Partners in power: Job mobility and dynamic deal-making

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Presentation at the Fifth Workshop on Networks in Economics and Sociology, Utrecht, June 22, 2006.

Theory

Inter-firm cooperative relations are known to be strategically vital

- firm performance
- longevity
- reputation

This notably holds for venture capital firms (VCs) who are linked by co-investment (syndication) ties.

Theory

Yet these inter-firm relations are created and maintained by senior investment managers (GPs).

There is the *potential* for these managers' social networks and managerial relations to contribute to syndication. Hence, GP moves *potentially* alter the network of syndication ties.

In fact, this even *may be* a reason to recruit a new GP.

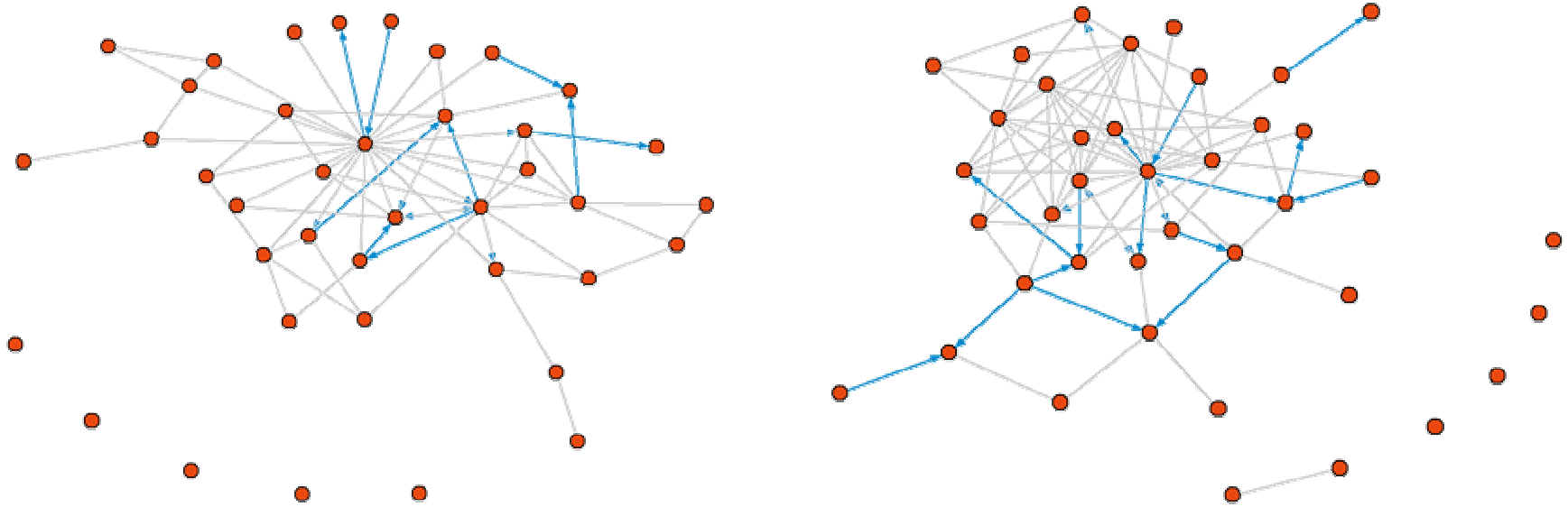
Main question

Is senior managers' job mobility causally significant in shifting inter-organisational ties?

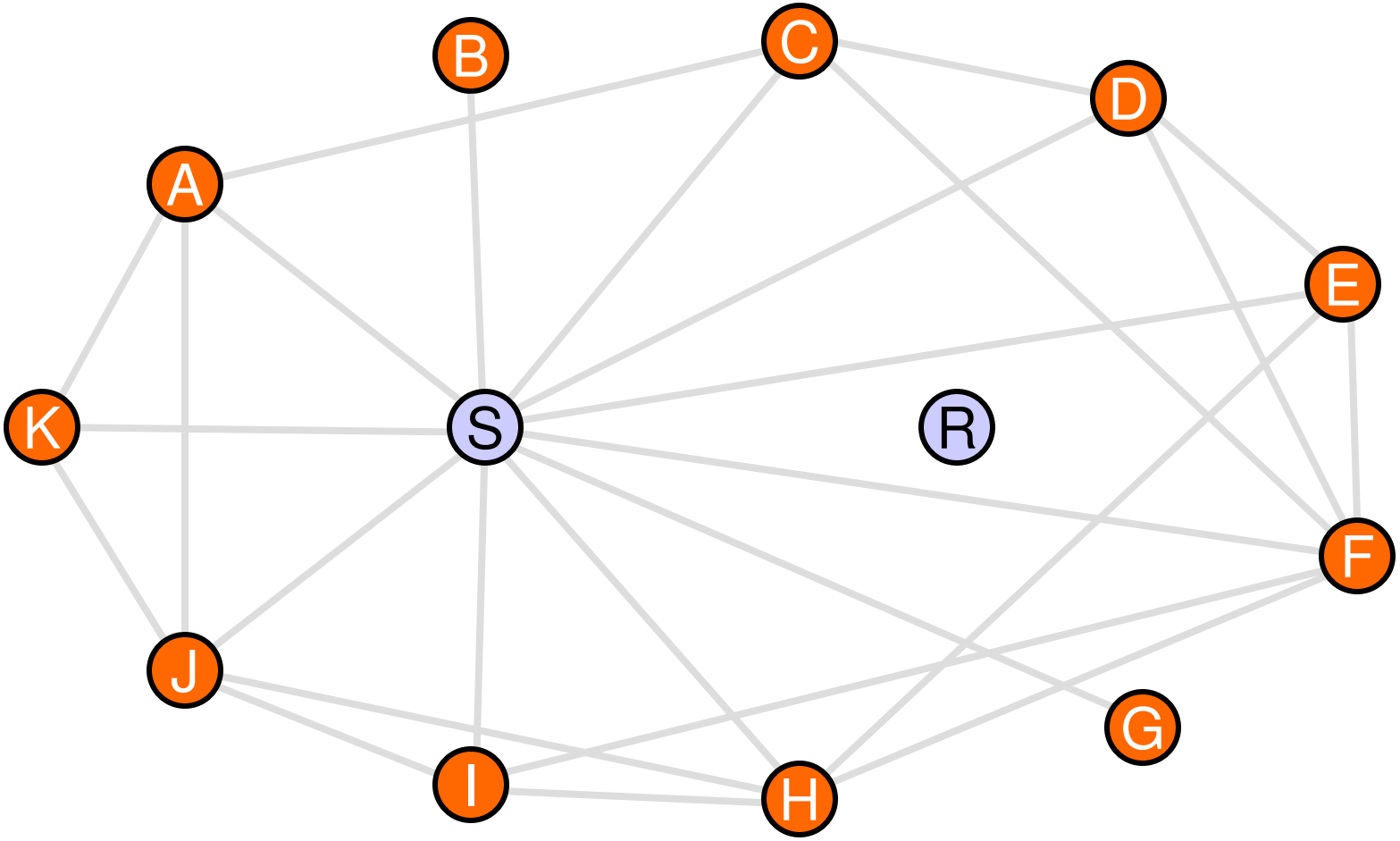
Data

- 39 venture capital firms in the UK ("VC")
- co-investment networks over a 7 year period
- job mobility of senior investment managers ("GP")
- individual firm characteristics

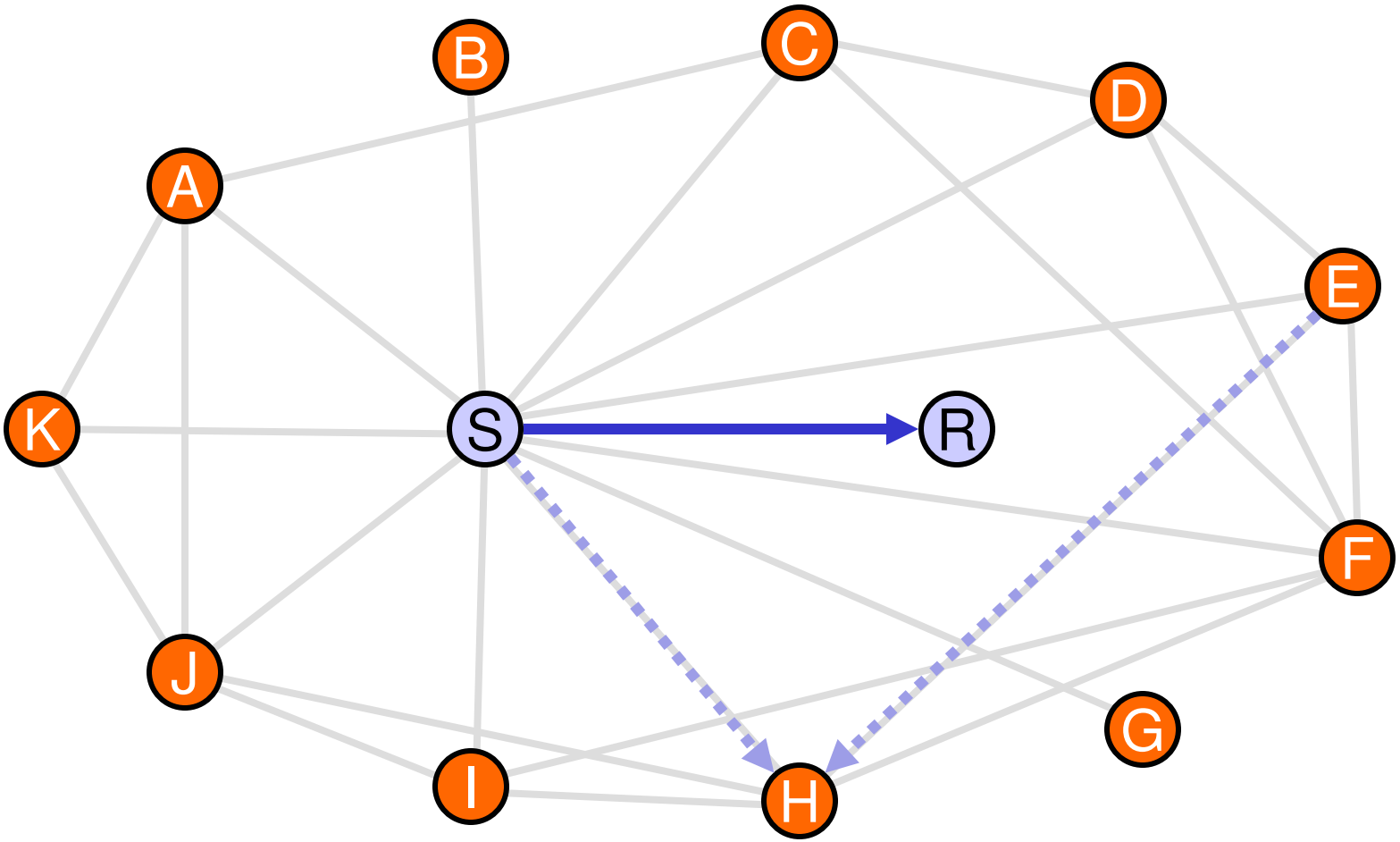
Networks of 1997-1998 and 2001-2002



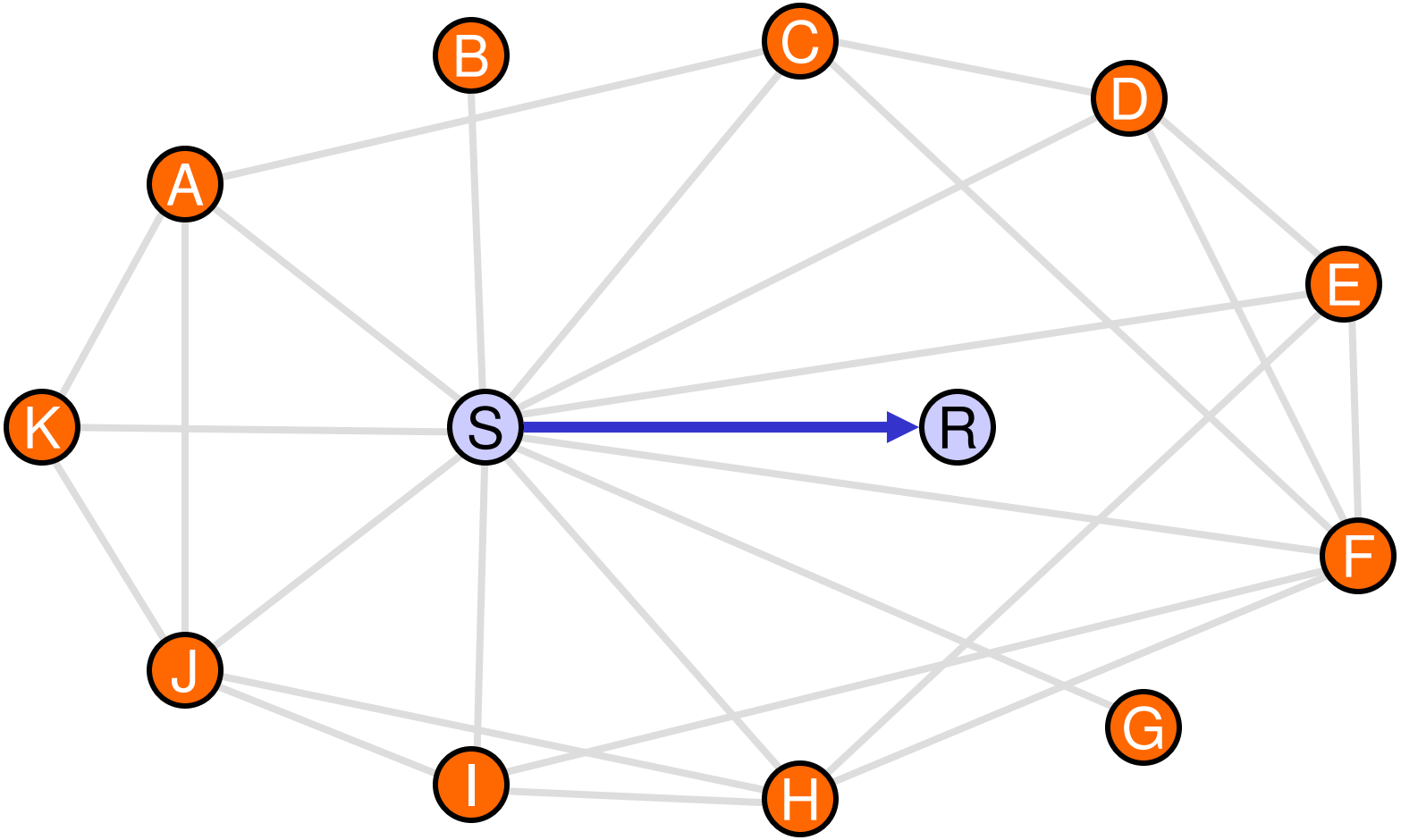
VC network in 2000



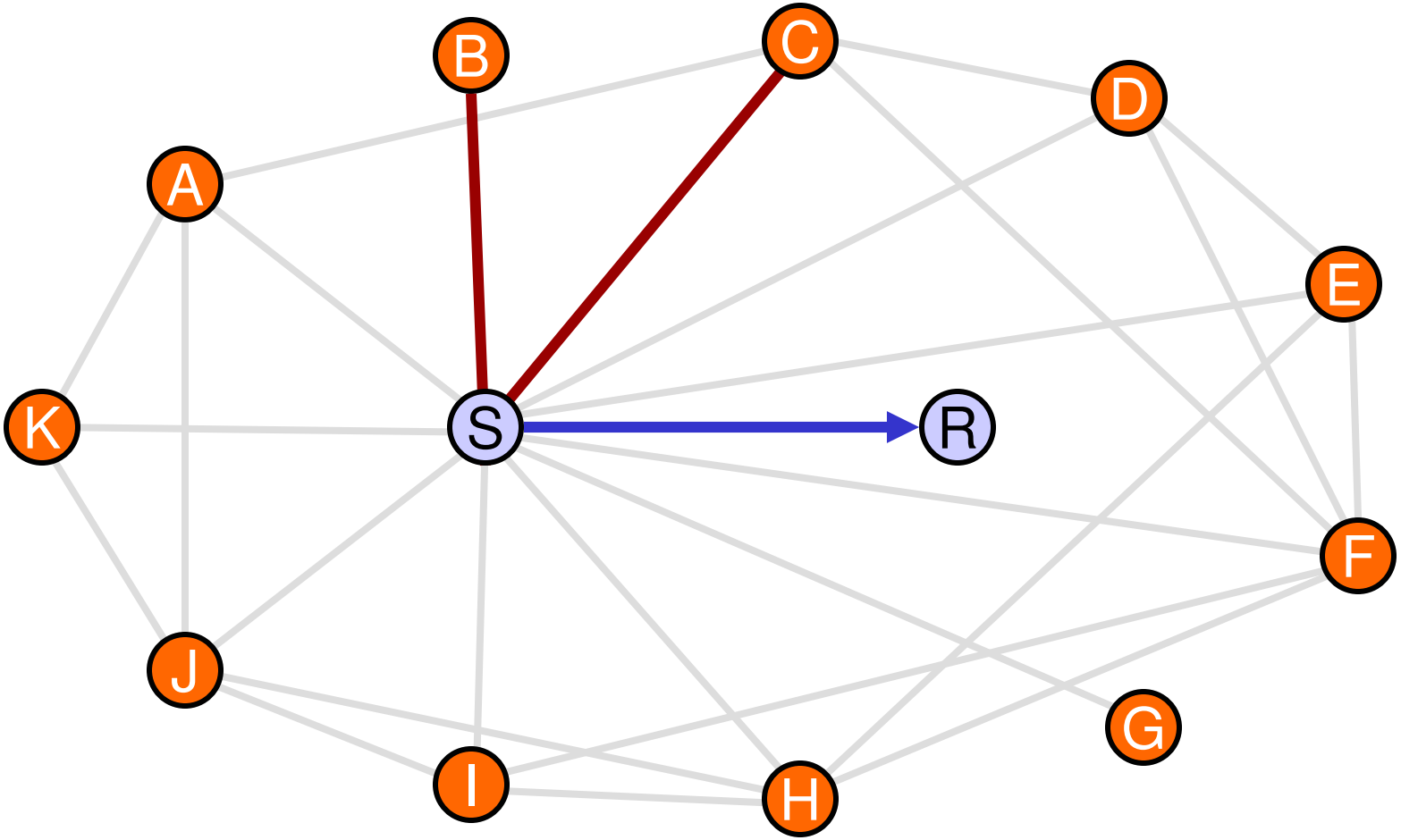
GP moves in same period



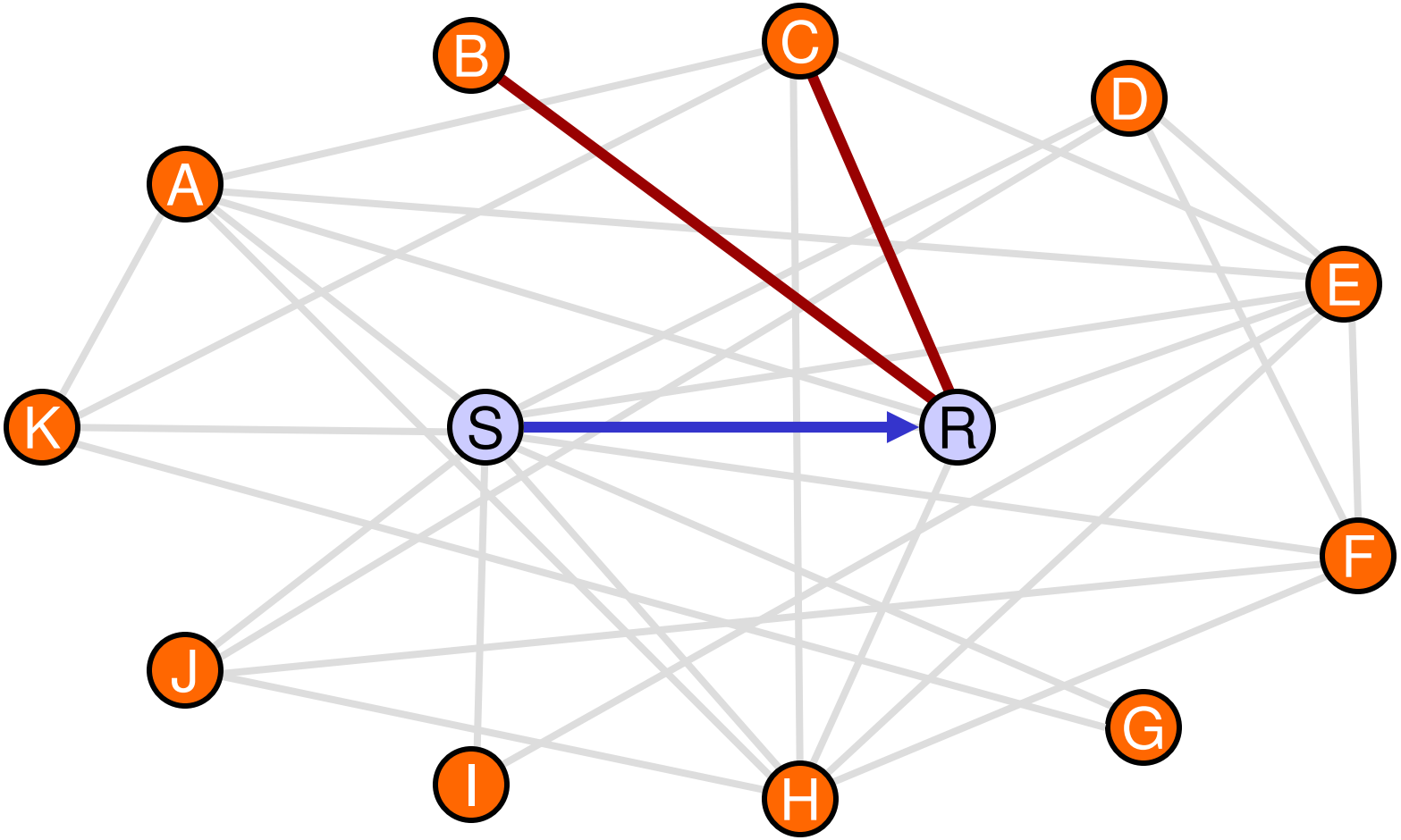
..focus on this one GP move..



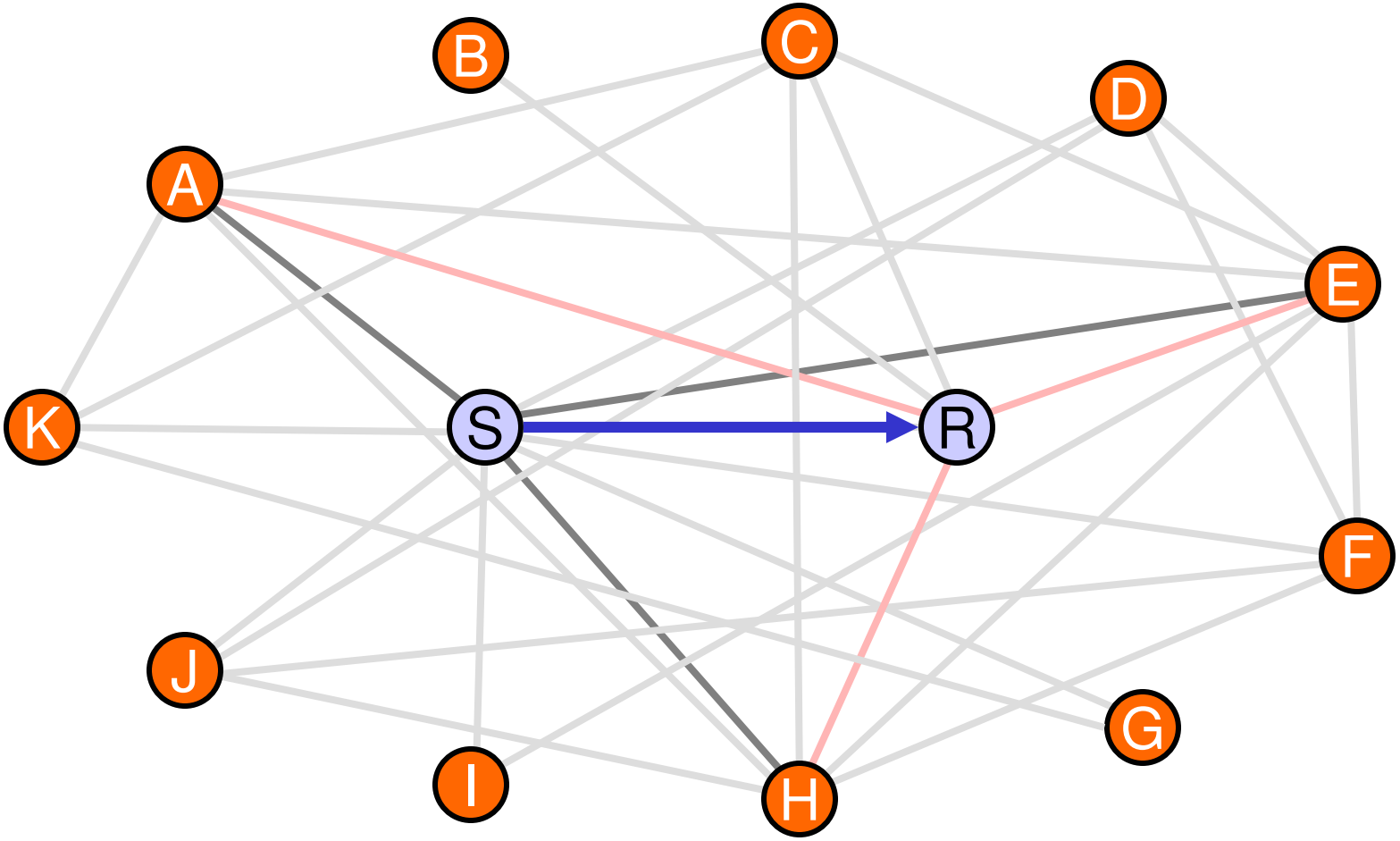
..and these two syndication ties in 2000..



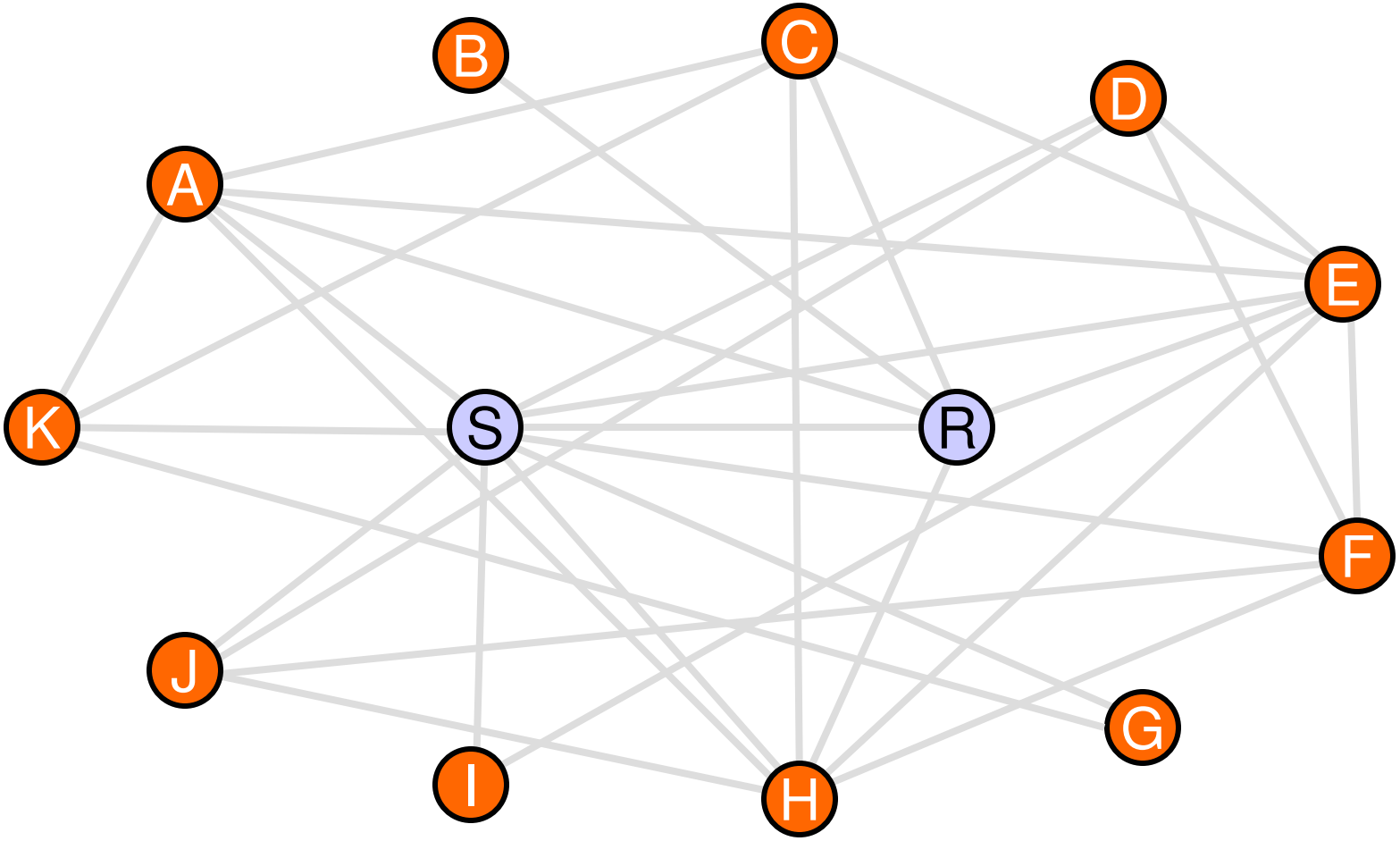
In 2001, they have fully shifted.



In addition, 3 ties have been 'copied'.



VC network in 2001



Refine main question (somewhat)

Is senior managers' job mobility causally significant in shifting inter-organisational ties?

- *Do senior managers, after moving from one VC to another, recreate their network of origin?*
- *Do partner VCs, when a GP moves to a new employer, shift along?*
- *Do these third parties stop and/or reduce cooperation with the former employer?*

Stochastic modelling by actor-driven models

- Stochastic process in the space of all possible network configurations.

  The cardinality of the state space increases at a squared exponential rate with the number of actors. For dichotomous, undirected ties it is $2^{\frac{n(n-1)}{2}}$.

- First observation of the network as the process' starting value.

  This way, contingencies leading to the first observation need not be modelled explicitly, but are conditioned upon.

- Change is modelled as occurring in continuous time.

  Usually, panel data are available for analysis. This modelling approach allows to deal with the left-truncation of such data.

- Network actors drive the process: individual decisions.

Stochastic modelling by actor-driven models

- Network actors decide about their network neighbours (selection, deselection).
- Two submodels, addressing the questions:
    - *When* can an actor make a decision? (rate function)
    - *Which* decision does that actor make? (objective function)
- Additional issue for *undirected* networks:
    - Which actor has *control* over which tie? (different model types)
- Technically: Continuous time Markov process.
- Beware: model-based inference!

How does the model look like?

State space

State **y**(**t**) contains adjacency matrix **y** at time point **t**.

Stochastic process

Network evolution is modelled by specifying *transition probabilities* between such states $\mathbf{y}(\mathbf{t}_1)$ and $\mathbf{y}(\mathbf{t}_2)$.

Continuous time model

- invisibility of to-and-fro changes in panel data poses no problem,
- evolution can be modelled in smaller units (*micro steps*).

Observed changes are quite complex – they are interpreted as resulting from a *sequence* of micro steps.

How does the model look like?

Micro steps that are modelled explicitly

- $\mathbf{y}(\mathbf{t}_1)$ and $\mathbf{y}(\mathbf{t}_2)$ differ in one tie variable $\mathbf{y}_{ij}$ only.

Actor-driven model

- Micro steps are modelled as *outcomes of actors' decisions*.
- Actors involved in a micro step may have asymmetric *control* over the decision outcome.
- The micro steps occur *conditionally independent*, given the current state of the process.

How does the model look like?

Model types for the evolution of undirected networks (Snijders 2005)

1. Unilateral initiative suffices for tie creation.
2. Unilateral initiative is followed by reciprocal confirmation.
3. Bilateral consideration is followed by two unilateral agreements.

… *several other types are possible.*

Timing of decisions / transitions

- Waiting times λ between decisions are assumed to be exponentially distributed (Markov process).
- They naturally depend on model type.
- They can additionally depend on state, actors, and time.

How does the model look like?

Unilateral part of the micro step / decision by actor **i**

- Choice options (depends on model type)
  - change tie variable to other actor **j**, or
  - change nothing.

- Maximize objective function + random disturbance

$$f_i(\beta, y, t, j) + \varepsilon_i(y, t, j)$$

- Choice probabilities resulting from distribution of ε are of multinomial logit shape.

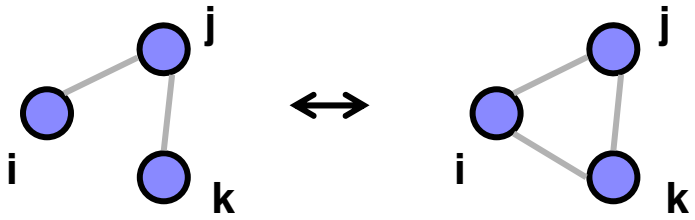
How does the model look like?

Network micro step / network decision by actor **i**

- Objective function **f** is linear combination of “effects”, with parameters as effect weights.

  Example: *Transitive closure effect*

$$\sum_{jk} y_{ij} y_{jk} y_{ik}$$



Remarks on model estimation

- The likelihood of an observed data set cannot be calculated in closed form, but can at least be simulated.

  $\rightarrow$ *simulation-based inference is necessary*.

- Currently available:
  - Method of Moments estimation (Snijders 1996, 2001)
  - Maximum likelihood approach (Snijders & Koskinen 2003)
  - Bayesian estimation (Schweinberger 2006)

- Implementation: program **SIENA**, part of the StOCNET software package (see link in the end).

Coding issues: matrices *Y*

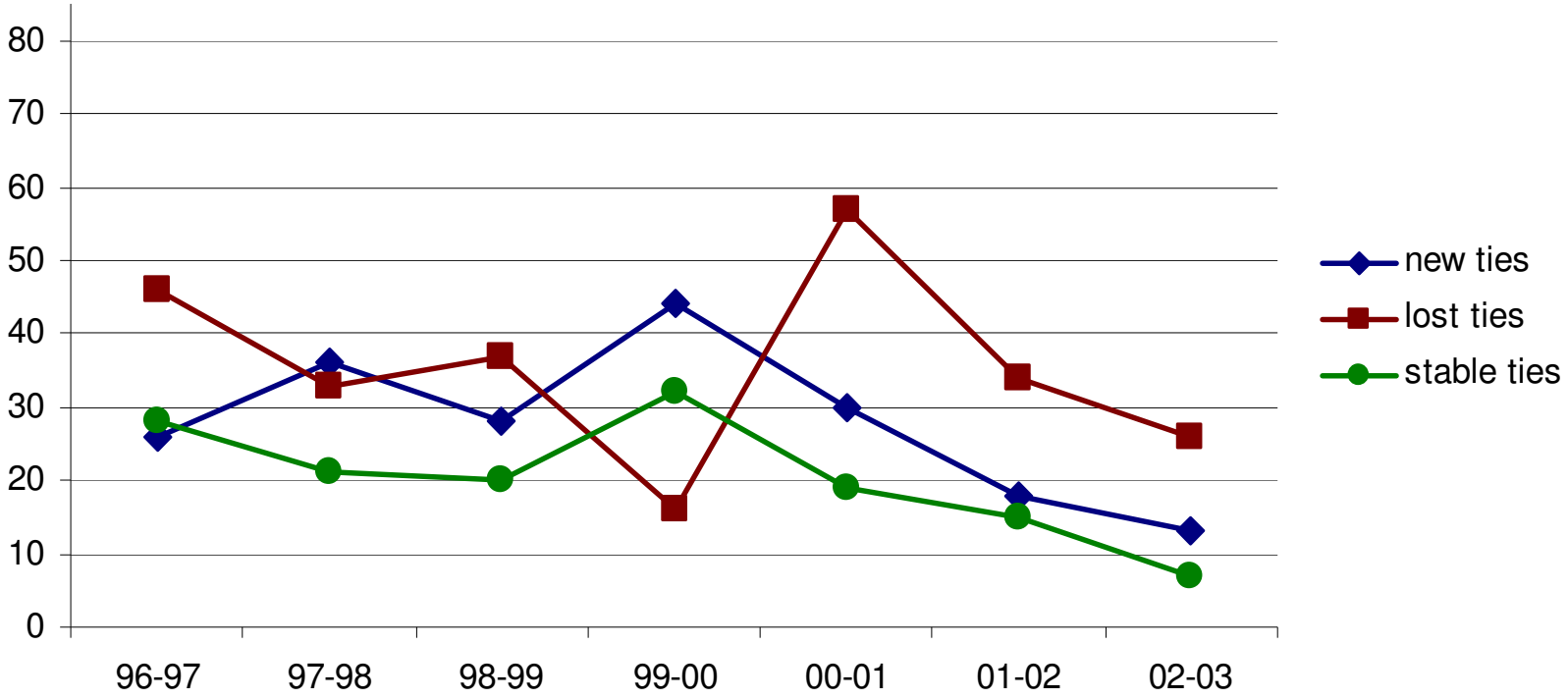
- The actor-driven model makes sense for networks that are interpretable as measurements of slowly-changing, underlying *states* of a relationship.

- The syndication data we have are *event* data, on top of that they are right-censored (we do not know when a co-investment venture ends).

→ Take some decisions, but assess their impact by also running analyses with decisions taken otherwise.

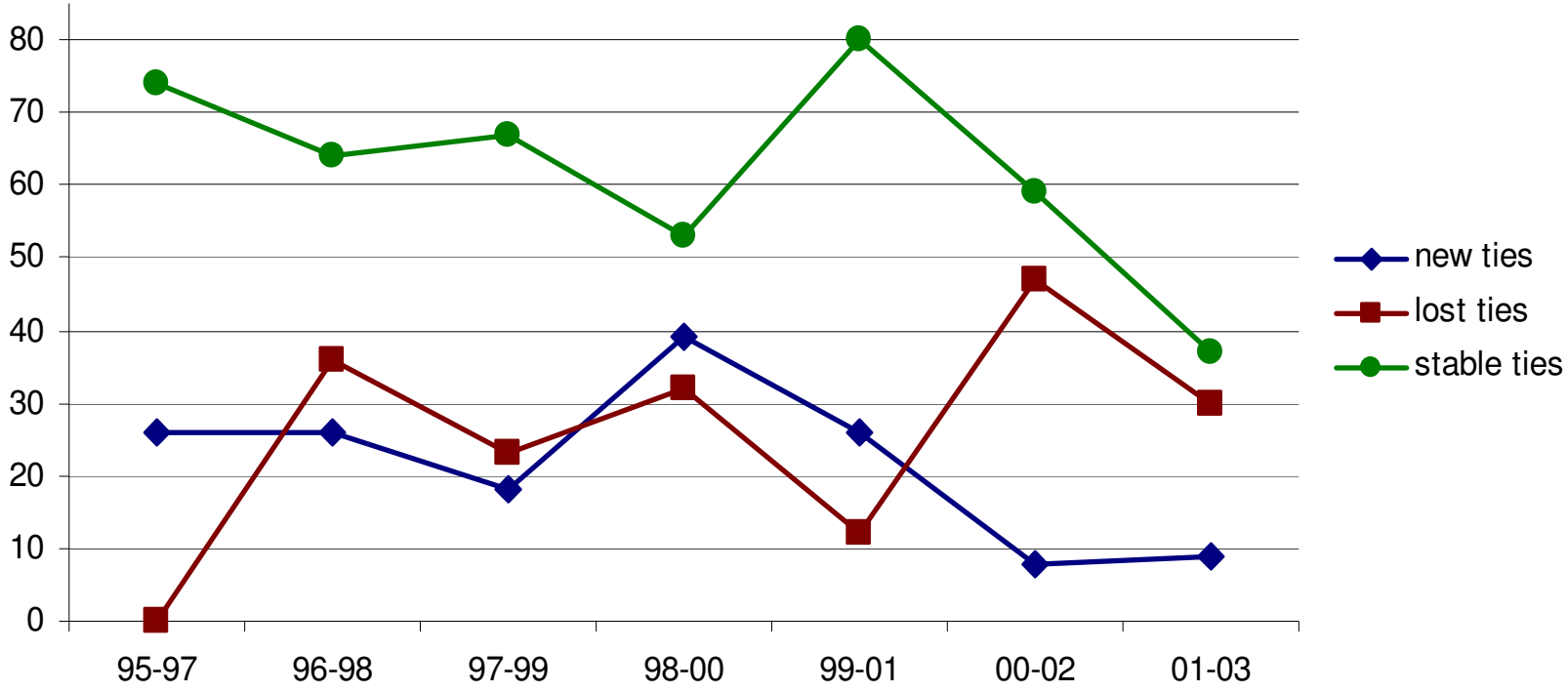
Coding issues: matrices *Y*

Tie dynamics given aggregation over one year $(\varepsilon = 1)$:



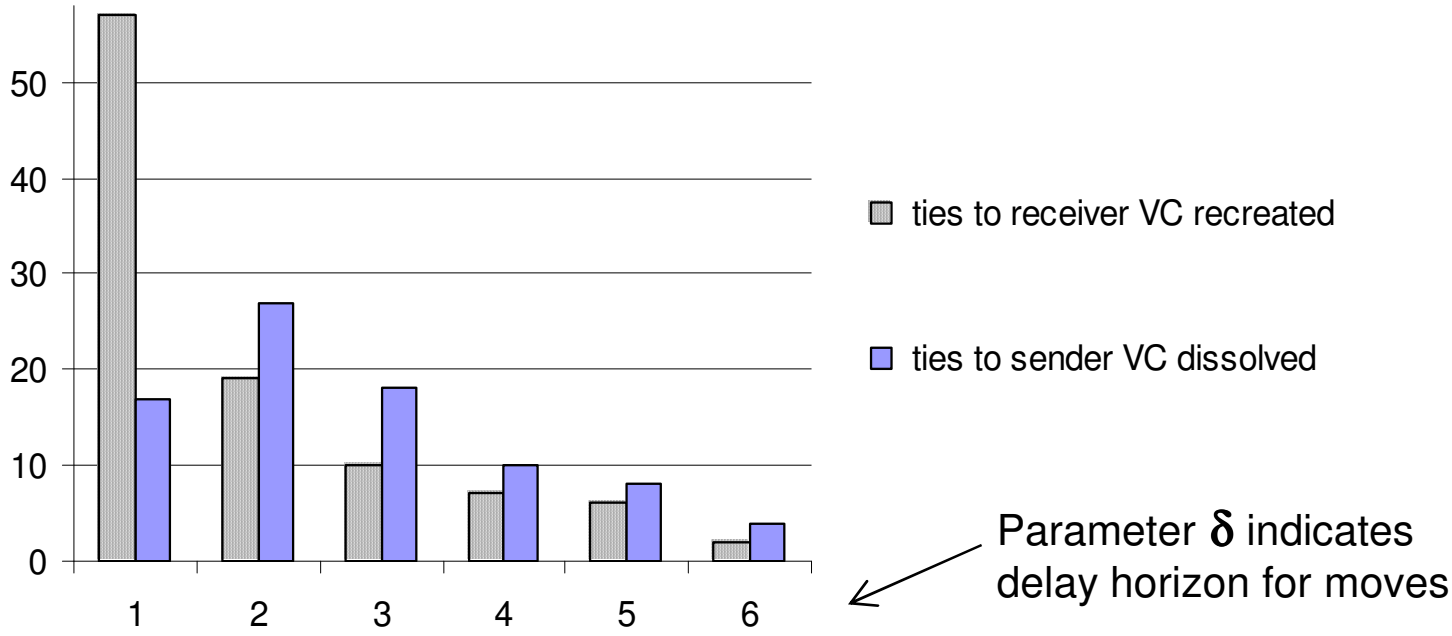
Coding issues: matrices *Y*

Tie dynamics given aggregation over two years $(\mathcal{E} = 2)$:



Coding issues: matrices *W*

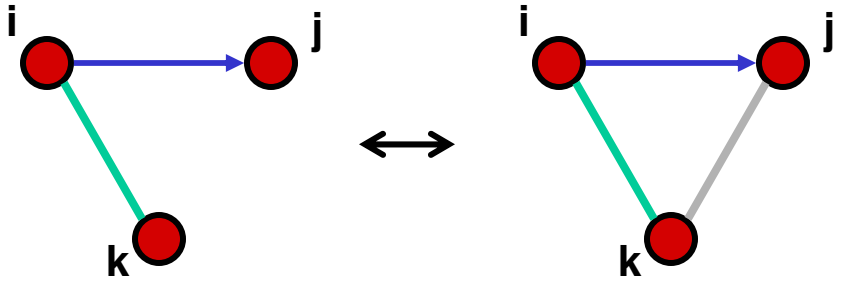
- If at all, *when* can GP movements be expected to have an effect? *Diagram: observed lag in years after GP move.*



Operationalisation of "network dragging"

Assume $y_{ij}(t)$ are syndication tie between firms i,j $\left(y_{ij} = y_{ji}\right)$ and $w_{ij}(t)$ are director moves from firm i to firm j at time t.

Effect *"recreate ties with former employer as ties with new employer"*:

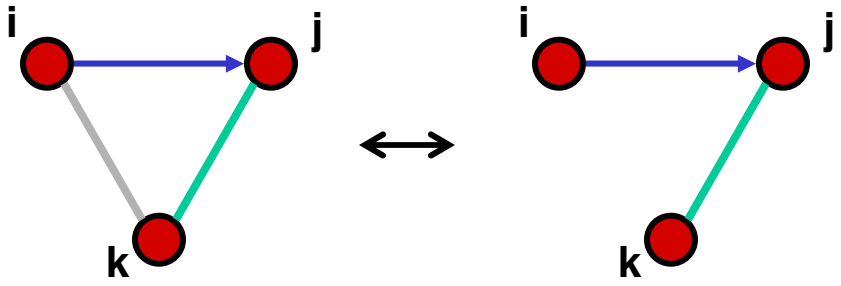


$$\int_{0\le\tau\le\delta} \sum_{i,j} y_{ik}(t-\tau) w_{ij}(t-\tau) y_{jk}(t)$$

as statistic in the objective function of actor **k** at time t (pos. par. expected)

Operationalisation of "network dragging"

Effect *"dissolve potentially recreated ties to former employer"*:



$$\int_{0 \le \tau \le \delta} \sum_{i,j} y_{ik}(t-\tau) w_{ij}(t-\tau) y_{ik}(t) y_{jk}(t)$$

as statistic in the objective function of actor **k**. `

(neg. par. expected)

Several other effects are also possible.

Model specification

Include…

- general tendency to form ties (trend),
- tendency towards transitive closure,
- tendency towards bridging structural holes,
- ‘recreate’ effect & ‘dissolve’ effect,
- some controls.

We proceed by forward model specification.

Results basis model (2 year VC, 2 year GP moves)

	estimate	*st.err.*	*t-score*	
degree	**–2.02**	**0.54**	**–3.75**	*tie creation is costly*
triadic closure	**0.22**	**0.03**	**7.09**	*partners of partners are preferred*
brokerage	0.37	0.27	1.38	*some evidence for str. holes* ?
in-moves alter	0.06	0.05	1.25	*arrival of GPs attracts ties*
out-moves alter	**0.17**	**0.09**	**2.18**	*departure of GPs attracts ties –* **?**

Results are counter-intuitive / don't make sense.

It turns out that controlling for an outlier-VC "firmX" is necessary.

Results adjusted basis model (same data coding)

	estimate	*st.err.*	*t-score*	
degree	**–1.27**	**0.05**	**–23.26**	*tie creation is costly*
triadic closure	0.41	0.02	17.97	*partners of partners are preferred*
brokerage	0.01	0.01	0.46	*no evidence for structural holes…*
firmX is alter	**1.74**	**0.28**	**6.11**	*…beyond firmX's position*
in-moves alter	**0.09**	**0.05**	**1.92**	*arrival of GPs attracts ties*
out-moves alter	0.05	0.05	0.96	*departure of GPs has no effect*

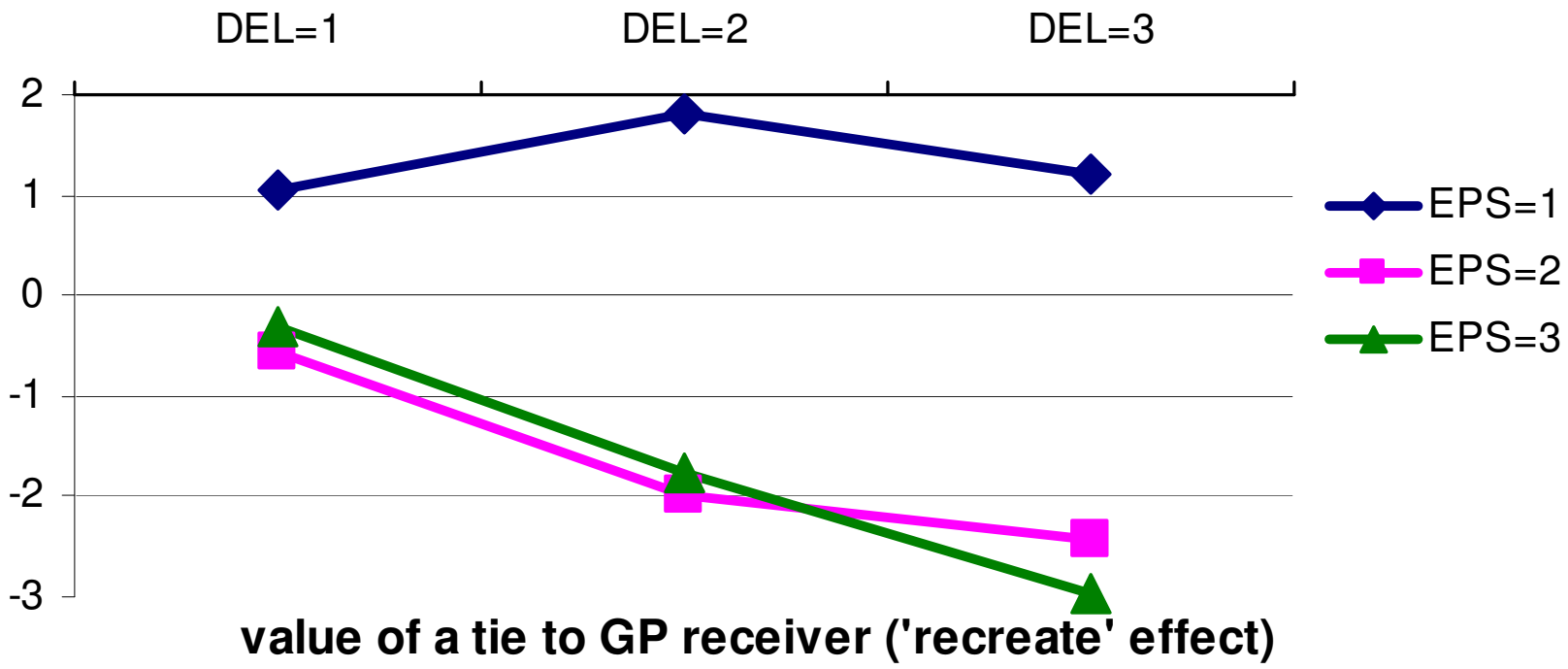
One might diagnose "unspecific support" for the social capital argument (see *in-moves* effect), BUT total #GPs not yet controlled for.

Results extended model (same data coding)

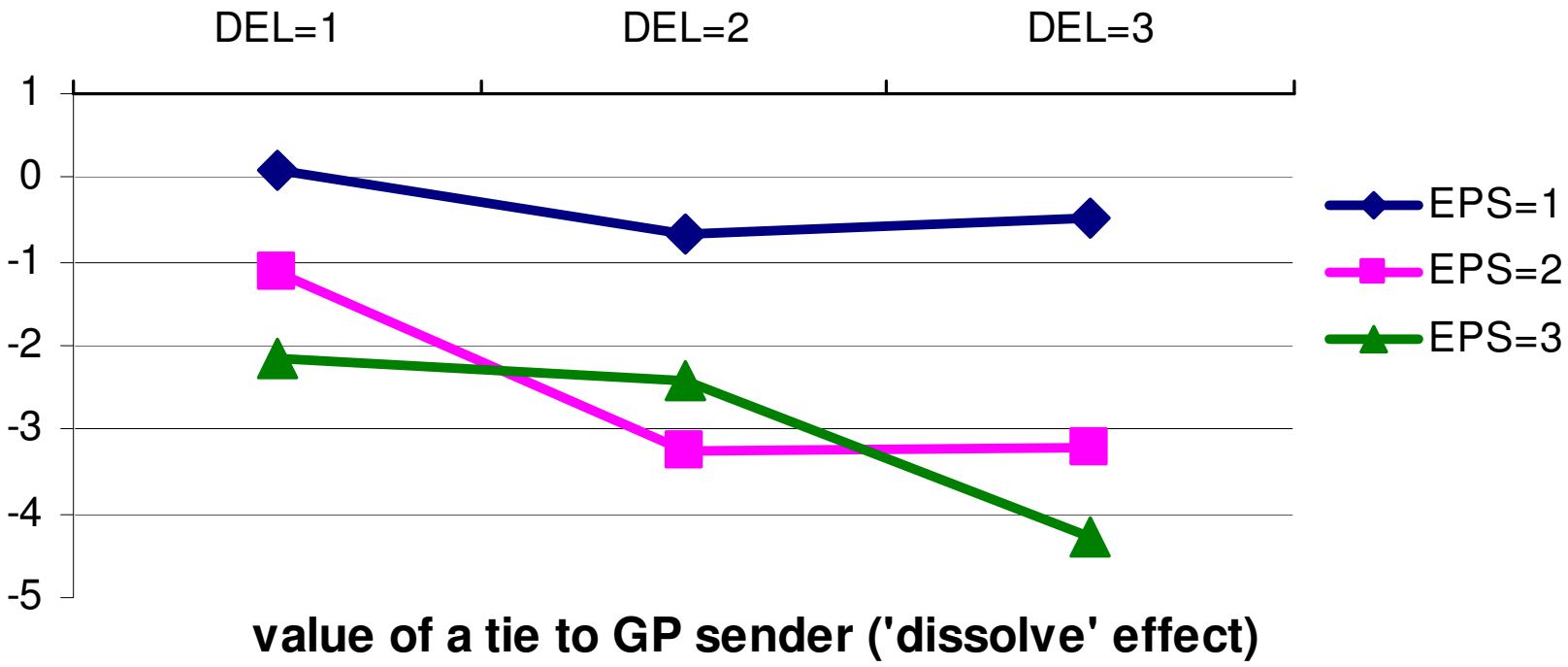
	estimate	*st.err.*	*t-score*	
firmX is alter	**2.09**	**1.06**	**1.97**	*firmX is popular partner*
in-moves alter	**0.19**	**0.09**	**2.17**	*arrival of GPs attracts ties*
out-moves alter	0.07	0.08	0.86	*departure of GPs has no effect*
recreate ties	**–0.23**	**0.12**	**–1.98**	*evidence against dragging*
dissolve ties	**–0.57**	**0.17**	**–3.27**	*evidence for dragging*

To some degree “specifically supportive” of social capital arguments.
Let’s look at the interesting effects for other coding of the data…

Results extended model (t-scores for other data codings)



Results extended model (t-scores for other data codings)



Preliminary conclusions

- *Unspecific support for in-movements entailing more syndication activity.*

  Note that this is compatible with an institutional perspective, where managers figure as resources!

- *Specific support for network dragging:*
  - *Longstanding cooperation ties of the sender VC ($\varepsilon > 1$) are not likely to be dragged, dragging even is avoided.*

    (i.e., the 'unspecific effect' holds for ties other than those)

Preliminary conclusions

- *Specific support for network dragging:*
  - *Ties that have the potential of being dragged along with a GP movement are those that manifest themselves in deals between 3rd parties and the sender VC directly prior to the GP's departure ($\varepsilon = 1$).*
  - *This dragging can manifest itself directly after the GP's movement, or later (no substantive sensitivity to the δ - parameter).*

Ongoing and future extensions

- *Add some covariates: funds under management, number of GPs employed, investment portfolio, …*
- *Distinguish the two roles of the epsilon parameter.*
- *Distill structural characteristics of ties that are shifted.*

  What is the role of direct links between sender and receiver of GPs?
- *Investigate at whose initiative are ties shifted.*
- *Work with bigger / better data set.*

Thank you !

…and check out our software at

http://stat.gamma.rug.nl/stocnet/