The Structural Change of Korean Sociological Academic Community

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Abstract: Korean sociology has been institutionalized through different stages such as the foundation of Korean Sociological Association, the influence of American Sociology, a reflexive turn, and the launch of a counter-association in search for alternatives. This study analyzed the co-evolution of sociologist-association ties and sociologist-specialty ties to examine the structure of Korean sociological community and its change. We found that patterns of affiliation between sociologists and associations have structured homophilous interactions along the lines of gender, employment status, and university prestige. A core-periphery hierarchy of associations has become weaker, but the Korean Sociological Association of accumulative advantages constitutes the core, together with the counter-association and the Historical Sociology association. Following-the-trend in tandem with increased clustering of specialties has led the structure of specialty space towards a weak core-periphery. As sociologists have increasingly joined more specialized associations, the correlation between sociologist-association ties and sociologist-specialty ties has risen. However, it will be tough for both the Korean Sociological Association and the counter-association how to play integrative roles and accommodate newly emerged specialties given a discrepancy between stable stratification in the structure of associations and increased differentiation in the structure of research fields.

Keywords: affiliation networks, professional associations,
specialties, Korean sociological community

Introduction

Spencer's sociology as a new social thought was imported to Korea in the late 19th Century. During a few decades from Korea's annexation to its liberation (1910-1945), Japan was the translator of Western modernity. Korean sociology as a distinctive discipline was not recognized until 1946 when the Seoul National University had the sociology department in the College of Humanities and Arts. It is under the influence of American sociology that Korean sociologists in the 1950s and 1960s were interested in modernization theory, structural functionalism, and survey methods. The issues of 'indigenization' and 'relevance' were, however, raised during the 1970s and 1980s. The Korean Sociological Association (KSA hereafter) organized in 1957 made efforts to accommodate wide-ranging critiques from within and outside, but Korean sociology had to get through a 'reflexive turn.' Some groups of sociologists sprang up to advocate 'Sociology for the oppressed grassroots,' 'Korean sociology,' and 'Sociology of the Third World,' with a growing concern with urban problems, stratification, and cultural anomie. As the number of academic circles or associations in search for alternative perspectives and theories increased, another nationwide association, the Korean Industrial Sociological Association (KISA hereafter), was founded in 1984 under the banner of critical sociology. This association has been holding annual conferences and publishing journals to this day independently from the KSA. Korean sociology is reaching the peak of its diversity in specialties, sociologists, and associations from 1990 onwards (Kim, 1987; Park and Chang, 1999).

It seems that there are two different views among Korean sociologists on the historical development of their academic community. Some would contend that it is characterized by the lack of leading sociologists, recognized research fields, and dominant associations. In other words, there have been no 'stars,' sociologists have treated research interest like a passing fad, and the KSA has never been legitimized. Others would say that there have been ruling elites, main paradigms, and leading associations, with supportive evidences such as academic colonialism too much dependent on American sociology, a strong preference to US-trained doctorates, and employment discrimination against Korean doctorates. Which way Korean sociology has been institutionalized and what its academic community today looks like? Whether has the Korean sociological academic community been structured by a clear contest between the two major nationwide associations, the KSA and the KISA? Whether have some particular specialties been more popular in the discipline of Korean sociology or have a broad diversity of specialties competed with each other? These questions are meaningful and timely because there are some studies on the history of Korean sociology institutionalization (Kim, 1987; Park and Chang, 1999), but no empirical research until now.

In our study, the main focus is on the co-evolution of 'network of sociological associations' and 'network of specialties.' There are some reasons we prefer these two relations to citation or

collaboration most commonly used in existing studies. First, professional associations play decisive roles in the development of discipline since they give members the opportunity of networking and communication for research through various activities such as organizing meetings, publishing journals, and exchanging information. Second, interest areas provide valuable insights into processes of growth and decline of research areas because of the scope of their substantive spectrum[1] (Phaedra, 2001). Third, co-membership of professional associations and interest areas among sociologists increases the chance of citation and collaboration. Given the co-evolution of multiple networks in which associations and interest areas are two different contexts, we will be able to examine the structure of Korean sociological academic community as a field and its change over time through social network analysis.

The Co-evolution of Multiple Affiliation Networks in Sociology of Science

Co-membership matrices in social network analysis show the similarity between persons (or between groups) that is proportionate to the number of groups two actors join commonly (or to the number of actors that two groups share). Although this two-mode affiliation network approach might not reflect 'real' network in the sense that we do not extract group structure from one-mode network in which actors choose each other directly, we are able to see the emergence of social network and its change in a different way: how do individuals by sharing contexts, create social structures while, at the same time, social structures develop an institutionalized reality that affects the behavior of the individuals embedded in them (Hanneman and Riddle, 2005)?

People are engaged in multiple contexts, however. This is why there has been growing interest in the relationship between "systems of social relations" and "systems of meaning" (Hay, 1994) among students of social network analysis over the past decades[2]. In sociology of science, it refers to the relationship between 'social structure' and 'knowledge production' or between "social and cognitive development in scientific fields (Whitley, 1974)." There are not a few sociological studies on scientific community in the US (Hagstrom, 1965; Crane, 1972; Cole and Cole, 1973; Mullins, 1973; Gattrell, 1984; Whitley, 1984; Turner and Turner, 1990)[3], and the relational data were employed in recent researches (Ennis, 1992; Cappell and Guterbock, 1992; Diapha, 2001). Only a few recent studies in sociology of science took full advantages of social network perspectives or social network analyses[4]: university prestige or market structure (Hanneman, 2001; Burris, 2004; Han, 2003); and collaboration network (Newman, 2001; Moody, 2004). Moody (2004) is a good starting point for our study although he concluded links between networks and ideas without multiple network datasets.

Topology of Network Structure

Moody (2004) posited three types of collaboration networks and their implications: "theoretical fragmentation" that a small-world network model best fits; "star production" based on a scale-free network model; and "wide-reaching structurally cohesive collaboration" generated by the opposite process of preferential attachment, in which stars are not crucial for connecting the network, and ideas are more likely to spread over the entire network.

He equated highly clustered networks with small-world networks, and star networks with scale-free networks, however. A network with a high degree of clustering might or might not be a small-world network. For instance, a highly clustered network with a few stars can be a scale-free network. Besides, small-world phenomena could happen in scale-free networks but for different reasons. Also, he did seem to separate one typology of scale-free network and small-world network from the other typology of core-periphery structure and factional structure.

In this study, we define a small-world network with 'scales' by a factional structure with some random intermediate ties in it and highly clustered factions, while a scale-free network by a network with a few hubs that constitute the core, which is less highly clustered than a 'scale-dominant' small-world network but more highly clustered than a random network[5]. In a core-periphery structure, the core has 1 block, and the periphery has 0 block in a two-by-two image matrix. When the densities of both off-diagonal blocks are 0s (or 1s), this core-periphery structure is 'strong' (or 'weak') (Borgatti and Everett, 1999). In a 'strong' factional structure, the densities of both diagonal blocks (and densities of both off-diagonals) are 1s (and 0s). If the densities of both off-diagonal blocks are significantly higher or/and the densities of both diagonal blocks lower, this factional structure is called 'weak.'

Typology of Network Dynamics

Studies on two-mode networks run the gamut from correspondence analysis (Roberts, 2000) to generalized blockmodeling (Doreian et al., 2005), but their dynamics have been rarely examined. Watts (2004) criticized no element of social structure in Babarási's model of scale-free networks to highlight instead affiliation or matching. He concluded that affiliation in itself, not any particular matching procedure, yields clusters in two-mode networks, and a random affiliation network is always a small-world network. Affiliation in real social networks scarcely happens on the principle of pure random matching, however. Some other mechanisms should be proposed to represent the dynamics of affiliation networks.

We suggest four possible social processes of affiliation ties, drawing upon Powell et al. (2005) on 'attachment' mechanisms such as "accumulative advantage" (i.e. preferential attachment[6]), "homophily," and "follow-the-trend." Regarding sociologists' choice of their professional associations, the first one is 'homophily-biased random affiliation,' that is,

homophily-based affiliation – new members are introduced to associations through social ties with old members affiliated in them based on homophily bias – with some randomness. However, this process alone cannot explain why the distribution of degree is very unequal in most of social networks. The second is therefore 'degree-biased random affiliation.' With some randomness, every time new sociologists are added, the chance that an existing association can be connected to them is proportional to the number of ties it already has. In this way, we can extend Babarási's model to affiliation network, relaxing his assumption of one link per person since sociologists can have multiple memberships.

The first process of matching between sociologists and specialties is 'specialist-biased random matching.' The concept of 'structural constraint (Burt, 1992),' the extent to which ego is invested in people who are invested in other of ego's alters, is pertinent here: the higher constraint, the more overlap of specialty niches, the higher chance of specialist-based selection of research fields. The second one is 'trend-following biased random matching.' Actors observe others and attempt to match their actions to the dominant behavior of the overall population. 'Following-the-trend' is similar to preferential affiliation of association, but the number of links is not the reason many sociologists were interested in, for example, "Social Movements" in the 1980s and 1990s. Their choices are either mutual responses to common exogenous factors (e.g. the emergence of social movements under military regimes and their growth) or imitative behaviors (Powell et al., 2005: 1139-40). It should be noticed that: follow-the-trend increases the degree of specialty niche overlap more quickly than specialist-based matching[7]; and there is a negative relationship between network size and niche overlap. In other words, a gradual increase in niche overlap is unavoidable if network growth is curbed (i.e. the limited number of specialties) although the majority pursue the specialist-based matching.

Relationships between Network Structure and Network Dynamics

How network topologies and affiliation rules guide the choice of partners and shape the trajectory of field are summarized in Table 1. Homophily-biased random affiliation would produce a small-world network with a factional structure since homophilous affiliation generates clusters while random matching increases the number of bridging ties. Our study examines homophilous affiliation based on both gender and social status (i.e. who are professors and who not, where sociologists did undergraduate studies, and where they received their doctoral degrees). Degree-biased random affiliation would create a scale-free small-world network with a core-periphery structure. Besides homophilous affiliation, it is expected that sociologists have joined highly prestigious associations to make shorter links to as many as possible at once through preferential affiliation. Also, it is more likely that the association-association tie has shifted from a core-periphery structure to another core-periphery structure

with membership boundaries between the two major associations blurred. If these associations had exclusively competed with each other for members, a core-periphery structure would have changed into a factional structure.

Hypothesis 1: The sociologist-association network has been scale-free throughout the entire period.

Hypothesis 2: Homophily-based affiliation has produced the association-association tie of small-world properties.

Hypothesis 3: The association-association network has proceeded from a core-periphery structure to another core-periphery structure.

Trend-following based matching with some randomness would lead to a power-law regime and a core-periphery structure, but both regime and structure are weaker than those from sociologists' affiliation with associations: there is a high chance that some particular research areas such as Population, Development, Industrial Relations and Labor, and Social Movements have been popular to constitute the specialty core for a relatively long period of time. However, sociologists might want to follow some other newly emerging areas afterwards (e.g. Social Welfare, Cultural Studies). In other words, accumulative advantages of once-established core areas cannot be sustained longer in sociologist-specialty ties; and sociologists become more inclined to reduce competition among them by taking specialist strategies since following-the-trend increases the degree of niche overlap given the limited number of specialties. This specialist-biased random matching would lead to a small-world network with research clusters and bridging ties.

Hypothesis 4: The sociologist-specialty tie was scale-free network in earlier years, but its scale-free-ness has become increasingly weaker.

Hypothesis 5: The specialty-specialty tie has recently become a small-world network due to increased specialist-based matching.

Hypothesis 6: The specialty-specialty network has changed from a core-periphery structure to a factional structure.

Table 1 *Four Mechanisms for Affiliation Networks*

Type of 2-mode networks	Affiliation (Matching) processes	Structure of networks
Sociologist-Association ties	Homophily-biased random affiliation	Small-world and factional structure
	Degree-biased random affiliation	Scale-free and core-periphery structure

Sociologist-Specialty ties	Specialist-biased random matching	Small-world and factional structure
	Trend-following biased random matching	Scale-free and core-periphery structure

Co-evolution of Association Network and Specialty Network

The last question in our study is whether one field has been institutionalized independently from the other field over time. Measuring a correlation between two one-mode matrices tests if there is a tie between two actors in one relation, then there is more likely to be a tie between them in the other relation (Hanneman and Riddle, 2005). Hence, a high correlation implies that the more similar research areas sociologists share, the more likely that they are co-members. Furthermore, the stronger the correlation, the more salient professional identities as researchers on the one hand, and the more primary role professional associations have played for research.

Hypothesis 7: There has been a positive correlation between the two networks, and its strength has become more significant over the past decades.

Data

Two sets of binary data were collected – one about sociologists' affiliation with associations and the other about their affiliation with specialties[8] – from the Korean Research Foundation (KRF hereafter, www.krf.or.kr), an organization which is equivalent to the National Science Foundation in the US. Sociologists who register at the KRF are supposed to provide their quasi-resumes. Four different attributes of sociologists such as sex, whether one is a professor or not, where one received her or his bachelor's degree, and where one received her or his doctoral degree were also compiled. The summary of increased heterogeneity is provided in Appendix 2.

The population consists of those who satisfy all of the following criteria[9]: sociologists who got their PhDs after 1980; sociologists who register at the KRF; and they should have doctoral degrees in sociology as long as they are hired in universities. The issue of sample representativeness can be raised, but our approach is a 'full network method' which requires information about each actor's ties with all other actors to be collected (Hanneman and Riddle, 2005) in the sense that a census of ties in a population rather than a sample[10] was taken. Also, our data cover almost all of professional associations in the field of sociology, which maintains the sample representativeness.

Affiliation networks of sociologists with associations and specialties were collected at different three time points, 1989, 1999, and 2005[11]. The first two time points correspond to the last two stages of Korean sociology development, 1980-1990 and 1990-2000 in Park and Chang

(1999). The data at the last time point are expected to reveal the more recent structure of the Korean sociological community. The number of cases is 37 sociologists who received their Ph.D.s during 1980s; a new group of 131 PhD recipients during the 1990s in addition to 37 existing sociologists; and 113 new sociologists who received their PhDs from 2000 to 2005 on top of the same 168 sociologists**.** Over the past 25 years, the number of associations has changed from 26 through 107(=26+81) to 151(=107+44). Meanwhile, the number of specialties has increased from 28 through 43(=28+15) to 45(=43+2)[12].

If a person joined A in the 1980s, B and C in the 1990s, and none in the 2000s, then A is included in the first dataset, A, B, and C in the second, and A, B, and C in the third. The sociologist-specialty network was constructed in the same way, but since the KRF website does not provide direct information about the trajectory of research areas of each sociologist, we had to rely on some other databases such as Korean Studies Information Service System (kiss.kstudy.com) and Korea Education and Research Information Service (www.keris.or.kr) in order to trace it based on the list of published books and articles firstly, and, if any, keywords in them, secondly.

There are two assumptions in data building. We did not collect information about withdrawal from association and specialty. It is assumed that sociologists do not exit associations (and specialties) once they join (and once they dived in). These assumptions are plausible, but it should be acknowledged that they may result in overestimation of scale-free-ness and core-periphery-ness.

Analytical Methods

In this section we elaborate how to test our hypotheses with some theoretical discussion if necessary. To test whether homophilous affiliation is significantly different from random affiliation, some routines that estimate the goodness of fit for one-mode network partitions based on attributes are available in Ucinet (Borgatti et al., 2002). Its version 6.102 is used throughout this study. Among them, we apply (a) 'Joint-count' (i.e. test for two-group differences in tie density) for 'professor or lecturer,' 'male or female,' and 'Seoul or some other cities sociologists did undergraduate studies,' (b) 'Relational contingency table analysis' (i.e. test of three-group differences in tie density) for 'the US, South Korea, or yet some other foreign countries they earned their Ph.D.' and (c) 'ANOVA density model' (i.e. the variable homophily blockmodel of differences in tie density and the structural blockmodeling) for the same categories. Both (a) and (b) show a global test of difference from random distribution, while (c) can test more specific homophily models (Hanneman and Riddle, 2005).

Whether following-the-trend or specialty-based matching has been prevalent over time is

tested through hierarchical cluster analysis of the specialty-specialty ties. We prefer the Jaccard similarity coefficient which is reasonable particularly when researchers can ignore the cases of joint absence in low-density large networks (Hanneman and Riddle, 2005). We apply the E-I index (Krackhardt and Stern, 1988) in Ucinet (Borgatti et al., 2002) which measures the ratio of the numbers of ties within the clusters to ties between clusters. The cut-off point in cluster analysis can be provided by adjacent values of the E-I index which experience the most drastic change.

A scale-free network, when x is the number of ties and y is the number of nodes with x, is characterized by the power law distribution: $y=ax^k$ in which a is the constant, and k as the exponent of power law is the same with the slope in the log-log plot. We examine both x and y directly from two-mode affiliation networks, not one-mode networks transformed from them: both the numbers of sociologists' links to associations and specialties (i.e. x is the marginal sum of column) and their frequencies (y) are counted; and log(y) is regressed on log(x). The one-mode network approach to calculating x and y in existing studies is right, but it seems to be more reasonable to count both directly from two-mode network to preserve the person-group duality (Breiger, 1974) as long as the original network is two-mode. Besides, researchers are able to avoid the autocorrelation problem in one-mode networks[13].

We use two measures of network small-world-ness: the average geodesic distance and the average clustering coefficient[14]. We compare both measures in one-mode dichotomized networks and their equivalent random networks with the same number of nodes and density generated from Ucinet (Borgatti et al., 2002). We take advantages of the one-tailed t-test to check whether the differences between the two networks are statistically significant.

For the analysis of network substructure[15], we employ three blockmodeling techniques in Ucinet (Borgatti et al., 2002): Simple core-periphery analysis (SCP hereafter); Faction analysis based on the Tabu search algorithm (FA hereafter); and Optimized structural equivalence modeling based on the same algorithm (OSE hereafter)[16]. We apply these three techniques to dichotomized one-mode matrices converted from affiliation networks. We compare results from SCP, FA, and OSE with reference to the measure of goodness-of-fit by incorporating the QAP (Quadratic Assignment Procedure) correlation approach into FA[17], which would have been otherwise impossible.

Lastly, we measure the correlation between two affiliation networks by taking the QAP approach[18] in Ucinet (Borgatti et al., 2002). Among nominal, ordinal, and interval association measures, the simple matching and Jaccard similarity coefficients are used since our data are binary.

Results

Birds of a Feather Flock Together?

Whether Korean sociologists have mingled randomly with each other over time or not? As is shown in Table 3, it is more likely that professors socialized each other in the 1980s. Lecturers associated much less with either professors or lecturers during the same period, which is evidenced from the negative difference between expected ties and observed ties. The overall trend towards homophily in the 1990s was pretty much the same, that is, there were homophilous interactions among professors, but this was not the case with both ties between professors and lecturers and ties among lecturers. The recent trend is that homophilous interactions among professors become weaker although they are still less likely to socialize with lecturers. Meanwhile, ties among lecturers have become significantly more likely than random, which is in contrast with its trends over the 1980s and 1990s. In this way, the closure of social interactions among lecturers has been recently structured by sociologist-association affiliation patterns.

Table 3 *Test of Two-group Differences in Tie Density: Professor or Lecturer*

	1980s	1990s	2000s
Professor-Professor	499.0(447.3)***	4422.0(3613.4)***	1841.0(1866.1)
Professor-Lecturer	32.0(81.3)***	4112.0(4490.5)***	2870.0(3009.8)***
Lecturer-Lecturer	0.0(2.4)**	930.0(1360.1)***	1361.0(1196.2)**

Note: Expected numbers of ties in parentheses.
*p<.10; **p<.05; ***p<0.01.

There has been the consistent tendency towards homophily that male sociologists are more likely to socialize with each other while social interactions between male and female is less than is expected, as is shown in Table 4. Given the change in the proportion of female to male in the population from 0.216 through 0.226 to 0.278 (See Appendix 2), it is noticeable that female sociologists are significantly more likely to mingle with each other in the 2000s. The chance of homophilous interactions among sociologists of the same gender has increased with time.

Table 4 *Test of Two-group Differences in Tie Density: Male and Female*

	1980s	1990s	2000s
Male-Male	378.0(323.7)**	5938.0(5656.9)*	3447.0(3164.6)***
Male-Female	140.0(185.0)***	3108.0(3332.8)*	2024.0(2443.9)***
Female-Female	13.0(22.3)**	418.0(474.3)	601.0(463.5)***

Note: Expected numbers of ties in parentheses.
*p<.10; **p<.05; ***p<0.01.

Table 5 presents how university prestige comes into play in 'birds-of-a-feather-flocking-together.' None of results are statistically significant in the 1980s and 1990s, but homophilous interactions among sociologists who did undergraduate studies in Seoul began to appear in the 1990s and significantly conspicuous in the 2000s. Meanwhile, repulsive interactions were being shaped among sociologists of somewhere else and between sociologists of Seoul and sociologists of somewhere else in the 1990s. These trends became more significant over the recent five years.

Table 5 *Test of Two-group Differences in Tie Density: Where They Earned Bachelor Degrees*

	1980s	1990s	2000s
Seoul-Seoul	468.0(474.4)	7942.0(7742.3)	5014.0(4804.042)**
Seoul-Other cities	62.0(55.8)	1461.0(1640.8)	1004.0(1196.2)**
Others-Others	1.0(0.8)	61.0(81.0)	54.0(71.8)*

Note: Numbers in parentheses are expected number of ties.
*p<.10; **p<.05; ***p<0.01.

Ties between sociologists who received their Ph.D.s in the US alone support the tendency towards homophily in Table 6. It became more significant in the 1990s than in the 2000s, while the likelihood of homophilous interactions among those who did graduate studies in Korea increased during the recent five years. On the other hand, sociologists of US doctoral degrees are less likely to socialize with sociologists of somewhere else. In a similar way as above, university prestige has recently served as another important criterion for sociologists' affiliation with their professional associations on which their homophilous interactions are contingent.

Table 6 *Test of Three-group Differences in Tie Density: Where They Earned Doctoral Degrees*

	1980s	1990s	2000s
US-US	325.0(320.7)	3219.0(2685.8)**	1368.0(1133.82)***
US-Other countries	203.0(213.8)	1795.0(1892.2)	898.0(1056.95)**
Others-Others	37.0(30.5)	274.0(318.9)	380.0(239.8)
US-Korea	NA	2792.0(2929.9)	1813.0(2056.3)***
Others-Korea	NA	832.0(1020.5)	944.0(950.4)
Korea-Korea	NA	709.0(773.6)	950.0(915.8)**

Note: Numbers in parentheses are expected number of ties. The results about statistical significance are merged from 'variable homophily blockmodel' and 'structural blockmodel.'
*p<.10; **p<.05; ***p<0.01.

Sociologist-Association Ties are Scale-free?

More and more Korean sociologists have not joined the KSA as the first choice – the KSA was the first choice for 94.6% of Korean sociologists who graduated in the 1980s (i.e. 35 out of 37), whereas only 37.2% of new Ph.D.s in the 2000s (i.e. 42 out of 113), but the KSA was still the first choice for 46.5% of Korean sociologists over the past 25 years. The KISA comes next (9.6%), the association specialized in gender (4.4%), the association in historical sociology (4.1%), and the association in family (3.3%). The KSA in the 1980s had 33 links, but the second highest degree was four. In the 1990s and 2000s, the KSA had the highest degree, 136 and 226, respectively, while the second highest degrees were 37 and 60, respectively. It turned out in Table 7 that the ties between sociologist and association follow a power-law distribution since the global fitness is statistically significant (p=0.06 in 1980s and p=0.00 in both 1990s and 2000s), and all slopes of the regression lines are highly significant except the slope in the 1980s. Suffice to say here that the Gini coefficients, albeit not presented here, are 0.558(1980s), 0.661(1990s), and 0.713 (2000s). Overall, accumulative advantages of the KSA have been persistent in the presence of the nationwide counter-association (KISA).

Table 7 *Test of Power-law Distribution in Sociologist-Association Ties*

	Constant	Slope	R-square
1980s	0.908** (0.183)	-0.702* (0.237)	0.745
1990s	1.160*** (0.185)	-0.844*** (0.175)	0.608
2000s	1.230*** (0.159)	-0.796*** (0.133)	0.642

Note: Numbers in parentheses are standard errors.
*p<.10; **p<.05; ***p<0.01.

Association-Association Ties are Small-world?

Table 8 presents the average distances and the clustering coefficients: the observed average distances are shorter than expected, while the observed clustering coefficients are bigger than expected. All of results are statistically significant (p<0.05) according to the one-tailed t-test, and those tendencies in clustering and bridging have become more significant with time although. It can be concluded that homophily-based affiliation together with degree-based affiliation due to accumulative advantages of the KSA has led the association-association tie towards a 'scale-free small-world network.'

Table 8 *Small-world Properties of Association-Association Ties*

	1980s	1990s	2000s
Average distance	1.840(2.395)	1.996(2.441)	1.976(2.389)
Z-value	-6.780***	-56.142***	-79.884***

Clustering coefficient	0.298(0.169)	0.238(0.055)	0.267(0.071)
Z-value	2.155**	29.613***	40.203***

Note: The numbers in parenthesis are calculated from 100 random graphs with the same densities and the same numbers of nodes.
*p<.10; **p<.05; ***p<0.01.

Core-periphery Structure among Associations?

The results on blockmodeling of association networks are summarized in Table 9. First, the association-association tie in the 1980s was a strong core-periphery structure[19]: the KSA alone constituted the core; there were four associations in the semi-peripheral block; and all other associations including the KISA comprised a periphery of the very low density, 0.10. Next, the block density in the 1990s represents a weak core-periphery[20]: the core was still a clique, but it had weaker connection to associations in the periphery. Meanwhile, the four associations in the semi-periphery over the 1980s lost their cohesiveness to be merged into the periphery in the 1990s. Instead, two new associations successfully entered the core block: the KISA and the association specialized in information and communication. Already at the end of 1990s, the KISA was absorbed into the KSA-led core, instead of competing with the KSA to make another hegemonic block. Lastly, the block density in the 2000s is almost the same as that in the 1990s[21], which implies that a hierarchical core-periphery structure among Korean sociological associations has been stably reproduced over the recent years (See also Figure 1). Besides the two major associations, the association specialized in Sociology of History (SH) consists in the core clique, however. This implies that students of historical sociology are forming a 'school' – in terms of not only networking but also research – since the SH, unlike the KSA and the KISA which covers a broad range of interest areas, has distinct specialized areas; and all of other associations in the periphery are connected very sparsely to each other, but much more densely to the core block.

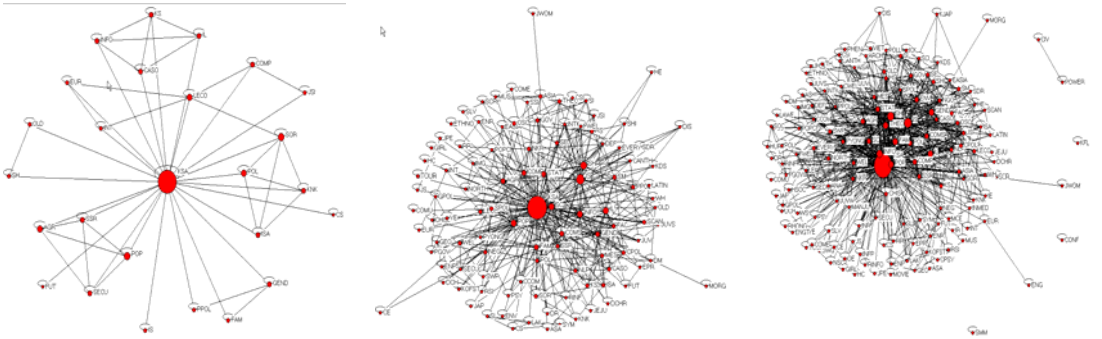

Figure 1 *How do Association-Association Ties Look like?*[22]
Note: 1980s (Left); 1990s (Middle); 2000s (Right)

Table 9 *The Change in Association-association Ties*

1980s				1990s			2000s		
Strong core-periphery				Weak core-periphery			Weak core-periphery		
	Core	Semi	Peri		Core	Peri		Core	Peri
C(1)	1.00	1.00	1.00	C(3)	1.00	.513	C(3)	1.00	.543
S(4)	1.00	1.00	.00	P(104)	.513	.051	P(148)	.543	.050
P(21)	1.00	.00	.10	* R^2=0.400. (SCP)			* R^2=0.380 (SCP)		
* R^2=0.567 (OSE)									

Note: Figures are the block densities of association-to-association links from dichotomized sociologist co-membership. The numbers of associations are recorded in parentheses.

How have Research Areas been Clustered?

Table 10 through 12 shows how stably what research areas have been clustered over time: some specialty clusters emerged in the 1990s and have continued until recently such as Criminology and deviation and Psychology, Statistics and Social Network Analysis, Economic Sociology and Organization and administration, Urban Sociology and Social Movements, Politics and East Asia, and Political Economy and Marxism; interestingly, Economic Sociology used to be closer to Politics in the 1980s, but it has been grouped with Organizational Sociology since the 1990s. It is also noticeable that Political Economy has been another cluster separately from Economic Sociology since the 1990s; both Urban Sociology and Social Movements and Politics and East Asia have formed the biggest cluster together with Development, and Industrial Relations and Labor since the 1990s. These areas besides Political Economy and Marxism have been the main research fields for scholars of critical sociology who join the KISA; three new research areas are being recently clustered such as Social Welfare and Policy, Theory and Cultural Studies, and Religion and Korean Studies and Confucianism; and Population and Aging, and Family and Gender have been stably clustered over the past 25 years.

Table 10 *Research Area Clusters (1980s)*

1	Population, Aging	13, 36
2	Information, Religion	32, 12
3	Politics, Economic Sociology	3, 22
4	Linguistics, Mass Media	42, 35
5	Gender, Family	6,2
6	All of the others are too distinct to merge	

Table 11 *Research Area Clusters (1990s)*

1	Population, Aging	13, 36
2	(Criminology & Deviation, Psychology), Law	(15, 10), 40
3	Statistics, Social Network Analysis	17, 53
4	Economic Sociology, Organization & Administration	23, 7
5	Family, Gender	2, 6
6	(Urban sociology, Social Movement), Development, (Politics, East Asia), Industrial Relation & Labor	(9, 22), 11, (3, 29), 1
7	Linguistics, Mass Media	42, 35
8	Theory, Social Philosophy	5, 18
9	Political Economy, Marxism	24, 25
10	Leisure, Sports	44, 47
11	All of the others are too distinct to merge	

Table 12 *Research Area Clusters (2000s)*

1	Population, Aging	13, 36
2	(Family, Gender), (Social Welfare, Policy)	(2, 6), (21, 20)
3	Criminology & Deviation, Psychology	15, 10
4	(Urban sociology, Social Movement), (Politics, East Asia), Development, Industrial Relation & Labor	(9, 22), (3, 29), 11, 1
5	Theory, Cultural Studies	5, 8
6	(Statistics, Social Network Analysis), (Economic Sociology, Organization & Administration)	(17, 53), (23, 7)
7	Political Economy, Marxism	24, 25
8	Religion, Korean Studies and Confucianism	12, 43
9	All of the others are too distinct to merge	

Sociologist-Specialty Ties are Scale-free?

The summary of fitting sociologist-specialty ties into the log-log plots is provided in Table 13. All of regression lines are statistically significant in terms of both global and local fitness ($p<0.01$), and the degree distribution is very unequal as is indicated from the Gini coefficients (i.e. 0.419 in the 1980s, 0.518 in the 1990s, and 0.486 in the 2000s). It should be noted, however, that cut-off regions around both the x and y intercepts in sociologist-specialty ties are bigger than those in sociologist-association ties. The sociologist-specialty ties in the 1990s and 2000s have a power-law regime with the relatively low R^2s which is primarily owing to the fact that the percentage increase of the degree x is much higher than the percent decrease of the number

of links with x. In other words, since only few sociologists have very small numbers of research areas, the cut-off regions around the y intercept are quite big and thereby the regression slopes are far from -1.

Table 13 *Test of Power-law Distribution in Sociologist-Specialty Ties*

	Constant	Slope	R-square
1980s	0.870*** (0.101)	-0.826*** (0.133)	0.810
1990s	0.439*** (0.095)	-0.261*** (0.076)	0.318
2000s	0.281*** (0.063)	-0.162*** (0.044)	0.282

Note: Numbers in parentheses are standard errors.

*p<.10; **p<.05; ***p<0.01.

Specialty-Specialty Ties are Small-world?

As is shown in Table 14, the one-tailed t-tests validate that the average clustering coefficients of specialty networks are significantly bigger than those of equivalent random graphs ($p<0.01$). However, all the average distances of observed graphs are longer than those of random graphs ($p<0.01$). Therefore, none of specialty networks are small-world although the degrees of small-world-ness of the specialty network in the 1990s and 2000s are higher than that in the 1980s. Taken all together from Table 13 and 14, we can point out a power-law regime without small-world-ness in the 1980s to be followed by more or less scale-dominant small-world-ness recently. This is consistent with the conclusion from hierarchical cluster analysis that following-the-trend was dominant in the 1980s and specialty-based matching became more popular afterwards.

Table 14 *Small-world Properties of Specialty-Specialty Ties*

	1980s	1990s	2000s
Average distance	2.085(2.011)	1.617(1.587)	1.464(1.457)
Z-value	2.756***	45.000***	49.261***
Clustering coefficient	0.479(0.231)	0.650(0.413)	0.755(0.545)
Z-value	8.701***	27.160***	37.661***

Note: The numbers in parenthesis are calculated from 100 random graphs with the same densities and the same numbers of nodes.

*p<.10; **p<.05; ***p<0.01.

Core-periphery Structure among Specialties?

The specialty network in the 1980s is characterized by a weak core-periphery structure rather than a faction structure[23]. This hierarchy still remains almost the same[24], but with its strength

weaker over time (Table 15. See also Figure 2). From Table 16, we can find whether there has been a significant trend or a passing fad over the past decades in terms of what research areas sociologists have chosen commonly: only five specialties has stably constituted the core throughout the entire period such as Industrial Relations and Labor, Politics, East Asia, Theory, and Gender; some areas have experienced the shift from the core to the (semi-)periphery such as Class and Stratification, Development, Community, Social Movements, North Korea, and Statistics; some areas have been consistently peripherized such as World Systems, Anarchism, Linguistics, Literature, Aesthetics, Visual Sociology, Leisure, Sports, Army, and Geography; some other areas have grown out of the periphery or entered the cohesive core. To name a few, Economic Sociology, Organization and Administration, Social Network Analysis, Policy, Social Welfare, Psychology, Criminology and Deviation, Cultural Studies, Environmental Sociology, and Information, Science and Technology; and Marxism is the only one that have lost popularity over time.

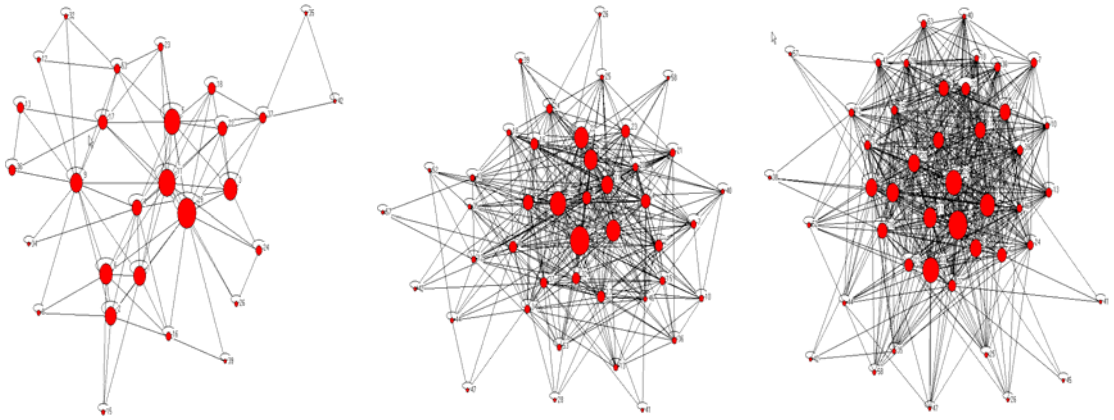

Figure 2 *How do Specialty-Specialty Ties Look like?*

Note: 1980s (Left); 1990s (Middle); 2000s (Right)

Table 15 *The Structural Change of Specialty-specialty Ties*

1980s			1990s				2000s			
Weak core-periphery			Weak core-periphery				Weak core-periphery			
	Core	Peri		1	2	3		1	2	3
C(14)	.549	.158	C(16)	.96	.73	.26	C(11)	.89	.83	.31
P(14)	.158	.077	S(13)	.73	.27	.12	S(22)	.83	.83	.20
* R^2 is 0.422 (SCP)			P(14)	.26	.12	.07	P(12)	.31	.20	.06
			* R^2=0.413 (OSE)				* R^2= 0.405 (OSE)			

Note: Figures are the block densities of specialty-to-specialty links from dichotomized sociologist co-membership. The numbers of specialties are recorded in parentheses.

Table 16 *What Specialties Constitute Blocks?*

1980s	1990s	2000s
Core: 17 11 9 1 6 2 5 3 4 18 29 37 22 16	Core: 17 9 11 1 6 5 3 4 22 29 37 8 32 16 23 20	Core: 1 6 40 5 3 29 24 8 53 43 21
Periphery: 13 36 15 24 42 35 32 12 53 8 23 26 34 39	Semi-periphery: 2 15 46 18 24 35 12 53 34 43 21 7 25	Semi-periphery: 13 36 17 2 9 34 22 11 28 15 10 46 4 18 37 32 12 16 20 23 39 7
	Periphery: 13 36 40 10 42 58 26 39 41 28 44 52 47 57	Periphery: 47 42 35 58 26 25 41 44 52 45 57 38

Note: Each number designates a particular interest area. See Appendix 1.

Have Association and Specialty Networks Co-evolved?

In Table 17, the first column is observed degree of association, while the third column is the average score of association across a large number of trials in which the rows and columns of the two affiliation matrices with the same set of sociologists have been randomly permuted. In the 1980s, there seemed to be a positive correlation, but this was not statistically significant provided with the small difference between the two columns. However, there are significant positive correlations in the 1990s and 2000s ($p<0.05$ and $p<0.01$, respectively). This implies that roles of professional association as the center for research became more salient with time, which is consistent with the fact that the number of more specialized associations has increased since the 1990s.

Table 17 *The Correlation of Association Ties and Specialty Ties between Sociologists*

	Observed	Significance	Random	Standard Deviation
1980s	.429	.246	.408	.030
	.335	.246	.319	.023
1990s	.551	.022**	.515	.020
	.462	.022**	.431	.017
2000s	.554	.004***	.525	.015
	.473	.004***	.449	.013

Note: For each period, the results at the first row and the second row are about simple matching and Jaccard coefficient, respectively.

*p<.10; **p<.05; ***p<0.01.

Conclusions

Korean sociology was founded by a small and socially homogeneous group of scholars who were trained in the US. As its community expanded, new Ph.D.s entered the field who are

different from each other and also from existing members in terms of social backgrounds, perspectives, and interest areas. In the mid-1980s, radical scholars organized a nation-wide counter-association under the banner of critical sociology to compete with the Korean Sociological Association not only for legitimacy and status but also for new members and theoretical perspectives.

We found several interesting features of the Korean sociological academic community structure and its change over the past two decades. Patterns of affiliation between sociologists and associations have shaped homophilous interactions along the lines of gender, employment status, and university prestige. Scale-free properties of sociologist-association ties are observed throughout the entire period, but its strength has been on the decline. Meanwhile, the increased tendency towards homophily has made small-world-ness more prominent. The structure of associations has changed from a strong core-periphery to a weak core-periphery. The current core is composed of the association specialized in Historical Sociology, besides the two 'generalist' organizations, Korean Sociological Association of accumulative advantages and the counter-association once, Korean Industrial Sociological Association.

Although some areas have been established into the core while some others marginalized, a few fields have been commonly researched (e.g. Industrial Relations and Labor, Politics, East Asia, Theory, and Gender) throughout the past two decades. This following-the-trend has pushed the structure of specialty space towards a core-periphery with scale-free properties. However, this core-periphery structure has become weaker since more sociologists were increasingly pursuing specialist strategies. With increased clustering of specialties, specialty-specialty tie has come much closer to a small-world network.

As more sociologists have joined more specialized associations, the association between sociologist-association ties and sociologist-specialty ties has increased over time. However, this co-evolution is marked by the transition from a limited number of dominant research areas to more diverse specialty niches with an interorganizational hierarchy led by a very few associations excluding a significant number of specialist organizations. Given this discrepancy between stable stratification in the structure of associations and increased differentiation in the structure of research fields, it will be a challenging task for both the Korean Sociological Association and the counter-association how to play integrative roles and accommodate newly emerged specialties.

Appendices

1. The list of specialties

1 Industrial Relation and Labor

2 Family

3 Politics

4 Class and Stratification

5 Theory

6 Gender

7 Organization and Administration

8 Cultural Studies

9 Community (Rural, Regional, Urban)

10 Psychology

11 Development

12 Religion

13 Population

15 Criminology and Deviation

16 Sociology of History

17 Statistics

18 Social Philosophy and Sociology of Knowledge

20 Policy

21 Social Welfare

22 Social Movement

23 Economic Sociology

24 Political Economy

25 Marxism

26 World System

28 Education

29 Comparative Sociology (East Asia including China and Japan, South East Asia, America, Western and Eastern Europe, South Africa…)

32 Information, Science and Technology

34 Environment

35 Mass Media

36 Aging

37 North Korea

38 Literature

39 International Relations

40 Law

41 Army

42 Linguistics

43 Korean Studies and Confucianism

44 Leisure

45 Geography

46 Human Right and Minorities

47 Sports

52 Visual Sociology

53 Social Network Analysis

57 Aesthetics

58 Anarchism

* Total number of specialties: 45 (Numbers on the left for identification and coding).

2. Change in Degree of Homogeneity

A. Job

	1980s	1990s	2000s
Index of Qualitative Variation	0.298	0.943	0.988
Professor	34	104	156
Lecturer	3	64	125

B. Sex

	1980s	1990s	2000s
Index of Qualitative Variation	0.678	0.700	0.802
Male	29	130	203
Female	8	38	78

C. Where Sociologists Did Undergraduate Studies

	1980s	1990s	2000s
Index of Qualitative Variation	0.205	0.345	0.393
Seoul	35	152	250
Others	2	16	31

D. Where Sociologists Did Graduate Studies

	1980s	1990s	2000s
Index of Qualitative Variation	0.552	0.906	0.956
US	28	89	119
Other foreign countries	9	31	55
Korea	0	48	107

3. Basic Statistic of One-mode Networks

A. Sociologist-Sociologist Ties from Sociologist-Association Affiliation Networks

	1980s	1990s	2000s
Number of Nodes	37	168	281
Number of components	4 (3 isolates)	12 (11 isolates)	13 (12 isolates)
Density	.7973	.6747	.6781

B. Association-Association Ties from Sociologist-Association Affiliation Networks

	1980s	1990s	2000s
Number of Nodes	26	107	151
Number of components	1	1	5 (3 isolates, 1 isolated pair)
Density	.1600	.0771	.0695

C. Sociologist-Sociologist Ties from Sociologist-Specialty Matching Networks

	1980s	1990s	2000s
Number of Nodes	37	168	281
Number of components	1	1	1
Density	.3486	.5450	.5702

D. Specialty-Specialty Ties from Sociologist-Specialty Matching Networks

	1980s	1990s	2000s
Number of Nodes	28	43	45
Number of components	1	1	1
Density	.2328	.4142	.5434

E. How Many Associations Sociologists Have Affiliated?

	1980s	1990s	2000s
Mean	1.97	2.90	3.16
Standard deviation	1.34	1.84	2.00
Min	0	0	0
Max	5	10	12

F. How Many Specialties Sociologists Have Chosen?

	1980s	1990s	2000s
Mean	3.05	4.32	4.79
Standard deviation	1.08	1.67	1.60
Min	1	1	2
Max	5	11	11

Notes

I am very grateful to Robert A. Hanneman for his unceasing encouragement and insightful comments on earlier versions of this paper.

1. The examination of clustering patterns among sections could be a far more reliable measure of the dynamic interface between the cognitive and organizational structure of sociology (Phaedra, 2001). Indeed, Cappell and Guterbock (1992) looked at joint membership in ASA sections, instead of using interest areas as the unit of analysis (e.g. Ennis (1992)). However, Korean sociological academic community is quite different since there are lots of associations besides the KSA and the KISA. Additionally, it is recently that some sections in the two major associations are organized and maintained.
2. To name a few of examples, Diani (1992) and Ansell (1997) in social movement analysis and Labov (1986) and Milroy and Milroy (1992) in sociolinguistics.
3. For example, Cole and Cole (1973) analyzed citation patterns to examine "whether scientific progress is built on the labor of all 'social classes' or is primarily dependent on the work of an 'elite' (p.216)." As another instance, Crane (1972) designated the role of opinion leaders as 'connectors,' and investigated the diffusion of ideas in the light of contagion processes. One of her central theses is that a small number of prominent scientists from the core of each specialty's collaboration network and most of others are connected to the rest of the community through those highly active individuals.
4. As exceptions in the past, Rossum (1974) simply inspected co-authorship of editors and their affiliation with universities, while Breiger (1976) revealed the structure of personal relationships among scientists in a biomedical research specialty through blockmodeling.
5. Babarási and his colleagues found hubs in small-world networks. All small-world networks are not scale-free, of course. See Ball (2004: 400) for the distinction between 'scale-dominant small-world networks' and 'scale-free small-world networks.'
6. The issue here is: preference for what? They posited, "a power-law degree distribution can reflect not only preferential attachment by incumbency but also preferences for attractiveness, legitimacy, diversity, or a concatenation of mechanisms (p.1152)." There are various motives for preferential attachment, but we instead limit its meaning to preference for '(Freeman) degree.'
7. Niche overlap can be conceptualized by structural equivalence given observed patterns of relations (DiMaggio, 1992; Burt, 1992; Burt and Talmud, 1993), instead of the redundant size of attributes (McPherson, 1983).
8. See Appendix 1 about the list of specialties.
9. Some cases of those who graduated in the 1980s were excluded in the final data since they did not either have information substantially equivalent to that in the 1990s and 2000s or they made it invisible.
10. To make the sample representative it would be best to survey people from systematic sampling. However, it is impossible to get all rosters of sociologists who affiliate with at least one association, whether they can be representative of Korean sociologists. More seriously, a representative sample of people does not necessarily give a useful of their relations (Alba, 1982). In other words, the number of relations among members of the

sample may be a very small subset of all their relations, and there is no reason to believe that the relations identified among the agents in the sample would themselves be a random sample of all the relations of these same agents (Scott, 2000: 59).

11. The descriptive statistics of four one-mode networks is presented in Appendix 3.
12. See Appendix 4 about the distribution of the number of associations and specialties selected by sociologists.
13. Jones and Handcock (2003) pointed out some problems with the simple regression in log-log plots (Moody, 2004): the regression method improperly weights cases and fails to account for autocorrelation between points. Their alternative maximum likelihood techniques also suggest that the observed data do not conform to a preferential attachment process.
14. The clustering coefficient of an actor is defined by the density of its open neighborhood: $C_j=2E_j/[k_j(k_j-1)]$ when an actor j connects its neighborhood with the number k_j of ties. E_j is the actual number of ties in an actor j's neighborhood, and $k_j(k_j-1)/2$ is the possible number of ties formed in the neighborhood for undirected ties. The overall clustering coefficient is the mean of the clustering coefficient of all the actors.
15. There are a couple of worthwhile points here: since another step-wise increment in the number of blocks would increase the goodness-of-fit, researchers have to choose the best fitness at the step where the percent rate of its increase reaches the maximum; it is better to apply several times blockmodeling to arbitrarily permuted data from different initial configurations and compare results; and the QAP approach in Ucinet is sensitive to permutation because it recognizes the list of nodes in order from the top to the bottom or from the left to the right. It is the best to make the order of nodes in two matrices identical before using the QAP approach.
16. Unlike the first method, both FA and OSE can have the number of blocks more than two. Unlike the first two techniques, OSE can fit the data into the most appropriate structure without any priori assumptions about the ideal structure of blocks.
17. FA in Ucinet, unlike SCP and OSE, does not give goodness-of-fit test results. Given the observed block density in Table 2, it is apparently reasonable to use the following equation: $R^2=[(A+B)(A+B-1)-(X+Y+Y+Z)]/[(A+B)(A+B+1)]$ since R^2 is [(the number of total possible ties – the final number of errors in total)] / (the number of total possible ties), and the number of total possible ties is $(A+B)(A+B)-(A+B)$ after excluding diagonal ties.

Table 2 *Observed Block Density*

	1(A)	2(B)
1(A)	X	Y
2(B)	Y	Z

Note: the number of actors (A and B) in each block; and the final number of errors (X, Y, and Z) in each block.

However, this simple approach is very sensitive to patterns of permutation. What is worse, it would give us the same goodness-of-fit as long as the number of total possible ties is the same with the final number of errors, regardless of the number of ties in each block. Another plausible approach is to use the number of actual ties instead of the number of total possible ties to consider actual densities. Therefore, R_{adj}^2 becomes [(the number of

actual ties – the final number of errors in total)] / (the number of actual ties). This approach is problematic, however, in the sense that it does not take into account different ways the same matrix can be permutated. Besides, it suffers from the same limitation like the former approach, as is shown in Density=$(1-R^2)/(1-R_{adj}^2)$.

18. Each observation in network data is almost always non-independent, but the permutation approaches in Ucinet help to calculate sampling distributions of statistics directly from observed networks by using random assignment across hundreds or thousands of trials under the assumption that null hypotheses are true (Hanneman and Riddle, 2005).
19. The goodness-of-fit in FA and SCP was 0.0625 and 0.384, respectively. Both approaches suggest a weak core-periphery structure.
20. SCP yielded 0.400 which is much better than the goodness-of-fits from the other two approaches. R^2 is 0.0234 from FA, but R^2 is 0.205 when 2 blocks and 0.260 when 3 blocks from OSE.
21. Blockmodeling suggests another plausible substructure of the association network in the 2000s with the same level of goodness-of-fit (R^2=0.380) although it is still a weak core-periphery. 39 associations – rather than three associations – consist in the much less cohesive core (0.435) – rather than the clique, the density between the core and the periphery is much lower (0.084), and the density of the periphery is lower (0.016). Suffice to say here that either of the two core-periphery networks is far from a factional structure: R^2 is 0.0279 when 2 blocks from FA, while R^2 are 0.155 and 0.156 when 2 blocks and 3 blocks, respectively, from OSE.
22. We utilized NetDraw (Version 2.34), a software for network visualization.
23. R^2 from OSE is 0.098 when 2 blocks and 0.286 when 3 blocks, while R^2 from FA is 0.103 when 2 blocks and 0.287 when 3 blocks.
24. R^2 from OSE is 0.405, and R^2 from SCP is 0.362. R^2 from FA is 0.278 when 2 blocks and 0.336 when 3 blocks.

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