Modeling network dynamics - from REMs to ABMs and back to REMs

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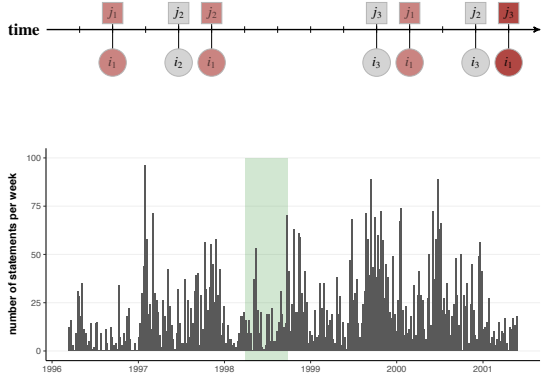
Overview

1. REM - advantages and disadvantages
2. REM and ABMs
3. Example: causal mechanism of homophily effects
4. Using synergies between REMs and ABMs

Relational event models - advantages and disadvantages

- Very specific **data structure**
  - relational events:
  - time-stamped or time-ordered data
  - sender–target interactions
  - possible sources: archive data, newspaper data, proceedings/words, online social behavior
- **Computational efficiency**



Data requirements for REMs

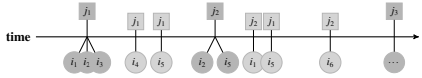
- Temporal information on relational events

Disadvantage

- data collection
- operationalization of micro-mechanisms

Advantage

- flexible combination of event types
- causal inference
- testing social theories at the micro-level



Computational limitations of REMs

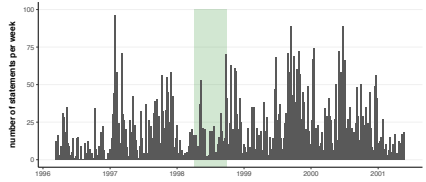
- Computational efficiency

Disadvantage

- null-events blow up *nobs*
- endogenous network statistics $\rightarrow$ complicated

Advantage

- works fine for few 100 events
- sampling?



REM and ABMs - use synergies!

1. Very specific **data structure**

No data? → Simulate it!

If there is a social mechanism you'd like to test but you don't have longitudinal data for it, build an ABM with the same mechanisms and compare static data

2. **Computational efficiency**

Too much data? → Simulate and compare!

If your data set is too large, build a simulation with the same mechanisms and compare the sequences (→ NO NULL-EVENTS!)

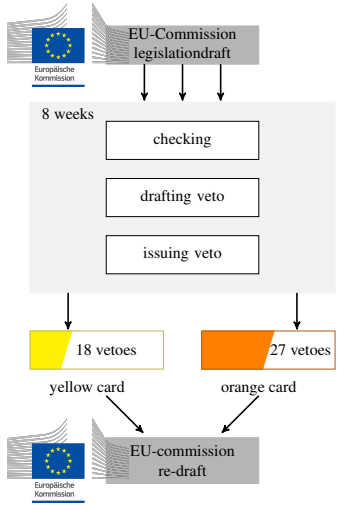
Relational event models and Agent-based modeling: An Example

- Example from yesterday: Vetoing dynamics in the EU parliament
- Evidence of homophily effects
  - selection effect: same interest, same proposals are vetoed
  - influence effect: convincing or mimicking among like-minded actors

Theoretical idea

Reading all proposals is time-consuming, so maybe you

- only check out proposals of some topics (= interest)
- only check proposals if someone you know well has vetoed it (=mimicking)



Vetoing dynamics in the EU parliament

	Relational event model		
	Coefficient	SE	P-value
Independent variables			
H1: Ideological homophily	10.688	3.0243	0.0004
H2: EU accession homophily	4.7879	3.532	0.1752
H3: EU location homophily	4.8067	4.0555	0.2359
H4: Institutional homophily	8.2675	1.9455	0.0000
Control variables	*yes*	*yes*	*yes*

The coefficients in the first column are reported as log odds.

Table: Results of the conditional logit regression on vetoing events

Relational event models and Agent-based modeling: An Example

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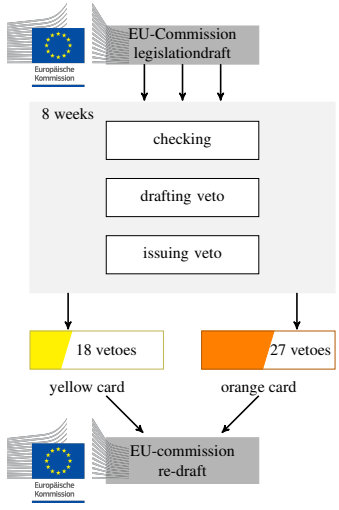
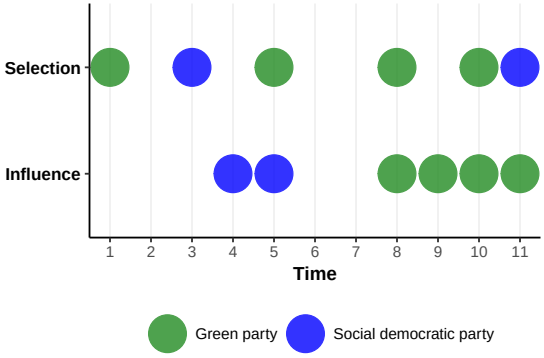


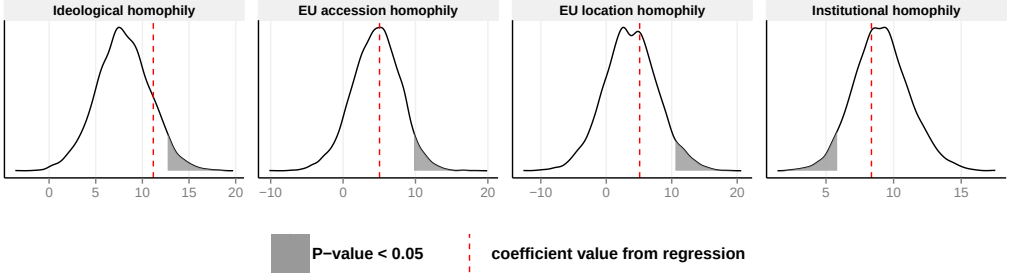
Homophily: Distinguishing selection from influence



- Our goal: understand if homophily stems from selection or influence
- Our idea: **temporal information of vetoes matters!**

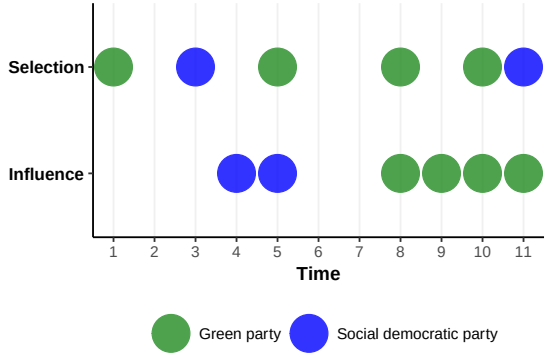
Vetoing dynamics in the EU parliament

- IF influencing means similar chambers vetoe in close temporal proximity
- THEN the coefficient from the REM should be high
- Permutation test: shuffle event sequence, re-run REM, save coefficient



Testing influence mechanism using an ABM

- Empirical evidence is weak
- Goal: use a simulation to test whether our assumption hold
- **Can selection and influence effects be detected using a REM?**



Simple ABM to generate homophilious event sequences

- **Simulate homophily-driven event sequences**
- Sender nodes S, with preference for targets (= sender attribute)
- Target nodes T, with values $\in [0, 1]$ (= target attribute)
- Decision matrix $\rightarrow S \times T$
  - each dyad has a higher probability of being chosen if
  - selection: sender and target attributes match
  - influence: previous senders (involved in target t) have similar preferences

Simulation results - selection vs. influence

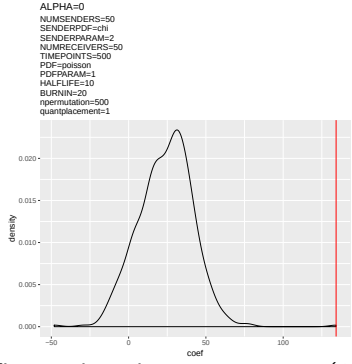


Figure: Influence-based event sequence (100% influence mechanism)

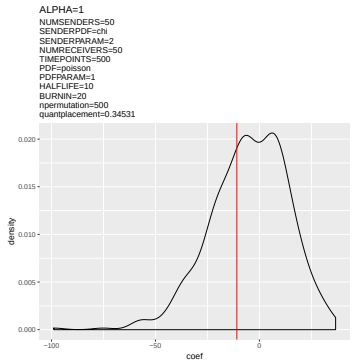


Figure: Selection-based event sequence (100% selection mechanism)

- **Can REMs be used to distinguish influence vs. selection effects?**

Simulation results - selection and influence mix

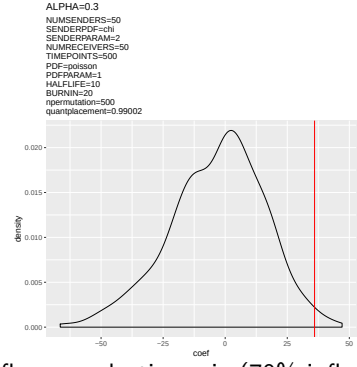


Figure: Influence-selection mix (70% influence, 30% selection)

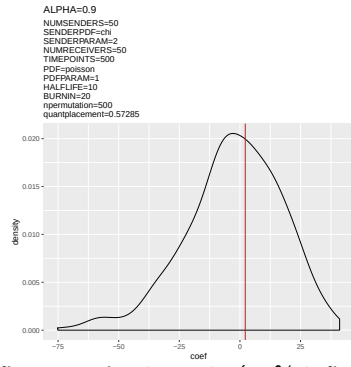


Figure: Influence-selection mix (10% influence, 90% selection)

- **Can influence over selection effects be detected if the two mechanisms are confounded?**

Conclusion

1. Very specific **data structure**

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If there is a social mechanism you'd like to test but you don't have longitudinal data for it, build an ABM with the same mechanisms and compare static data

2. **Computational efficiency**

Too much data? → Simulate and compare!

If your data set is too large, build a simulation with the same mechanisms and compare the sequences (→ NO NULL-EVENTS!)

3. **Combining agent-based modeling and REMs**

Not sure which mechanism should be the cause? → test–simulate–retest!

If parts of your theory are difficult to operationalize or empirical data is too noisy, test it with an ABM or get some inspiration on powerful mechanisms from previous ABM studies on the subject.