The Effect of Failure sites in the Asset Exchange Model

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Introduction

- We use an **agent-based** mode to understand economic inequality.
- Set up a system of \( N \) agents.
- Choose two agents at random.
- Interaction: Each agent has equal probability of winning \( \alpha \) percent of the poorer agents' wealth.

\[ W_i < W_j \]
Introduction

- Wealth will accumulate into a single agent as we let this run over time. This is called **wealth condensation**.

- Introducing **growth** and **taxation** can result in steady state systems that are effectively ergodic.

- Define a **timestep** to be $N$ trades for $N$ agents. Each agent starts with $w(0) = 1$.

- Define rescaled wealth $\tilde{w} = \frac{w_i}{W(t)}$ Where $W(t)$ is total wealth in system.
• To better model reality, I introduce **failed sites** that must be **bailed out**.

• After 10 timesteps, I introduce $\Omega$ failures with negative wealth.

• Other agents must then **bail out** these agents with all other agents contributing equal amounts to their wealth, bring wealth to 1.

• How long until the system recovers? $\alpha = 0.01$ here, difficult to see but wealth condenses.
Introduction

- Correlation Function
- Relationship between rank and rank at previous times.
- \( \Omega = 0.99 \).
Introduction

- Real economies have growth: Introduce **constant growth** to the system.

- After every trade, each agent gets wealth $k$.

- No trading here. 5 trades after shock.

- Rich agents are growth independent, but poor agents are $\Omega$ independent for certain values of growth.

- Growth is too low to offset wealth they are losing,
Constant Growth

- What if we add trading?
- Same qualitative behavior holds
- $\alpha = 1.00$
Constant Growth

- We are interested in the results in the **extremes**.

- We see that increasing the failure rate **increases** the number of poor agents.

- **Dichotomy** in wealth. Especially for high growth systems.
Constant Growth

- Reintroduce trading

- Fixed growth $k = 0.10$.

- Relationship between trading percent and failure percent.

- Rich agents don’t care about failure! They want high $\alpha$.

- Poor agents really don’t want a high failure rate.
Flat Tax

- Fix $k = 0.1$. $\alpha = 0.01$. What does the wealth distribution look like?

- Introduce a flat tax, take a percent $\psi$ from all agents, redistribute equally.
Flat Tax

- Take a percent of every agents wealth $\psi$.
- Redistribute equally
- With no growth, no failure sites, we get:
- Growth gives same rescaled wealth distribution

Student Version of MATLAB
• Take a percent of every agents wealth $\psi$.
• Redistribute equally
• With no growth, no failure sites, we get:
• Growth gives same rescaled wealth distribution
Flat Tax

• Let $\psi = 0.10$, $k = 0.10$, $\alpha = 0.01$

• Shrinks the dichotomy by lowering the wealth of the richer agents.

• Evens out the wealth.
Sales Tax

- Take a portion of interaction wealth, determined by $\beta$.
- Redistribute evenly to all agents.
- No failure, no growth gives phase transition!

Wealth Condensation  Steady state
Sales Tax

- Sales tax in effect with failing sites results:
  - $\alpha = 0.01$ here.
- Nothing. Sales tax is weak, masked by growth.
- Most agents independent of beta.
Sales Tax

- No failed sites or growth: Phase transition.

- $\alpha = 0.99$ here.

- Rich agents: Little $\beta$ dependence, but they would prefer less.

- Poor agents want high $\beta$, want high or low failure rate.
Gini Coefficient

- Used to measure economic inequality.
- \( G = 1 \rightarrow \) Completely equal
- \( G = 0 \rightarrow \) Completely unequal.
- Measure 5 trades after shock.
- No growth: \( \alpha / \Omega \)
Gini Coefficient

- Used to measure economic inequality.

- $G = 1 \rightarrow$ Completely unequal

- $G = 0 \rightarrow$ Completely equal.

- $\alpha = 0.99$, Growth/Omega

- Low $\alpha \rightarrow$ Almost completely equal.
Gini Coefficient

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- $\alpha = 0.01, \beta / \Omega$
Gini Coefficient

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• $\alpha = 0.99, \psi / \Omega$
Conclusions:

- $\Omega$, $\alpha$, $\beta$, $\psi$, $k$, lots of ways to go with this data

- So far we have seen:
  
  - Time-recovery of a “shock”.
  
  - Failures affect which agents prefer a constant growth, affects wealth distribution.
  
  - Failures break phase transition in sales tax model.
  
  - Wealth distribution becomes independent of sales tax with failures.
  
  - After shock - equality is dependent on $\alpha$ even with growth. Depends on $\beta$ only for high $\alpha$. 
Questions?