Network Formation with Limited Foresight

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Dominik Morbitzer & Vincent Buskens

Department of Sociology / ICS
Utrecht University

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Introduction

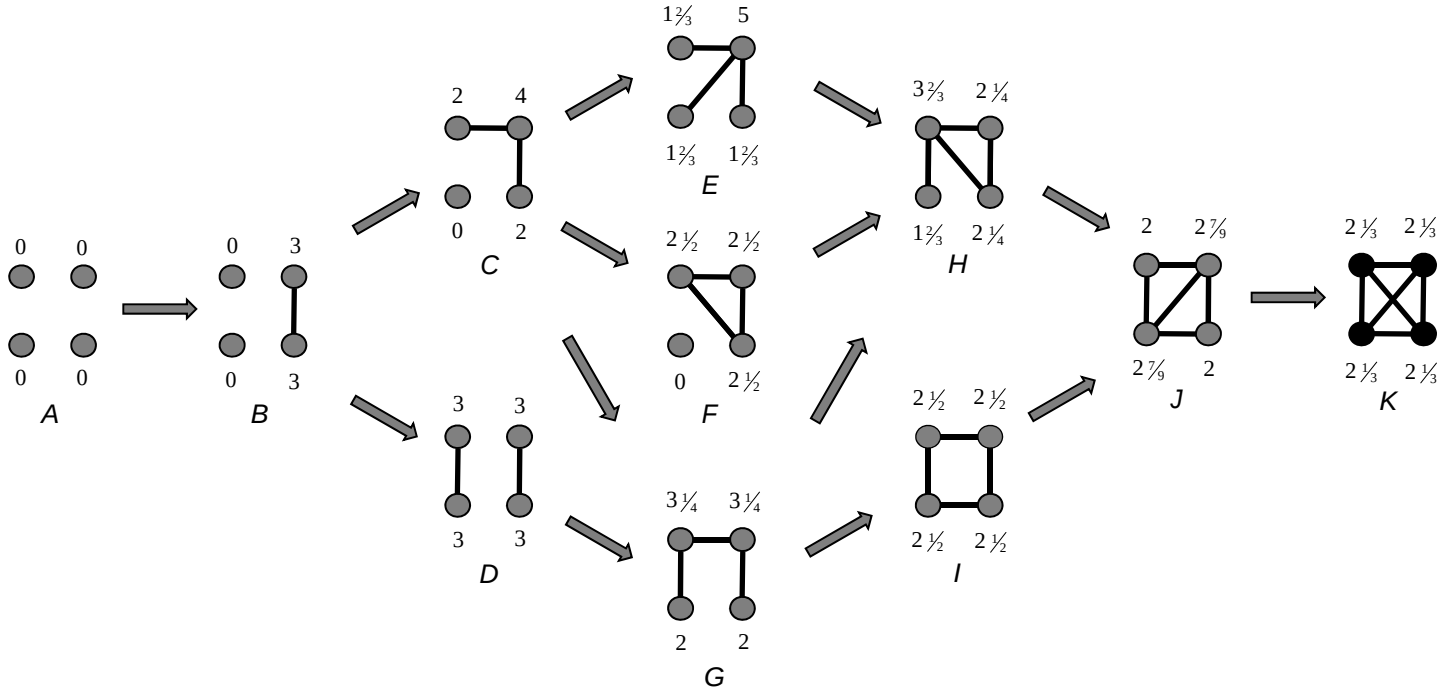
- In order to understand the different characteristics observed in real-world networks, one needs to analyze how and why networks form, the impact of network structure on agents' outcomes, and the evolution of networks over time
- Models of network formation in several disciplines try to model these processes

- Examples:
  - Co-authorship in research
  - Collaborations among firms
  - Friendship relations

Models of Strategic Network Formation

- Actors realize that certain network positions are beneficial and choose their relations to optimize their benefits
- Jackson & Wolinsky (1996) consider network formation as a dynamic process in which pairs of actors sequentially decide whether to change their relations or not
- A network is considered stable if no actor wants to delete a link and no pair of actors wants to add a link
- Most models assume that actors are making these decisions myopically, meaning that they only look at their immediate network gains and neglect subsequent network changes
- However predictions of these models give unrealistic predictions and also fail in experimental tests

Metanetwork of Network Formation



Payoff from co-author model (Jackson & Wolinsky 1996): $u_i(g) = \sum_{j:ij \in g} \left[\frac{1}{n_i} + \frac{1}{n_j} + \frac{1}{n_i n_j} \right]$

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Farsightedness in Models of Network Formation

- *Perfect* Foresight (Page et al. 2005; Dutta et al. 2005; Herings et al. 2009; Pantz 2006) can be also considered an implausible assumption
- *Limited* Foresight (Berninghaus et al. 2008)
- Evidence of *limited* farsightedness from experimental research e.g. in behavioral game theory (Camerer 2003)
- People are heterogeneous in looking ahead

The Beauty Contest Game

- People have to choose numbers between 0 and 100. The number closest to some proportion *p* of the average number chosen wins the prize
- Results indicate that most people use between 1 and 2 steps of iterated reasoning
- Foreseeing reactions of others in network situations different compared to here
- Starting point of the model: Thinking one step ahead!

Looking One Step Ahead: Model Assumptions

- Networks form dynamically over time
- In each round one pair of actors decides whether or not to create or break a link
- Actors anticipate on (myopic) reactions of other network actors and themselves
- Actors can anticipate on reactions from actors with whom they are connected (own ties), that are in their local network (local) and all actors in the network (global)
- As expected benefits, actors can look at the minimum value, maximum value and mean value of possible network positions

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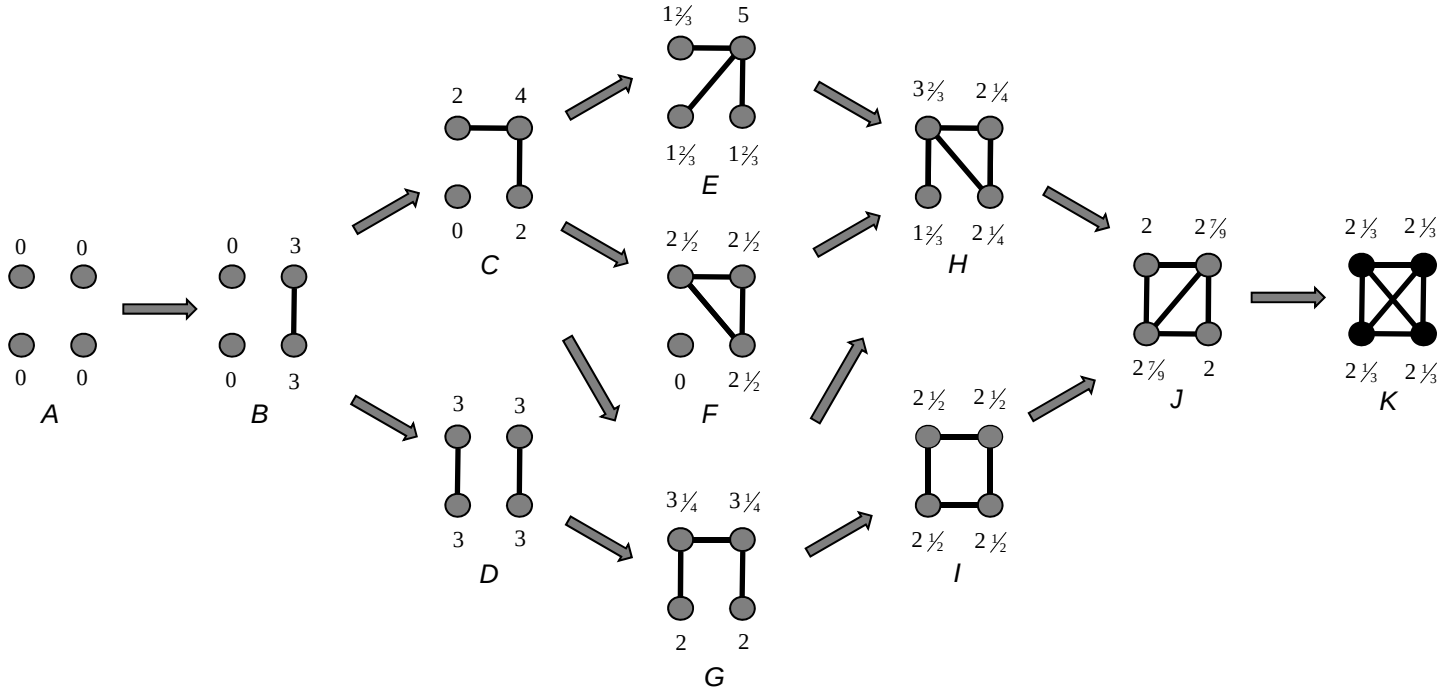

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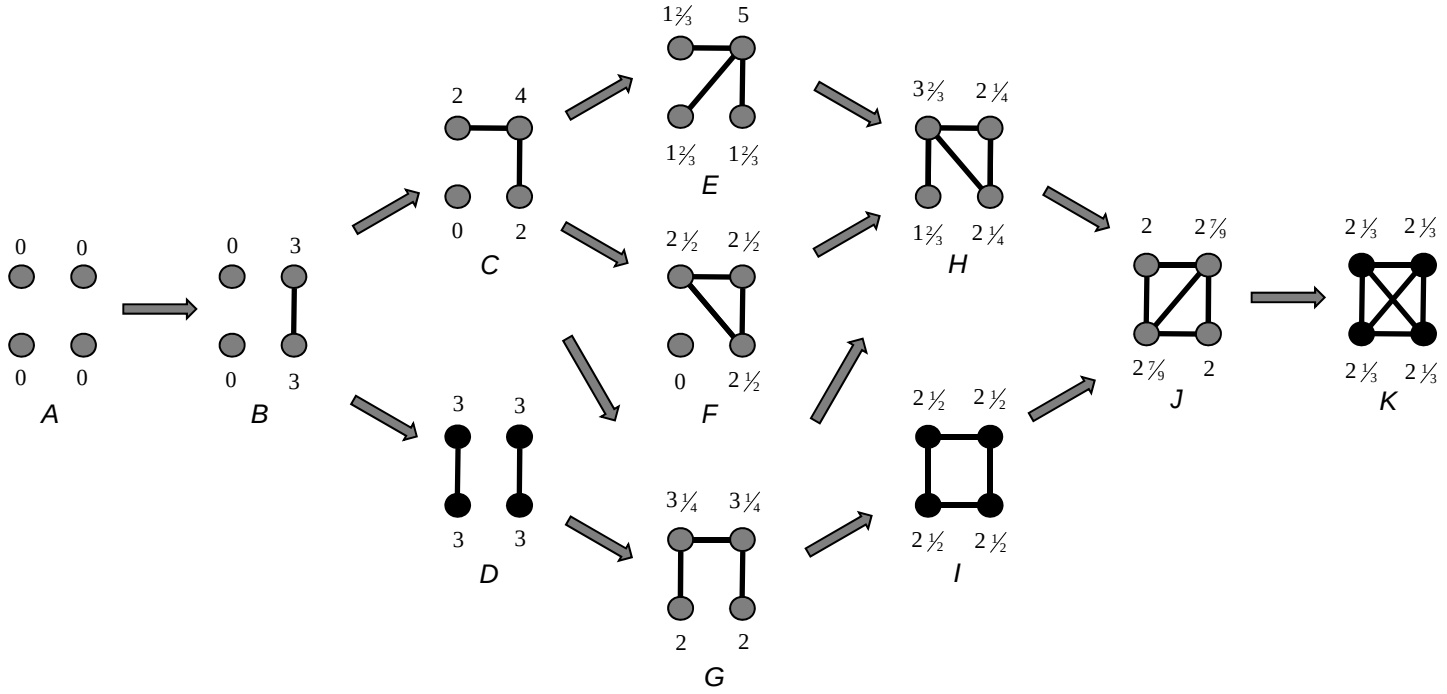

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Simulation results from the co-author model

Number of stable networks (with global/local information)

Size	PS	FLPS(min)	FLPS(mean)	FLPS(max)
2	1	1	1	1
3	1	2	2	2
4	1	3	3	2
5	1	7	2	1
6	2	14	2	1
7	2	45	2	2
8	2	153	4	2

Simulation results from the co-author model

Likelihood of stable networks, myopic predictions

	n=2	n=3	n=4	n=5	n=6	n=7	n=8
myopic							
full	1.0	1.0	1.0	1.0	.99	.99	.99
dyad	1.0	--	--	--	--	--	--
other	--	--	--	--	.01	.01	0.1

Simulation results from the co-author model

Likelihood of stable networks, farsighted predictions

	n=2	n=3	n=4	n=5	n=6	n=7	n=8
min							
full	1.0	.50	.48	.54	.64	.75	.83
dyad	1.0	.50	.27	.09	.03	.01	.00
other	--	--	.25	.	.	.	.

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Simulation results from the co-author model

Likelihood of stable networks, farsighted predictions

	n=2	n=3	n=4	n=5	n=6	n=7	n=8
mean							
full	1.0	.50	.55	.91	.93	.99	.99
dyad	1.0	.50	.12	--	--	--	--
other	--	--	.33	.09	.07	.01	.01

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Simulation results from the co-author model

Likelihood of stable networks, farsighted predictions

	n=2	n=3	n=4	n=5	n=6	n=7	n=8
max							
full	1.0	.50	.29	1.0	1.0	.99	.99
dyad	1.0	.50	--	--	--	--	--
other	--	--	.71	--	--	.01	.01

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Simulation results from the co-author model

Scenario	Density	Average Payoff
Myopic	.998 (.036)	2.14 (.049)
FLPS(min)	.904 (.197)	2.19 (.104)
FLPS(mean)	.988 (.075)	2.16 (.068)
FLPS(max)	.959 (.125)	2.16 (.057)

Future Research

- Other utility functions
- Experimental tests for the new predictions
- Including heterogeneity into theoretical model based on observed distributions to calibrate predictions
- Considering heterogeneity in farsightedness and risk preferences

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Thank you for your attention!

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