The Network of Foreign Direct Investment Flows: Theory and Empirical Analysis[1]

John Schoeneman[2]
jbs5686@psu.edu
PhD Candidate

Boliang Zhu[2]
bxz14@psu.edu
Assistant Professor

Bruce Desmarais[2]
bdesmarais@psu.edu
Associate Professor

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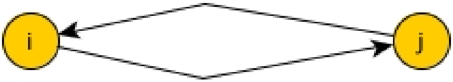
[2]Pennsylvania State University

Introduction

- Motivation
  - Violation of Independence Assumptions
  - Theoretical Importance of Dependence Terms
- FDI as a Network
  - Reciprocity
  - Transitivity
- Simultaneously test exogenous variables

Reciprocity

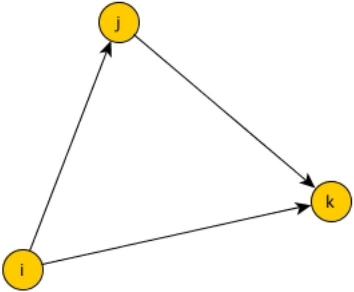
- Reciprocity



- Standard practice to resolve political opposition from competing firms
- Anti-reciprocal relationship in mixed dyads

Transitivity

- Transitivity



- MNC expansion and supply-chain fragmentation
- Risk of Expropriation
- PTA networks

FDI Data and Exogenous Covariates

- Bilateral FDI statistics from UNCTAD, 2001-2012

- Dyad-level Covariates
  - Gravity +
  - Contiguity +
  - Common Language +
  - Four Types of Defense Treaties +
  - Colonial Relationships +
  - PTA depth +

- Node-level Covariates (s/r)
  - GDP per capita +/-
  - GDP Growth Rate +/+
  - Polity IV +/+
  - Political Violence -/-
  - Trade Openness +/+

The Exponential Random Graph Model (ERGM)

The probability (likelihood function) of observing the network is:

$$\Pr_{\boldsymbol{\theta};h;\boldsymbol{g}}(\boldsymbol{Y} = \boldsymbol{y}) = \frac{h(\boldsymbol{y})\exp(\boldsymbol{\theta} \cdot \boldsymbol{g}(\boldsymbol{y}))}{\boldsymbol{\kappa}_{h,\boldsymbol{g}}(\boldsymbol{\theta})}$$

Decomposition:

$$\underbrace{\boldsymbol{h(y)}}_{Distribution} \qquad \underbrace{\boldsymbol{\theta}}_{Effects} \qquad \underbrace{\boldsymbol{g(y)}}_{Net\ Stats} \qquad \underbrace{\boldsymbol{\kappa}_{h,\boldsymbol{g}}(\boldsymbol{\theta})}_{Normalizer}$$

ERGM Constants

$$\text{Sum} : \boldsymbol{g}(\boldsymbol{y}) = \sum_{(i,j)\in\mathbb{Y}} \boldsymbol{y}_{i,j}$$

$$\text{Sum, Fractional Moment} : \boldsymbol{g}(\boldsymbol{y}) = \sum_{(i,j)\in\mathbb{Y}} \boldsymbol{y}_{i,j}^{1/2}$$

$$\text{Non-Zero} : \boldsymbol{g}_k = \sum_{(i,j)\in\mathbb{Y}} \mathbb{I}(\boldsymbol{y}_{i,j} \neq 0)$$

ERGM Dependence Terms

$$\text{Reciprocity} : \boldsymbol{g}(\boldsymbol{y}) = \sum_{(i,j)\in\mathbb{Y}} min(\boldsymbol{y}_{i,j}, \boldsymbol{y}_{j,i})$$

$$\text{Transitive Weights} : \boldsymbol{g}(\boldsymbol{y}) = \sum_{(i,j)\in\mathbb{Y}} \min\Big(\boldsymbol{y}_{i,j}, \max_{k\in N}\big(\min(\boldsymbol{y}_{i,k}, \boldsymbol{y}_{k,j})\big)\Big),$$

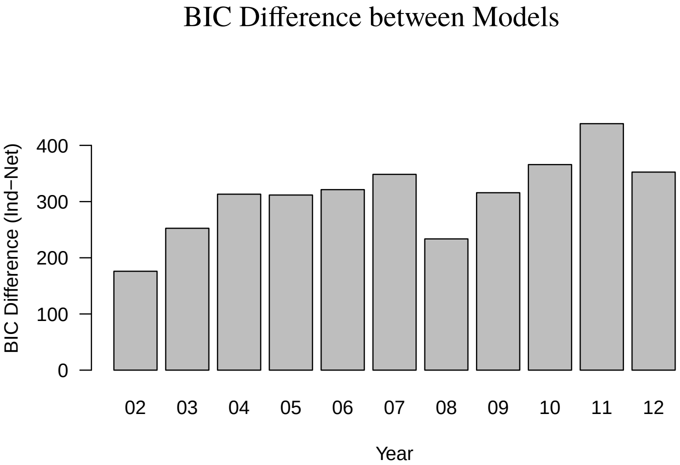
ERGM Covariates

$$\text{Dyadic Covariate} : \boldsymbol{g}(\boldsymbol{y}, \boldsymbol{x}) = \sum_{(i,j)} \boldsymbol{y}_{i,j} x_{i,j}$$

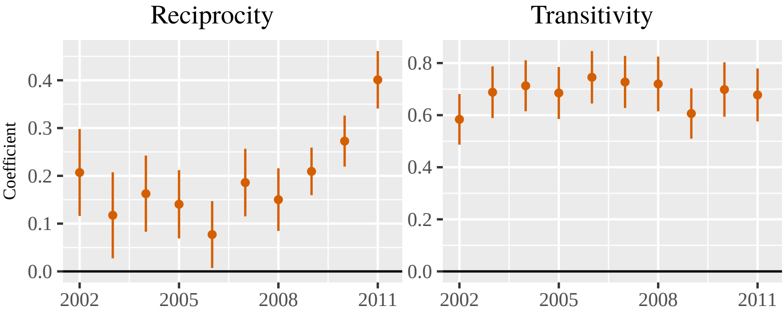
$$\text{Sender Covariate} : \boldsymbol{g}(\boldsymbol{y}, \boldsymbol{x}) = \sum_{i} x_i \sum_{j} \boldsymbol{y}_{i,j}$$

$$\text{Receiver Covariate} : \boldsymbol{g}(\boldsymbol{y}, \boldsymbol{x}) = \sum_{j} x_j \sum_{i} \boldsymbol{y}_{i,j}$$

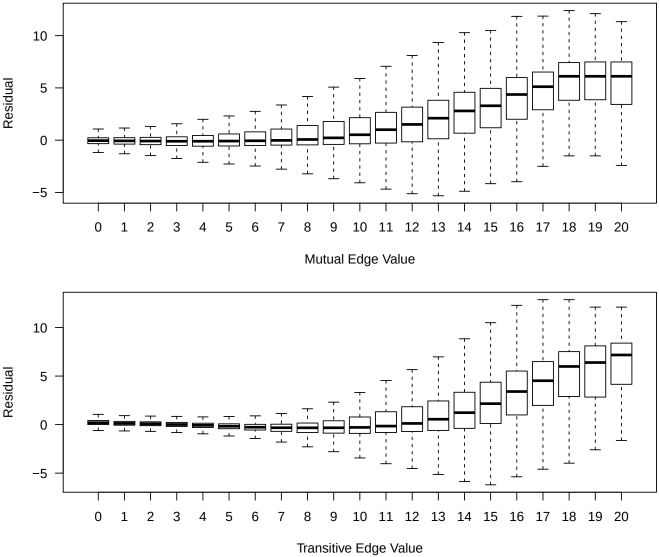
Model Fit and Bias



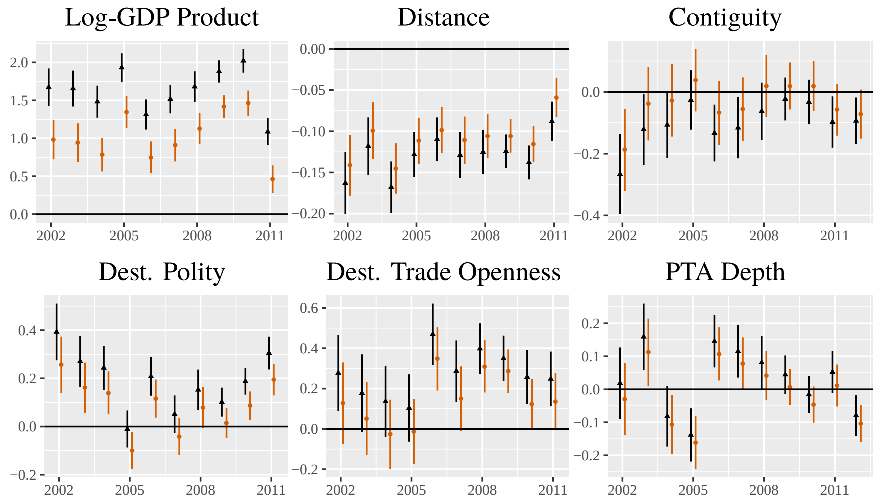
Count Model and Network Dependencies



Network Statistics



Covariate Results



Conclusion and Future Research

- Conclusion
  - Network terms are substantively important
  - Network terms need to be modeled instead of being assumed away
- Future Steps
  - Cyclical Weights
  - Network dynamics

Additional Covariates