The Strength of Professional Relationship Ties: A Network Analysis of East Coast Law Firms

46062

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1. Empirical network vs Configuration Model network

Table 1: Metrics for Advice, CoWork, and Friend Networks

Network	density	avg_path_len	reciprocity	transitivity
Advice	0.179	2.243	0.392	0.479
CoWork	0.222	1.886	0.685	0.452
Friend	0.116	2.505	0.612	0.449

Among the three relationship networks, the coworker network is the most tightly knit, with a density of 0.222, meaning that 22% of all possible coworker ties are realised. This network also has the shortest average path length, meaning that nearly everyone is connected by just one or, at most, two colleagues, making it the easiest network through which to connect across the firm.

The configuration model was chosen as the baseline because it preserves each lawyer's degree which means it retains how many ties each node has while randomising who they connect to. This ensures that any differences we observe between the real networks and their randomised counterparts arise from higher order structures such as reciprocity, transitivity, average path length, and overall community organisation, rather than from simple variations in degree.

Table 2: Empirical vs Configuration Model Network metrics

Network	density	density_mean	reciprocity	reciprocity_mean
Advice	0.179	0.179	0.392	0.146
CoWork	0.222	0.222	0.685	0.204
Friend	0.116	0.116	0.612	0.147

For that reason, network density remains identical between the empirical networks and their corresponding configuration models across all three cases. In contrast, measures such as average path length, reciprocity, and transitivity show divergence and highlights patterns that cannot be explained by degree alone. This suggests meaningful network structure beyond random chance. In the coworker network, reciprocity jumps from 20% in the random graphs to 68% in the empirical network, showing that formal working relationships are far more mutually acknowledged than random wiring would produce. A similar jump occurs in the friendship layer which also indicates overwhelmingly mutual nature of such ties. Reciprocity in the advice network shows a jump as well but is closer to the baseline, suggesting that hierarchical norms and expertise may impact the directionality of such ties.

Table 3: Empirical vs Configuration Model Network metrics

Network	avg_path_len	avg_path_len_mean	transitivity	transitivity_mean
Advice	2.243	2.124	0.479	0.348
CoWork	1.886	1.897	0.452	0.389
Friend	2.505	2.294	0.449	0.291

All three networks have average path lengths that are fairly similar to those of their corresponding configuration models, suggesting that global connectivity is largely informed by the degree distribution. However, the advice and friendship networks are slightly less efficient in terms of connectivity, with marginally longer average path lengths than their randomised counterparts. This could indicate the presence of structural features such as clustering or selective ties that limit the reach of these networks. In contrast, the coworker network shows virtually no difference, with an average path length of 1.88 compared to 1.89 in the configuration model. This suggests that formal work relationships connect the firm as efficiently as possible, given how many ties each lawyer has.

Across all networks, empirical transitivity is consistently higher than in the configuration models. This points to a greater than random presence of triadic closure, where individuals are more likely to be connected to their colleagues' connections (Granovetter, 1973). The pattern is particularly strong in the Advice network, where transitivity is 0.479 compared to 0.348 in the configuration model. This suggests a network structure shaped by professional familiarity which are commonly observed in advice-seeking networks (Zagenczyk et al., 2009).

2. Assortativity and Community Detection

Table 4: Assortativity by Network and Attribute

Network	Gender Assort.	Age Assort.	Status Assort.
Advice	0.087	0.237	0.320
CoWork	-0.021	-0.045	-0.100
Friend	0.206	0.446	0.552

The friendship network displays the highest assortativity across all attributes making it the most homophilous of the three networks. This suggests that friendships are strongly shaped by social similarity, especially by age (0.446) and professional status (0.552). In contrast, the advice network shows moderate assortativity, led by the same attributes, indicating that advice-seeking is influenced by seniority and experience as well, but less strongly than friendship ties. The coworking network exhibits disassortativity across all three attributes. This means that individuals are slightly more likely to be connected to colleagues who differ from them in these attributes suggesting that coworking relationships are more heterogeneous.

Table 5: Method vs Community

	1	2	3
Infomap	71	0	0
Leiden	28	25	18
Louvain	28	25	18

Infomap identified a single community, offering no meaningful partitioning. Both Louvain and Leiden detected three communities, but Leiden was selected as the final model because its multi-level modularity optimization ensures more stable and well-connected communities (Traag et al., 2019). It was run on an

undirected aggregated network, as the focus was on identifying cohesive subgroups rather than modelling for directional dynamics.

Table 6: Alignment of Leiden Communities with Node Attributes

Metric	Office	Practice	Status
Purity	0.930	0.873	0.606
Assortativity	0.354	0.34	0.148
Modularity of Aggregated network	0.298		

Table 7: Leiden Community Composition by Node Attributes

Row	Comm1	Comm2	Comm3
Office - Boston	28	20	0
Office - Hartford	0	1	18
Office - Providence	0	4	0
Practice - Litigation	28	2	11
Practice - Corporate	0	23	7
Status - Partner	11	12	13
Status - Associate	17	13	5

The office attribute shows the strongest alignment with community structure, with the highest purity (0.930) and assortativity (0.354) among all attributes. Community 1 consists entirely of Boston based lawyers, and Community 3 is composed exclusively of those in Hartford, indicating strong geographic clustering. Community 2 includes lawyers from all three offices, suggesting thst it serves as a bridge between locations. Overall, office affiliation is the primary driver of community formation in the network. Figure 2 visualises this distribution of office affiliation within the detected communities.

The practice attribute also aligns strongly with community structure, with a high purity (0.873) and assortativity (0.340). The presence of litigation lawyers across all three communities suggests this practice group is broadly integrated in the network. In contrast, corporate lawyers appear only in Communities 1 and 2, indicating some clustering by practice, but less rigid than office-based clustering. This pattern suggests that office location has a stronger influence on how communities form than professional roles. By contrast, status has the least influence on network formation with a purity of 0.606, and assortativity of 0.148. Each community contains a mix of partners and associates. This indicates that hierarchical rank does not strongly structure interactions in the aggregated network. Figures 3 and 4 illustrate these community compositions by practice and status, respectively.

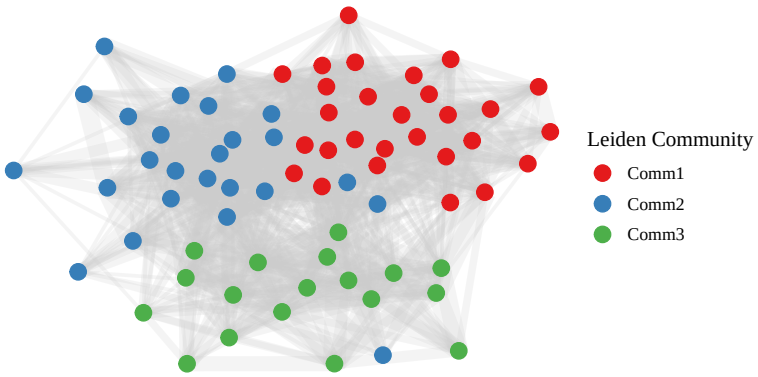


Figure 1: Leiden Communities

Overall, the Leiden-detected communities are visually well-defined in Figure 1. The modularity score of 0.298 indicates that the network exhibits meaningful clustering and is not purely random. However, the division is moderate, with some overlap in node attributes. Office and practice attributes shape ties across the relationship networks, while status plays a minimal structural role. This suggests a network in which community is driven more by geographic proximity and profession than by hierarchy.

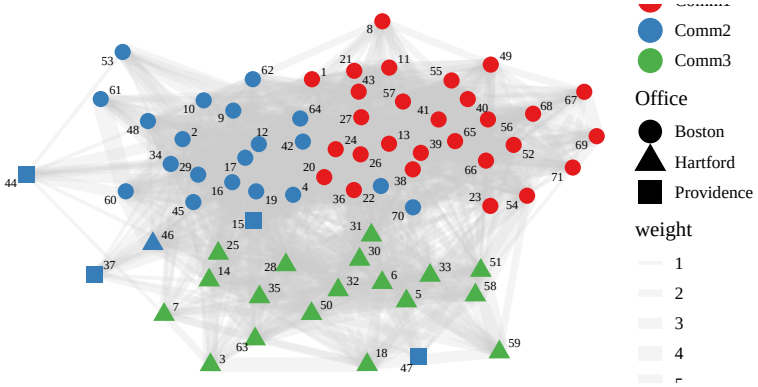


Figure 2: Leiden Communities & Office

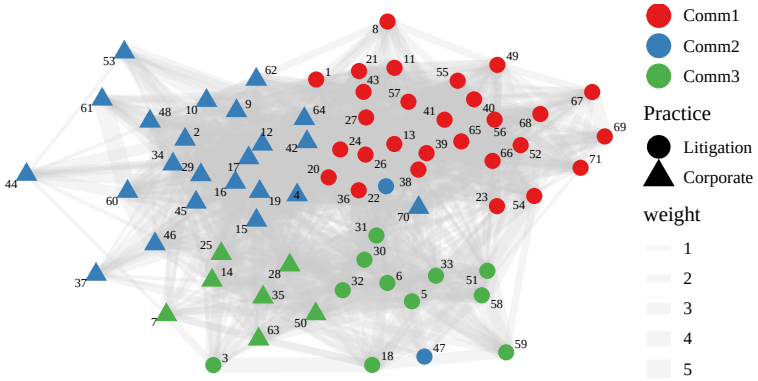


Figure 3: Leiden Communities & Practice

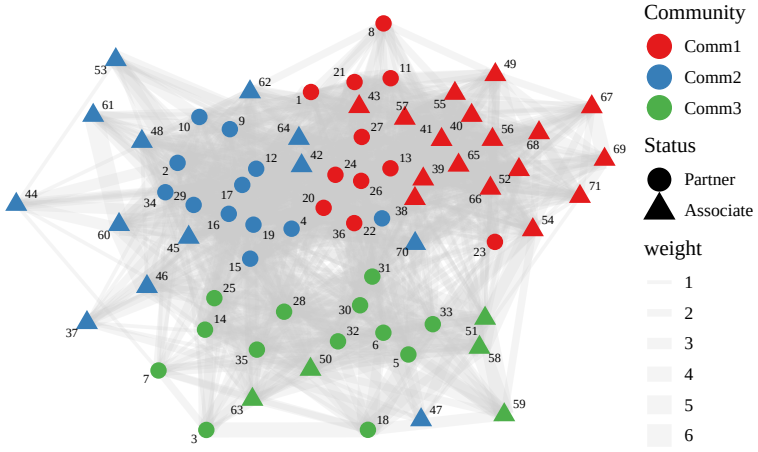


Figure 4: Leiden Communities & Status

3. ERGM on Advice Network and Goodness of Fit

Table 8: ERGM on Advice Network

Term	Estimate	Std.Error	p-value	Odds Ratio	CI Lower	CI Upper	Signif
edges	-3.040	0.294	0.000	0.048	-3.616	-2.465	***
Age (overall activity)	-0.021	0.004	0.000	0.979	-0.028	-0.013	***
Status on incoming ties (Partner)	1.531	0.103	0.000	4.624	1.329	1.733	***
Status on outgoing ties (Partner)	0.301	0.097	0.002	1.351	0.110	0.492	**
Gender homophily	0.416	0.091	0.000	1.515	0.238	0.593	***
Office homophily	1.690	0.094	0.000	5.419	1.505	1.875	***
Practice homophily	1.426	0.089	0.000	4.160	1.251	1.600	***

Note:
Signif. codes: *** p<0.001; ** p<0.01; * p<0.05

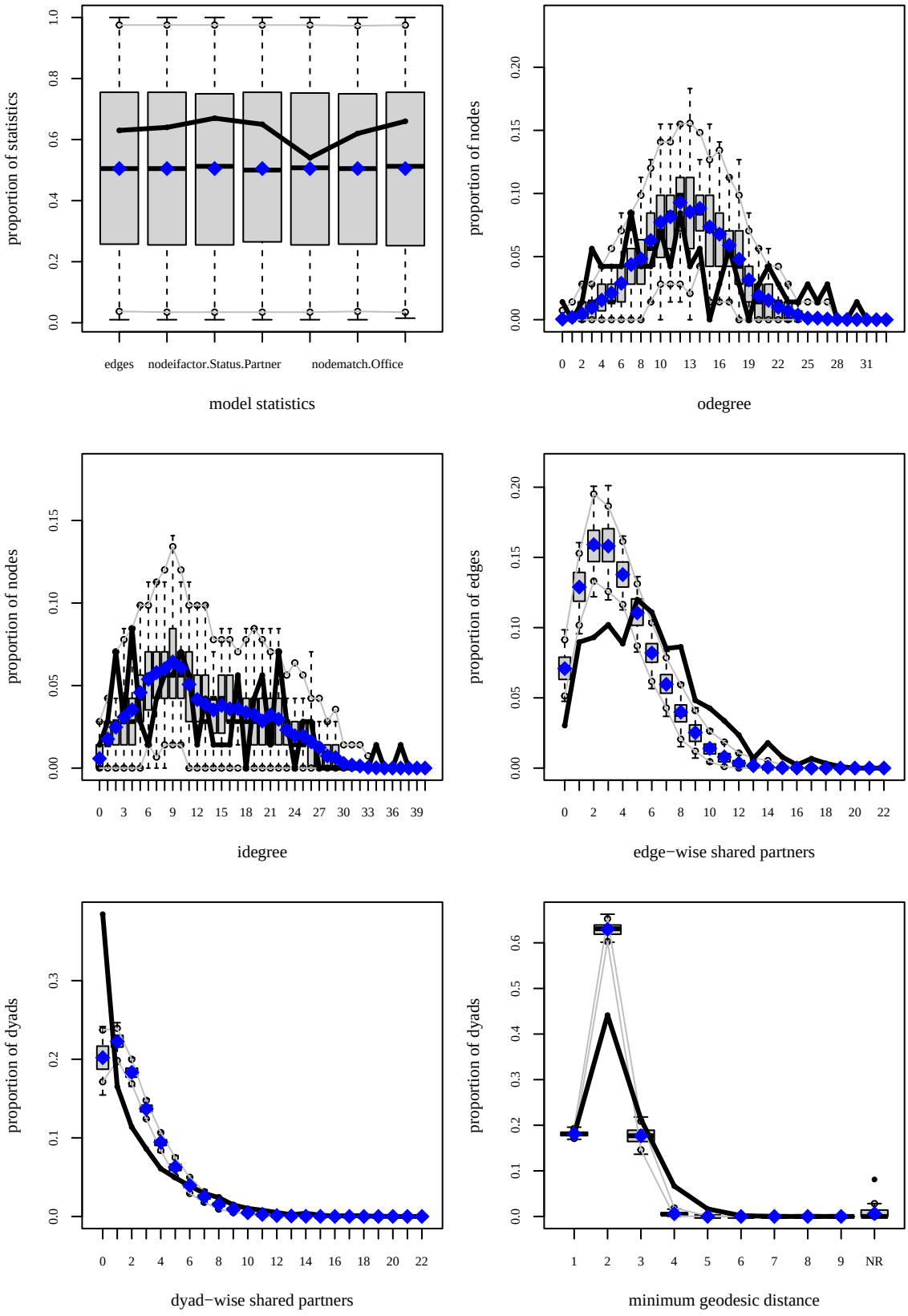
The ERGM results reveal that advice giving relationships among lawyers are most strongly predicted by office location, practice area, and partner status. Office homophily has the strongest effect, with an odds ratio of 5.419, indicating that lawyers working in the same office are over five times more likely to form advice ties. Practice homophily is relatively high, showing that colleagues in the same legal specialty are 4.160 times more likely to seek advice from each other. Partner status strongly increases one's viability as an advice source, since partners are 4.624 times more likely than associates to be asked for guidance. They are also 1.351 times more likely to ask for advice from others in the network. This attribute demonstrates the asymmetrical influence of hierarchy on advice seeking. Gender homophily is modest, with same gender pairs about 1.515 times more likely to exchange advice than mixed gender pairs. Finally, age has a small but negative effect, suggesting that as lawyers grow older, their likelihood of seeking advice declines slightly. These findings reinforce that proximity and shared professional context captured by office and practice are the strongest drivers of advice-giving, but also reveal that demographic and hierarchical factors play an important role in advice networks.

The goodness-of-fit tests indicate that the predictors used in the ERGM provide a partial fit for the advice network. In the model statistics plot, the observed values fall within the simulated range, confirming that the model accurately captures the effects of the included terms.

However, the model fits certain structural features less well. In both the out-degree and in-degree distributions, observed values deviate from the simulations, particularly for the degrees at the higher end (around degree 10 for out-degree, and even earlier for in-degree). This means the model captures how much advice is given reasonably well, but struggles to account for who is highly consulted for advice. While the model explains advice-seeking behavior based on attributes, it does not account for individuals who may act as advice hubs, likely due to the absence of predictors that model for popularity or centrality. The edge-wise shared partners plot shows that the model underestimates local triadic closure, with the observed values exceeding the simulations for ties with 2–5 mutual contacts. Similarly, the dyad-wise shared partners plot indicates that lawyers share more mutual contacts than the model predicts, suggesting that it fails to capture the tendency of advice ties to form within tightly connected groups. Additionally, the minimum geodesic distance plot reveals that the model underestimates indirect connectivity, particularly second-degree paths. This implies that the real network contains more interconnected clusters than the model accounts for (Hunter, 2005).

In summary, while the ERGM effectively captures attribute-based effects and overall connectivity, it misses local structural patterns. Including additional structural terms such as transitivity will improve the model's fit.

Goodness−of−Fit Diagnostics



4. ERGM on coworking, advice and friendship lawyer networks

The negative age coefficients across all three networks indicate that as lawyers get older, they become slightly less likely to form advice (-0.009), coworking (-0.008), and friendship (-0.007) ties. Partner status as a receiver has the strongest effect in the advice network where partners are 1.080 times more likely than associates to be asked for guidance. The effect is smaller in the coworking (0.380) and friendship (0.278) networks. As senders, partners are less likely to seek advice (0.361) or nominate coworkers (0.282) than associates. In the friendship network, partner status has no statistically significant effect, suggesting no consistent difference between ranks. Gender similarity modestly increases the likelihood of forming advice (0.271) and friendship ties (0.185), but has no reliable effect on coworking.

Office and practice alignment significantly increase the odds of tie formation across all networks. Lawyers in the same office are 0.943 times more likely to share advice, 0.799 to cowork, and 0.499 to form friendships, compared to those in different offices. This suggests that advice is more influenced by location than friendship. Sharing a practice area increases the likelihood of advice (0.898) and coworking ties (0.821), consistent with expectation on expertise alignment, while its effect on friendship (0.261) is relatively weak.

Reciprocity and transitivity are the strongest structural predictors across all networks. Reciprocity is especially prominent in coworking and friendship, reflecting the mutual nature of those ties. In contrast, advice ties are more directional because a lawyer is 0.642 times more likely to seek advice from someone who has sought advice from them. The significant positive gwesp terms (decay = 0.7) confirm strong triadic closure. Each additional shared advice partner increases the odds of a tie by 1.069, while each extra common coworker or friend raises the odds of a tie by 0.980 and 0.945, respectively.

Overall, physical proximity and shared professional context are the strongest predictors of tie formation. Hierarchy most clearly shapes advice ties, while coworking is driven by office proximity, reciprocity, and closure. Friendship, by contrast, relies more on demographic similarity and transitive clustering. Community detection reinforces these findings, showing that office location is the dominant force behind network structure. Lawyers tend to cluster geographically, while practice area contributes to grouping less rigidly, and status shows minimal influence. ERGM results also align with this structural view because office and practice homophily were strong predictors of advice ties. However, goodness-of-fit diagnostics reveal that while the model effectively captures attribute-based tie formation, it under represents structural features such as clustering and centralisation.

5. Conclusion

Descriptive network metrics provided an initial view of connectivity, mutuality, and clustering. These revealed that coworking and friendship ties are highly reciprocal, reflecting mutual collaboration, whereas advice ties are more directional, indicating asymmetry and hierarchy typical of expertise-based relationships. All three networks showed evidence of triadic closure, but descriptive metrics alone cannot determine whether these structural patterns result from random processes or systematic tendencies such as homophily or role based interactions.

To address this, the configuration model was used to isolate structural tendencies. This approach confirmed that transitivity, assortativity, and path length in the empirical networks differ from what would be expected by chance alone. However, the configuration model only highlights deviations from randomness and does not indicate which node level attributes drive community formations.

To uncover subgroups influenced by such attributes, undirected Leiden community detection was applied to the aggregated network. This revealed that office location dominates community structure, with practice area contributing moderately, and status playing a minimal role. However, this approach required collapsing the directed advice network into an undirected graph to make it compatible with coworking and friendship ties. This trade-off limited the ability to model the clear directional nature of advice, which could have provided a more nuanced view of hierarchy and information flow.

To statistically evaluate which attributes and structural features predict tie formation, ERGMs were employed. These confirmed that office homophily is the strongest predictor of advice ties (odds ratio = 5.419),

followed by practice alignment and partner status. These results support the idea that physical proximity and shared expertise drive most relational patterns. However, goodness-of-fit diagnostics revealed that the model explains who connects based on shared attributes, but not fully how ties form through indirect paths or shared contacts.

Findings on triadic closure, reciprocity, and the role of proximity in coworking and advice ties can generalise to other knowledge intensive professions where collaboration and expert consultation are required. Similarly, homophily in friendship networks based on shared age, gender, and status is broadly applicable across contexts. However, the geographic divide between Massachusetts and Hartford, in Conneticut appears firm-specific, producing three distinct communities unlikely to occur in other organisations. The distinct partner associate hierarchy reflects the U.S. law firm structure and may not apply in non-US organisations. Likewise, the practice area clustering mirrors this firm's legal subcultures and may differ in industries such as marketing or consultanacy with more specialisations. Future models could test how office distance or attribute interactions influence tie formation more generally.

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