‘Let’s Formalize Behavior’: The Early Adoption of Rational Choice Theories at the Cowles Commission, 1944-1965

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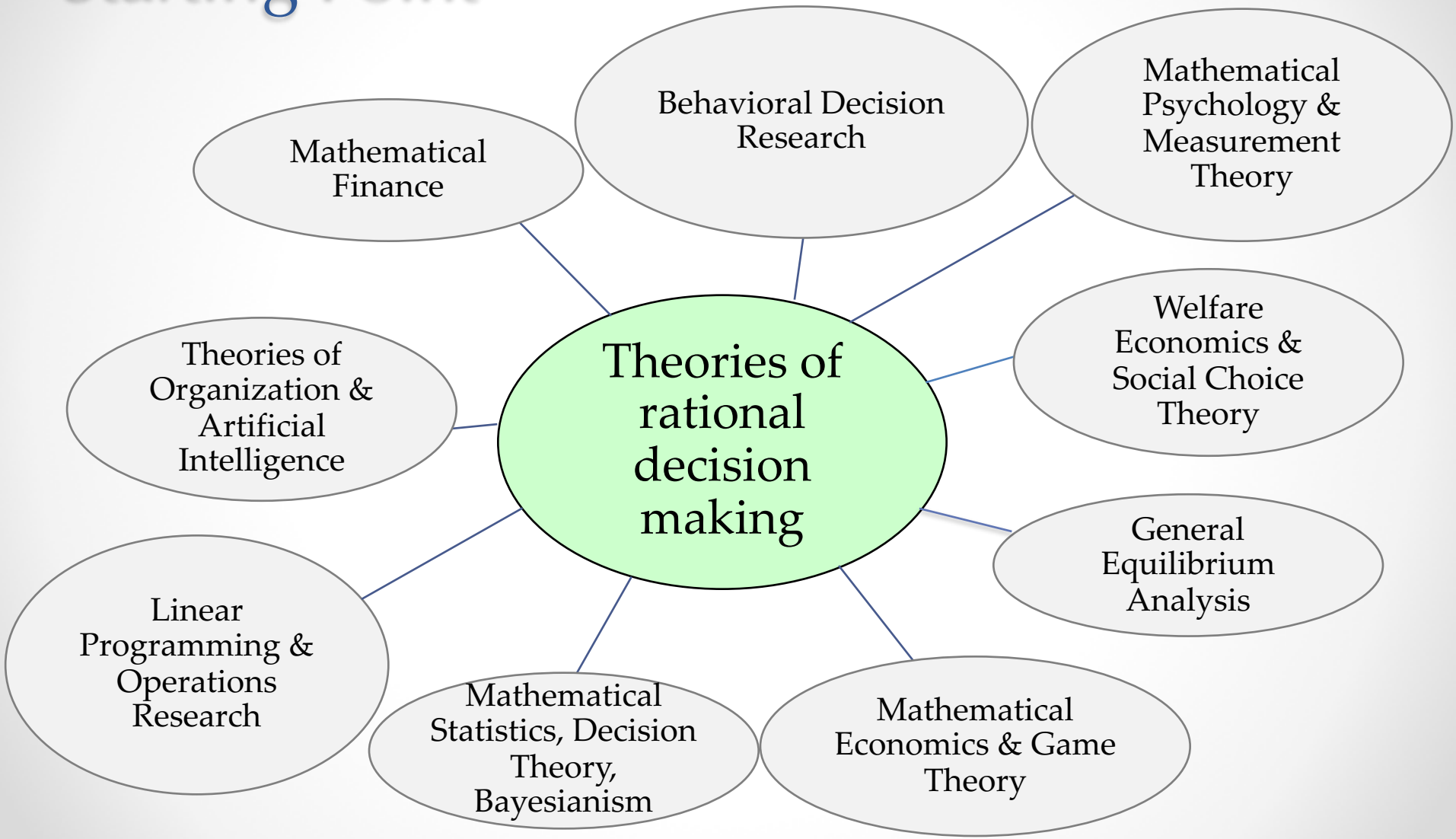
ASSA 2020

Starting Point



Starting Point

General objective of project

- Understand how rational choice theories (RCT) in general, and game theory in particular, was adopted in order to diffuse within and across scientific communities.

Scientific Innovation

Pioneers

- J. von Neumann and O. Morgenstern's *Theory of Games and Economic Behavior* (1944) (TGEB).

Innovation

- New mathematical tools (i.e. axiomatic method, theory of convex sets, theory of relations, topology) that would be applied across social sciences.

Contribution

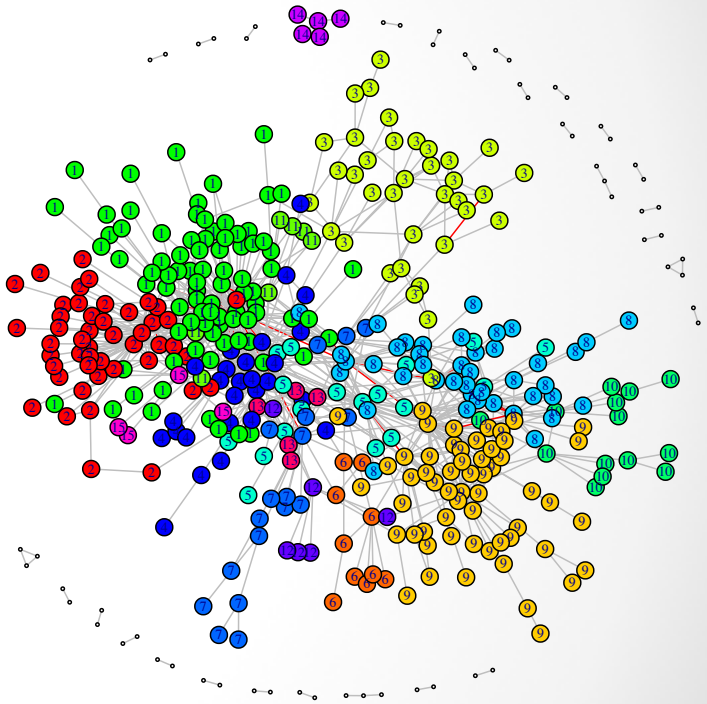
- Two concepts of rational decision-making:
  - Expected utility theory
  - Minimax theorem

Oskar Morgenstern and John von Neumann at Spring Lake, 1949.
Courtesy of the Institute for Advanced Study, Princeton.

Co-Citation Analysis

Research fields affected by RCT

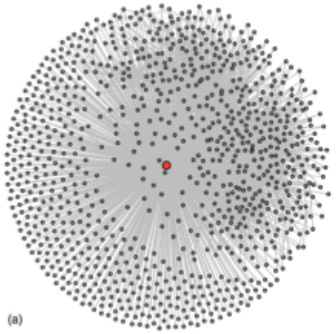
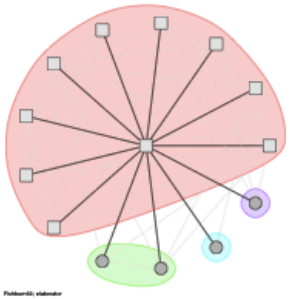
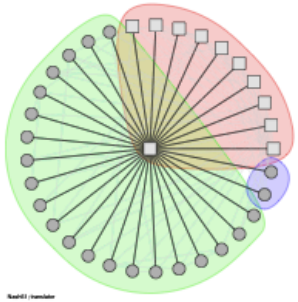
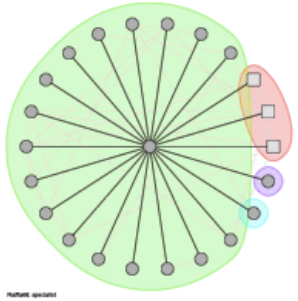
1. Foundations of statistics, decision theory, classics
2. Non-cooperative game theory, bargaining theory, cybernetics
3. Cooperative game theory, coalition formation, market games
4. Behavioral decision research, mathematical psychology
5. Stochastic decision theory, foundations of decision theory
6. Incomplete information, conventions
7. Theories of conflict and cooperation
8. Mathematical finance
9. Risk and uncertainty, measurement theory
10. Behavioral decision theory
11. Linear programming, operations research
12. Statistical decision theory
13. Economic theory of value
14. Evolutionary biology
15. General equilibrium analysis



442 nodes | 971 ties

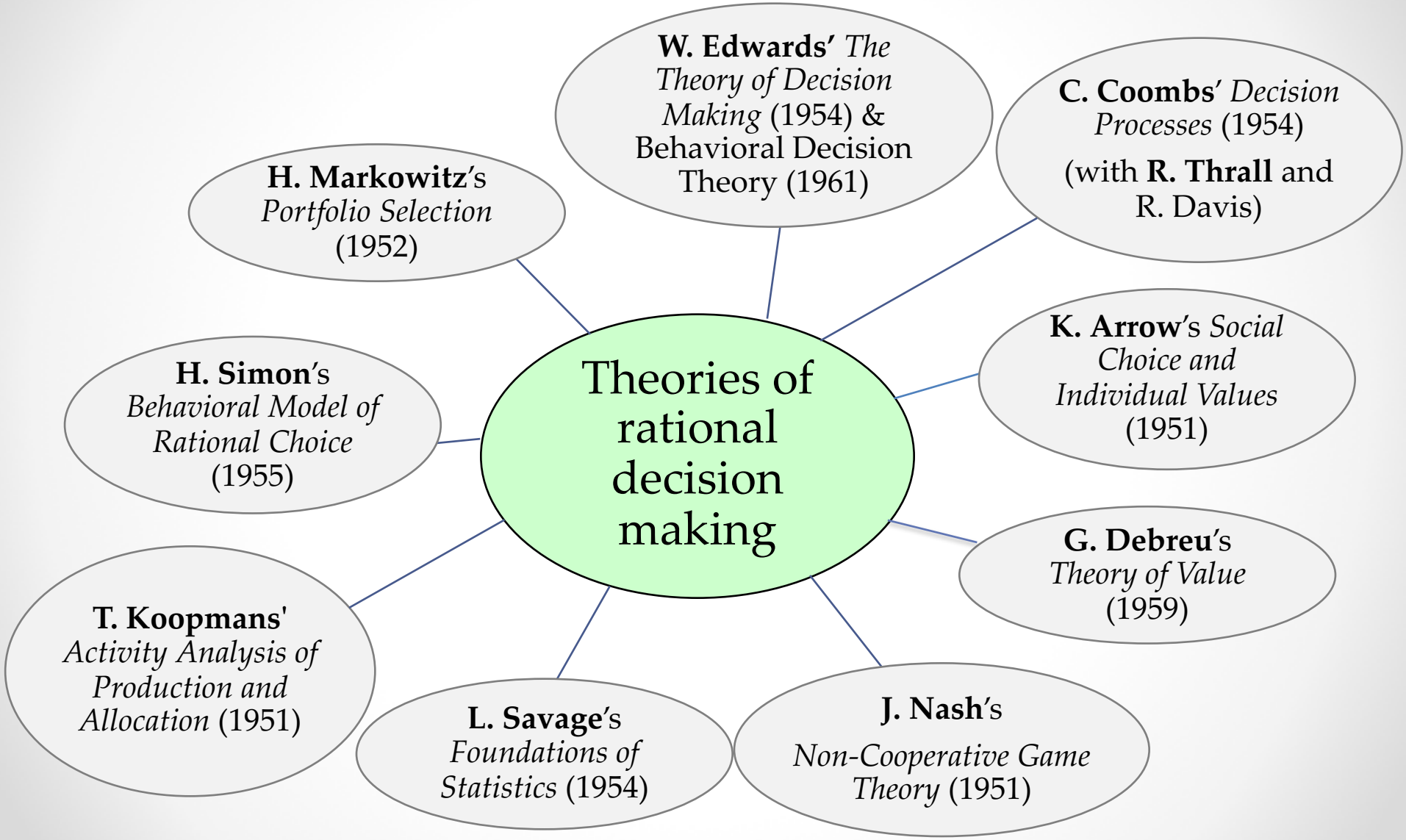
(Herfeld/Doehne 2018)

Role Typology

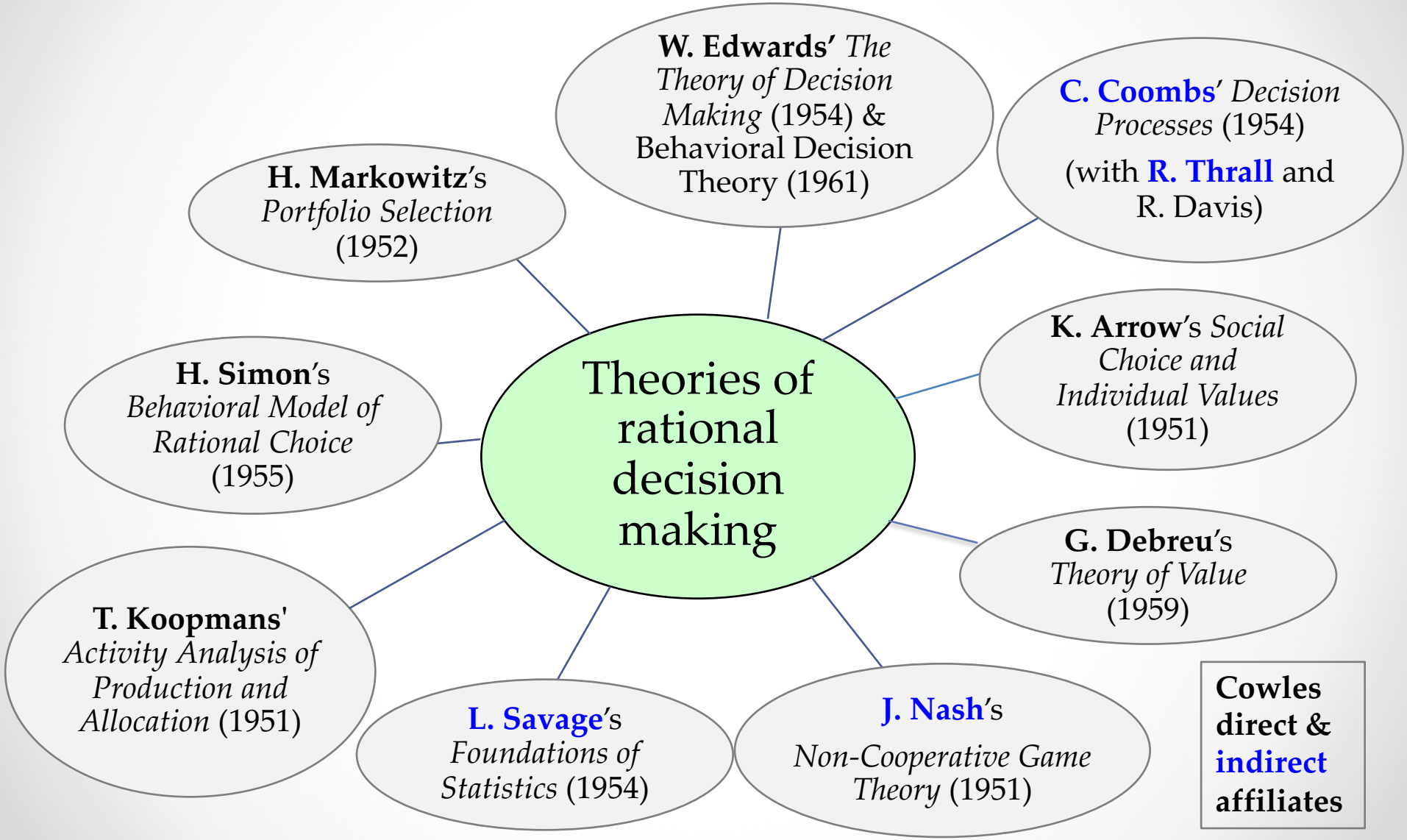
	Innovator	Elaborator	Translator	Specialist
Function	· Articulates innovation in way that motivates its elaboration.	· Adopts innovation and develops it further.	· Establishes bridge between elaborators and specialist.	· Uses translated innovation for doing "normal science".
Technical criterion	· Identified model-exogenously. · Starting point for data generation.	· Part of the epistemic core without connection to clusters.	· Connects epistemic core with a cluster. · Has highest degree centrality in its cluster.	· Not part of epistemic core. · Connected to at least half as many contributions in its cluster as translator.
Network representation				

(Herfeld/Doehne 2018)

Translators



Translators at Cowles



Reception of the *Theory of Games*

Reviews of the *Theory of Games* between 1944 and 1950

1.	M. G. Kendall	*Journal of the Royal Statistical Society*	1944	statistics
2.	N.N.	*Psychological Abstracts*	*1945*	psychology
3.	C. Chevalley	*View, The Modern Magazine*	1945	mathematics
4.	N.N.	*The Times Literary Supplement*	*1945*	mathematical
5.	H. A. Simon	*American Journal of Sociology*	1945	social sciences
6.	A. H. Copeland	*Bulletin of the American Mathematical Society*	1945	mathematics
7.	L. Hurwicz	*American Economic Review*	1945	economics
8.	D. Hawkins	*Philosophy of Science*	1945	philosophy
9.	R. W. Harrison	*Journal of Farm Economics*	*1945*	economics
10.	E. J. Gumbel	*Annals of the Am. Academy of Pol. and Soc. Sc.*	1945	social sciences
11.	W. E. Deming	*Journal of the American Statistical Association*	1945	statistics
12.	C. A. B. Smith	*The Mathematical Gazette*	1945	mathematics
13.	Ernest Nagel	*The Journal of Philosophy*	1945	philosophy
14.	Louis Weisner	*Science & Society*	1945	social sciences
15.	Louis O. Kattsoff	*Social Forces*	1945	social sciences
16.	Ben B. Seligman	*Commentary*	*1946*	(popular writing)
17.	J. Marschak	*Journal of Political Economy*	1946	economics
18.	T. Barna	*Economica*	1946	economics
19.	C. Kaysen	*Review of Economic Studies*	1946	economics
20.	L. Hurwicz	*Annals of Mathematical Statistics*	1947	mathematical statistics
21.	Abraham Wald	*Review of Economic Statistics*	1947	mathematical statistics
22.	J.R. N. Stone	*Economic Journal*	1948	economics

Reception of the *Theory of Games*

Cowles
direct & indirect
affiliates

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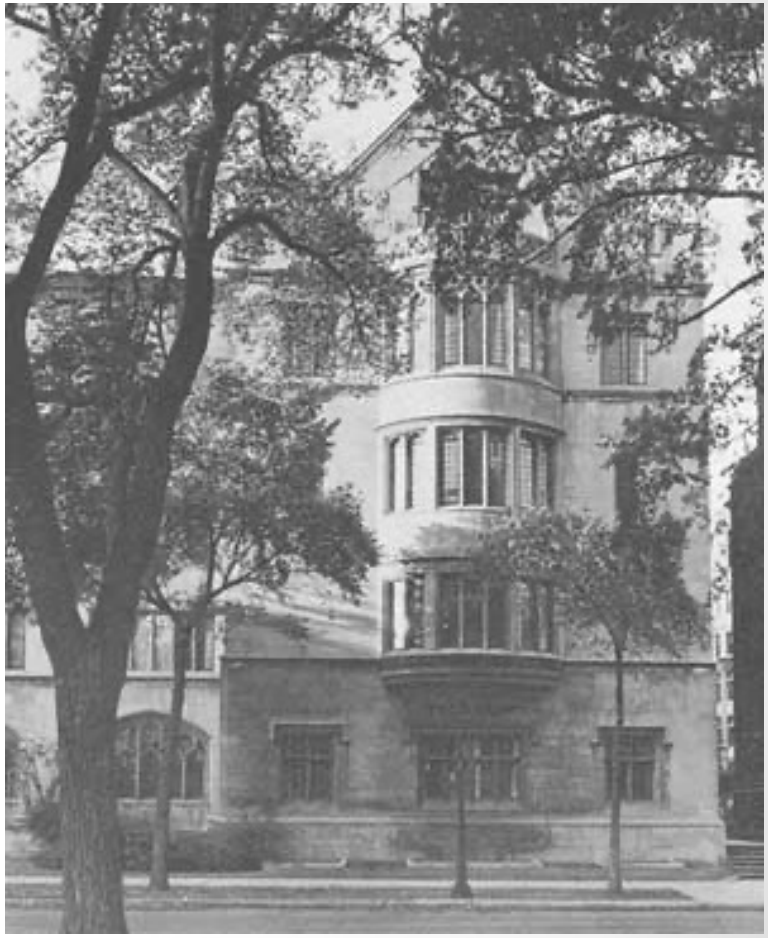
Early Adoption Period

The Cowles Commission

- At the University of Chicago from 1939 until 1955.
- At Yale University from 1955 onwards.
- Became stronghold of mathematical economics.
- Directors:
  - Jacob Marschak: 1943-48
  - T. Koopmans: 1948-55, 1965-67
  - James Tobin, 1955-61, 1964-65



Social Science Research Building at the University of Chicago
Source: Cowles Foundation

Theoretical Setup

Observation

- Directors did not make *seminal* contributions.
- In their social role, directors differed *structurally* from other scientists at Cowles (e.g., Arrow, Markowitz, Hurwitz, etc.)

Departure point

- Do scholars occupying distinct social roles at an institution influence the diffusion of scientific innovations in different ways?

Hypothesis

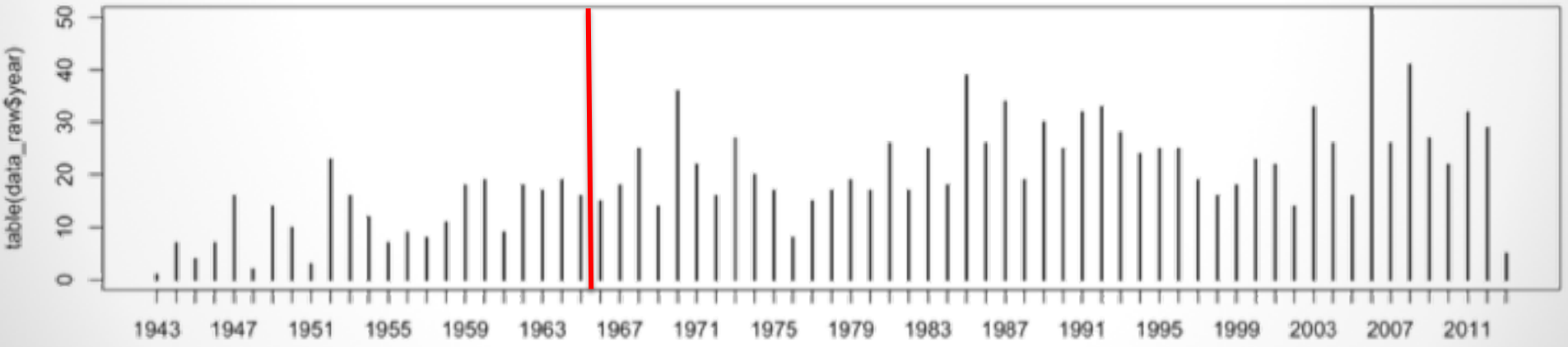
- The administrative leaders at Cowles played a crucial role in initiating the diffusion process by occupying the role of academic 'opinion leaders,' i.e., those individuals from whom others seek advice and information (e.g., Rogers 2003).

Theoretical Setup

- **Aim**: Systematically analyze how each individual's social role at Cowles affected the early adoption of rational choice theories by engaging with TGEB.
- **Analytical framework**: Blockmodeling → method for reducing a social network to a set of (structurally equivalent) social roles.
- **Dataset**: Acknowledgements in reprints/papers written at the Cowles Commission between 1944 and 1965.
- **Novelty**: Studying acknowledgement networks

Dataset: Acknowledgements

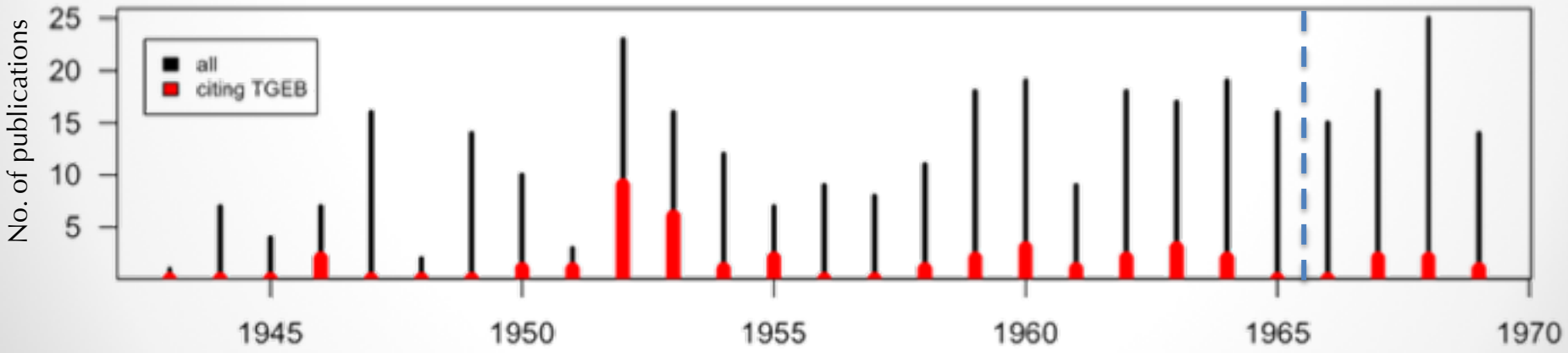
- Cowles Commission/Foundations Papers (Reprints)
  - 1,424 reprints of publications (1943-2013)
  - 250 contributions from 1943-1964*



* Cowles Monograph Series not included

Dataset: Acknowledgements

- Cowles Commission/Foundations Papers (Reprints)
  - 1,424 reprints of publications (1943-2013)
  - 250 contributions from 1943-1964*
  - 38 of 250 publications cite TGEB (~15%)



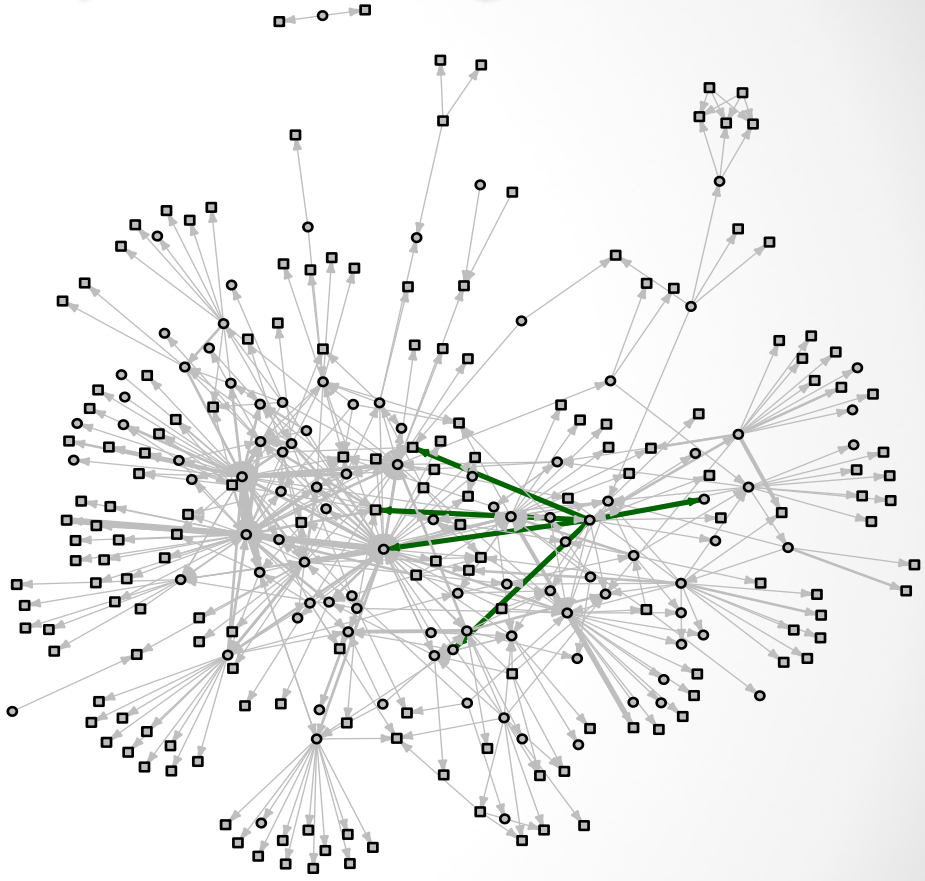
* Cowles Monograph Series not included

Acknowledgements

- Differs from a citation and is not ‚reducible' to scientific content.
- Potentially reflects formal and informal social structure at an institution.
- Acknowledgements signal (among other things):
  - general feedback
  - suggestions for further development of a work
  - inspiration and advice-giving
  - financial and other kinds of dependencies
  - any kind of support
- Regarding **scientific content**
  - can refer to all levels of the analysis, i.e., to general idea, theoretical approach, methods, proof procedures, etc.
  - acknowledged person can channel information flows, direct topical emphasis, push research agendas.
- Regarding **social structure**
  - acknowledgements are given to scholars that are central, whereby central can mean many things.

Initial Dataset (before processing)

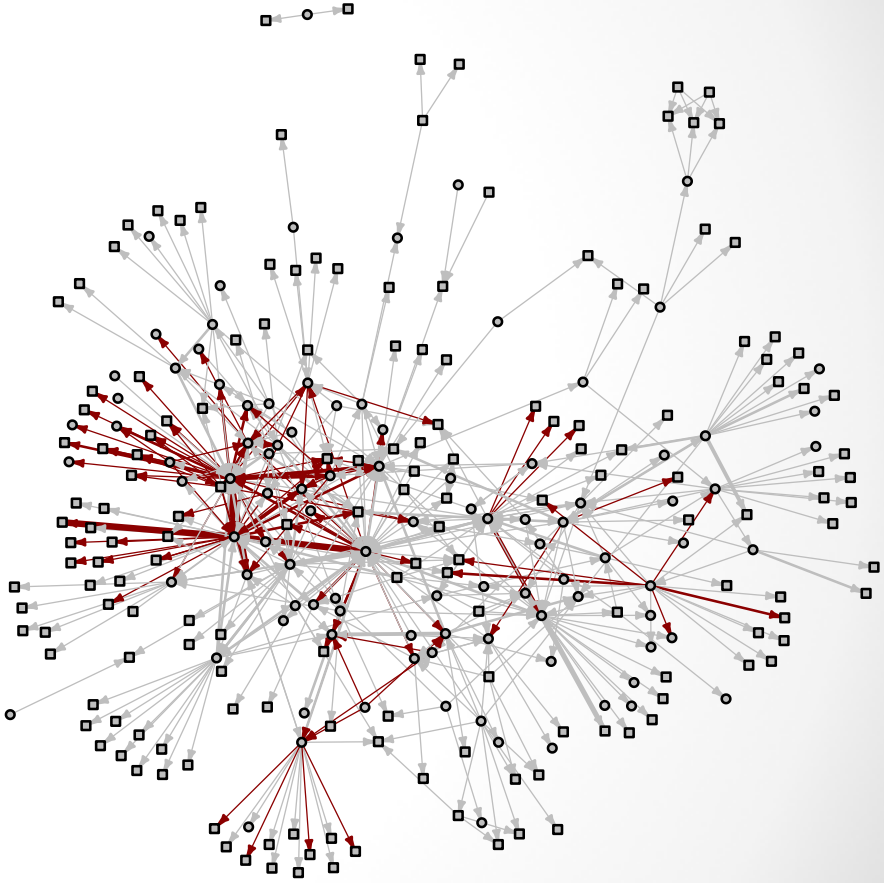
- **Collection of acknowledgements**
  - 144 of 250 contributions published at Cowles between 1943-1964 acknowledge one or more individuals.
  - Raw data: 530 acknowledgement relations expressed in 144 papers that were (co-)authored by 78 individuals.



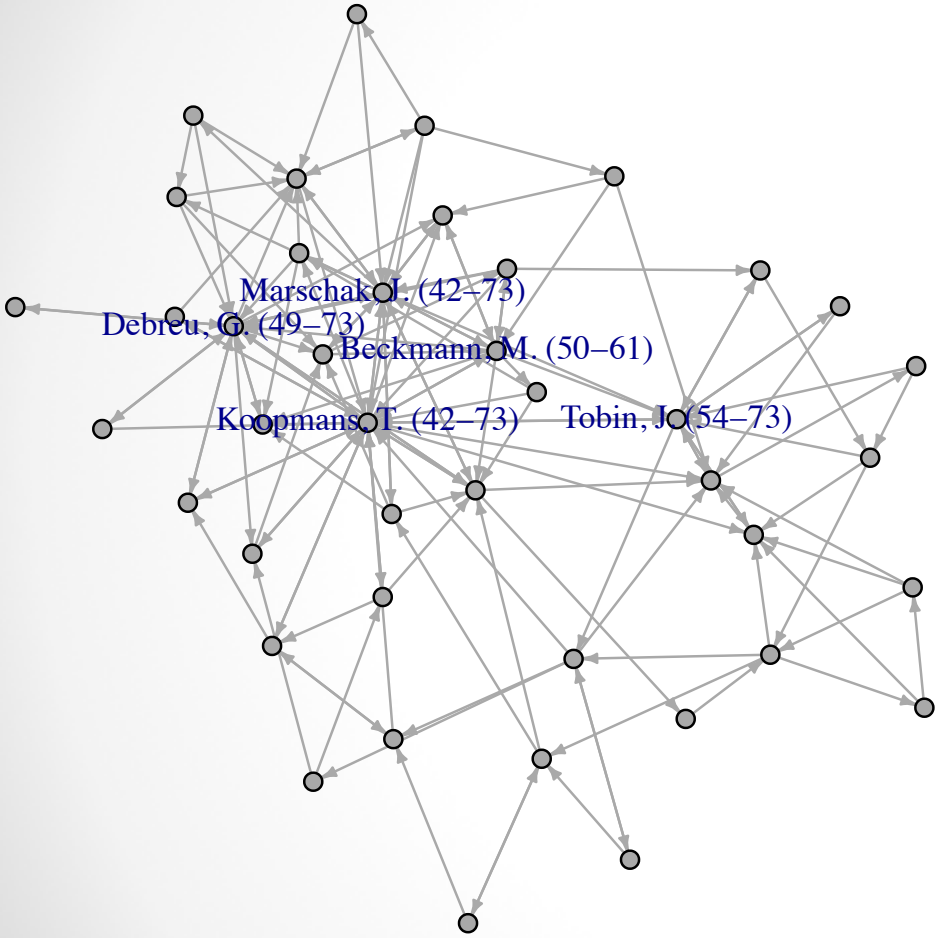
* The author is associate professor of economics at Yale University. He owes a great debt to Tjalling C. Koopmans who contributed the basis for the theorems established in the second part of this paper. David Cass, Peter A. Diamond, Paul A. Samuelson, and Robert M. Solow made useful comments on an earlier draft. The author alone is responsible for any errors in the final product.

Acknowledgements Network

- **Collection of acknowledgements**
  - Of these: 23 papers citing TGEB, by 17 authors (acknowledging 62 individuals).
  - Acknowledgements of papers citing TGEB originate in one subsection of the network.
  - Few nodes with high acknowledgements-outdegree account for much of the spread of TGEB at Cowles.



Centrality in Acknowledgement Network



- Names of individuals included with 5 or more papers.

person	betweenness	eigenvector_c
Koopmans, Tjalling C.	1.00	1.00
Marschak, Jacob	0.58	0.94
Tobin, James	0.56	0.40
Debreu, Gerard	0.50	0.86
Arrow, Kenneth J.	0.42	0.60
Hurwicz, Leonid	0.30	0.45
Beckmann, Martin J.	0.19	0.66
Phelps, Edmund S.	0.16	0.07
Okun, Arthur M.	0.14	0.24
Klein, Lawrence R.	0.14	0.27
Radner, Roy	0.06	0.38
Manne, Alan S.	0.03	0.38
Simon, Herbert A.	0.01	0.27
Haavelmo, Trygve	0.00	0.15
Anderson, Theodore W.	0.00	0.04

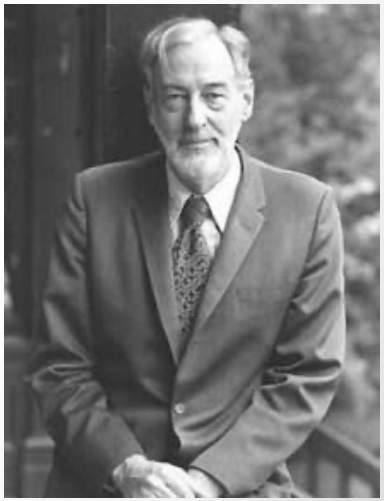
- Directors have highest betweenness centrality.
- However, they did not feature in the co-citation network.

Why TGEB?

- **Fostering exposure to TGEB**
  - 1946: Writing and circulating review article on TGEB
  - 1945: Invitation of von Neumann to lecture on TGEB
  - 1949: Seminar series
- **Why formal choice theories?**
  1. Conformed to proper standards of science
  2. Great power of generalization
  3. Formal concepts specifiable for concrete problems
  4. Quantifiable concepts applicable to data

(Marschak 1946)

Jacob Marschak at Cowles Commission Seminar, ca. 1945. Source: Cowles Foundation website



1949	January 9	L.J. Savage, Research Associate in Mathematics, University of Chicago, "The Theory of Games: Zero-Sum Games"
	January 20	Kenneth J. Arrow, "The Theory of Games: Multi-Person Games"
	February 17	Kenneth J. Arrow, "The Theory of Games: Applications to Economics"
	March 3	Jacob Marschak, "The Theory of Games: Measurable Utility"
	March 10	M.A. Girshick, Professor of Statistics, Stanford University, "The Theory of Games: Continuous Games"
	March 31	L.J. Savage, "The Theory of Games: Application to Statistical Inference"
	April 14	Herbert A. Simon, "The Theory of Games: Application to Politics and Administration"
	May 12	Herman Rubin, "Statistical Treatment of Nonlinear Econometric Models"
	May 26	Tjalling C. Koopmans, "Utility Analysis of Decisions Involving Future Periods"
	October 6	Tibor Scitovsky, Department of Economics, Stanford University, "The Meaning of National Product Estimates"
	October 20	Anatol Rapoport, Committee on Mathematical Biology, University of Chicago, "Outline of a Mathematical Approach to

Cowles as "Social Sciences Lab"

"Hybrid institution between a university and a national laboratory" (Düppe/Weintraub 2012, 8; Erickson et al. 2013).

Characteristics

- Close collaboration, also between scholars and director.
- Unbounded brainstorming
- Highly interactive (i.e., in seminars, workshops, informally)
- Short communication channels

→ Similar social structure to RAND Corporation, Center for Advanced Studies in the Behavioral Sciences at Stanford.

Source: Cowles Foundation

Method: Blockmodeling

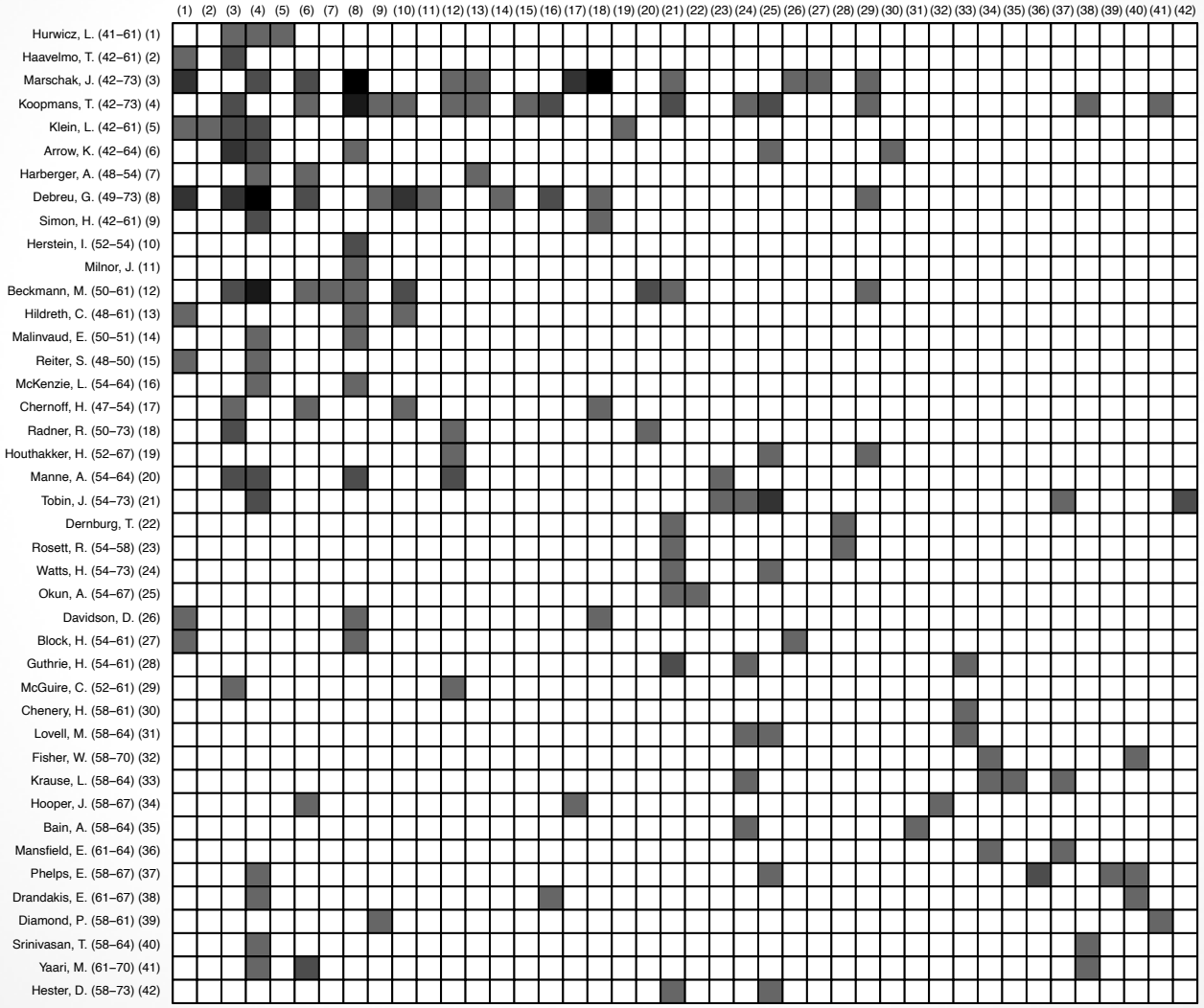
- **Idea**: Reveal role structure from relations (Lorrain & White 1971, White et al. 1976, 1976b, Winship & Mandel 1983).

- **Structural equivalence**: Measure of similarity of individuals by identifying the similarity of their patterns of relations to all other individuals.

- **In our case → structural similarity**: Cluster individuals by identifying their similarity of their network position.

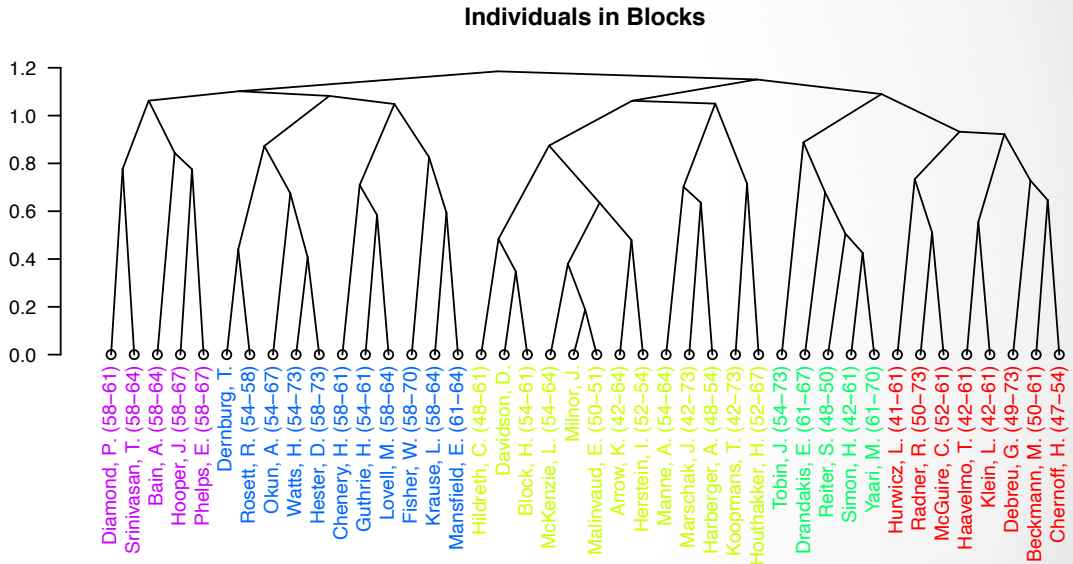
- **In effect**: Rearrange the socio-matrix such that a predefined number of clusters of structurally similar social roles can be identified solely on the basis of the existence or nonexistence of (observed) relations (Doreian et al. 2005, Karrer & Newman 2004, Ziberna 2014, Breiger et al. forthc.).

Procedure: Sociomatrix



Procedure: Clustering

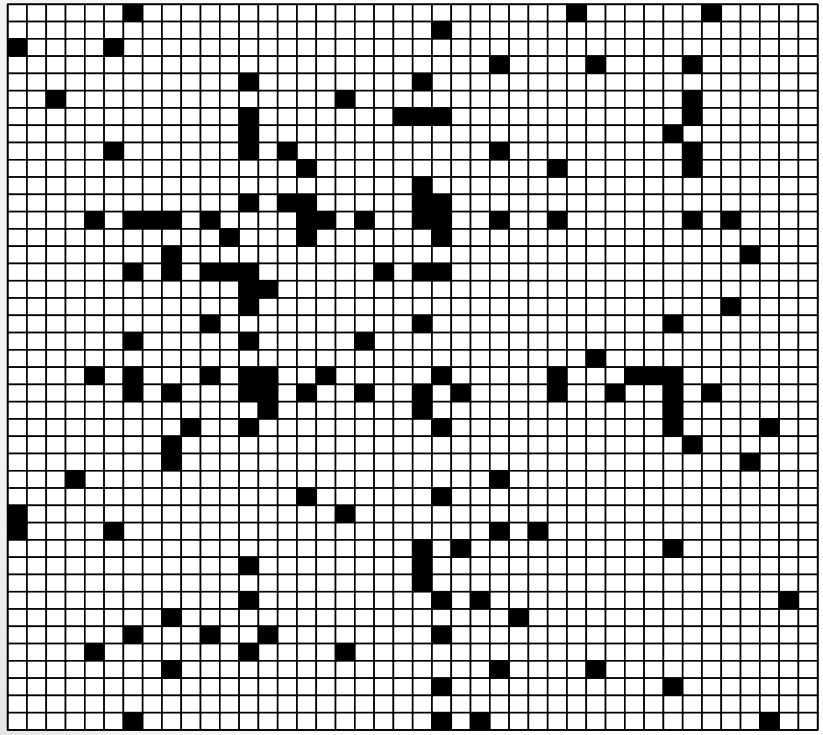
- **Clustering actors by their structural similarity**
  - Establish dissimilarities in network relations for each actor pair i-j (1-PPMCC).
  - Partition the network into a predefined number of blocks (hierarchical clustering).



Procedure: Application

Unsorted data

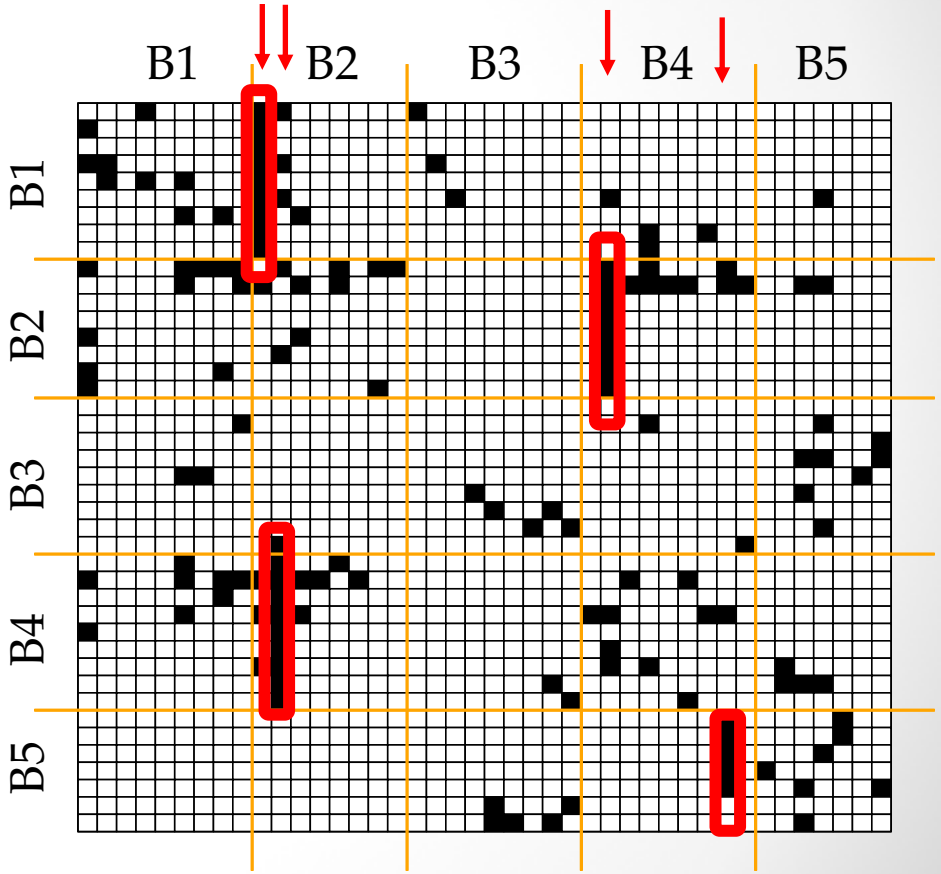
Acknowledged party



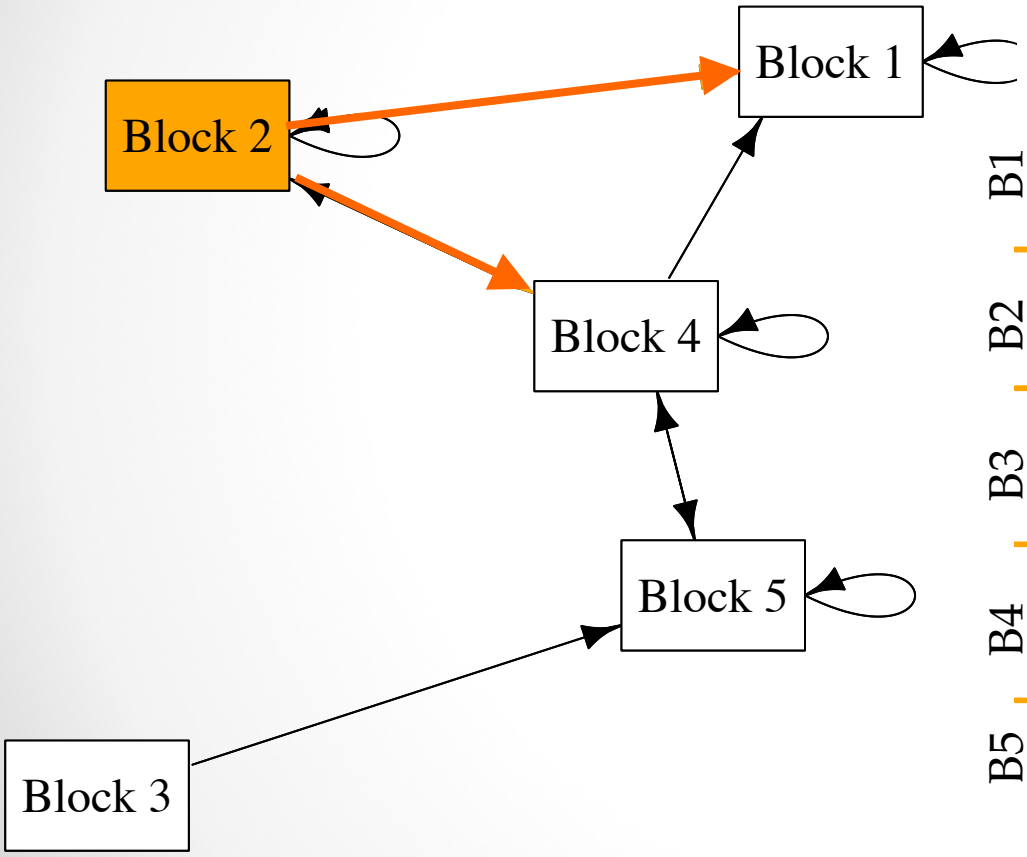
Author

n x n (author x acknowledged person)

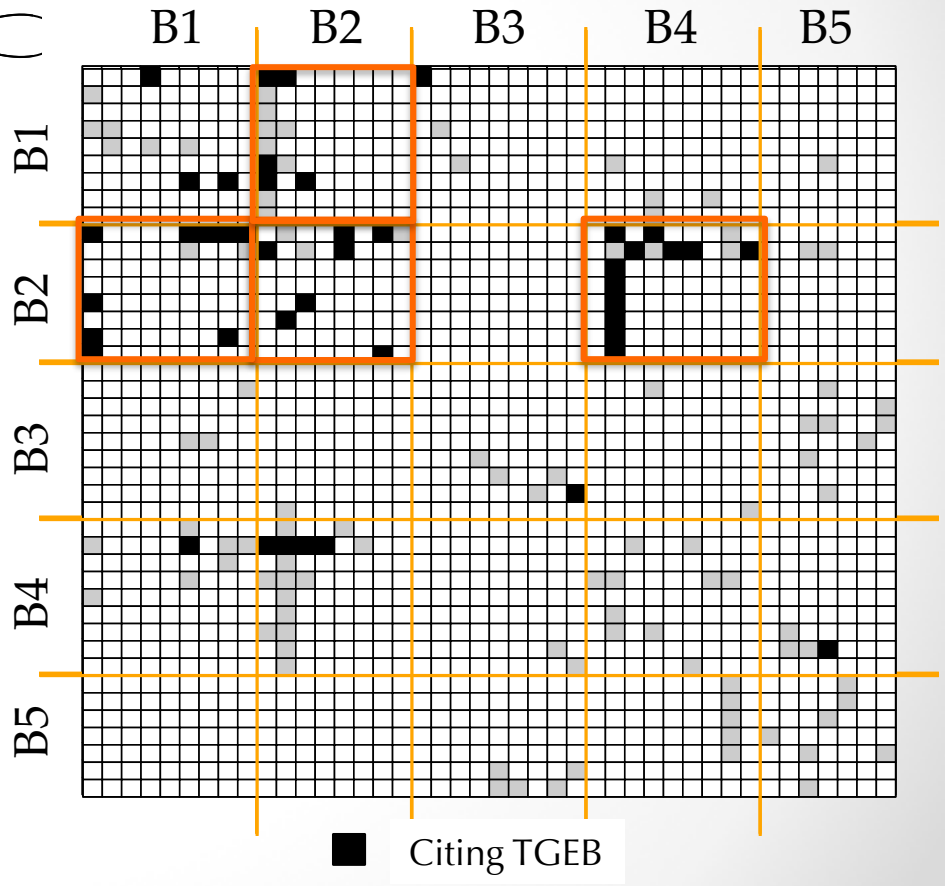
Blockmodel output



Procedure: Application

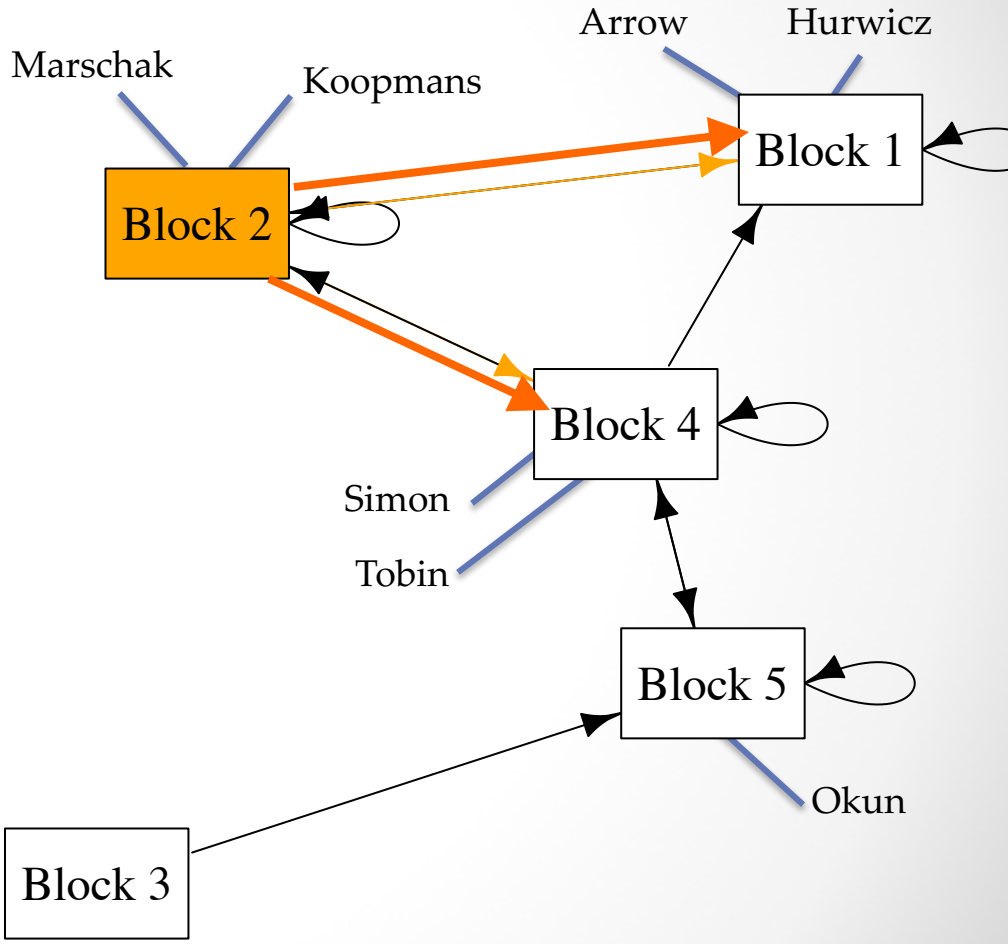


Blockmodel output



Social Structure at Cowles

- Members of block 2 acknowledge members of blocks 1 and 4.
- Members of block 4 acknowledge members of block 1.
- Members of block 3 did not acknowledge each other.



Summary Statistics (5 Blocks)

block	person	pubs	pubs (sd)	pubs citing TGEB	years at cowles	at CASBS	indeg	outdeg	between	ev	TGEB
1	9	6.00	4.53	0.78	9.11	0.44	3.44	3.33	0.11	0.31	14.00
2	8	7.38	10.00	2.00	8.12	0.50	5.12	4.88	0.20	0.42	68.00
3	9	4.22	2.59	0.11	3.44	0.44	1.67	2.11	0.09	0.06	2.00
4	9	8.33	7.11	1.22	8.67	0.44	4.11	4.56	0.15	0.39	23.00
5	7	2.71	2.14	0.00	6.57	0.00	3.14	2.43	0.10	0.10	0.00

Table 1: summary statistics for five blocks

Preliminary Conclusions

- Adoption of rational choice theories depended on scientific engagement of scholars but was also shaped by the presence and influence of academic 'opinion leaders' at the Cowles Commission.

- Our research shows the structural importance of (directorial) appointments for initiating the engagement with a scientific innovation.

Thank you!