



UNIVERSITY OF CENTRAL FLORIDA

## A Comparative Simulation Study on the Benefits of Entrepreneurial Support Organization Membership: Preliminary Results

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## Motivation

What are the **factors** that contribute to  
the well-being of **Regional Economy**?

How do we design **effective policies**  
for

Economic  
Growth

## Related Work

- Regional Economics
  - Jun, K. (2007). Determinants of Localized Technology Spillovers: Role of Regional and Industrial Attributes. *Regional Studies*, 41(7), 995-1011.
  - Goldstein, H. A., & Renault, C. S. (2004). Contributions of Universities to Regional Economic Development: A Quasi-experimental Approach. *Regional Studies*, 38(7), 733-746.
  - Giesecke, J. A., & Madden, J. R. (2010). Uncovering the Factors behind Comparative Regional Economic Performance: A Multi-regional Computable General Equilibrium (CGE) Approach. *Regional Studies*, 44(10), 1329-1349.
- Innovation Ecosystems
  - Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31(3), 306–333. doi:10.1002/smj.821
  - Borgh, M., Cloudt, M., & Romme, A. G. L. (2012). Value creation by knowledge-based ecosystems: evidence from a field study. *R&D Management*, 42(2), 150–169. doi:10.1111/j.1467-9310.2011.00673.x
- Public Policy / Technology Transfer
  - O’Neal, T., Ford, C., Lasrado, V., Sivo, S.: The effect of regional characteristics on the relationship between university resources and knowledge-based startups performance. *Technology Transfer in a Global Economy* p. 233 (2012)
  - Breznitz, S. M. (2011). Improving or Impairing? Following Technology Transfer Changes at the University of Cambridge. *Regional Studies*, 45(4), 463-478.

## Methodologies

- Common Methodologies
  - Surveys, focus groups, structured interviews, etc
  - Secondary Data Sets: census, statistics, others
  - Some Issues
    1. Isolating causation is challenging
    2. Longitudinal dynamics
- Wouldn’t it be nice to have a Methodology that:
  - Allows for easy isolation of cause/effect relations and longitudinal studies
  - Provide a “wind-tunnel” to test what-if policy scenarios for pragmatic policy decision making

# Complexity

- Central Question: How do emergent phenomena emerges from low level building blocks?
- Attempt to develop concepts, methods and tools that transcend specific disciplines
- **Method: Find low level assumptions about interaction of key building blocks that correctly reproduce high level emergent phenomena**
- Data driven, bottom up approach
- Successful for epidemics, traffic, metabolism, physics and economics

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	Complexity Economics	Traditional Economics
Dynamics	Open, dynamics, nonlinear systems, far from equilibrium	Closed, static, linear systems in equilibrium
Agents	Modeled individually, decisions are algorithmic (can adapt and learn), bounded rationality, imperfect information, can make mistakes, heterogeneous	Modeled collectively; use complex deductive calculation to make decisions; perfectly rational; perfectly informed; no learning or adaptation; representative agent
Networks	Explicitly modeled interactions between individual agents; networks change over time	Assume agents only interact indirectly through market mechanisms (auctions), full mixing.
Emergence	Macroeconomic patterns emerge as a result of microeconomic behaviors and interactions	Micro- and macroeconomics remain separate disciplines
Evolution	Evolutionary process off differentiation, selection, competition, adaptation provide systems with novelty and growth in order and complexity	No mechanism for endogenously creating novelty or growth in order or complexity

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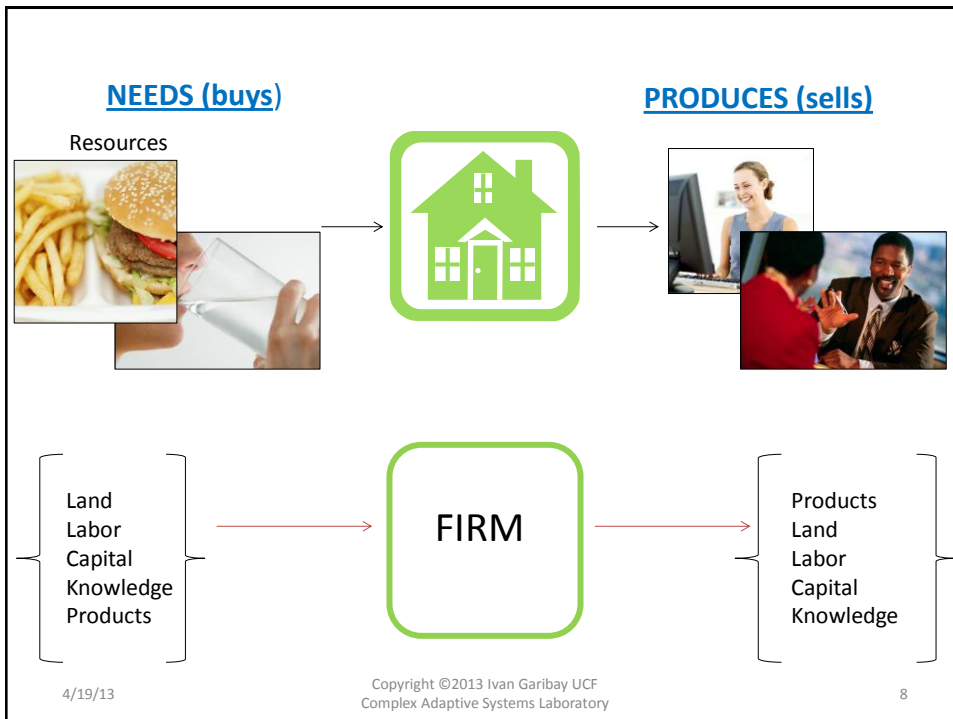
# Naïve micro-foundations of general macroeconomics

Principles/Assumptions	Computational Process
<b>Bounded Rationality</b>	Agents are only aware of and interact with other agents on their close vicinity <i>vision radius= 6</i>
<b>Schumpeterian Creative Destruction</b>	Evolutionary Algorithm: <ul style="list-style-type: none"> <li>• Wealth = fitness metric</li> <li>• Fit individuals survive, thrive</li> <li>• Unfit individuals wither down, die</li> <li>• Population computational agents constantly adapt and compete for scarce resources</li> </ul> <i>Mutation Probability= 0.2</i> <i>Initial Population Size= 100</i>
<b>Ecosystems, Self-organization Transformation Networks</b>	<ul style="list-style-type: none"> <li>• Economic agents can be all modeled as resource transformers (RTs)</li> <li>• RT's knowledge represented as a rule based system</li> <li>• RTs self-organize into productive cycles</li> <li>• Economies are complex adaptive systems and can be represented by collections of RTs</li> </ul>

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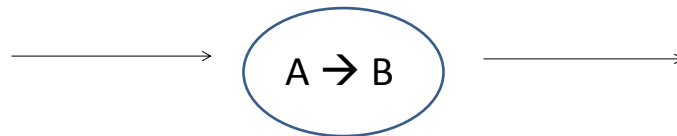


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## Singleton one-to-one Transformation Rule



- Simpler- single input, single output
- Restrictive, but we want to start from simple possible care and build from there

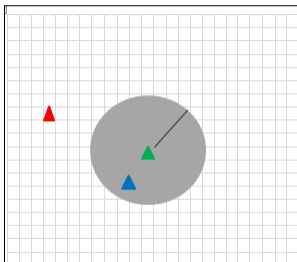
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## Econoscape

### 2D Environment



### Economic Agents

- Move
- Acquire resources
  - Trade
- Transform resources
  - Production
  - Driven by transformation rules
- Reproduce

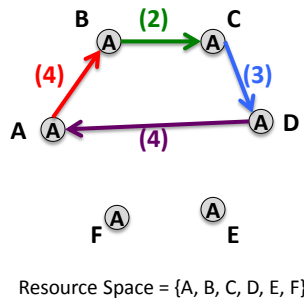
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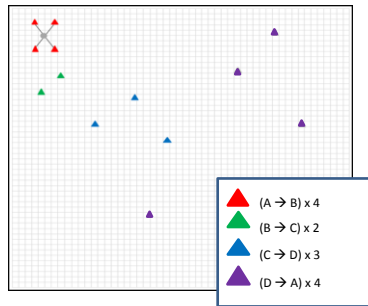
# Ecosystem of Resource Transformations

Transformation Network



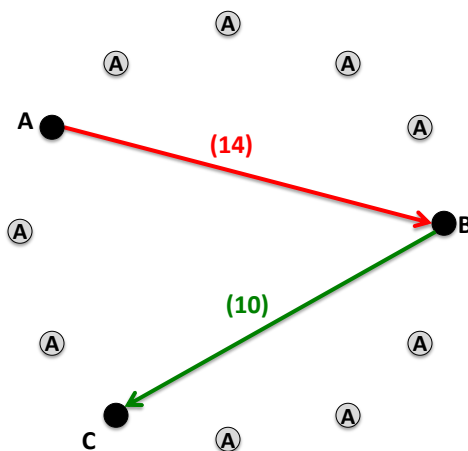
Resource Space = {A, B, C, D, E, F}

2D Grid Environment (52x52)

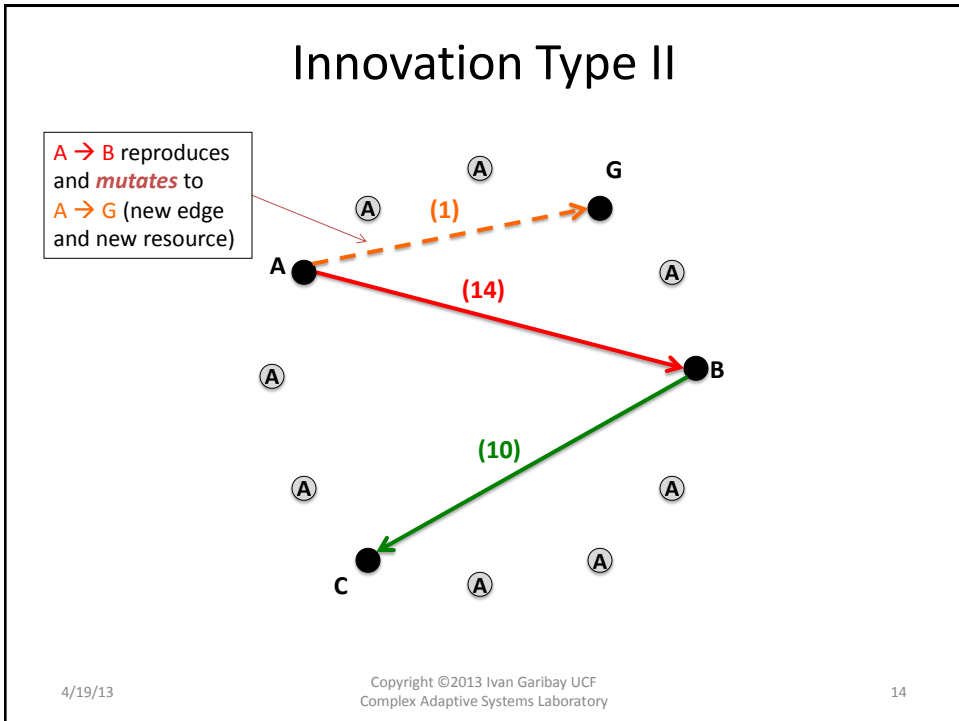
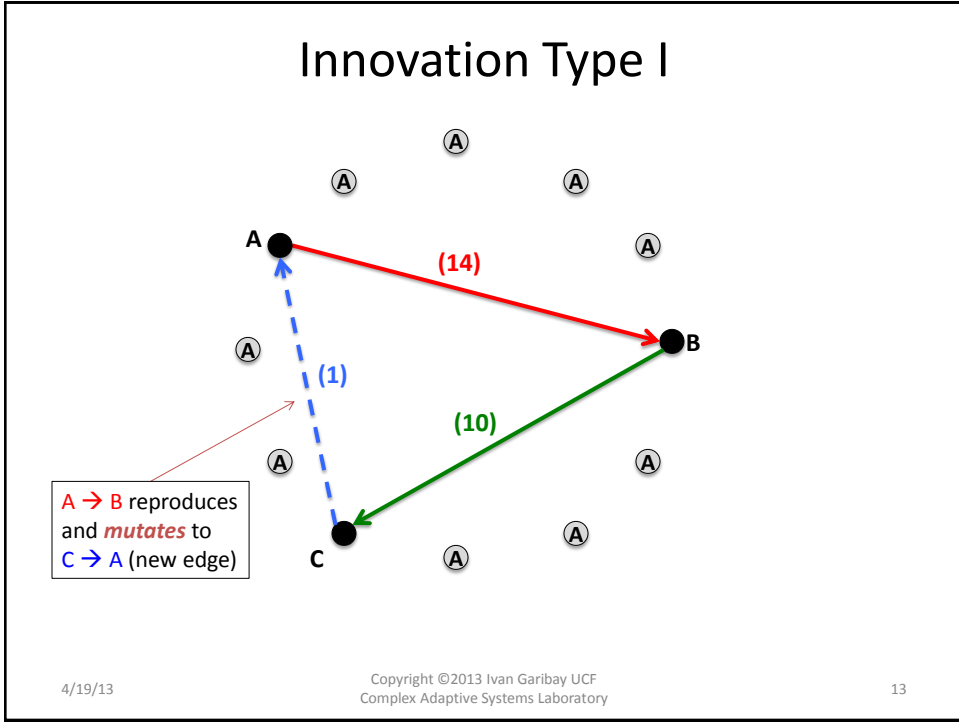


Agent population = 13

# Innovation in a Transformation Network



- Resources space size = 12
- Existing resources = {A,B,C}
- Existing agents :  
14 of type A→B  
10 of type B→C
- Current agent population size = 24



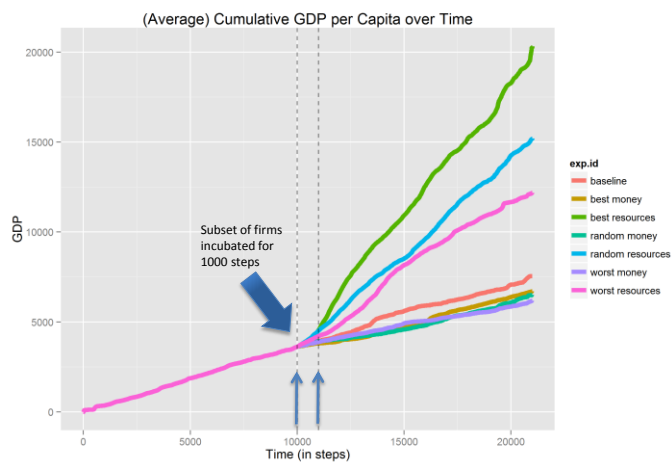
Can temporary incubation of a subpopulation of firms result in a permanent increase in the **economic growth and performance** of the entire region?

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## Results (MASON system)



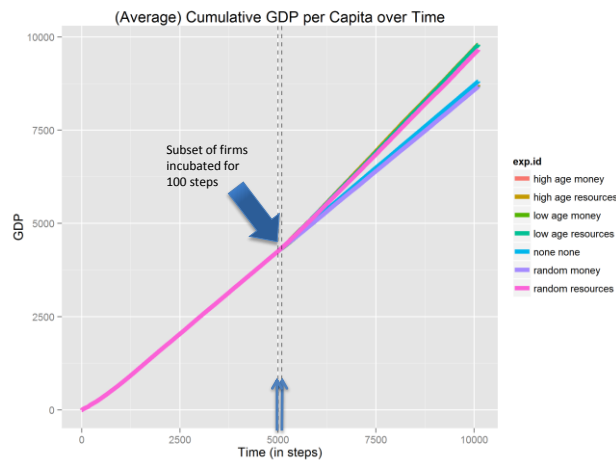
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## Results (Netlogo system)



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## Results

These results were produced in the context of

Basic assumptions

Plus many other economic assumptions required to build the model  
(in the DDO document)

Around 35+ parameters and algorithmic definitions of behaviors

The results may be fragile but in the context of a  
simulation we can

Test every parameter impact on results to isolate sensitivities

Figure out boundary condition

Conduct sensitivity analysis and functional analysis

Conduct control experiments

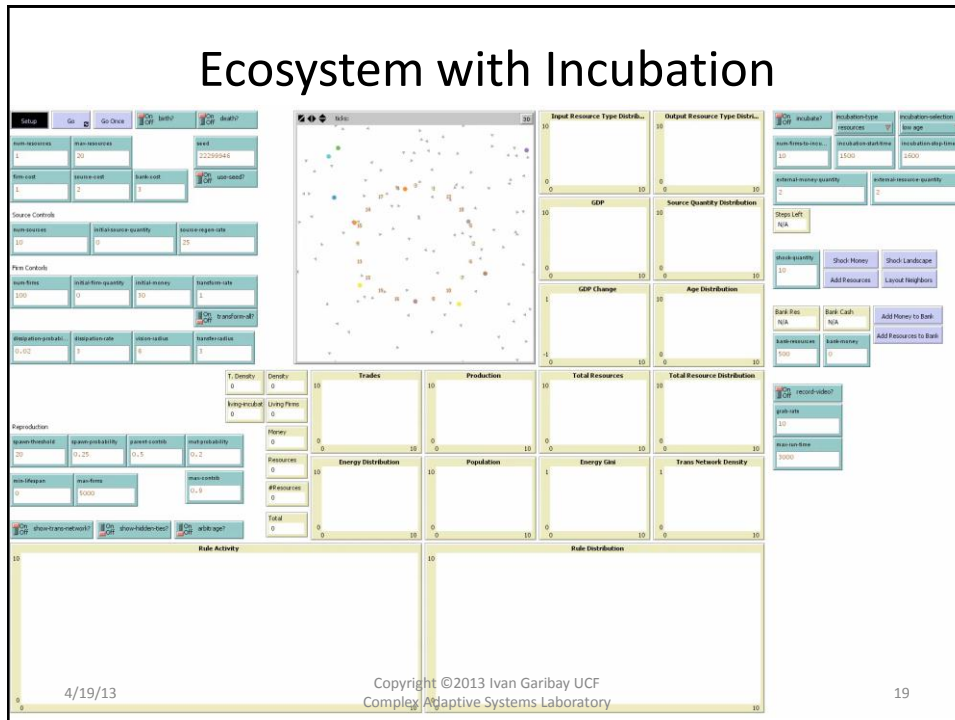
Test “what-if” scenarios

Develop “intuition” to refine existing theories or build new ones.

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## Method Limitations

- Only meaningful if we can show that emergent phenomena corresponds with real world data and complements other methodologies.
- Stylized facts validation: skewed wealth distribution, skewed firm age distribution, zipf distribution of firm size, etc.

## Summary

- Complementary methodology that we hope is helpful
- Agent-based modeling approach to model innovation ecosystems and regional economic growth
- Existing data from various studies can be used to
  1. Inform the micro-level agent behaviors defined on the models
  2. Validate the emergent macro-level results
  3. Calibrate the model
- ABM, then, can provide synthetic data for longitudinal studies and cause/effect relationships
- Needs to fully validate/calibrate model

Feedback? Questions? Collaborations?

**THANK YOU**