>

NOTE — These are the percent of contacts of each row kind, on average within the 700 Chinese networks. One contact can be multiple kinds (e.g., a neighbor can also be a former classmate and a female). Test statistics are for the hypothesis that the percentages in a row are equal. The tests are F-tests with (3,696) degrees of freedom, except in the last two rows, which are chi-square statistics with three degrees of freedom (and the “Percent Naming a Woman” test includes a control for the higher tendency for female respondents to name a female contact). * P < .05  ** P < .01  *** P < .001
# Table 3.
## Who Is at the Top of the Hierarchy?

<table>
<thead>
<tr>
<th></th>
<th>Most Central Contacts in Extreme Partner Networks</th>
<th>Most Central Contacts in the Three Other Kinds of Networks</th>
<th>Test for No Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Percent</td>
<td>Cases</td>
</tr>
<tr>
<td>Family, Nuclear</td>
<td>28</td>
<td>24.8</td>
<td>59</td>
</tr>
<tr>
<td>Family, Extended</td>
<td>16</td>
<td>14.2</td>
<td>40</td>
</tr>
<tr>
<td>Childhood Friend</td>
<td>1</td>
<td>0.9</td>
<td>17</td>
</tr>
<tr>
<td>Classmate</td>
<td>10</td>
<td>8.8</td>
<td>74</td>
</tr>
<tr>
<td>Co-Member from Business Organization</td>
<td>1</td>
<td>0.9</td>
<td>8</td>
</tr>
<tr>
<td>Colleague from Military</td>
<td>6</td>
<td>5.3</td>
<td>5</td>
</tr>
<tr>
<td>Neighbor</td>
<td>5</td>
<td>4.4</td>
<td>28</td>
</tr>
<tr>
<td>Colleague from Party (CCP)</td>
<td>4</td>
<td>3.5</td>
<td>9</td>
</tr>
<tr>
<td>None of the Above</td>
<td>44</td>
<td>38.9</td>
<td>381</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>100%</td>
<td>587</td>
</tr>
</tbody>
</table>

NOTE — These are the percent of each kind of row contact among the most central contacts in the networks. One contact can be multiple kinds (e.g., a neighbor can also be a former classmate and a female). “None of the Above” are contacts who are none of the eight kinds listed above. The test statistic is a chi-square with 1 degree of freedom. * P < .05  ** P < .01  *** P < .001
Table 4. Success and Kinds of Networks

<table>
<thead>
<tr>
<th></th>
<th>Broker Networks</th>
<th>Clique Networks</th>
<th>Partner Networks</th>
<th>Row Test Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Z-Score Business Success in 2012</td>
<td>.15</td>
<td>-.09</td>
<td>-.04</td>
<td>-.15</td>
</tr>
<tr>
<td>Return on Assets, 2011</td>
<td>.28</td>
<td>.26</td>
<td>.27</td>
<td>.19</td>
</tr>
<tr>
<td>Average Return on Assets, 2009-2011</td>
<td>.29</td>
<td>.25</td>
<td>.28</td>
<td>.20</td>
</tr>
<tr>
<td>Mean Network Constraint</td>
<td>45.65</td>
<td>63.82</td>
<td>53.90</td>
<td>78.52</td>
</tr>
</tbody>
</table>

NOTE — Cells are means on the row variable for each kind of network. Business success in the first row is a z-score defined by the first principal component of patents, employees, and sales adjusted for having a research and development department, adapted from Burt and Burzynska, 2017:226). Return on assets over the year before the survey, and average return on assets for the three years before the survey come from Burt and Opper, 2017:520:n11). Test statistics are F-tests with (3,696) degrees of freedom for the hypothesis that the means in a row are equal. * P < .05 ** P < .01 *** P < .001
Table 5. Predicting Business Success

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Constraint</td>
<td>-.42 (-3.58) ***</td>
<td>-.50 (-2.80) **</td>
</tr>
<tr>
<td>Respondent Is Founder</td>
<td>-.37 (-4.42) ***</td>
<td>-.37 (-4.40) ***</td>
</tr>
<tr>
<td>Firm Age (years since founding)</td>
<td>.05 (6.56) ***</td>
<td>.04 (6.49) ***</td>
</tr>
<tr>
<td>Business Has R&amp;D Department</td>
<td>.69 (11.07) ***</td>
<td>.69 (11.21) ***</td>
</tr>
<tr>
<td>Level of Success at Founding (z-score)</td>
<td>.43 (6.23) ***</td>
<td>.44 (6.17) ***</td>
</tr>
<tr>
<td>Broker Network</td>
<td></td>
<td>.10 (1.36)</td>
</tr>
<tr>
<td>Clique Network</td>
<td></td>
<td>.02 (0.26)</td>
</tr>
<tr>
<td>Extreme Partner Network</td>
<td></td>
<td>.20 (1.87)</td>
</tr>
<tr>
<td>Family Firm</td>
<td>-.01 (-.12)</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.14</td>
<td>1.39</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.45</td>
<td>.46</td>
</tr>
</tbody>
</table>

No Contribution from Last Four Variables 1.45

NOTE — OLS regression predicting business success from row variables with industry and city fixed effects (and robust t-tests in parentheses, 700 Chinese entrepreneurs). Business success is a z-score (vertical axis in Figure 1A) defined by the first principal component of patents, employees, and sales adjusted for having a research and development department, from Burt and Burzynska, 2017:226). Success at founding is a similar z-score for the date when the business was registered as a private enterprise (Burt and Opper, 2017:520). Network constraint is measured as the log of 100 times constraint (horizontal axis in Figure 1A). Firm age is 2012 minus the year in which the business was registered as a private enterprise. Broker, clique, and extreme partner network are dummy variables distinguishing the four kinds of networks in Table 2 and Figure 3. Family firm is a dummy variable distinguishing owner-operated businesses in which the respondent’s spouse or children are employees. The test in the bottom row for no additional prediction from distinguishing the four kinds of networks and family firms is an F-test with (4,680) degrees of freedom. * P < .05  ** P < .01  *** P < .001
Figure 1.
Starting Point: Network-Success Association

A. 700 Chinese Entrepreneurs

B. 2,193 Senior People in American and European Companies

NOTE — Dots are average scores for a five-point interval of network constraint within a study population. Correlations are computed from the plotted data. Lines are vertical axis predicted by log network constraint. Graph A shows business success increasing with more structural holes in networks around Chinese entrepreneurs (business success is a z-score defined by the first principal component of patents, employees, and sales adjusted for having a research and development department, adapted from Burt and Burzynska, 2017:226). Graph B shows personal success increasing with more structural holes in the networks around Americans and Europeans (business success within each study population is defined by evaluation, compensation, or promotion, adjusted for job and background variables, see text).
Figure 2. Network Metrics

NOTE — Table shows measures of size, density, hierarchy, nonredundant contacts, betweenness, and constraint for networks varying by size and structure. To keep the sociograms simple, relations with ego are not presented. Top graph plots network hierarchy by network density for 700 Chinese entrepreneurs. Bottom graph is the same plot for 2,193 Americans and Europeans.
Figure 3. Network Hierarchy Associated with Constraint

NOTE — Bold lines connect average hierarchy scores within 5-point intervals of constraint. Broker networks are indicated by white circles (low constraint, low hierarchy). Cliques are indicated by solid circles (high constraint, low hierarchy). Partner networks are indicated by triangles (high hierarchy, examples displayed in Figures 4 and 5 are indicated). High-low distinctions are defined by sample medians for the Chinese, company medians for the Americans and Europeans.
Figure 4. Family Firm Example Of Extreme Partner Network

Line thickness indicates closeness.
No line is “distant” relation.
Square is respondent.
Five Contacts (Size)
47.3 Network Density
22.3 Network Hierarchy
81.2 Network Constraint
-1.37 Z-Score Business Success
-0.25 Z-Score Return on Assets

1. Uncle cited as most valued in founding the business, during the first significant event (found new operations manager), and during the second significant event (helped replace major supplier), known 41 years, meets daily, $c_{ij} = 36.8$

2. Son currently one of respondent’s most valued contacts, most valued employee, and cited as most valued during third (first big contract) and fourth significant events, known 18 years, meets weekly, $c_{ij} = 19.3$

3. Son currently one of respondent’s most valued contacts, and cited as most valued during the fifth significant event, known 23 years, meets weekly, $c_{ij} = 19.3$

4. Person currently one of respondent’s most valued contacts, known 3 years, meets weekly, $c_{ij} = 5.3$

5. Person most difficult for respondent to deal with this year (job hopping, took away customers), known 8 years, meets weekly, $c_{ij} = 0.5$

Respondent founder of 13-year business, now 23 employees
Figure 5. Pure Business Example Of Extreme Partner Network

Line thickness indicates closeness.
No line is “distant” relation.
Square is respondent.

Five Contacts (Size)
44.0 Network Density
23.2 Network Hierarchy
73.2 Network Constraint
-1.25 Z-Score Business Success
-0.62 Z-Score Return on Assets