Repeated Cooperation Matters — An Analysis of Syndication in the Chinese VC Industry by ERGM Model

Luo, Jar-Der, Li, Ray-Chi, Fan, Fun-Da, and Tang, Jie

If cited, please cite the following:
Luo, Jar-Der , Li, Ray-Chi , Fan, FangDa and Tang, Jie, forthcoming. "Mining Data for Analyzing Guanxi Circle Formation in Chinese Venture Capitals' Joint Investment". In Fu, Xiaoming, Margret Boos and Luo, Jar-Der (Eds.). *Interdisciplinary Social Network Analysis.* NY: Taylor & Francis Group.

I. Guanxi Circle Phenomenon in the Chinese VC Field

1. Guanxi in the Chinese VC Industry

Chinese venture capital is a newly emergent industry, in which government policies keep changing, governance structure is immature, and information asymmetry always bothers investors. All these make the Chinese investment environment highly uncertain and short-term rational calculation of investors often in vain. Thus Chinese VCs seeks to build up a robust network in which long-term social exchanges help hedging against the impacts of environmental uncertainty. This research thus aims to analyze the VCs' consideration behind building relations, rather than the motivations for investing behaviors. We adopt both qualitative and quantitative methods to collect data (King, et al., 1994; Small, 2011). First, several interviews to 3 informants help us understanding why Chinese VCs build connections with other investors in joint investment. We then collect the data of 2060 VCs and 12,414 investment events in a period of 17 years from SiMuTon database, and analyze the network dynamics of this field over the years 1995-2011 by using ERGM method.

Table 1 is about Here

There are many excellent researches studying the syndication in VC industry. Some of them focus on the compensation of each other’s insufficiency (Lockett and Wright，2001; 2003), so that rich and diversified resources may increase the probability of success of an investment (Brander et, al.，2002). Some studies put emphasis on the motivation of risk-sharing behind joint investments, which generally involve with huge uncertainty (Wilson, 1968). In such an uncertainty environment, the governance mechanism for hedging opportunitism behaviors (Williamson, 1996) has also been proposed on the research agenda (Holmstrom, 1982; Admati and Pfleiderer，1994; Tykvov ́a, 2007). However, a solely performance-focused approach constricts the contribution of syndication research. Comparing scrutinized previous research of syndication there is few in corporate finance literature due to the difficulties of analyzing syndication patterns empirically and verifying the complexity of motives behind syndication (Lerner, 1994). Attachment patterns and logics behind relation building might be the key to well explaining this field (see Herchberg, et. al, 2010). Especially in the context of emerging countries such as China and India, the difficulties of data collection often blocks the promotion of the research.

Although Chinese VCs share some common grounds of their western counterparts, the institution and culture place emphasis on guanxi (Chinese term, social relations) and networking rather than individual self-interest motivations, which might bring about different activities and relation-building logics (Bruton and Ahlstrom, 2003; Bruton, et. al, 2005). Relatively few literatures have shed light on the VC industry and syndication network in the Chinese context.

In an environment with well-developed markets, personal properties are well-defined and resources flow following some certain rules. But it is not true for the Chinese VC industry, since unclear property rights and high information asymmetry make the access to a good project extremely difficult. Without good *guanxi*, it is almost impossible to get enough information to analyze a project. Especially, whether a project is good or not highly depends on the policies of central or local governments, so it requires good guanxi to get the prior information concerning the attitudes of governments. Relation building is thus needed to access good project.

In addition to searching for good investment opportunities, guanxi-building of Chinese VCs is also very helpful for hedging against free-riding (Olson, 1966) and opportunitism behaviors (Williamson, 1985), as well as protecting their own interests collectively from the interference of continuously changing governmental policies (Luo, 2015). Guanxi-building behaviors in the VC community bring about a type of network structure, which is centered on one or several leaders with multiple layers of group members. This is what we called "guanxi circle" (in Chinese, Quan Zi or Xiao Quan Zi) shown in Figure 1, as the senior investor Mr. Y says that there is a three-layer network structure, as he puts it:

There are few investors in the first layer [in terms of power and number of projects],…they have unique resources….In the second layer, some famous PE [private equity] are in this layer….Those in the third layer are generally not famous nationwide, but even some globally famous investors sometime need their cooperation, [since they may have special resources] such as local government relations, local market knowledge, etc.

Figure 1 is about Here

The following sections of this paper will use the method of complex network to investigate the structure of guanxi circles in syndication. And then, we first need to ask what a guanxi circle is?

2. What is a Guanxi Circle

Guanxi circle phenomena are often seen in various types of Chinese workplaces. It was found rooted in two Chinese traditional ways of networking, i.e. what indigenous sociologist Fei's theory "the differential modes of association" (1992), and what indigenous anthropologist Hsu's argument about "clan-like group" (1963).

A Chinese often builds up his/her own guanxi network based on family ethics (Liang, 1963), and applies different rules of social exchanges for various types of guanxi. The most inner circle of this ego-centered network is "family ties" (Yang, 1993) or "pseudo-family ties" (Chen, 1994; Luo, 2005), since some most intimate friends may be taken as family members and good fit for the exchange principles of family ethics (Hwang, 1987). The middle ring of this network is called "familiar ties", which is good fit for "rules of favor-exchange", since there are always various types of expressive and instrumental exchanges existed among good friends in the Chinese society (Yang, 1993; Hwang, 1988). The outer ring is composed by weak ties, which are mainly instrumental ties without much expressive exchanges. Fei called this ripple-like network "the differential modes of association", because the different rings in an ego-centered network are differentially treated, from strong to weak requirements in terms of family ethics.

Hsu's theory attempts to describe the Chinese type of informal group as a "clan-like" network (Boisot & Child, 1996), while the Western type as a "club-like" group. The former is a social network built around a patriarch (Fei, 1992), and generally composed of mixed ties, i.e. the mixture of expressive and instrumental ties (Hwang, 1987), since clan members have not only patrilineage relations among one another but also the division of labor for the network's common goal (Fei, 1992). On the contrary, built upon a voluntary base, a club is composed of individuals with equal-rights membership who generally share a common eco-social background, hobby, vision, or memory.

Just like a clan, a guanxi circle in the Chinese workplace is built around a patriarchal leader (Farh & Cheng, 2000) and circle members have mixed ties among each other. In general, there are at least two rings in a guanxi circle. The inner-most ring is composed of "confidants" (in Chinese, Chin-Xin; Chi, 1996) and "basic team members" (in Chinese, Ban-Di; Chen, 1998), who constitute the core of a circle. Outside this inner ring, there are a larger number of peripheral circle members, who form a protective belt for the core (Luo & Yeh, 2012).

Chinese VC investors apply this ripple-like networking to build up their own guanxi circles in the industrial community, as shown in Figure 1. The most inner ring is a hard core composed by confidants, who are imitation of family members in the investors' working places. The middle ring is full of frequent cooperators, who conduct both instrumental and expressive exchanges with the circle's center. And the most outside ring is the peripheral members of the circle, in which occasional joint investments occur based on self-interest calculation. As a CEO of a state-owned VC firm, Mr. C, said:

"…A big brother has reputation and good investment portfolio to support this reputation.… A little brother likes the big brother, because he can use money to exchange reputation. He directly gets reputation from cooperating with a big name….In addition, a little brother may manipulate guanxi [in the big brother's guanxi circle], and gradually move into the inner rings. It is possible for the little brother someday somehow to become a big brother [the center of his own guanxi circle]."

In other words, a "big brother" is the center of a guanxi circle, and "little brothers" join in the circle. The new entrances gradually move to the inner ring and then the hard core, so as to build up their own guanxi and resources in this process. In the following, we will use ERGM to analyze the network structure of joint investments, and use the guanxi circle phenomenon to interpret the simulation results.

II. The Analytical Method--ERGM Model

1. The Method of ERGM

In general, we describe a network by its statistical features rather than the whole picture of the network in detail. However, there are many networks good fit for a certain statistics. For example, a bunch of networks, or what we call an "ensemble", may meet the requirement of network structure with 1000 nodes which have the average degree of 10 (we certainly can assume more statistics, such as how many k-stars, cycles, links between certain nodes, etc.). An ensemble in the context of this paper means a set of possible networks good fit for a set of given network features. ERGM (Exponential Random Graph Model) tries to answer the following question: which one best fits the actual network in the ensemble, given a part of statistics of the actual network?

The basic idea of ERGM is to generate all the possible networks, given a set of network statistics, and then measure their difference to the target network (or a certain feature of the target network). We thus get a simulated network which is most likely to be the real one. However, this process is very complex. For example, when the number of nodes is 1000, then the ensemble $\mathcal{Y}$ will contain as many as $2^{C_2^{n(x)}}$ networks. The question is thus how to find the best choice among these networks in an ensemble. We generally compare each simulated network and the real one to get a weight of a network feature, which forms a probability distribution under condition of a relatively small number of constraints. Then, averaging the simulated networks with their weights will give us the network best fitted for the real one. The way is similar to many physicists' and statisticians' work following Willard Gibbs' provoking innovation, which have been developed for over a hundred years since the late nineteenth century. In practical work, instead of the complex computation enumerating all the network features in an ensemble, we generally employ Monte

Carlo random simulation to simplify the computing process (Handcock,).

ERGM can also be used to perform sensitivity (significance) analysis for the underlying mechanisms in the network evolution. After adding a new factor into a model, we may prove this factor significantly influencing the process of network evolution, if the ERGM gives us a better prediction. On the contrary, if this factor doesn't improve the predictive ability, then it may not be a significant factor.

In any simulation experiment, there are some network features taken into account, and cycles are certainly one of the most important among these factors. In our experiments, closed quadrangles among four nodes (in brief, it is denoted as "cycle4") are our main concern. Experimental Model is defined as a model with all given network features, while in Control Model, "cycle4" is taken out from Experimental Model. If the error rate of the control model is significantly worse than that of the experimental model, then we can conclude "cycle4" as an important factor in the network evolution.

The error rate is defined as follows:

$$ErrorRate = \mathrm{abs}(simulated - target)/\max(target, simulated)$$

where, "simulated" means a set of simulated networks, and "target" indicates the target network.

Exponential model is a statistical model with the probability function satisfying the following：

$$f_X(x|\theta) = h(x)g(\theta)\, exp\big(u(\theta)T(x)\big).$$

ERGM (Exponential Random Graph Model) uses exponential models in network analysis. In ERGM, if a target network is denoted as x, then x can be constructed by different networks with various structures, each accompanied with a certain probability. A set of various network structures is $g(x)$ with a set of probability, which is coded as the coefficient θ. Then, we may take x as one of the network family which is randomly generated from the mathematical formula as follows:

$$P(X = x|\theta) = \frac{\exp(\theta^T g(x))}{\kappa(\theta)}$$

It can be also a logistic form as follows:

$$log\big(P(X = x|\theta)\big) = \theta^T g(x) - lo\,g\big(\kappa(\theta)\big),$$

Where, $g(x) = (N_{edge}(x), N_{VC-concurrent}(x), N_{kstar2}(x), \cdots)$, is a statistics vector from number of various network structures.

$\theta = (\theta_{edge}, \theta_{VC-concurrent}, \theta_{kstar2}, \cdots)$, is a coefficient vector.

$\kappa(\theta) = \sum_{y \in \mathcal{Y}} exp(\theta^T g(y))$, where $g(y)$ is a statistics vector, which normalizes the probabilities to 1.

$\mathcal{Y}$ is a set of networks which are generated under the constraint of some model parameters (in the following, we will use edges, VC-concurrent, Firm-concurrent, kstar2, kstar3, cycle3, cycle4 as parameters, which are described in the following section), which appear in the network x, too.

We aim to choose the best coefficient $\tilde{\theta}$ to get a family of random-generated networks, which has the largest probability to let x appear. So we regard x as a representative example of the family of random-generated networks, given some certain structures ($g(x)$ and $\tilde{\theta}$). Although the theory behind the solution is rather complex, the computing method is actually remarkably simple, i.e. the best choice of $\tilde{\theta}$ is to maximize the Gibbs entropy (Newman, 2010) as follows:

$$S = -\sum_{y \in \mathcal{Y}} P(y) lnP(y)$$

2. From An Open Quadrangle to A Closed Quadrangle

To explore the effect of guanxi circles to a certain joint investment, we will focus our study on how the strength of syndication tie between two VCs influence the new joint investment between them. In a two-mode network of VCs and invested companies, the basic analytical element for two VCs is an open quadrangle, as shown in the upper-left-hand diagram of Figure 2. Whether there is an open quadrangle between two VCs, separately named after VC_1 and VC_2, depends on at least three conditions as follows:

1. $Firm_1$ is invested by VC_1.

2. VC_1 invested another company (or some other companies), such as $Firm_2$.

3. There is another VC, called VC_2, which invested $Firm_1$.

In such an open quadrangle, VC_1 and $Firm_1$ are indirectly connected with VC_2 and $Firm_2$ separately. If VC_2 invests $Firm_2$, then this open quadrangle becomes closed, as illustrated in the upper-right-hand side of Figure 2.

Figure 2 is about Here

For measuring the effect of tie strength between two VCs on the new joint investment between them, we can use open and closed quadrangle as main statistics in ERGM model. The more closed quadrangles are formed between two VCs, the stronger is the syndication tie between them. In a small circle of network, joint investment brings about consecutive effects, which introduce more joint investments for syndicated partners and create more closed quadrangles. As shown in the lower-left-hand-side figure, VC_2 accompanied with VC_3 invests in Firm3, and thus introduce $Firm_1$ and $Firm_2$ to VC_3. In the lower-right-hand-side figure, we can see three more closed quadrangles therefore are created.

Guanxi Circle Theory assumes that open quadrangles may induce the formation of closed quadrangles, and a syndication tie with more joint investments formed between any pair of VCs will have higher probability to turn their open quadrangles closed. By using ERGM, we can investigate the effects of syndication tie strength on the formation of closed quadrangles, i.e. the more joint investments between two VCs, when given open quadrangles and other network features as controls.

3. Experimental Design

For controlling other significant factors in network evolution, our previous data mining provide three types of important features affecting the structure of network shown as the following. To prove the effect of closed quadrangles on the formation of joint investments, we also add them into our ERGM model as control variables.

1. Edge: In the completely random network of ERGM, each node has a probability of 0.5 to connect another node. But in target network, the density of edge is decided by the ration of actual number of joint investment over the maximum number of syndication ties. So the probability of each edge appears in this network is much lower than 0.5. This is measured by statistics “edge" (the actual number of edges in the target network).

2. Degree: In ERGM without given any controls, there can be many totally unconnected nodes, since edges are generated randomly. But in our target network, edges are created by investments, so there are only those connected node included. We should add some controls to measure the features of degree in the target network. The network statistics “VC-concurrent" is the number of VCs who have at least two investment ties, while “Firm-concurrent" indicates the number of invested firms who have two or more edges. “kstar2" means the number of 2-stars centered on any type of nodes, while “kstar3" is the number of 3-stars.

3. Cycles: the number of open quadrangles is named after “cycle3", since it is a cycle among three nodes in the joint-investment network. Higher number of cycle3 means more chances to bring about closed quadrangles, which is the indicator of joint investment between two VCs.

Our focus of this study is syndication tie strength, which is measured by the number of closed quadrangles between two VCs, and this explanatory variable is named after “cycle4". To conduct the significant analysis of Guanxi Circle Theory, the Experimental Model includes all controls and “cycle4", while the Control Model excludes “cycle4”.

III. The Data and Analytical Results

In China, existing major venture capital databases such as ChinaVenture, Zero2IPO, Simuton Data Base and Venture Capital Research Institute's annual reports release data about all public investments and relevant indexes in the venture capital field for the years of 1995 to 2011. Our study is based on publically available Simuton data to establish a venture capital database. We first collect 4164 VCs and their investment data to form a 2-mode network. From 1995 to 2009, there are 9,305 investment events involved with 2,060 VCs and 6,569 invested firms. From 1995 to 2011, the investment events increased to 12,414. The joint investments in the mature stage of a newly star-ups may not imply the cooperation between the two investors, since a “super-star” may attract many investors, who are chosen, rather than choose, to invest in this super-star. So the data of investment events in the mature stage is ruled out of our analysis.

In the following analyses, we compare the statistical information of target network with the experimental and control models. The dependent variable is the number of closed quadrangles between any pair of VCs, i.e. the number of their joint investments. First of all, it is necessary to estimate the ERGM coefficients of the two models. By doing that, we simulate the models 10 runs in each experiment. Our analyses then average the results of ten-run simulations, and finally compare these results with the actual statistics of target network.

We introduce our experimental and control models as follows:

1. Target network: the information of original network data

2. Experimental model: the ERGM estimation of the target network, with controls of edges, VC-concurrent, Firm-concurrent, kstar2, kstar3, cycle3 and the explanatory variable in our study, i.e. cycle4.

3. Control model: another ERGM estimation of the target network like the experimental model, except that it do not include the number of closed quadrangles "cycle4".

Figure 3 is about Here

As shown in Figure 3, we take investment network of 1995 - 2009 as the target network, and compute the statistics of this network listed above as the control and explanatory variables. The simulation results show that the error rates between the experimental and control models are not big at the very beginning. Both of the two models can predict the number of joint investment well between any pair of VCs. However, after a threshold value 3, i.e. three joint investments between any two VCs, the difference becomes huge. The experiment model is at least 30% better than the control model after the threshold point. In other words, the information of previous joint investments between two VCs indeed influences the model's prediction power. However, this influence is not significant before 3 joint investments. Another interesting finding is that 6- joint-investment is another threshold, after which the error rate of the experiment model drops sharply to 0, while that of the control model gets higher and higher.

For re-testing our simulation results, we use the investment network of 1995-2011 as the target network and run the ERGM models again. The results show very similar pattern. At the point 2, the difference between the two models turns to be significant, and becomes big after the threshold point 3. Between point 3 and 5, the error rate of the experiment model keeps around 30%, but then drops sharply again after the threshold point 5. In the same stage, the control model's error rate becomes higher and higher, until it reaches to 100%.

How can we explain the results of ERGM? Why does the difference between the two models increase sharply at the threshold points 3? At the point 5 or 6, why does the error rate of the experimental model drop sharply? In the following, we would like to use the qualitative data to interpret these results.

Figure 4 is about Here

VI. The Interpretations for Analytical Results

1. The Interpretations

There several interesting findings in the ERGM analysis. First, In comparison with random-generated network given only “edge” as a control, the control model’s error rate is not high in predicting the number of first and second syndication in the Chinese VC network. Second, after the threshold point 3, the explanation power of cycle4, i.e. the information of joint investments, becomes more and more significant. Third, at the threshold point 5 or 6, the error rate of the experimental model drops sharply to zero, while the control model has about 100% error rate.

In the interpretation of the first finding, we propose that the information of indirect ties between two VCs is important in newly formed syndications. Most Chinese VCs avoid cooperating with strangers, too, since contracts and the laws behind the contracts are not reliable. The third-party-trust (Burt and Knes, 1996) plays an important role at this moment. A mediator can transfer his or her guanxi to another friend. A bridge can help providing in-need information on time and at right time (Burt, 1992). Without knowing some detailed information concerning the possible new partner, a focal person may find it hard to make a decision. So the second key function of guanxi is to introduce new partners to old friends, as Mr. Z states:

I met him [the new syndication partner] several times to look for a new project. But, we didn’t have dialogue,…unfamiliar. Once, we meet in a dinner banquet, [a common good friend] introduce him to me,…I feel good [for cooperation],…then we invest jointly.

For interpreting the second finding, we suggest that first experience of joint investment between two VCs may not be the starting point of their long-term cooperation. Finding syndication partners is a try-and-error process, and the first cooperation may not be correlated to more joint investments. That is why the information of joint investments is not very useful for predicting the number of newly formed syndications. However, the information of joint investments turns to be more and more important for predicting the number of high-frequent syndications after passing the threshold point 3. We thus speculate that only two or more runs of joint ventures can make two VCs firmly bonded together in the future. In our interviews, Mr. Y once commented on this phenomenon in the following way:

Newly emergent VCs are naive, immature, and not so sophisticated. …it is easy to control them if they are absorbed in my circle [in Chinese terms, small circle or guanxi circle, i.e. a small and comparatively closed group centered on the interviewee]. The relationships among mature VC investors are not stable, and they seldom form a circle…we cooperate with each other for limited reciprocity, such as bringing money in to hedge risk. New VCs are willing to be cannon fodder [the sacrificed side],…they should pay tuition.

In other words, a guanxi circle's leader often finds new entrances, other than mature sophisticated VCs or old friends, as the limited partners in some risky investments, since they may be sacrificed at certain situations. In a highly uncertain environment, a new run of cooperation may be a zero-sum game. Particularly if an investment sometime involves a huge amount of profit or loss, and that unfair distribution may hurt friendship between old partners. For the sake of keeping a friendship, the focal person sometime avoids inviting familiar person to join in such a new investment. Newly formed syndication ties are thus not very stable.

However, a guanxi circle's leader also needs to build up long-term cooperation with certain partners, and the expectation for next runs of game ensures cooperative relations continue (Hardin, 2001; Axelord, 1984). This phenomenon may help explaining the third finding, which illustrate that a model can't explain high-frequent cooperation without knowing the information of joint investments. We thus speculate that repeated joint investments foster necessary trust which brings about long-term and frequent-cooperative ties.

As stated in Guanxi Circle Theory, Chinese tend to cooperate with familiar persons in the way of long-term favor exchanges (Hwang, 1987). This may lead us to suggest that a Chinese VC tends to initiate a joint investment with those who had cooperative experience with the focal person (the leader in a guanxi circle) in the past, as a junior partner of a VC firm, Mr. Y, put it:

First of all, firms [Chinese VCs] generally get bored with these [too detailed contract and too calculative financial arrangements].…Foreign investors pay too much attention on short-term profit…We are not like this. In China, we tends to foster something [in a long period], especially friendship.

2. The Conclusions

Summarizing the analytical results and interpretations stated above, guanxi is important in the sense of access to valuable projects and introducing new partners for a focal VC. However, in such a highly uncertain environment, the familiar partner may sometime not be the best choice in a new investment. But strangers or those with high relational distance are not good choice, either, since information asymmetry makes them untrustworthy. So those with short path of relational distance, such as friend's friends, are chosen in some risky investment. That is why the first or second joint investment may not be a good predictor for more cooperation.

However, previous experience of syndication may transform occasional partners into familiar ties, which breed expressive feelings and trust needed for long-term cooperation in the Chinese society. That is why the information of joint investment is necessary to predict frequent cooperation in the network.

At very high-level cooperation, the guanxi between two VCs changes again. A type of pseudo-family ties is established, that requires each side sharing opportunities with and not betraying to its confidant partner.

A robust network, rather than a good contract with careful self-interest calculation, is the best way hedging the risks in a highly uncertain environment. Guanxi-orientation thinking ensures a Chinese VC often pays more attention to its network position than the profit or loss in one single transaction. The center position will attract more partners, who thus are invited into a larger network so as to find more chances to get to know new friends. In return, they bring more good projects and key information in this network.

Reference

Handcock S.Mark.Package 'ergm'. http://statnet.org.

M.E.J. Newman. Networks: An Introduction. 2010, Oxford

Admati, A., Pfleiderer, P., Robust Financial Contracting and the Role of Venture Capitalists. *Journal of Finance*, 1994 (49, 2):371–403.

Ahuja, G., Soda, G., Zaheer, A., The Genesis and Dynamics of Organizational Networks, *Organization Science*, Articles in Advance, 2011:1-15

Alchain, A. A., Demsetz, H., Production, Information Costs, and Economic Organization, *The American Economic Review*, 1972: 777-795

Axelrod, Robert M., 1984, *The Evolution of Cooperation*. New York: Basic Books.

Barabasi, Albert-Laszlo and Albert, Reka. 1999. *Emergence of Scaling in Random Networks*. Science Vol. 286: 509-513.

Barley, S., Freeman, J., Hybels. R., 1992. *Strategic Alliances in Commercial Biotechnology. in Nitin Nohria and Robert G. Eccles, Networks and Organizations.* Boston:Harvard Business School Press.

Beckman, C. M., Haunschild P. R., Phillips, D. J., Friends or Strangers? Firm-Specific Uncertainty, Market Uncertainty, and Network Partner Selection, *Organization Science*, 2004(15,3):259-275

Brander, J.A., Amit, R., Antweiler, W., Venture-Capital Syndication: Improved Venture Selection vs. the Value Added Hypothesis. *Journal of Economics & Management Strategy*, 2002(11,3):422–452;

Bruton, G. D., Ahlstrom, D., 2003. An Institutional View of China’s Venture Capital Industry: Explaining Differences between China and the West. *Journal of Business Venturing*, 18: 233–259；

Bruton, G. D, Fried, V. H., Manigart, S., An Institutional View of the Development of Venture Capital in the U.S., Europe and Asia, *Entrepreneurship Theory and Practice,* 2005:http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.195.8313&rep=rep1&type=pdf

Burt,R., 1992, *Structural Holes: The Social Structure of Competition*, Published by

Cambridge: Harvard University Press.

Burt, R., Knes, M., 1996, The Gossip of the Third Party, in R. M. Kramer & T. R.Tyler(Eds.),*Trust in organizations*, London: Sage Publications, Inc.

Bygrave, W.D., Syndicated Investments by Venture Capital Firms: A Networking Perspective. *Journal of Business Venturing*, 1987 (2): 139–54.

Bygrave, W.D., The Structure of Investment Networks in the Venture Capital Industry. *Journal of Business Venturing, 1988(3):137–57*

Hardin, R., 2001. Conceptions and explanations of trust. In K. S. Cook (Ed.), *Trust in society*: 3-39. New York: Russell Sage Foundation.

Chiplin, B., Robbie, K., Wright, M., The Syndication of Venture Capital Deals: Buy-outs and Buy-ins. In Reynolds, P. et al. (Eds), *Frontiers of Entrepreneurship Research* 1997.Wellesley, MA: Babson College, 1997

Chowdhry, B., Nanda, V., Stabilization, Syndication, and Pricing of IPOs, *The Journal of Financial and Quantitative Analysis*,1996(31,1):25-42

Hochberg, Y.V., Ljungqvist, A., Lu, Y., Whom You Know Matters: Venture Capital Networks and Investment Performance, *Journal of Finance*, 2007(62,1):251-301.

Hochberg, Y.V., Ljungqvist, A., Lu, Y. Networking as a barrier to entry and the competitive supply of venture capital, *Journal of Finance*, 2010 (65, 3):829-859.

Holmstrom, B., Moral Hazard in Teams, *The Bell Journal of Economics*, 1982(13,2):324-340

Hwang, K. K., 1987. Face and favor: The Chinese power game. *American Journal of Sociology*, 92: 944-974.

Kaiser, G.D., Lauterbach, R., Schweizer, D., Total Loss Risk in European vs. U.S.-based Venture Capital Investment. *Venture capital in Europe*, Elsevier finance, 2007:371-387.

King，G.，Keohane，R., O., Verba. S., 1994. *Designing Social Inquiry: Scientific Inference in Qualitative Research*. New Jersey: Princeton University Press

Kogut, B., Urso, P., Walker, G., Emergent Properties of a new financial market: american venturecapital syndicaiton, 1960-2005.*Management Science*, 2007: 1187-1198.

Lerner, J., The Syndication of Venture Capital Investments. *Financial Management*, 1994 (23, 3): 16–27.Hardin, 2001

Lockett, A.,Wright, M., The Syndication of Venture Capital Investments. *Omega*, 2001 (29): 375–390.

Padgett, J. F., Powell,W. W., 2012,*The Emergence of organizations and markets*，New Jersey:Princeton University Press.

Podolny, J.M., A Status-Based Model of Market Competition. *American Journal of Sociology*, 1993(98):829–72;

Polidoro, F., Ahuja, G., Mitchell, W., When the Social Structure Overshadows Competitive Incentives: The Effects of Network Embeddedness on Joint Venture Dissolution, *The Academy of Management Journal*, 2011(54,1):203 - 223

Powell, W.D., White, D.R., Koput, K.W., Owen‐Smith, J., Network Dynamics and Field Evolution: The Growth of Interorganizational Collaboration in the Life Sciences. *American Journal of Sociology*, 2005 (110): 1132-1205.

Rowley, T. J., Greve, H. R., Rao, H., Baum J. A. C., Shipilov A.V., Time to Break up: Social and Instrumental Antecedents of Firm Exits from Exchange Cliques, *The Academy of Management Journal*, 2005(48,3):499-520

Small , M. L., How to Conduct a Mixed Methods Study: Recent Trends in a Rapidly Growing Literature. *Annual Review of Sociology*, 2011(37): 57–86.

Stacey, R., D., Gfiffin, D., Shaw, P., 2000. Complexity and Management. NY: Routledge.

Sorenson, O, T., Stuart, E. Syndication Networks and the Spatial Distribution of Venture Capital Investments. *American Journal of Sociology*, 2001(106,6):1546–88.

Sorenson, O., Stuart, T. E., Bringing the Context Back In: Settings and the Search for Syndicate Partners in Venture Capital Investment Networks. *Administrative Science Quarterly*, 2008 (53): 266-294.

Tykvov ́a, T., Who Chooses Whom? Syndication, Skills and Reputation. *Review of Financial Economics*, 2007(16,1):5-28.

Williamson, O. E., Transaction-Cost Economics: The Governance of Contractual Relations, *Journal of Law and Economics*, 1979(22,2):233-261

Wilson, R., The Theory of Syndicates. *Econometrica*, 1968 (36, 1): 119–132.

Wright, M., Lockett, A., The Structure and Management of Alliances: Syndication in the Venture Capital Industry. Journal of Management Studies, 2003(40,8): 2073-2102.

Table 1. The list of Interviewees

Interviewee	Occupation	Time	Location	
Mr. Z	An junior partner of private VC investor	2012/7	Tianjing	
Mr. Y	A senior partner of a private VC investor	2012/7 and 2013/4	Beijing	With recording
Mr. C	A CEO of a state-owned VC firm	2013/10	Tianjing	With recording

Figure 1. The Diagram of A Guanxi Circle

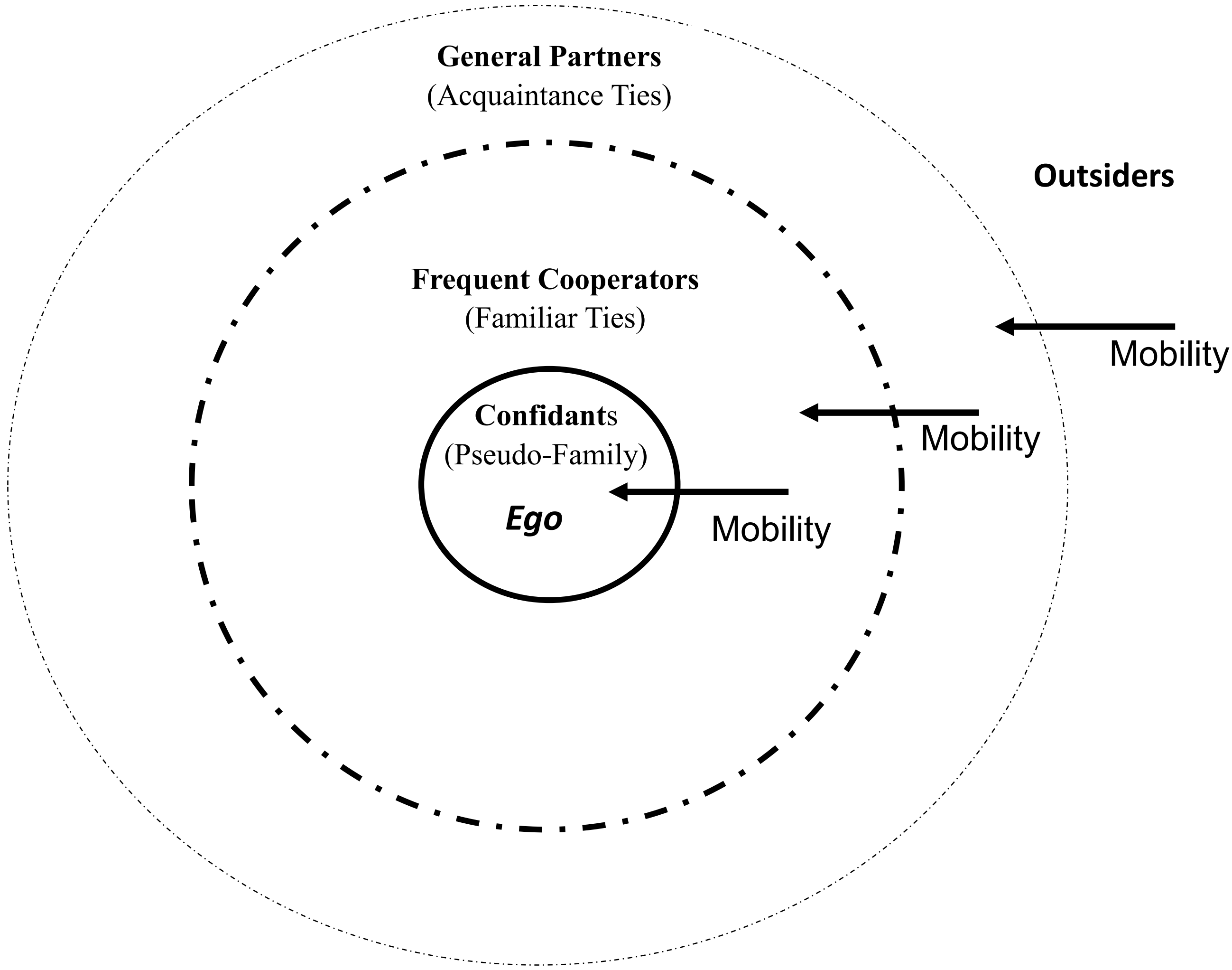


Figure 2. From Open Quadrangles to Closed Quadrangles

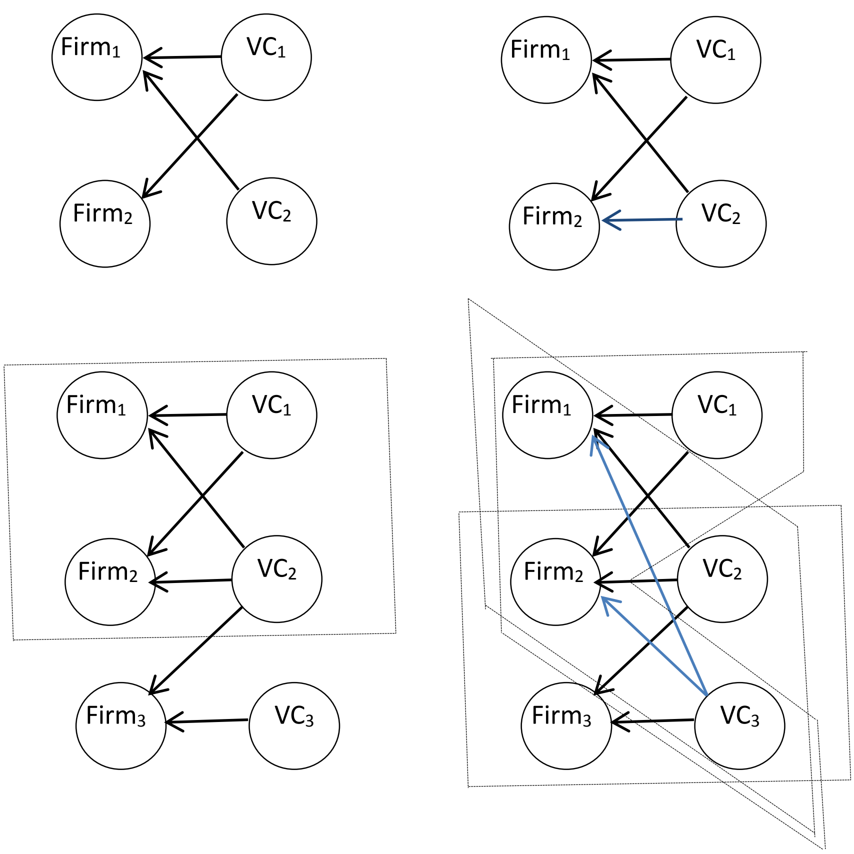
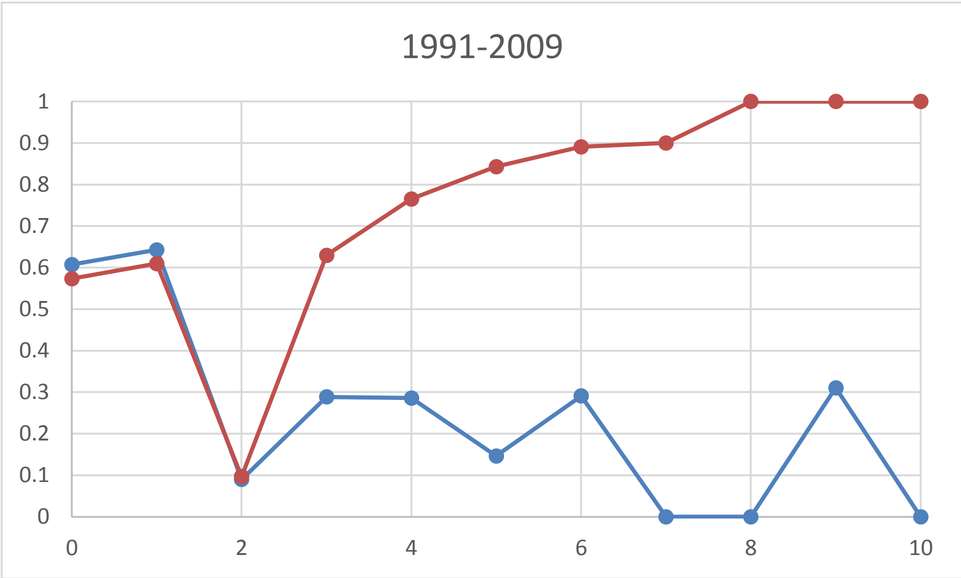
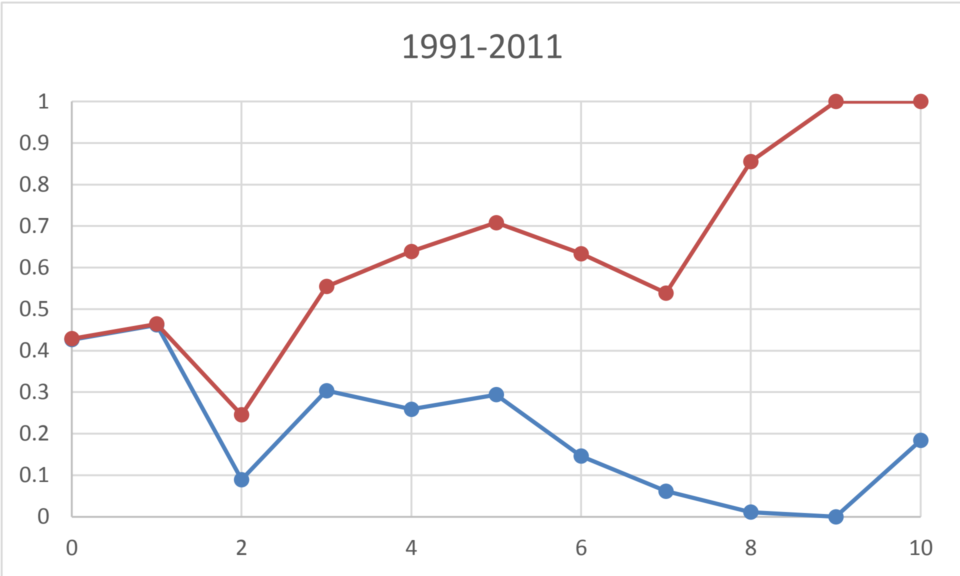


Figure 3: The Simulation Results by using 1995—2009 Data



Note: Y axis is the error rate. In other words, 0 is 100% prediction for target network, while 1 means 100% error rate. X axis is the number of joint investments between any pair of VCs. Red line is the error rate of the control model, while blue line is that of the experimental model. The difference between the two models is the significant influence of the network statistics cycle4.

Figure 4: The Simulation Results by using 1995—2011 Data



Note: Y axis is the error rate. In other words, 0 is 100% prediction for target network, while 1 means 100% error rate. X axis is the number of joint investments between any pair of VCs. Red line is the error rate of the control model, while blue line is that of the experimental model. The difference between the two models is the significant influence of the network statistics cycle4.