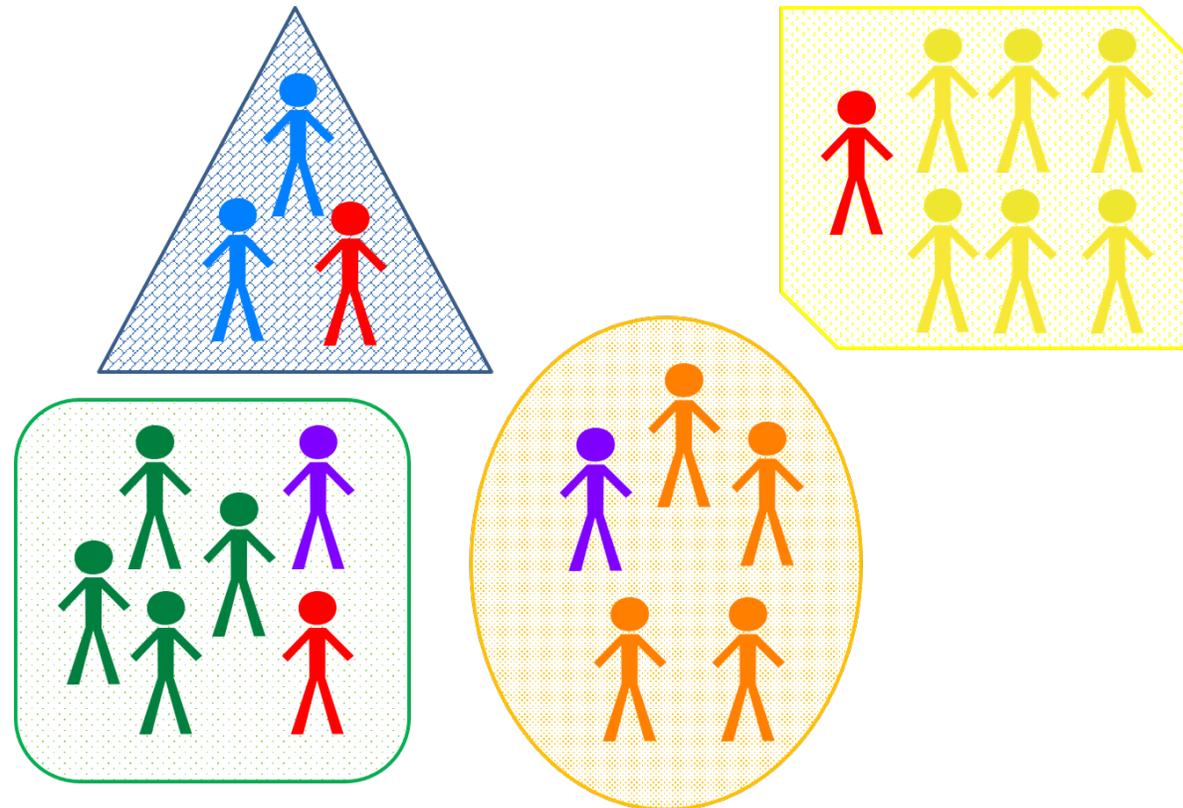


NETWORK STRUCTURE AND AUDITOR COMPENSATION: EVIDENCE FROM A BIPARTITE NETWORK

**Deju (James) Zhang, Reggy Hooghiemstra,
Floor Rink , Dennis Veltrop**
University of Groningen



BROADER SCOPE OF OUR PROJECT



BROADER SCOPE OF OUR PROJECT

- MTMs are a double-edged sword
 - **Demands of MTMs**
 - Task-related demands
 - Time-schedule conflicts
 - Switching costs (relocation and coordination)
 - Increased workload and time pressure
 - Social demands
 - Teams may be less socially coherent
 - Requires more effort/time to familiarize oneself with one's role in the team
 - Group incompatible roles (i.e. role overload, conflict, ambiguity) decrease employee functioning and performance
 - **Resources of MTMs**



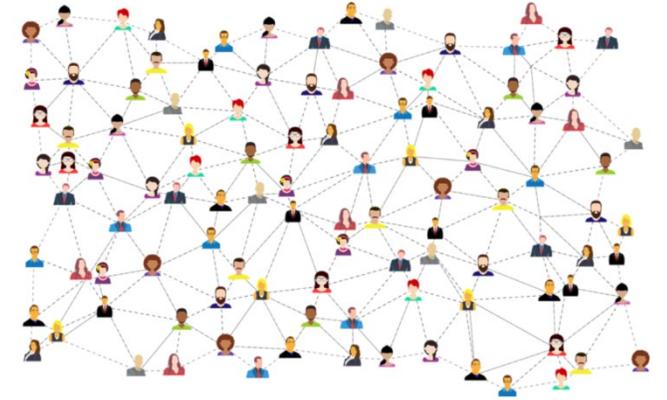
BROADER SCOPE OF OUR PROJECT



- MTMs are a double-edged sword
 - **MTMs as resource**
 - Networks of information, experiences and knowledge (O’Leary et al. 2011; 2012)
 - Learning including learning about how to develop more efficient work habits/routines (e.g., O’Leary et al. 2011 ; Van de Brake et al. 2018; Pluut et al. 2014)
 - Potentially more variety in tasks, social environment



TODAY'S PROJECT



- **MTM as resource**
 - Networks of information, experiences and knowledge (O'Leary et al. 2011; 2012)
 - Focus is on how an individual (non-partner) auditor's network and her compensation are associated
 - Today's project in a nutshell
 - Serving on multiple teams:
 - ... means that certain network structures are formed
 - ... these network structures facilitate interactions and knowledge sharing
 - ... individual auditors that have ties which are interconnected themselves benefit of them and show better performance
 - ... which will materialize into higher compensation



STRUCTURE OF PRESENTATION

- Prior studies on auditor compensation
- Social networks in auditing
- How are auditor compensation and social networks associated?
- Sampling and research design
- Main results
- (Some) robustness checks/sensitivity checks
- Conclusions and potential practical implications



AUDITOR COMPENSATION

- Auditor compensation has not been systematically studied due to a lack of data (e.g., Hoopes et al. 2018).
- Previous studies majorly focus on the determinants of partner compensation (Knechel et al. 2013; Bianchi et al. 2019; Vandenhoute et al. 2020)
- Hoopes et al. (2018): explorative study for determinants of audit personnel salaries using H-1B visa applications
- Our contribution to this emerging field:
 - Actual **non-partner** individual auditor compensation from personnel records
 - Role of the social network of individual auditors in explaining compensation



SOCIAL NETWORKS IN AUDITING

- “Social networks refer to patterns of relationships among actors in a system”
- “Social networks facilitate access to information, constitute a source of reward and punishment, and foster trust between individuals. As a result, they have the potential to affect economic outcomes (Granovetter 2005).”
- “Social networks are especially salient in the corporate environment, where sharing knowledge and interpersonal collaboration are key to decision-making.”
- A social network has three components:
 - Network consists of *nodes* that are connected through *ties*
 - Ties interconnect to form *paths*
 - Patterns of ties in the network has a structure and nodes’ positions within that structure matter



SOCIAL NETWORKS IN AUDITING

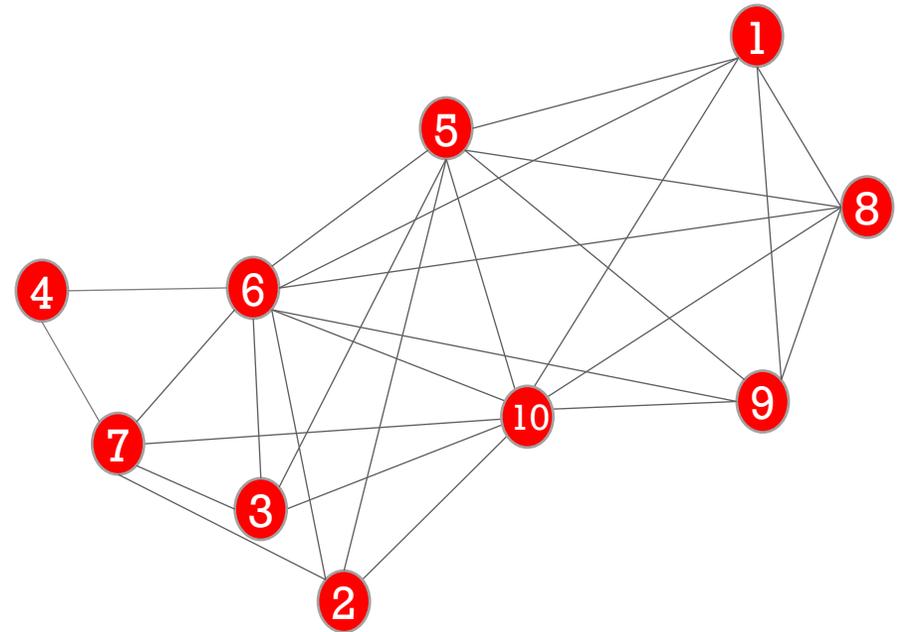
- One-mode networks



 = auditor

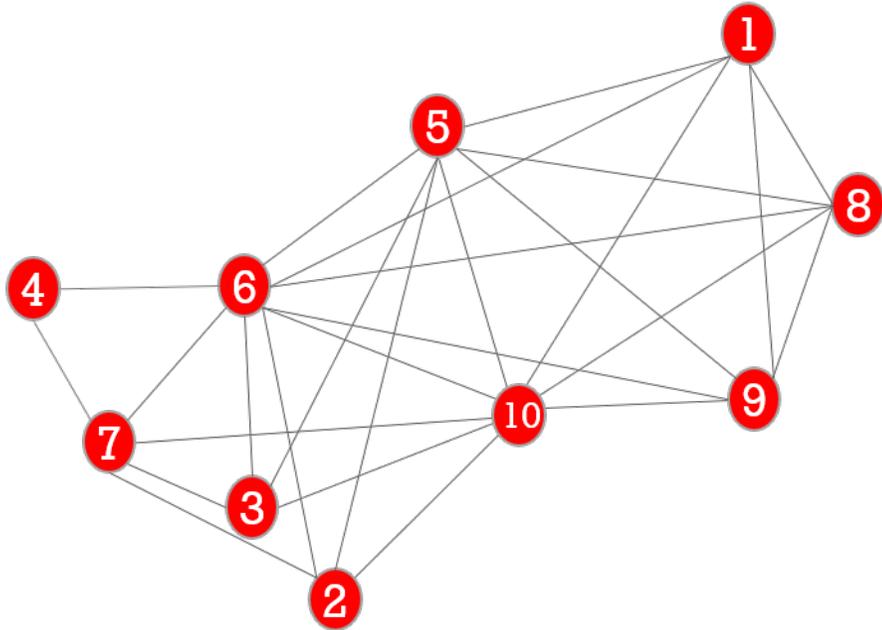
 = audit engagement

Current research: One-mode based on auditors



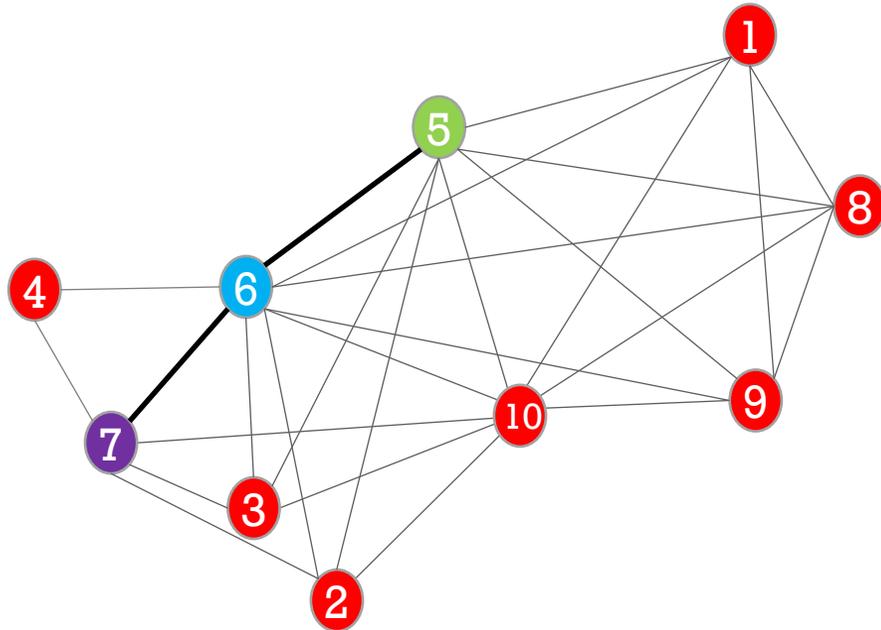
SOCIAL NETWORKS IN AUDITING

Current research: One-mode based on auditors

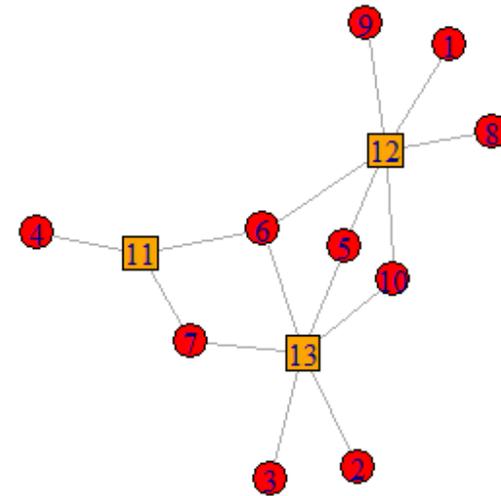


SOCIAL NETWORKS IN AUDITING

Current research: One-mode based on auditors



Our study: Two-mode networks

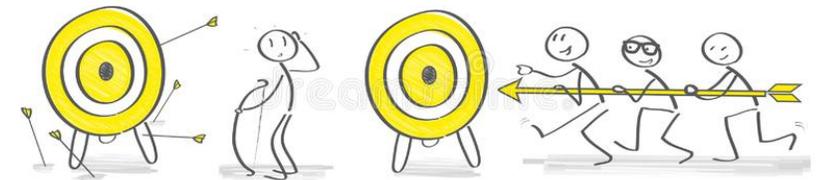


Note: This illustrates a two-mode network (i.e. bipartite network), consisting of two types of nodes, such as auditors (red nodes) and audit engagements (orange nodes).



SOCIAL NETWORKS IN AUDITING

- Auditors are assigned to different engagements where they meet other auditors inherently given rise to a (bi-partite) network
- **Feature 1:** Auditing depends on auditor interactions and knowledge sharing
 - Think of impairment judgments
 - Knowledge sharing is necessary to deliver high audit quality (e.g., Nelson and Tan 2005; Bianchi 2018)
 - Mostly is tacit audit knowledge (e.g., Vera-Muñoz et al. 2006; Bol et al. 2018; Causholli et al. 2021) referring to deeper understanding, knowledge that is developed experientially, and cannot be codified or communicated explicitly (Athanassiou and Nigh 1999)
- **Feature 2:** Duality of auditors and audit engagements
 - Shared team memberships help develop trust among team members
 - Working on the same engagement fosters goal achievement
 - Reinforce interactions and knowledge sharing



SOCIAL NETWORKS IN AUDITING

- Our study assumes the “Capitalization” view (Bianchi et al. 2020) implying that we:
 - (a) Focus on the benefits of social position in a network and emphasize the opportunities for an actor resulting from his/her social ties, and
 - (b) Assume the “network flow model” which highlights that connections between actors act as conduits for information, and that auditors that have more interconnected ties are likely to receive and use information sooner.

Indeed: strong ties:

- promote cooperation and coordination (Schilling and Phelps 2007; Uzzi and Spiro 2005; Phelps 2010)
- enhance trust and reciprocity among each other (Coleman 1988; Hansen 1999)

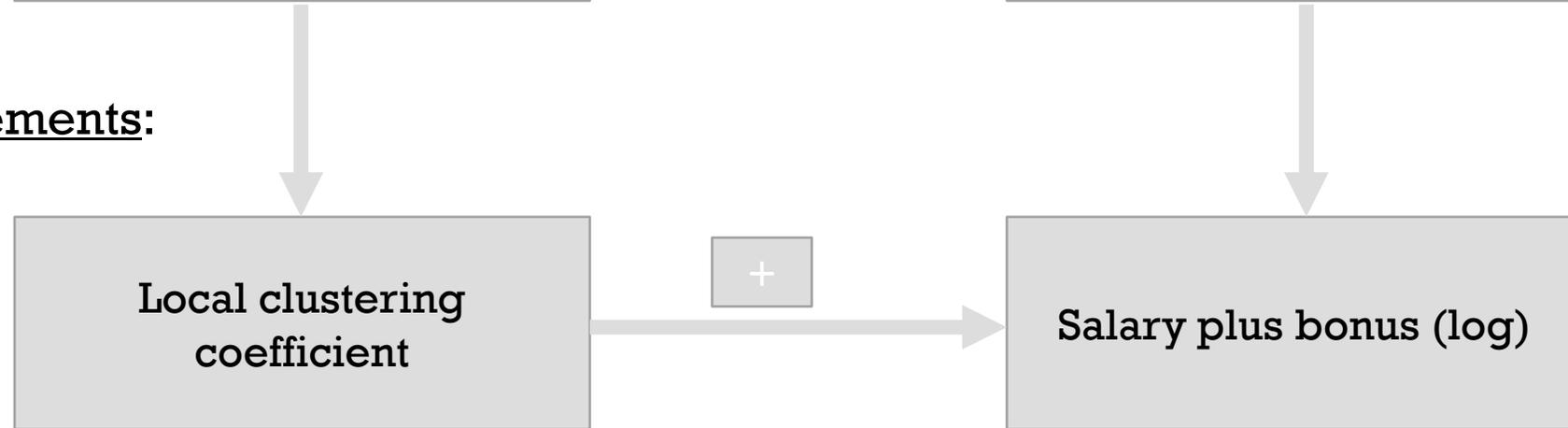


HYPOTHESIS

- Theoretical Constructs:



- Measurements:

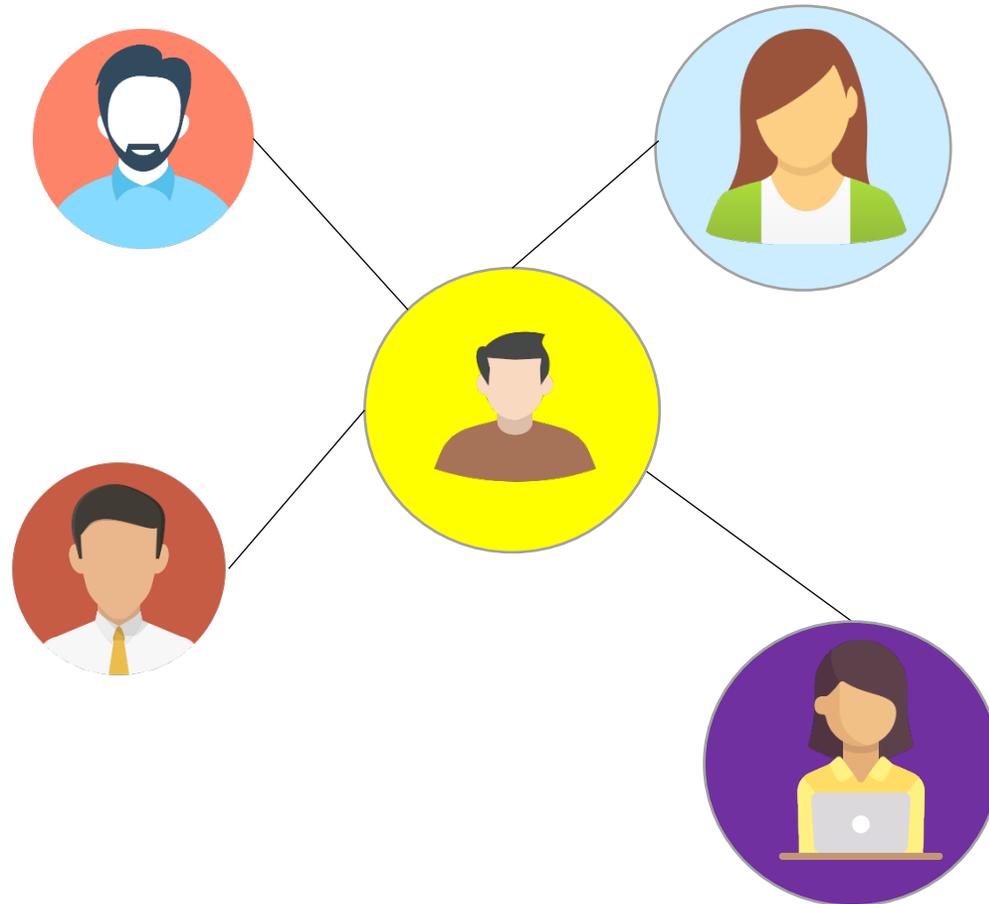


ILLUSTRATING CLUSTERING . . .

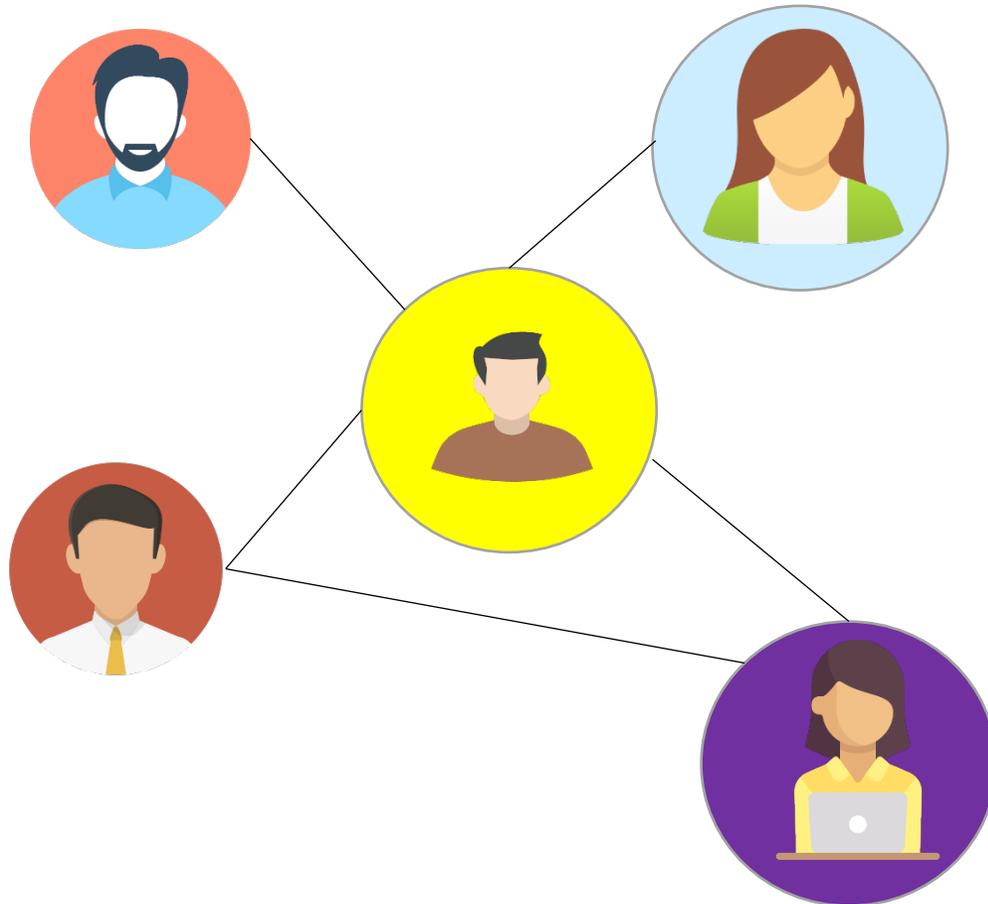
- Social network analysis shows nodes' tendency to cluster together. That is, in most real-world networks, and especially in social networks, nodes cluster into densely connected groups (Holland and Leinhardt, 1970; Opsahl and Panzarasa, 2009).
- A number of measures have been developed for testing this tendency. Specifically, the global clustering coefficient assesses the overall level of clustering in a network (Luce and Perry, 1949), and the **local clustering coefficient** assesses the clustering in a single node's immediate network (i.e., the node and its contacts; Watts and Strogatz, 1998).
- Simply put:
 - To what extent are nodes interconnected to each other or are they isolated?
 - A measure of embeddedness in the network. Or, "the density in a node's local network" (Opsahl, 2013)



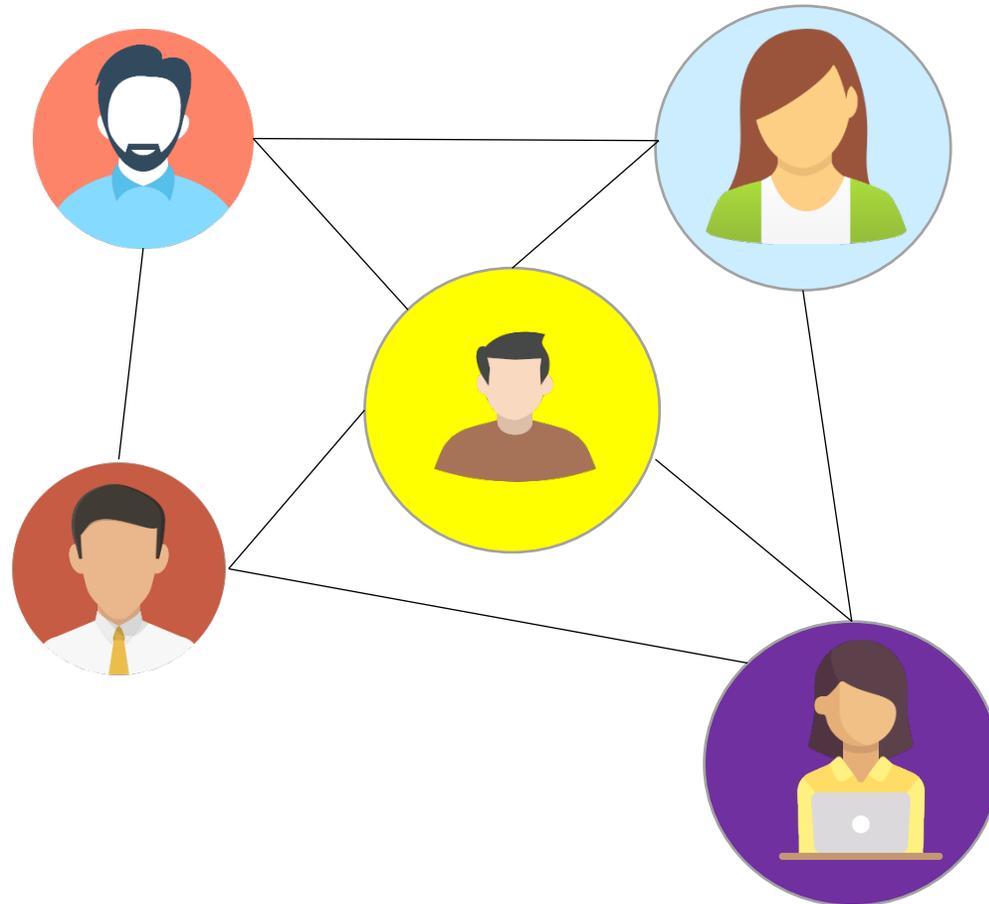
ILLUSTRATING DIFFERENCES IN CLUSTERING ...



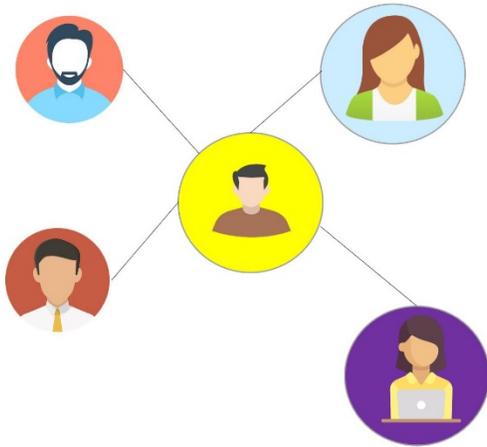
ILLUSTRATING DIFFERENCES IN CLUSTERING ...



ILLUSTRATING DIFFERENCES IN CLUSTERING ...



THE CLUSTERING COEFFICIENT (MAIN IDEA)



L.C.C. = 0



L.C.C. = 0



L.C.C. = 1/6

L.C.C. = 1/1



L.C.C. = 4/6

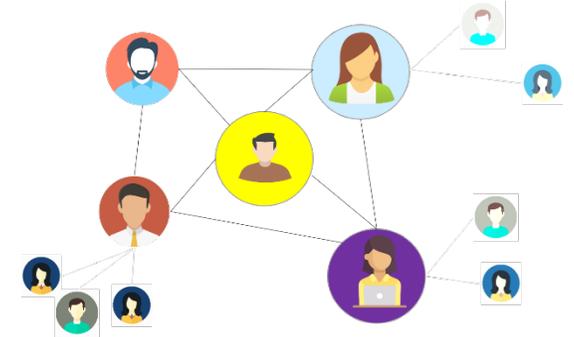
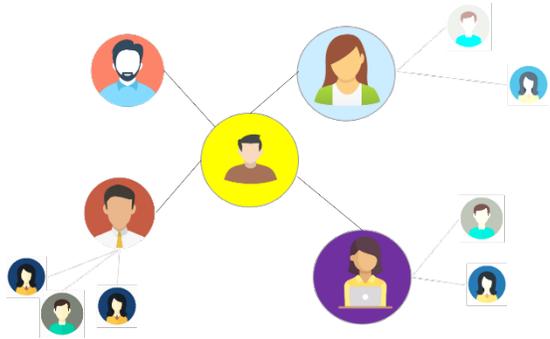
L.C.C. = 2/3



ADDING SOME COMPLEXITY ...



THE CLUSTERING COEFFICIENT, NOW IS ...



L.C.C. = 0

L.C.C. = 1/6

L.C.C. = 4/6



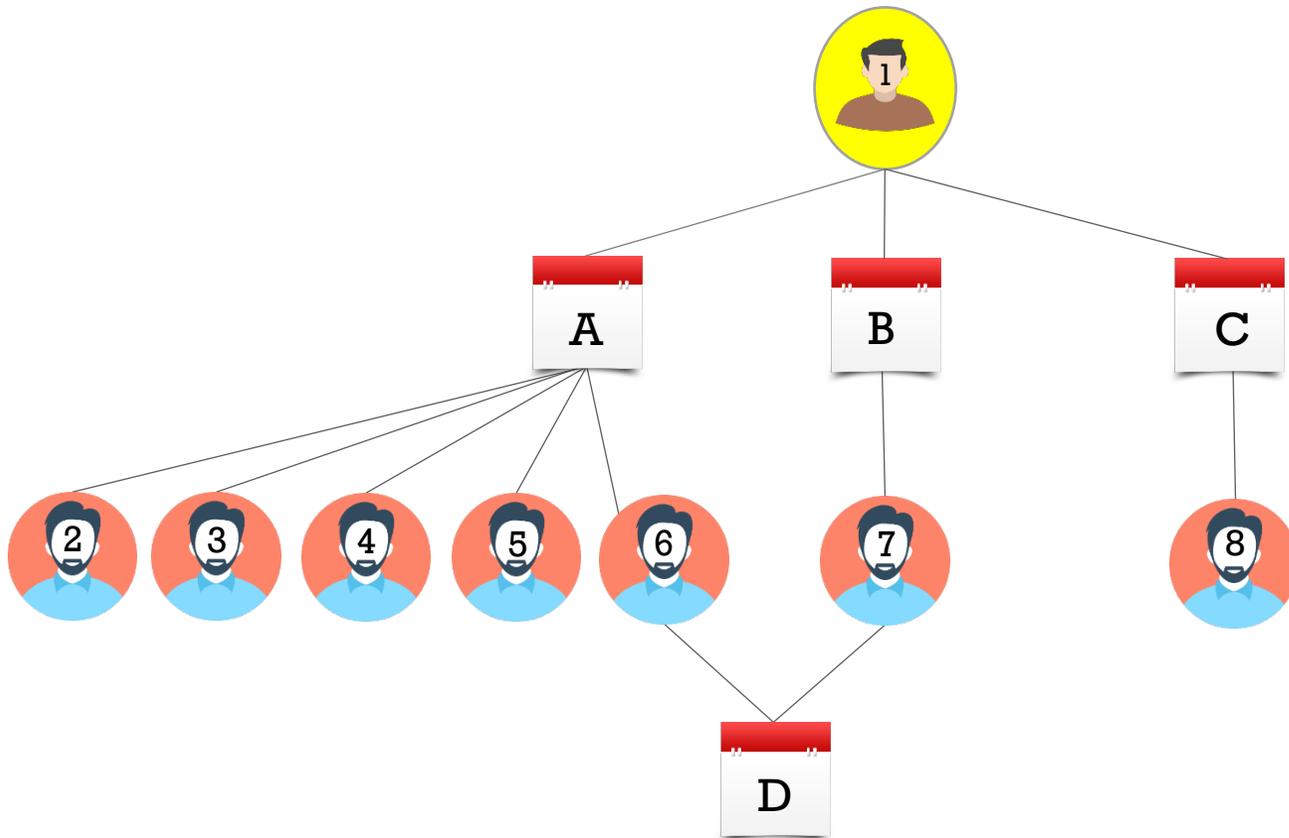
L.C.C. = 0

L.C.C. = 1/10

L.C.C. = 2/15



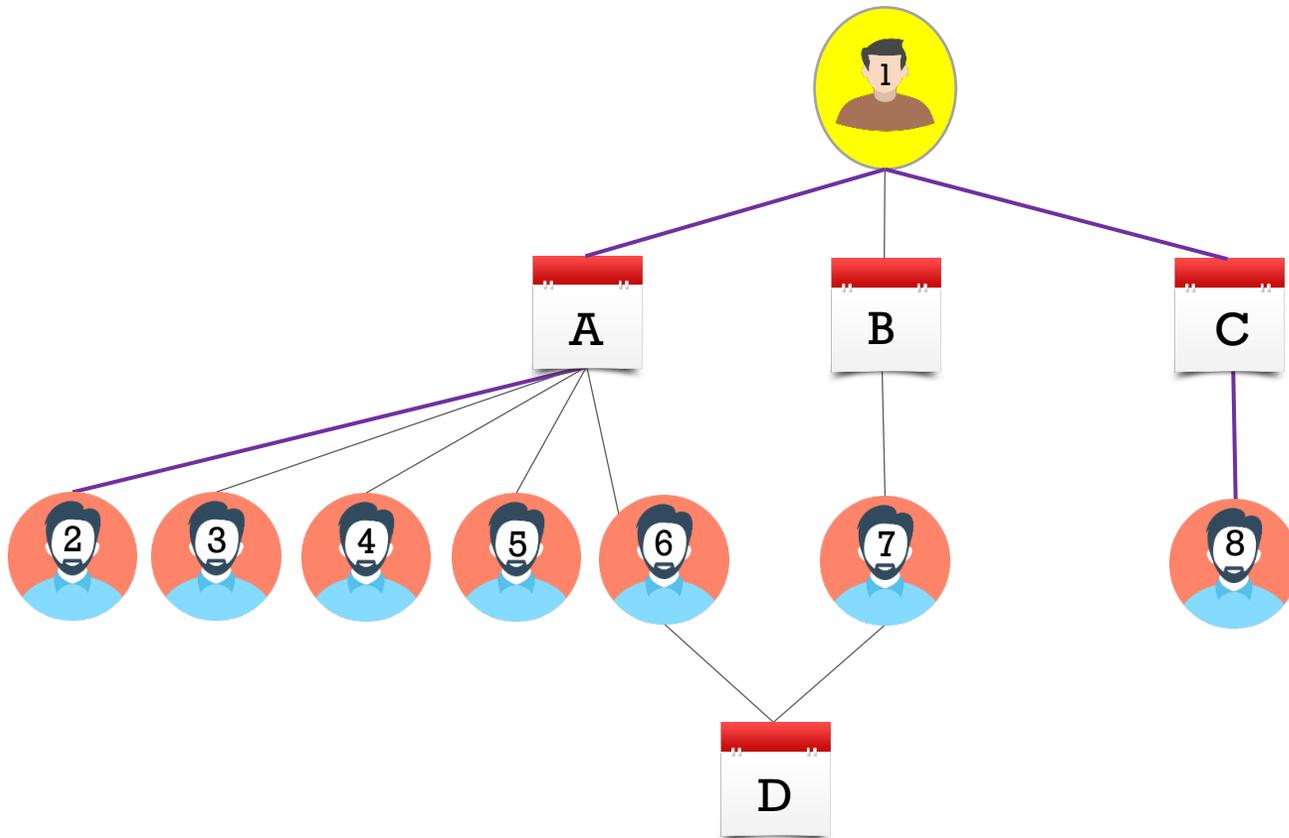
THE CLUSTERING COEFFICIENT ... BI-PARTITE



$$\text{L.C.C.} = \frac{\text{closed 4-paths centered on 1}}{\text{all 4-paths centered on 1}}$$



THE CLUSTERING COEFFICIENT ... BI-PARTITE



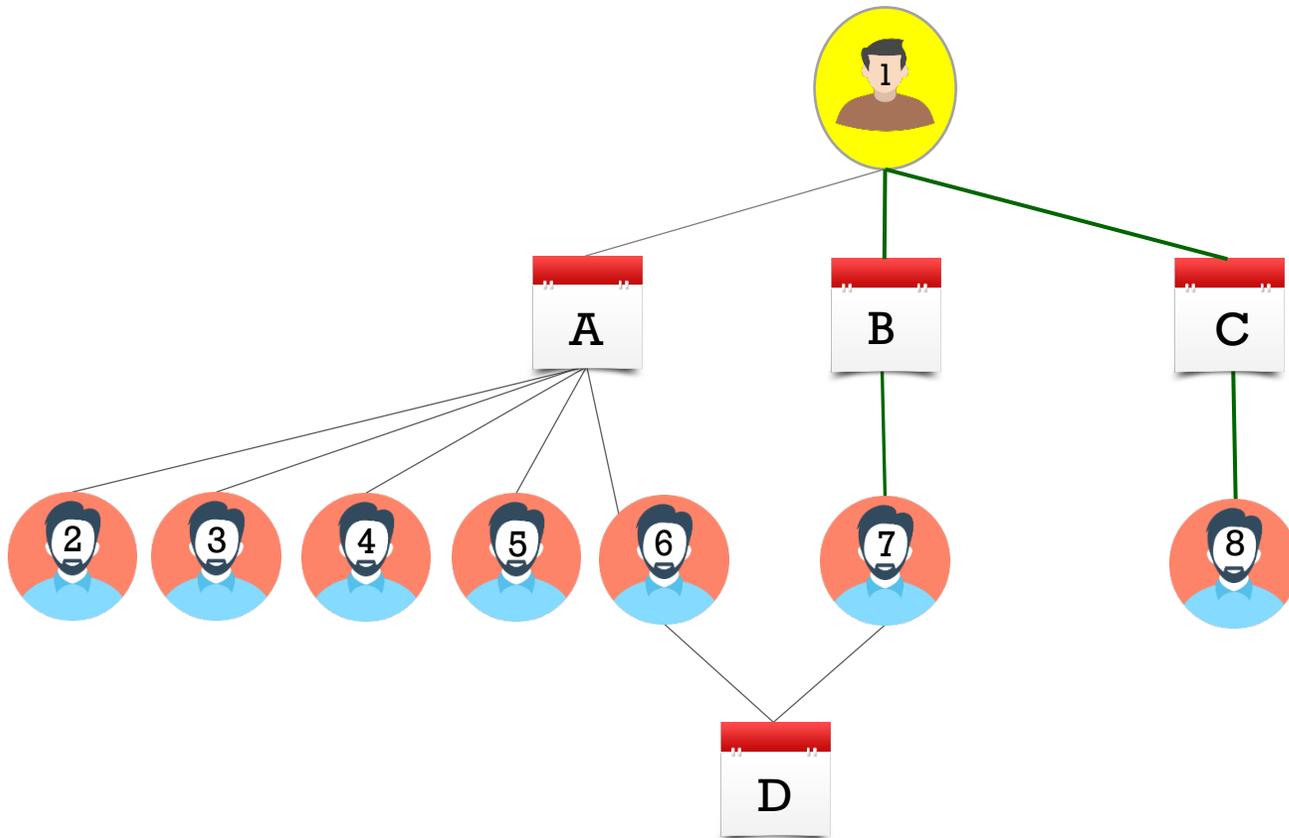
$$\text{L.C.C.} = \frac{\text{closed 4-paths centered on 1}}{\text{all 4-paths centered on 1}}$$

— = 5 4-paths with  in center

— = 5 4-paths with  in center



THE CLUSTERING COEFFICIENT ... BI-PARTITE

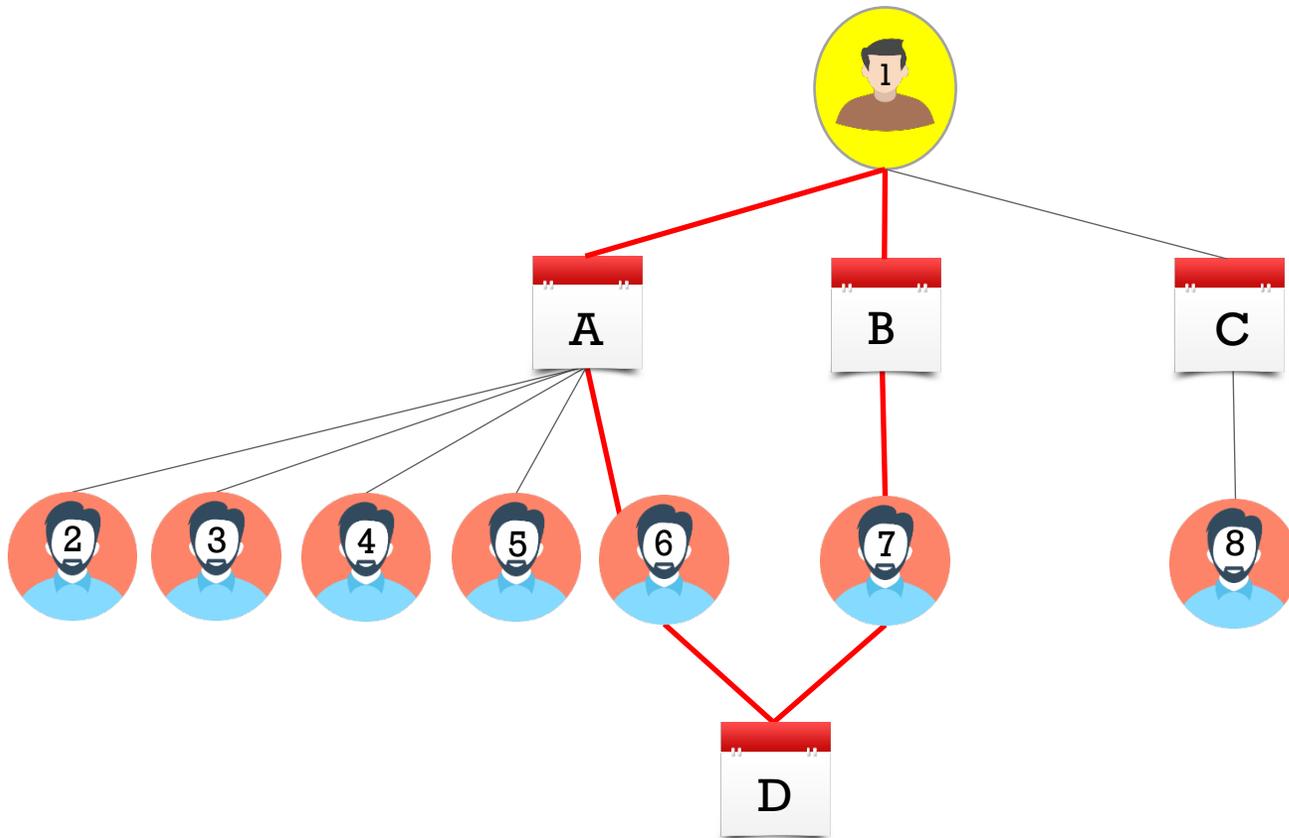


$$\text{L.C.C.} = \frac{\text{closed 4-paths centered on 1}}{\text{all 4-paths centered on 1}}$$

- = 5 4-paths with  in center
- = 5 4-paths with  in center
- = 1 4-paths with  in center



THE CLUSTERING COEFFICIENT ... BI-PARTITE



$$\text{L.C.C.} = \frac{\text{closed 4-paths centered on 1}}{\text{all 4-paths centered on 1}}$$

$$\text{L.C.C.} = \frac{1}{11} = 0,0909$$



CLUSTERING IN PRACTICE

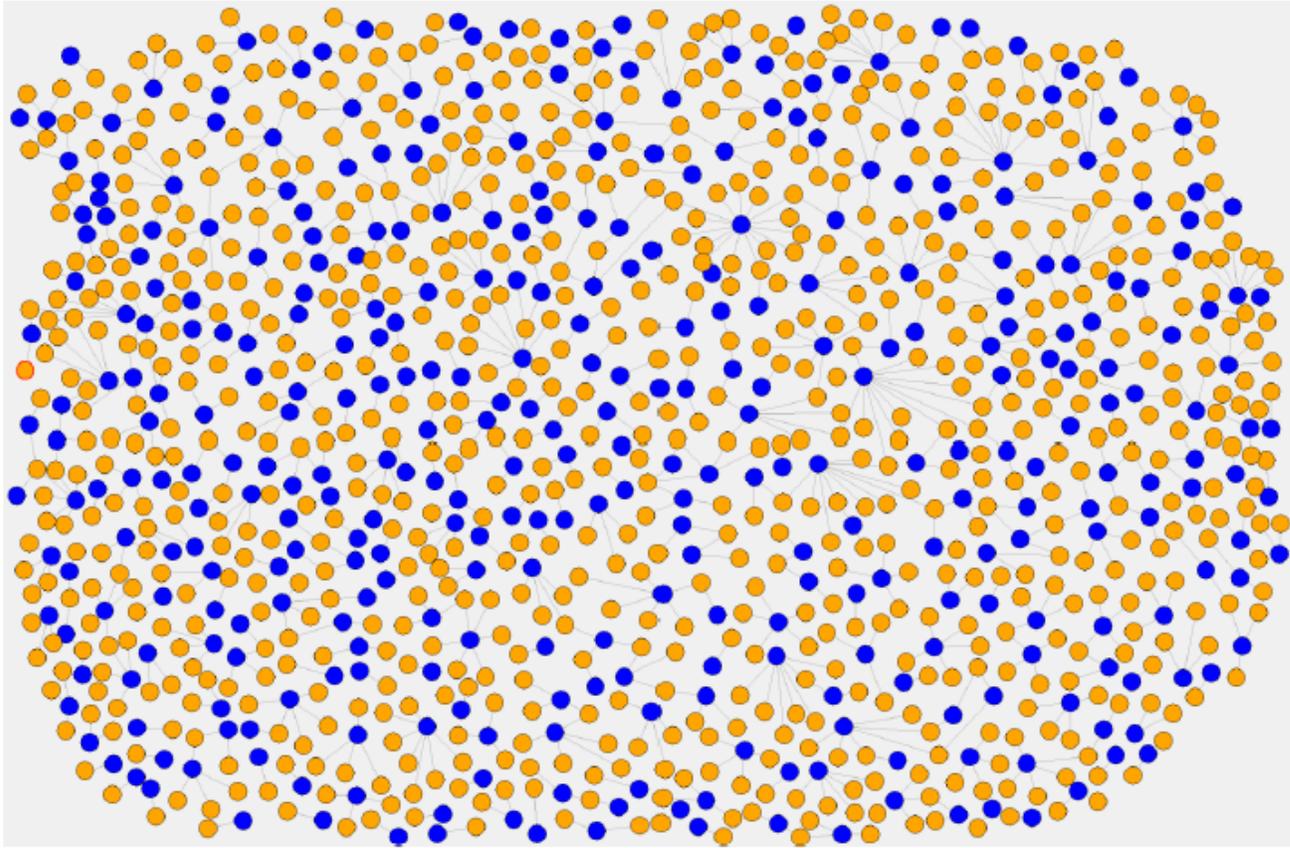


Fig. 2. This figure shows a network illustration from our data. For illustrative reason, we randomly select 900 auditor-engagement links, around 10% of the total links. We can see from this graph that auditors are embedded within audit engagements, and tacit audit knowledge may be transmitted through auditors sharing and changing audit engagements.



SAMPLE AND RESEARCH DESIGN

Sample

Data source: a Dutch audit firm

N=365 (97 assistants, 160 seniors, 50 managers, 37 senior managers and 21 directors)

Booked hours for each auditor as weights for network construction

Research Design

Determinants of wages in labor economics: *Mincer equation*

Key Variables

Dependent Variable: Auditor Compensation

Independent Variables: *Clustering*, *Clustering_{am}* (clustering under arithmetic mean of weights), *Clustering_{gm}* (clustering under geometric mean of weights), *Clustering_{ma}* (clustering under the maximum of weights), *Clustering_{mi}* (clustering under the minimum of weights)



MAIN RESULTS

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Clustering	0.095	2.82**								
Clustering_am			0.099	2.95**						
Clustering_gm					0.096	3.06**				
Clustering_ma							0.100	2.95**		
Clustering_mi									0.086	3.06**

Notes: This table reports the OLS output under different measures of clustering coefficients from the bipartite network. All controls are omitted for space consideration. Across all models, **Rank, Age, Age Squared, Tenure, CPA_Dummy** are all significant predictors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.



ROBUSTNESS CHECKS

- **Check 1: Alternative measure of clustering**

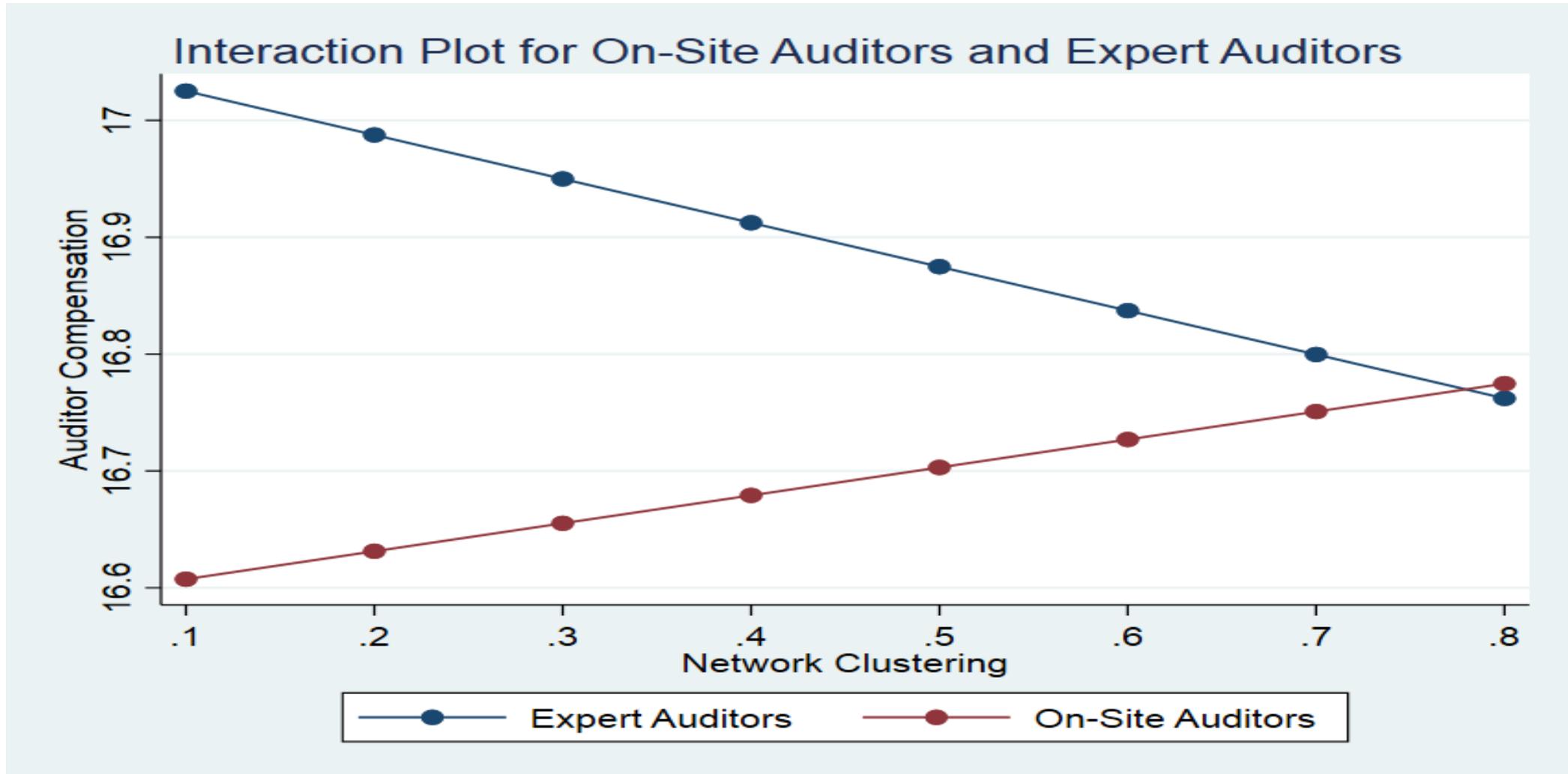
- Previous method: Project a two-mode network into a one-mode network (e.g. Newman 2001)

- **Check 2: Alternative explanation for centrality measures**

- Our results are robust to betweenness, degree, and closeness centrality measures



ADDITIONAL ANALYSES



SUPPLEMENTAL ANALYSES

- **1: Survey Evidence to validate clustering proxy**
 - “task variety compared with other engagement teams” (Likert-Scale 1-7; mean = 4.54, S.D. = 0.98)
 - “job relational learning” (Likert-Scale 1-7; mean = 5.63, S.D. = 0.85)

- **2: Mechanism of Performance Evaluations**
 - Results suggest that clustering coefficients is positively associated with auditor performance, which is significantly associated with auditor compensation for SENIORS and MANAGERS.



KEY CONTRIBUTIONS

1. The determinant of auditor (i.e., non-partner) compensation: tacit knowledge transfer from embedded network, especially beneficial for on-site auditors (assistants, seniors and managers)
2. Social Network Analysis to extend audit studies in auditor interactions and knowledge sharing, using a novel measure of clustering
3. Auditor/work characteristics and audit outcomes

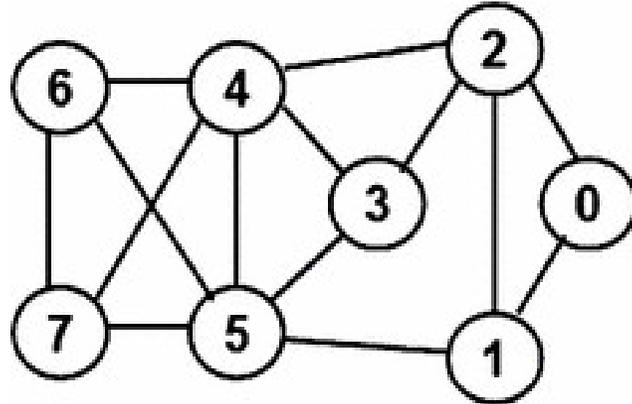


PRACTICAL IMPLICATIONS

1. Formal structure *has* important implications for performance (and, hence, most likely, audit quality)
2. Keep in mind effects of staffing decisions:
 - Especially at lower levels auditors (and typically seniors) benefit from sitting on multiple teams. This warrants against too early specialization
 - Important to keep in mind when deciding on promotion and bonuses. Performance of lower-level auditors also seem to depend on *possibility* of sitting on multiple teams







Vertex ID, v_i	Degree (k_i) Centrality	Local Clustering Coefficient, LCC
0	2	1.0
1	3	0.33
2	4	0.33
3	3	0.67
4	5	0.5
5	5	0.4
6	3	1.0
7	3	1.0

