

Endogenous Trade Networks: Example - Labor Market Study

Presenter:

Leigh Tesfatsion

Professor of Economics and Mathematics

Department of Economics

Iowa State University

Ames, Iowa 50011-1070

<http://www.econ.iastate.edu/tesfatsi/>

tesfatsi@iastate.edu

Outline

- ★ Labor Institutions and Market Performance:
What does ACE have to offer?

www.econ.iastate.edu/tesfatsi/alabor.htm

- ★ Illustration: (M. Pingle/L. Tesfatsion, 2003)

"Evolution of Worker-Employer Networks and Behaviors Under Alternative Non-Employment Benefits," pp. 256-285 in A. Nagurney (ed.), *New Directions in Networks*, Edward-Elgar, 2003.

Implemented via the Trade Network Game (TNG) Lab²

Labor Institutions and Market Performance:

Some Key Issues:

- ◆ Labor contracts typically **incomplete**
- ◆ Supplemented by government programs with **numerous eligibility restrictions**
- ◆ **Difficult to test program effects** by means of conventional analytical and/or statistical tools

Example: U.S. Programs Providing Unemployment Benefits (UB)

- ◆ UB only paid to “no fault of their own” unemployed
- ◆ UB recipients must continue to seek employment
- ◆ UB levels based on past earnings
- ◆ UB of limited duration
- ◆ UB financed by taxes imposed on employers
- ◆ Additional UB often granted when unemployment rate is abnormally high for prolonged periods

Empirical Findings

(Handbook of Labor Economics, Elsevier, 1999)

- ◆ Higher benefit **level** increases duration of unemployment spells.
- ◆ Increased benefit **duration** increases unemployment rate (unemployed as percentage of labor force).
- ◆ **Evidence of other impacts of UB is considerably more mixed** (small sample bias problems, confounding effects,...)

Common Approach to UB Modeling

- ◆ Dynamic Programming (DP)
- ◆ Representative worker uses DP to maximize lifetime expected utility
- ◆ Jobs arise and end randomly, and unemployment benefit received if unemployed
- ◆ At each time t that a job arises, worker compares DP value of new job vs. DP value of staying in current situation (old job or unemployment)
- ◆ **Precise predictions, empirical support unclear.**

Potential Contributions of an ACE Approach

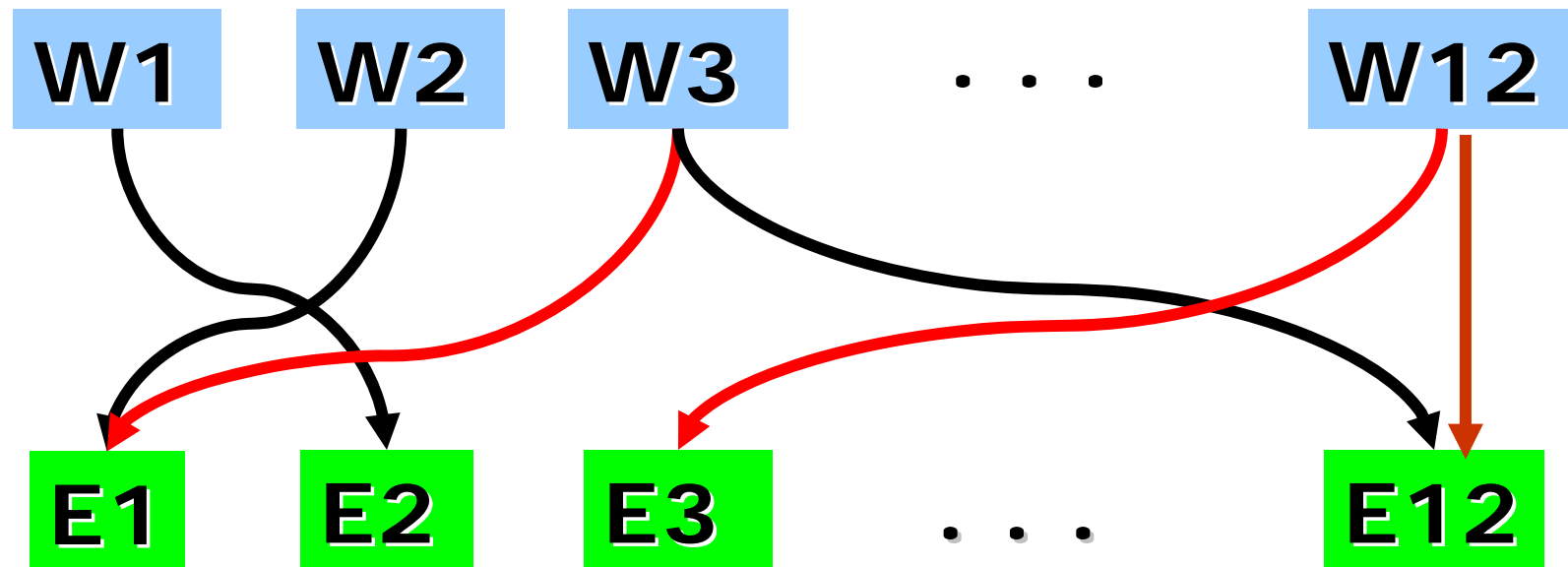
- ◆ Both workers & employers can be modeled as **utility-seeking interacting agents**
- ◆ Matching process can be preferential (**endogenous hires, quits, and firings**)
- ◆ **Learning** can be calibrated to data (empirical, human-subject experimental)
- ◆ **Evolution** of behaviors/interaction networks
- ◆ Relatively easy to incorporate **realistically detailed structural features** (market protocols, policy rules, program eligibility requirements,...)

An ACE Study of Unemployment Benefits

“Evolution of Worker-Employer Networks and Behaviors under Alternative Non-Employment Benefits: An ACE Study”

- ◆ **Joint work with M. Pingle (U of Nevada-Reno)**
- ◆ Published in *New Directions in Networks*, Edward Elgar, 2003, edited by Anna Nagurney
- ◆ Pre-print available at www.econ.iastate.edu/tesfatsi/alabmplt.pdf
- ◆ Parallel human-subject experiment conducted

ACE Labor Market Framework



Preferential job search with choice/refusal of partners:
Red directed arrow indicates **refused work offer**.

ACE Labor Market Framework...

- ❁ 12 workers with same **observable** structural attributes in initial period $T=0$
- ❁ 12 employers with same **observable** structural attributes in initial period $T=0$
- ❁ Only **observable** source of heterogeneity among workers and among employers is their expressed behaviors on the work-site

ACE Labor Market Framework...

- ❁ Each worker can work for at most one employer in each period T
- ❁ Each employer can provide at most one job opening in each period T
- ❁ Work-site strategies in initial period $T=0$ are **randomly determined and private information**

Each worker and employer has...

- ❁ ***Publicly available information*** about various market/policy protocols (e.g., UB eligibility rules)
- ❁ ***Private behavioral methods*** that can evolve over time
- ❁ ***Privately stored data*** that can change over time

A Computational Worker

Public Access:

// **Public Methods**

Protocols governing job search

Protocols governing negotiations with potential employers

Protocols governing unemployment benefits program

Methods for receiving data

Methods for retrieving Worker data

Private Access:

// **Private Methods**

Method for calculating my expected utility assessments

Method for calculating my actual utility outcomes

Method for updating my worksite strategy (**GA learning**)

// **Private Data**

Data about myself (my history, utility fct., current wealth...)

Data recorded about external world (employer behaviors,...)

Addresses for potential employers (permits communication)

A Computational Employer

Public Access:

// **Public Methods**

- Protocols governing search for workers
- Protocols governing negotiations with potential workers
- Protocols governing unemployment benefits program
- Methods for receiving data
- Methods for retrieving Employer data

Private Access Only:

// **Private Methods**

- Method for calculating my expected profit assessments
- Method for calculating my actual profit outcomes
- Method for updating my work-site strategy (**GA Learning**)

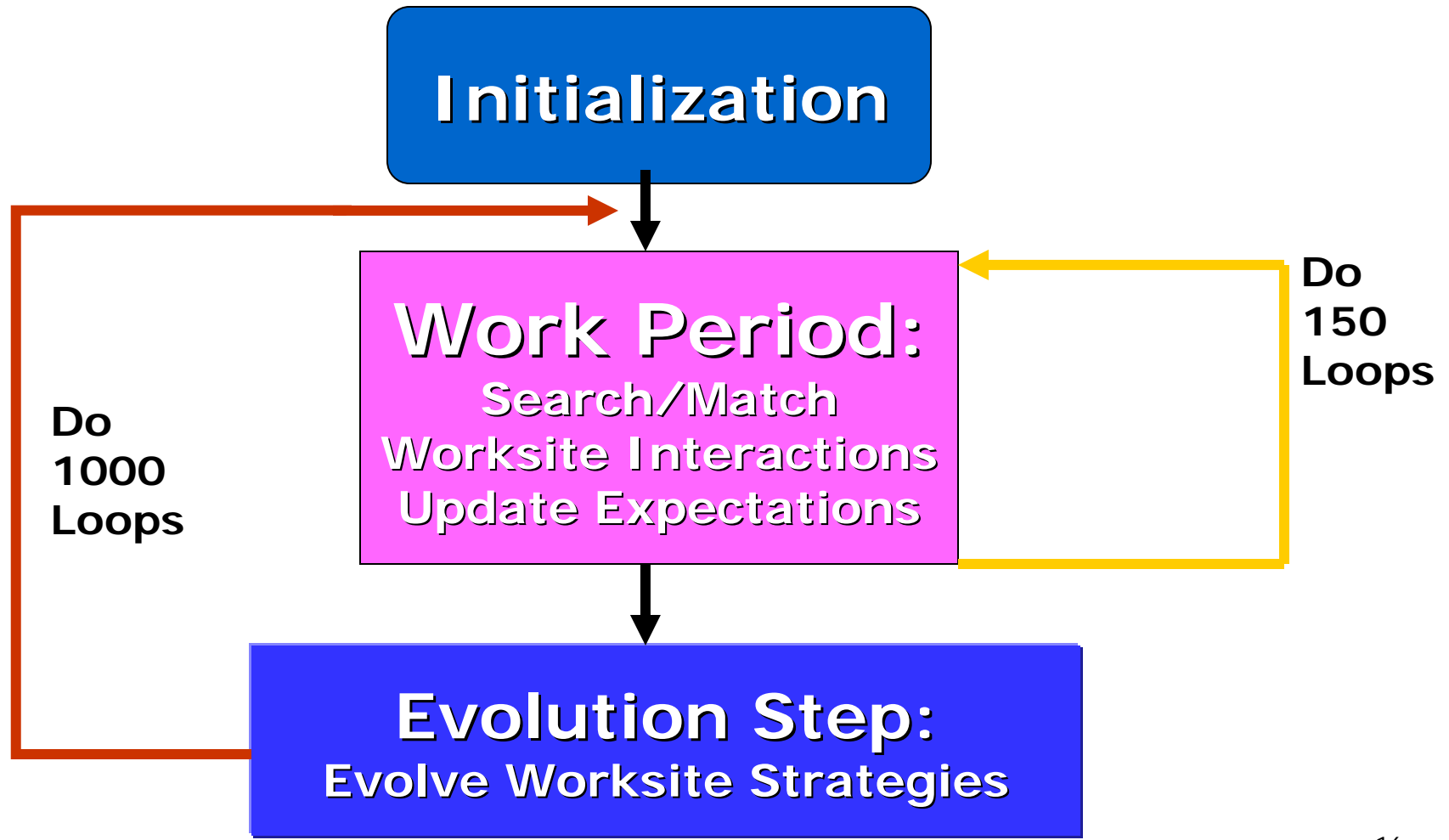
// **Private Data**

- Data about myself (my history, profit fct., current wealth...)
- Data recorded about external world (worker behaviors,...)
- Addresses for potential workers (permits communication)

Flow of Activities in the ACE Labor Market

- ❁ Workers make offers to preferred employers at a small cost per offer (**quits allowed**)
- ❁ Employers accept or refuse received work offers (**firings allowed**)
- ❁ Each matched pair engages in one work-site interaction (**PD game - cooperate or defect**)
- ❁ After 150 work periods, each worker and employer updates its work-site IPD strategy

Flow of Activities in the ACE Labor Market



Worksite Interactions as Prisoner's Dilemma (PD) Games

		Employer	
		C	D
Worker	C	(40,40)	(10,60)
	D	(60,10)	(20,20)

D = Defect (Shirk); C = Cooperate (Fulfill Obligations) 17

Key Issues Addressed

How do **changes** in the level of a “non-employment payment” NEP affect...

- ✦ **Worker-Employer Interaction Networks**
- ✦ **Worksite Behaviors:** Degree to which workers/employers shirk (defect) or fulfill obligations (cooperate) on the worksite
- ✦ **Market Efficiency** (total surplus net of UB program costs, unemployment/vacancy rates,...)
- ✦ **Market Power** (distribution of surplus)

Experimental Design

- ❁ **Treatment Factor:**

Non-Employment Payment (NEP)

- ❁ **Three Tested Treatment Levels:**

NEP=0, NEP=15, NEP=30

- ❁ **Runs per Treatment:**

20 (1 Run = 1000 Generations; 1 Gen.=150 Work Periods)

- ❁ **Data Collected Per Run:** Network patterns, behaviors, and market performance (reported in detail for generations 12, 50, 1000)

Three NEP Treatments in Relation to PD Payoffs

① $\mathbf{NEP=0} < L=10$

② $L=10 < \mathbf{NEP=15} < D=20$

③ $D=20 < \mathbf{NEP=30} < C=40$

- ❖ **NOTE:** Work-site PD payoffs given by:
L (Sucker)=10 < D (MutualD)=20
< C (MutualC)=40 < H (Temptation)=60

Market Efficiency Findings

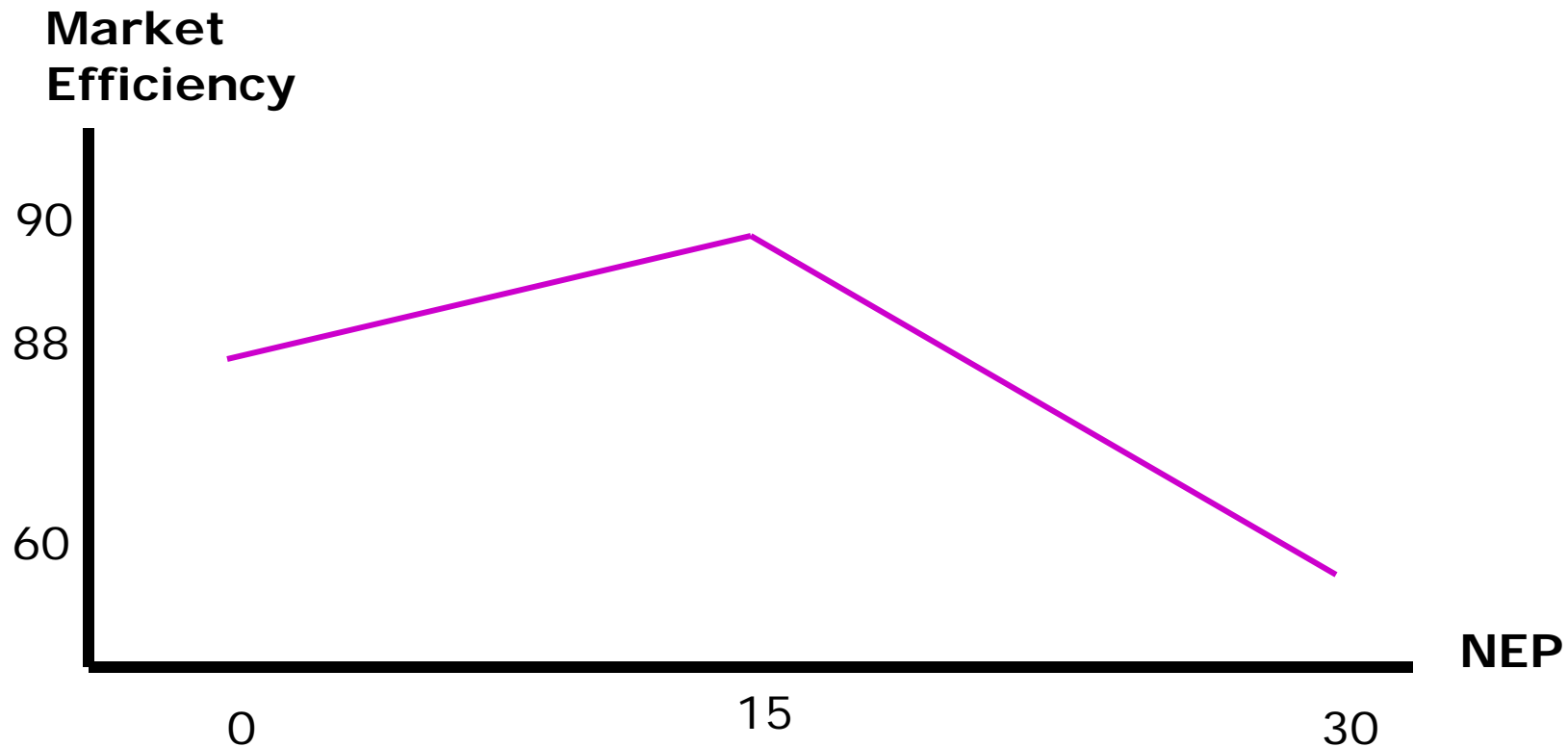
As NEP level **increases** from 0 to 30...

- ⊗ *higher* average unemployment and vacancy rates are observed; ← **KNOWN EFFECT**
- ⊗ *more* work-site cooperation observed on average among workers and employers who successfully match. ← **NEW EFFECT**

Note: These outcomes have potentially *offsetting* effects on market efficiency.

Efficiency Findings...

Market Efficiency (Utility less NEP Program Costs) Averaged Across Generations 12, 50, and 1000 for three different NEP treatments



Efficiency Findings...

- ❁ NEP=15 yields *highest efficiency*
- ❁ NEP=0 yields *lower* efficiency
(too much shirking)
- ❁ NEP=30 yields *lowest efficiency*
(NEP program costs too high)

Multiple Attractors

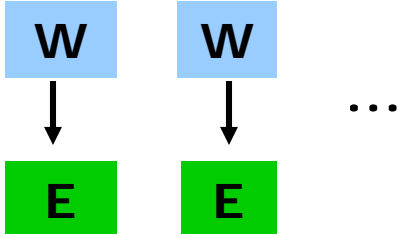
- * Two distinct “attractors” observed for each NEP treatment...
 - NEP=0 and NEP=15:
 - ◆ *First Attractor* = Latched network supporting *mutual cooperation*;
 - ◆ *Second Attractor* = Latched network supporting *intermittent defection*
 - NEP=30:
 - ◆ *First Attractor* = Latched network supporting *mutual cooperation*
 - ◆ *Second Attractor* = Completely disconnected network (*total coordination failure*)

The Following Diagrams Report...

① Two-sided (W-E) network distributions

0=Stochastic fully connected network

12=Latched in pairs



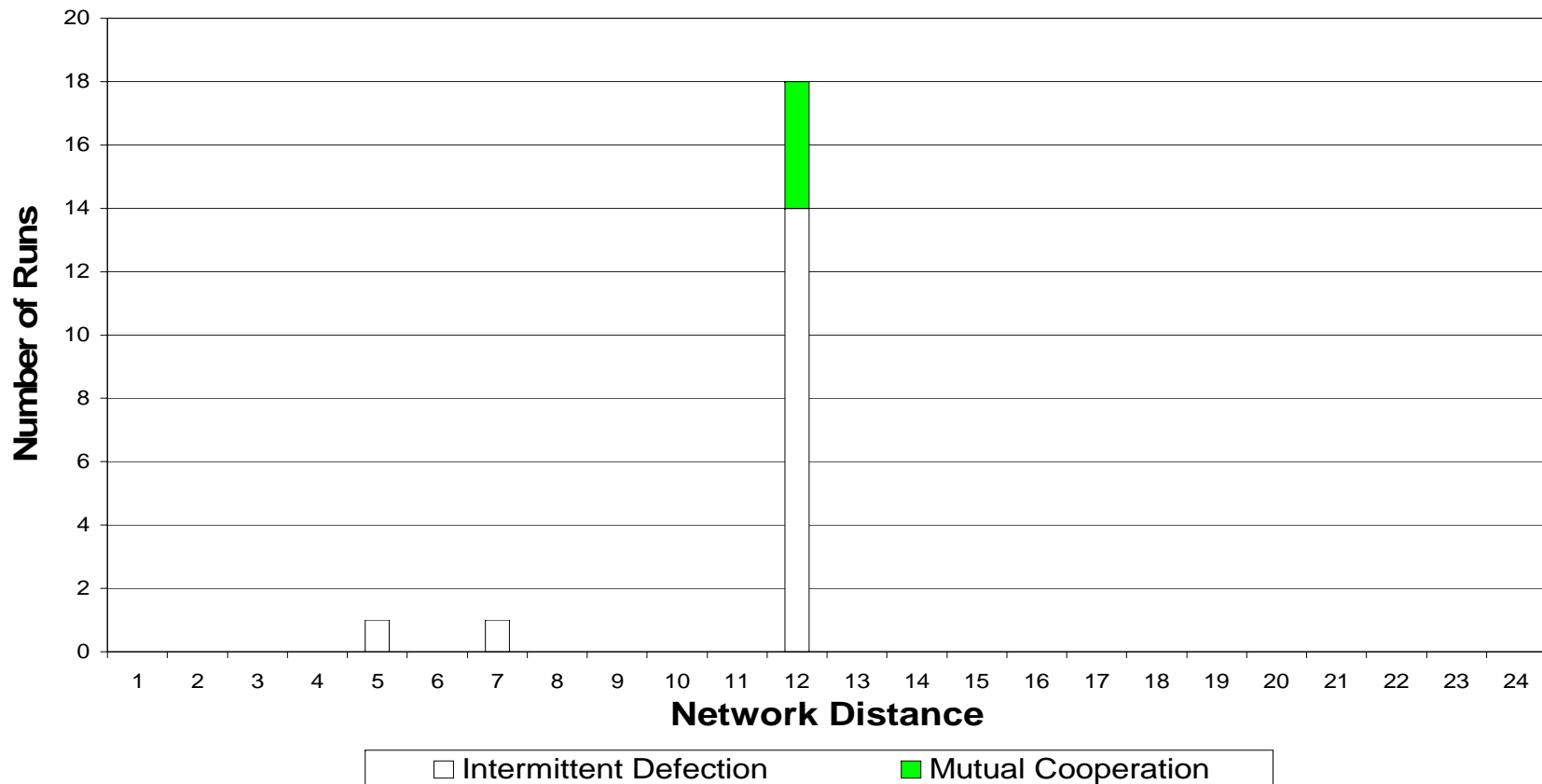
The diagram illustrates a latched pair of nodes. It consists of two blue rectangular boxes, each containing the letter 'W', positioned horizontally. Below each 'W' box is a black arrow pointing downwards to a green rectangular box containing the letter 'E'. To the right of the second 'E' box is an ellipsis (...).

24=Completely disconnected

② Worksite behaviors supported by these network outcomes

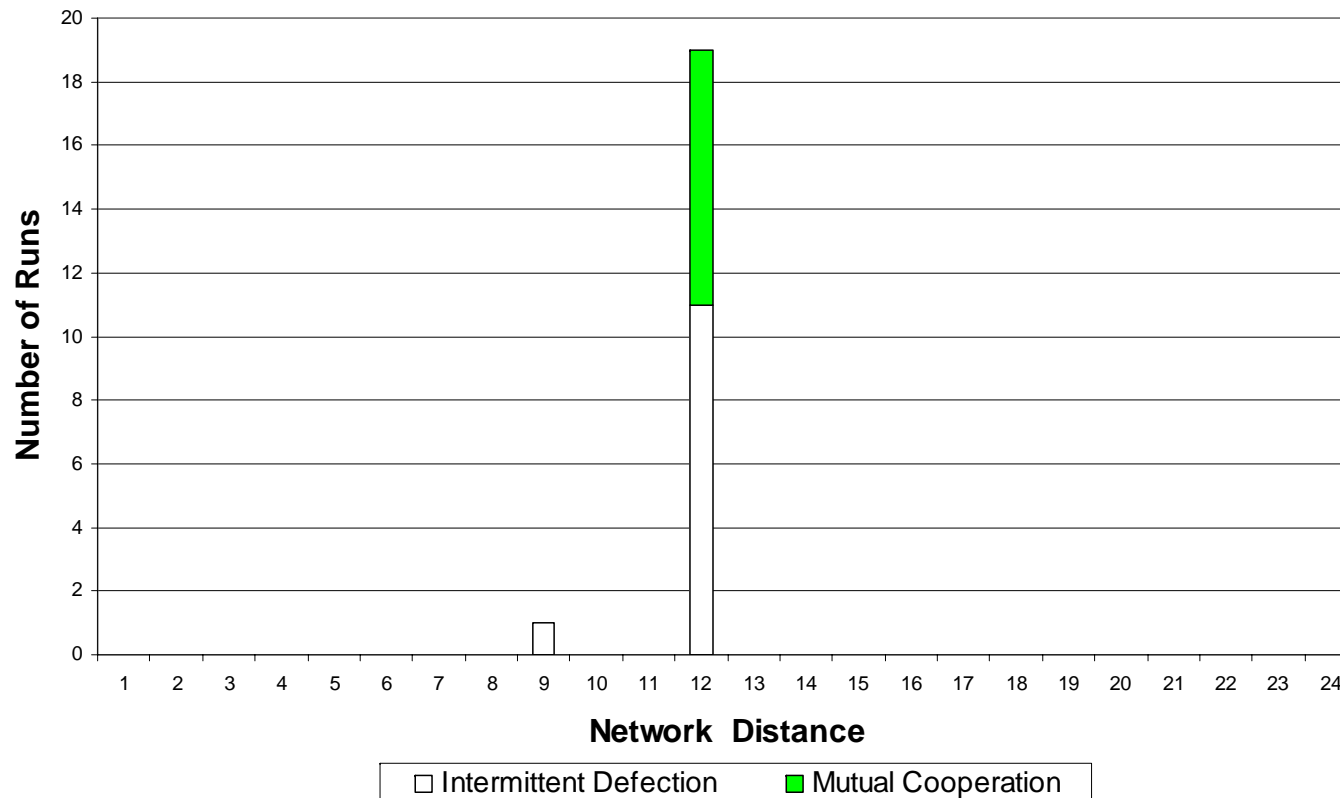
Network Distribution for NEP=0 Sampled at End of Generation 12

Network Distribution for ZeroT:12



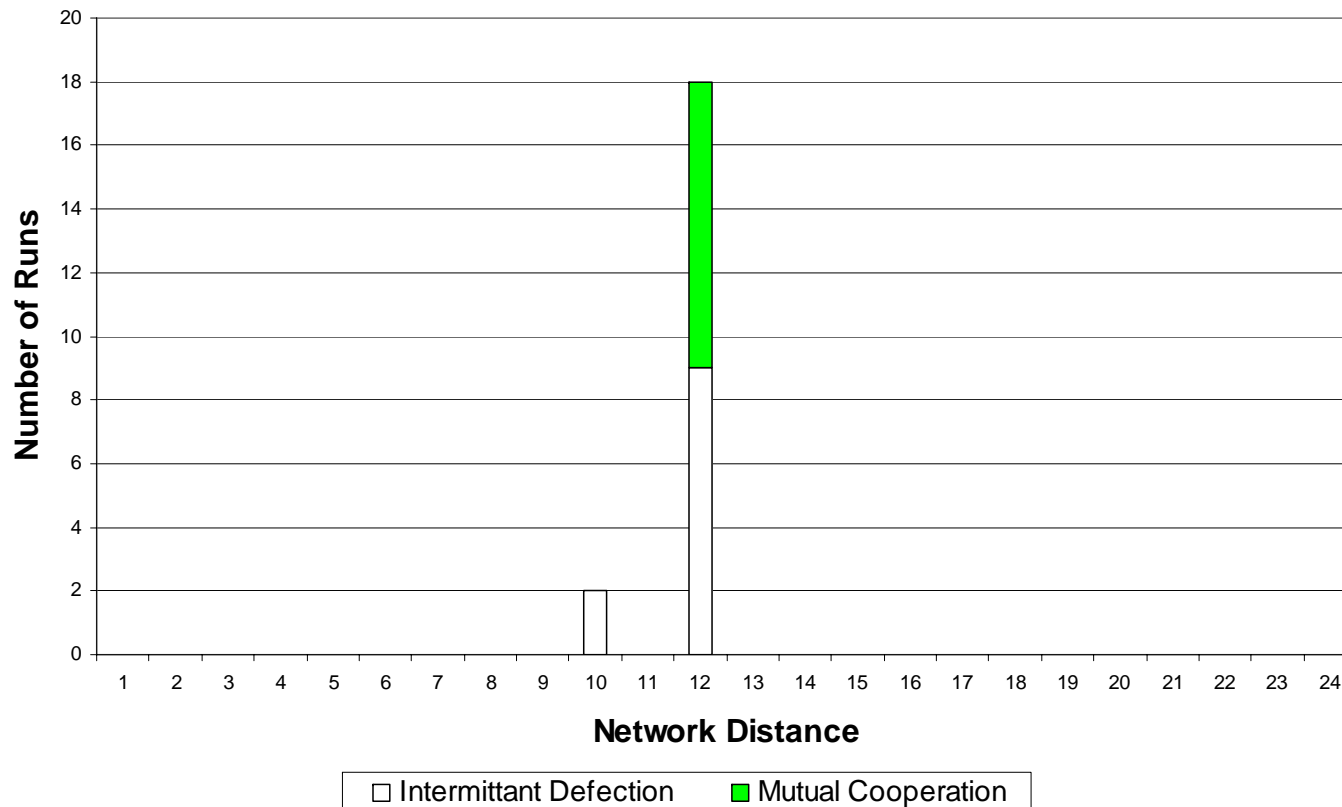
Network Distribution for NEP=0 Sampled at End of Generation 50

Network Distribution for ZeroT:50



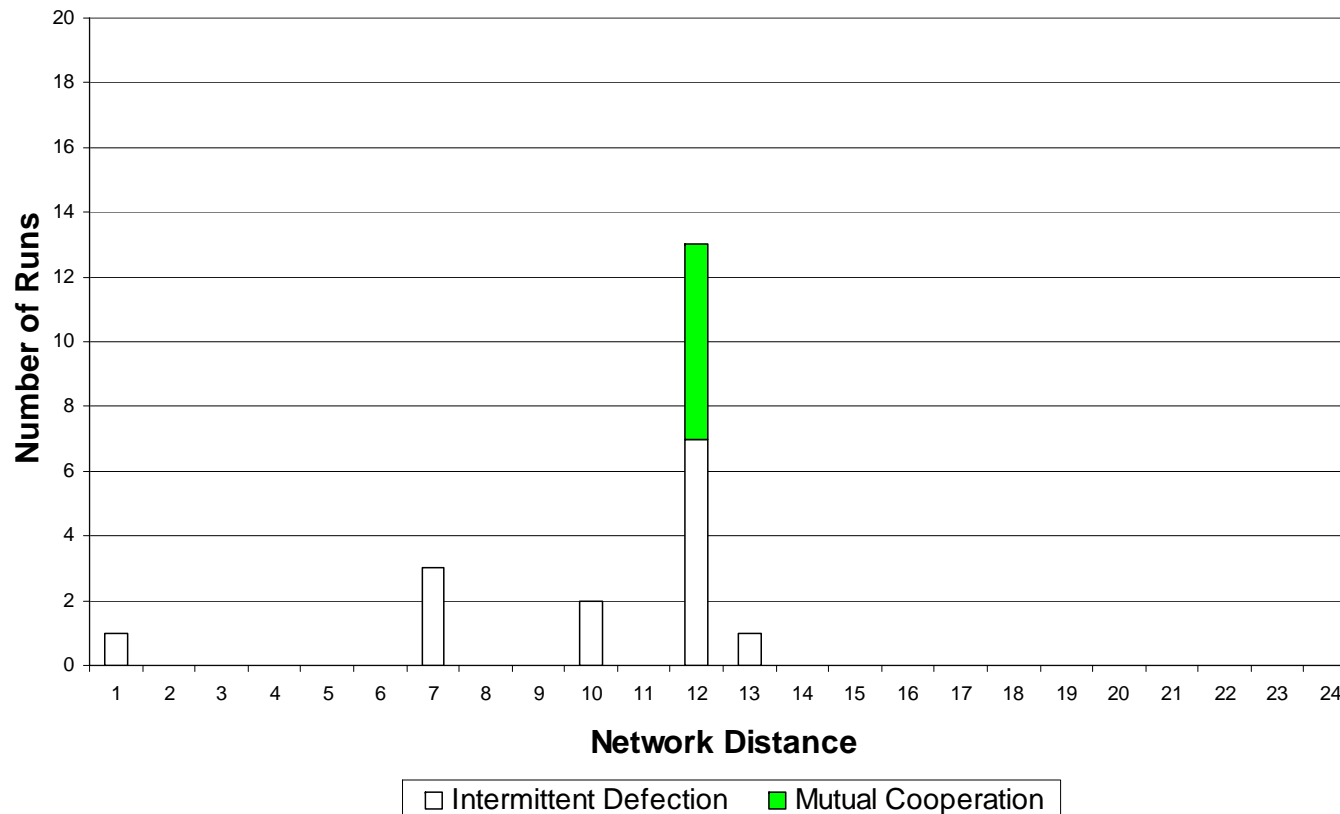
Network Distribution for NEP=0 Sampled at End of Generation 1000

Network Distribution for ZeroT:1000



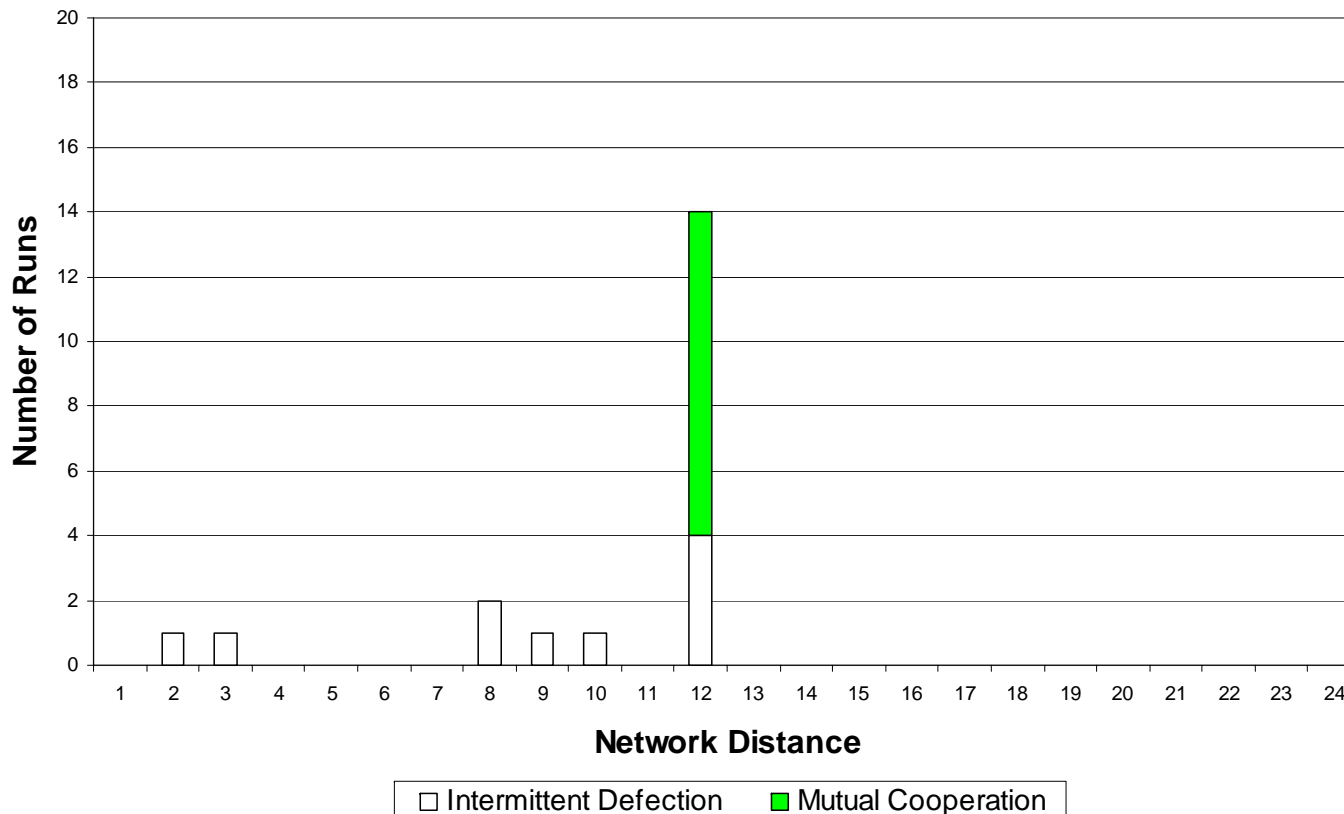
Network Distribution for NEP=15 Sampled at End of Generation 12

Network Distribution for LowT:12



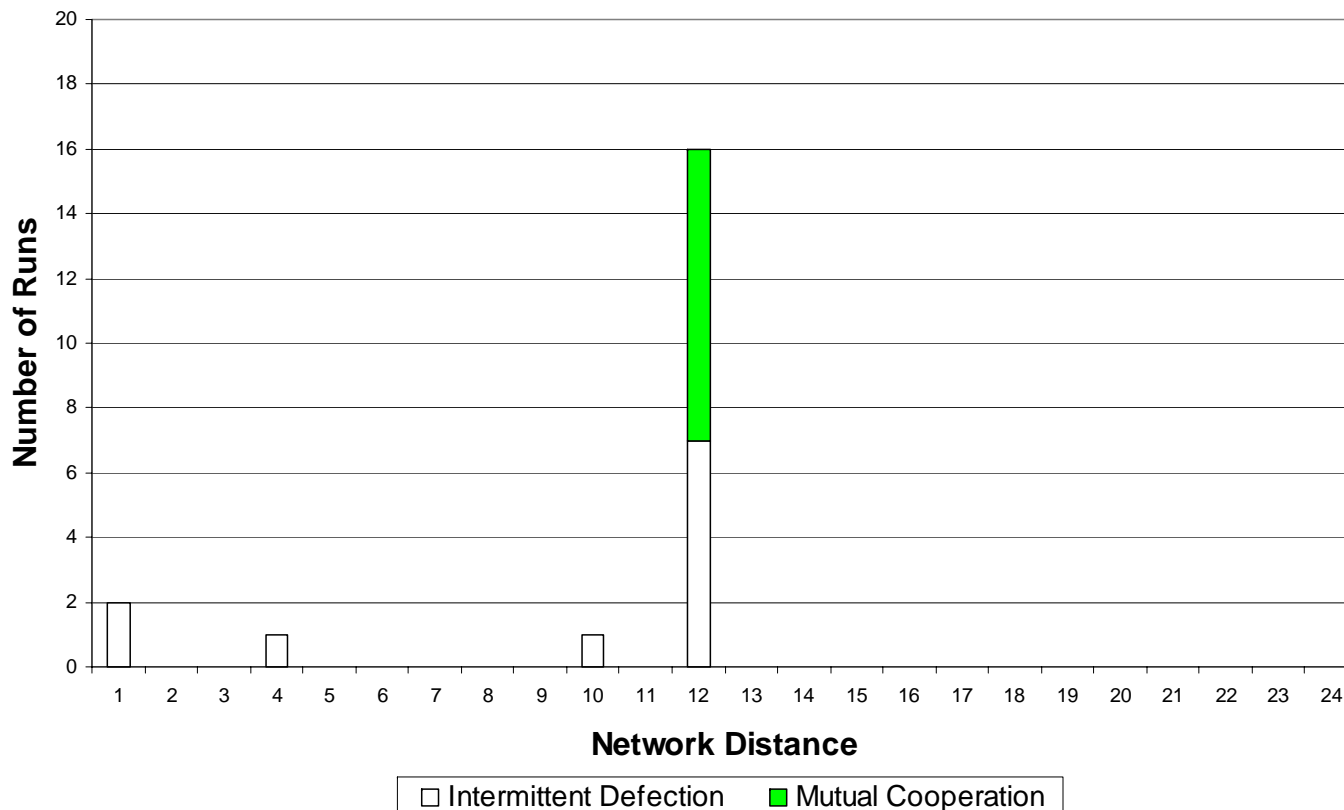
Network Distribution for NEP=15 Sampled at End of Generation 50

Network Distribution for LowT:50



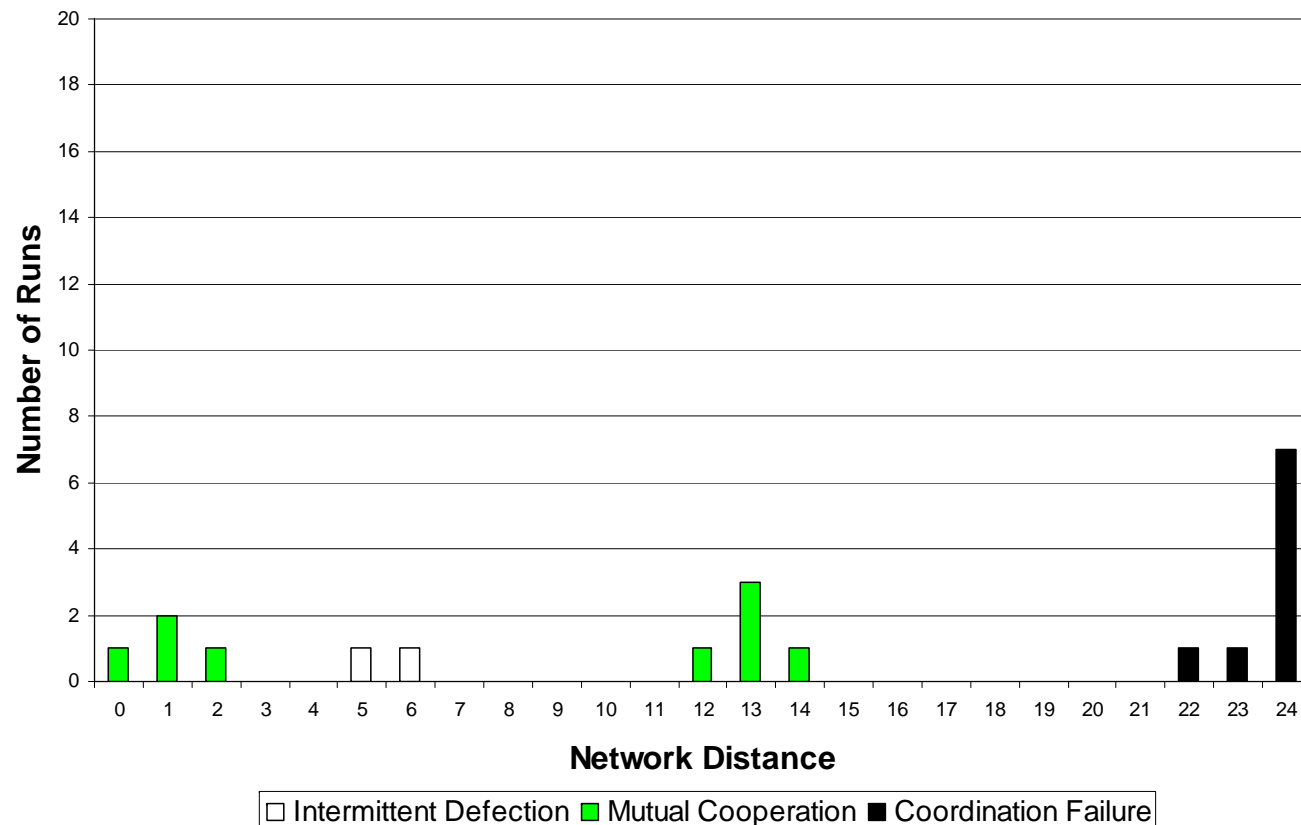
Network Distribution for NEP=15 Sampled at End of Generation 1000

Network Distribution for LowT:1000



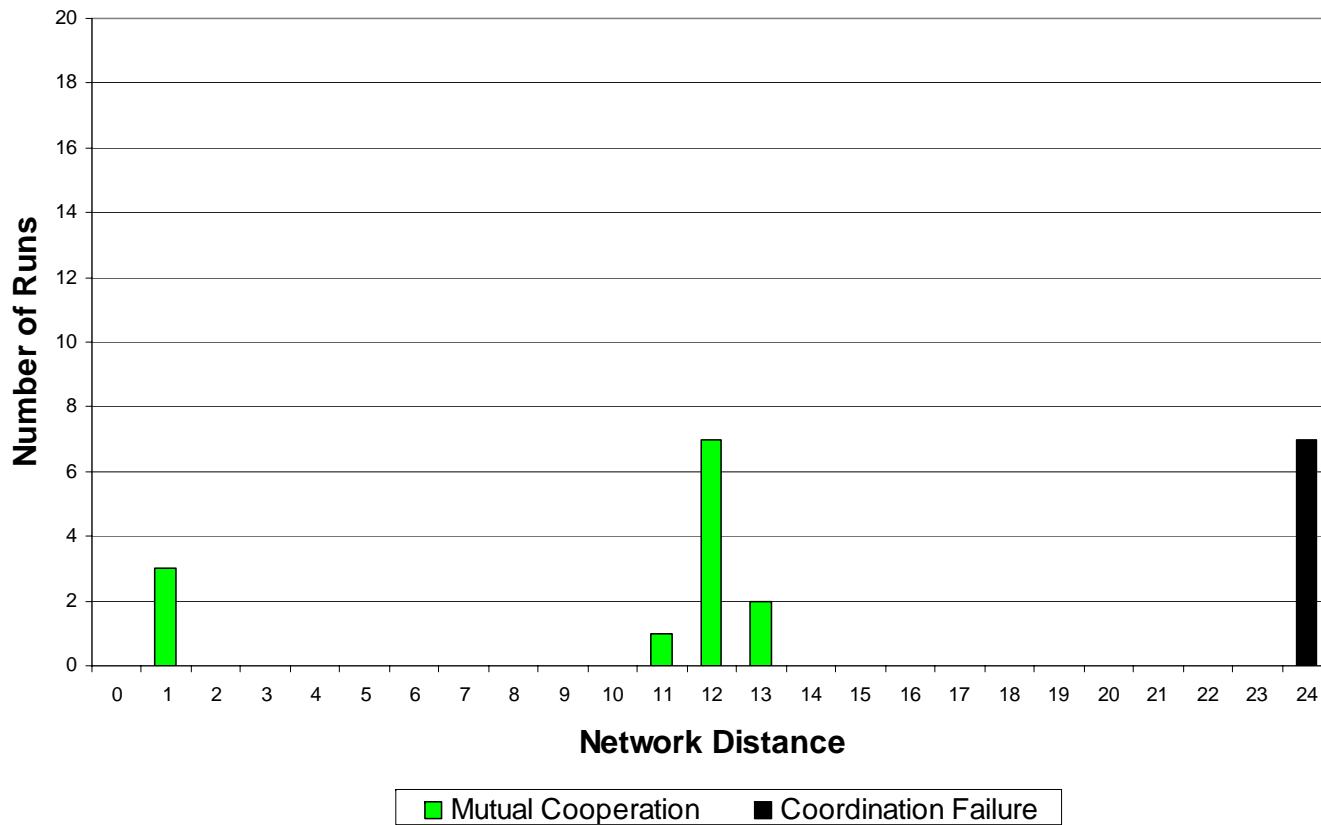
Network Distribution for NEP=30 Sampled at End of Generation 12

Network Distribution for HighT:12



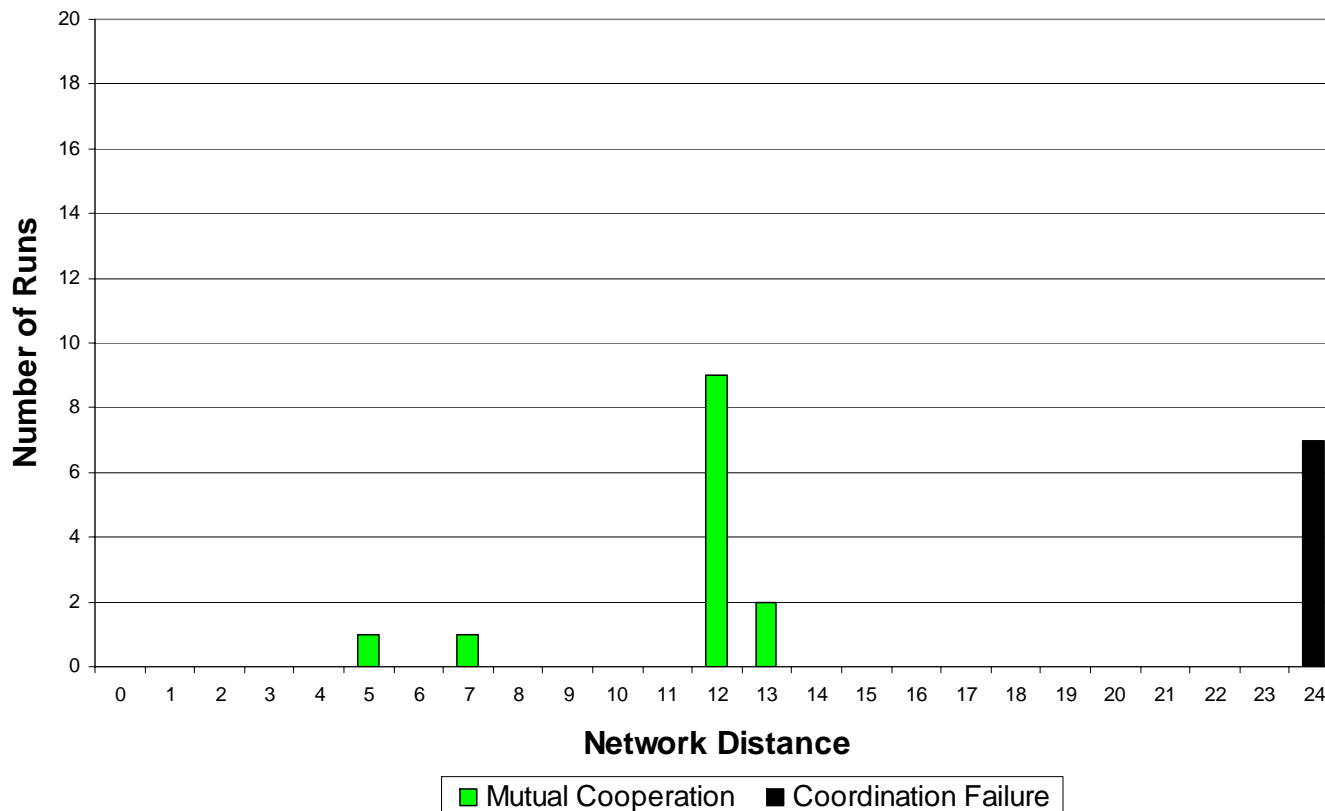
Network Distribution for NEP=30 Sampled at End of Generation 50

Network Distribution for HighT:50



Network Distribution for NEP=30 Sampled at End of Generation 1000

Network Distribution for HighT:1000



Summary of Findings

- ❁ Changes in NEP *systematically* affect unemployment, vacancy, worksite behaviors, and welfare outcomes
- ❁ Worker-employer networks tend to be either *fully latched in pairs* or *completely disconnected*
- ❁ But... even fully latched networks support *multiple peaked* behavioral distributions (potential pooling problems)