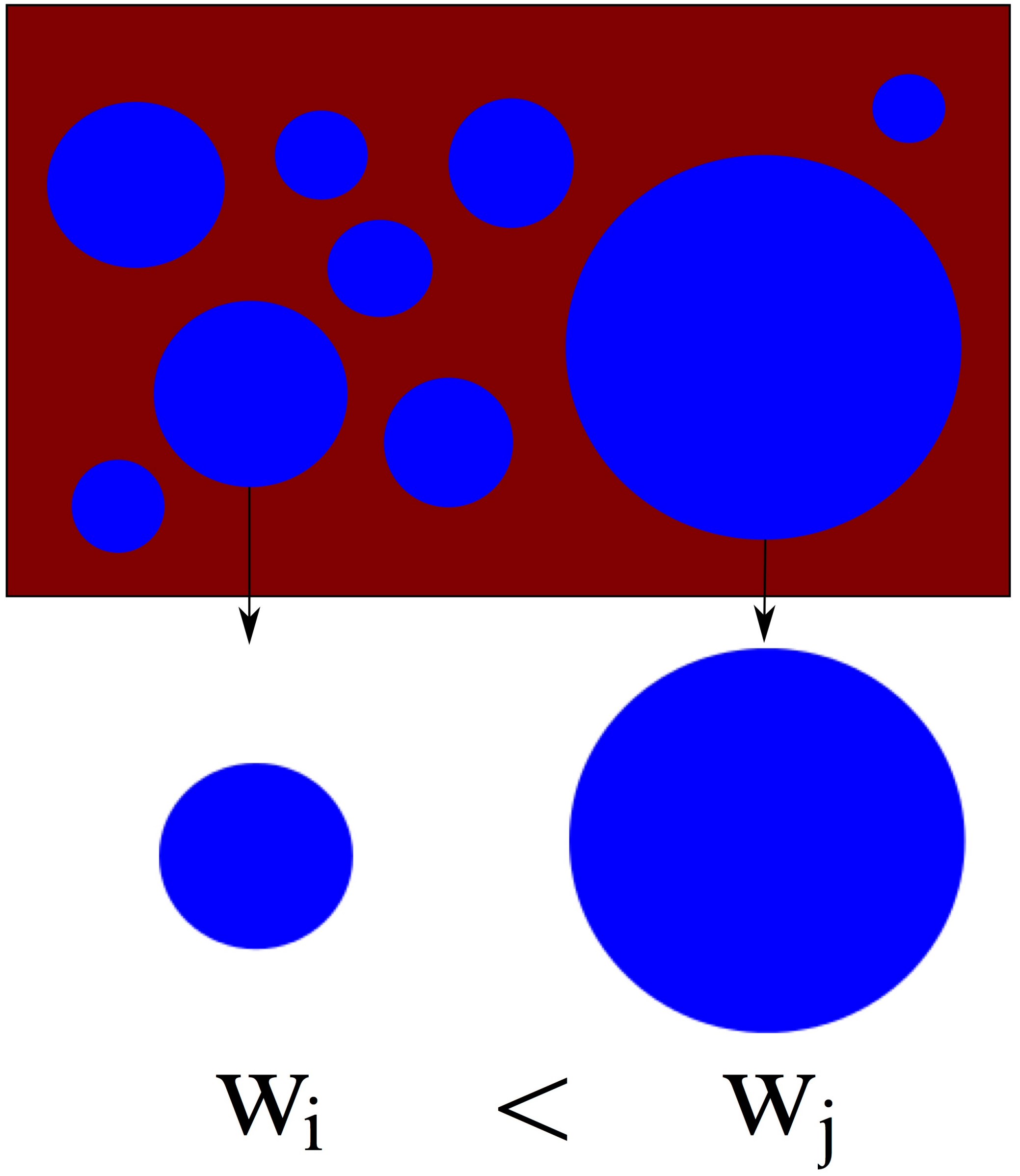
The Effect of Failure sites in the Asset Exchange Model

Jan Makkinje
Boston University

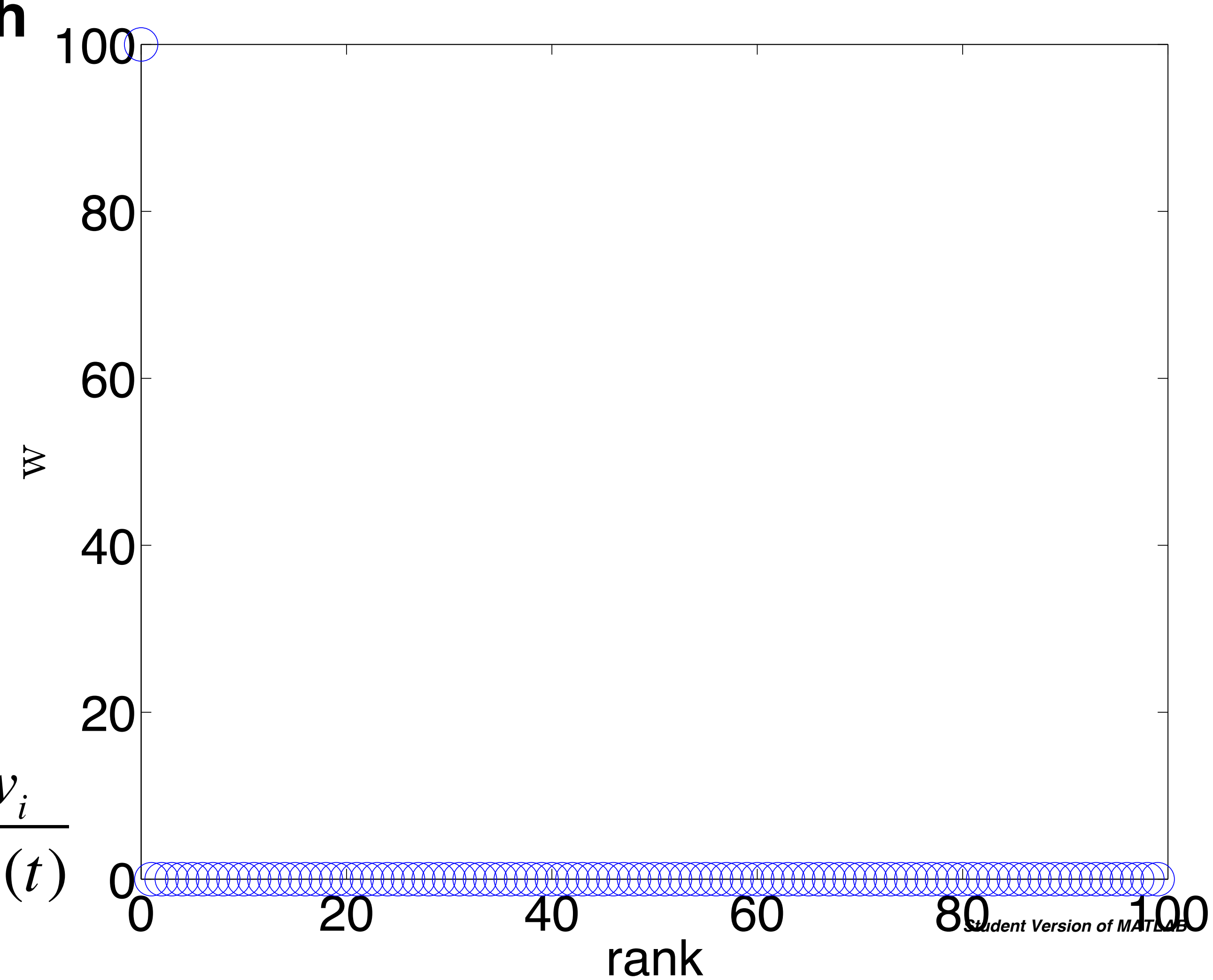
Introduction

- 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 α percent of the poorer agents wealth.



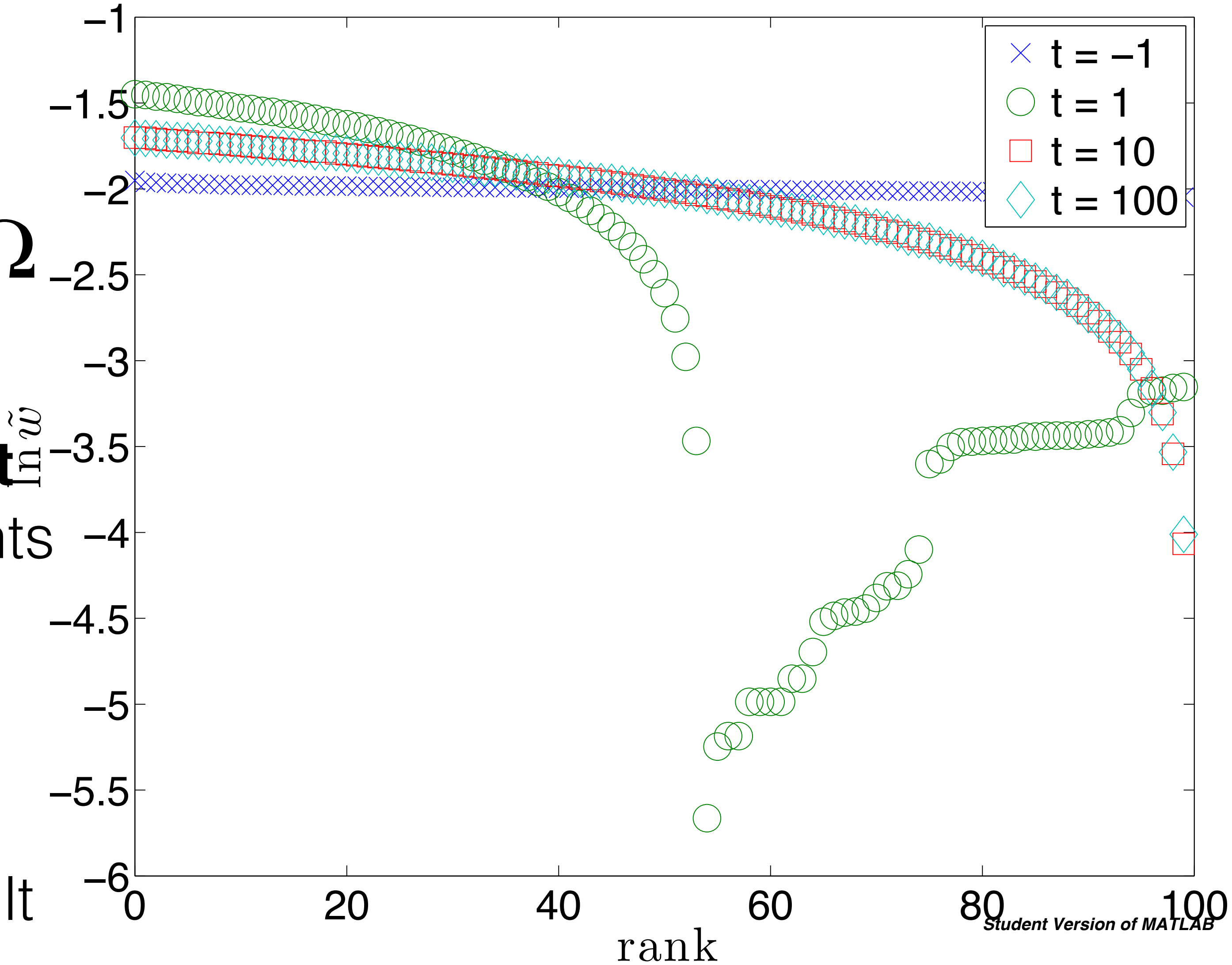
Introduction

- 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



Introduction

- To better model reality, I introduce **failed sites** that must be **bailed out**.
- After 10 timesteps, I introduce Ω 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? α = 0.01 here, difficult to see but wealth condenses.

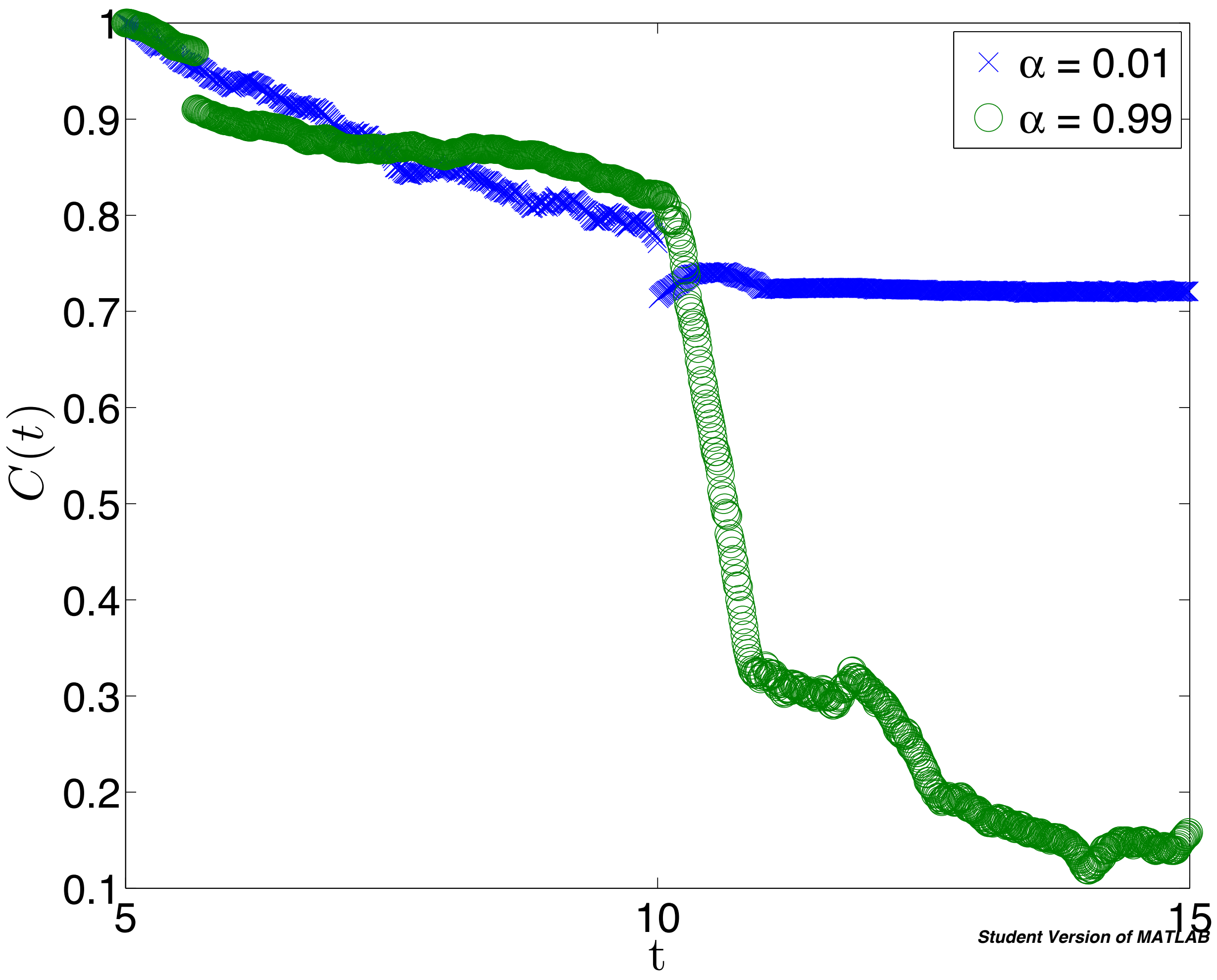


Introduction

- Correlation Function

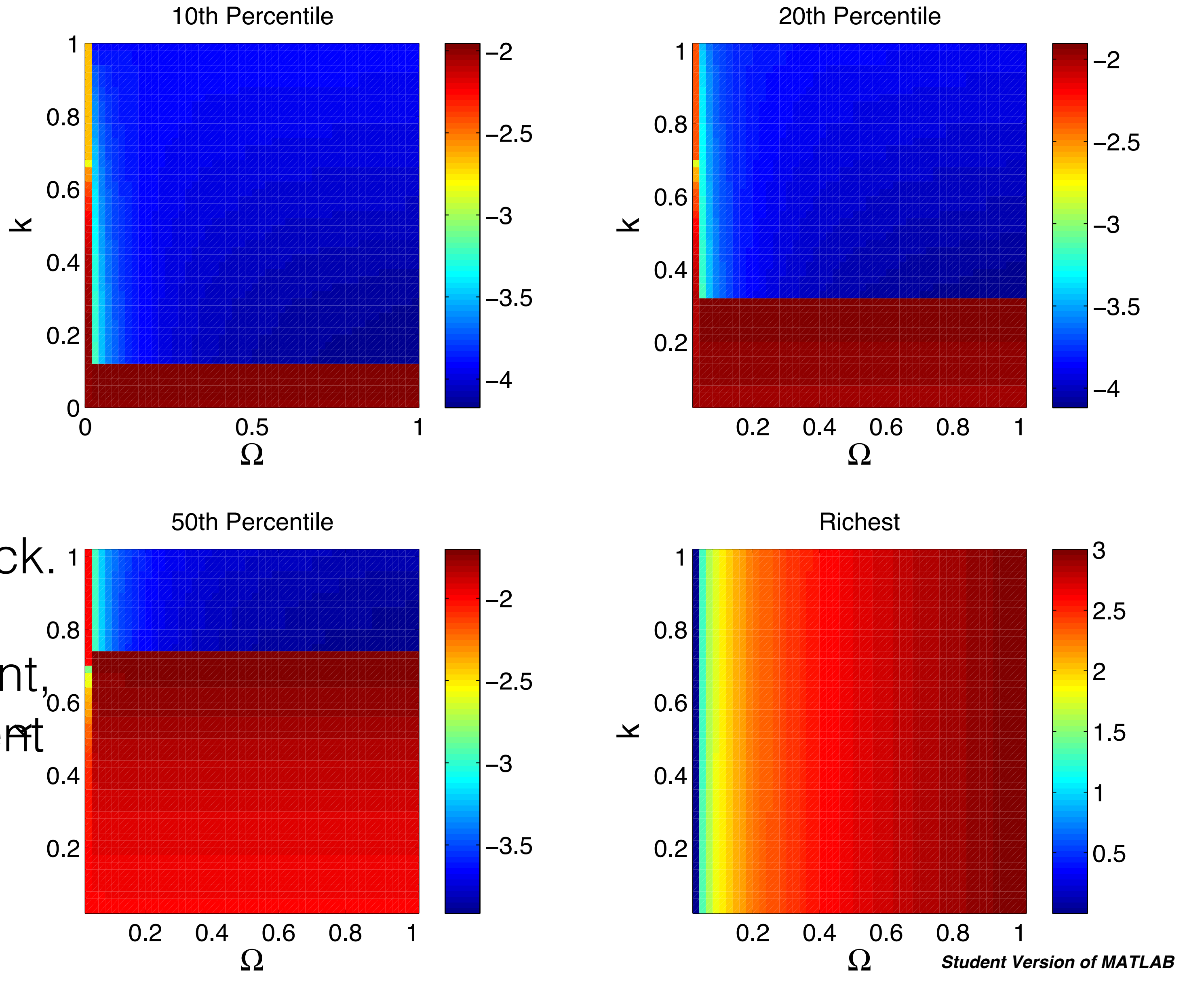
- Relationship between rank and rank at previous times.

- Ω = 0.99.



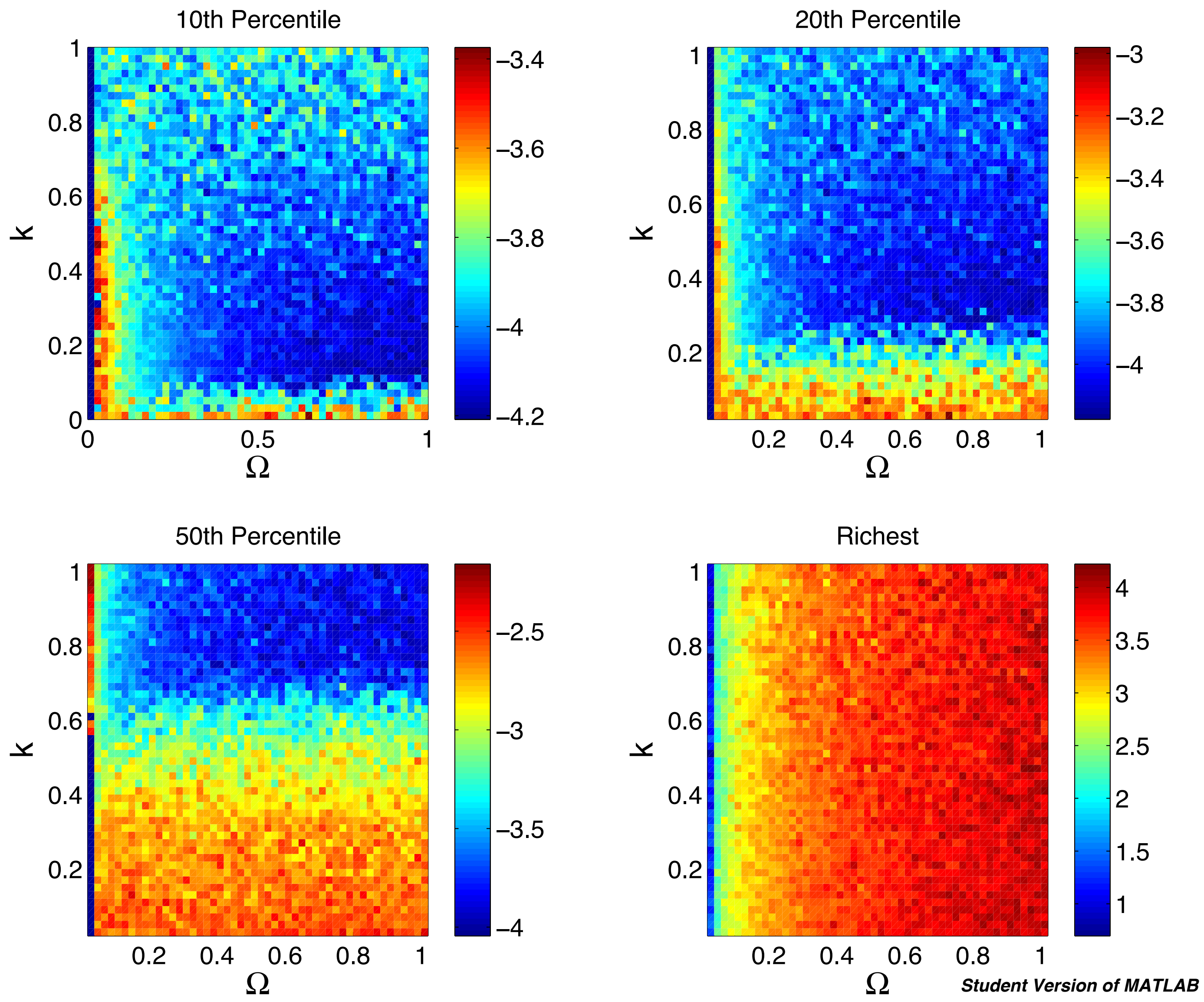
Introduction

- Real economies have growth: Introduce **constant growth** to the system.
- After ever trade, each agent gets wealth ***k.***
- No trading here. 5 trades after shock.
- Rich agents are growth independent, but poor agents are Ω independent for certain values of growth.
- Growth is too low to offset wealth they are losing,



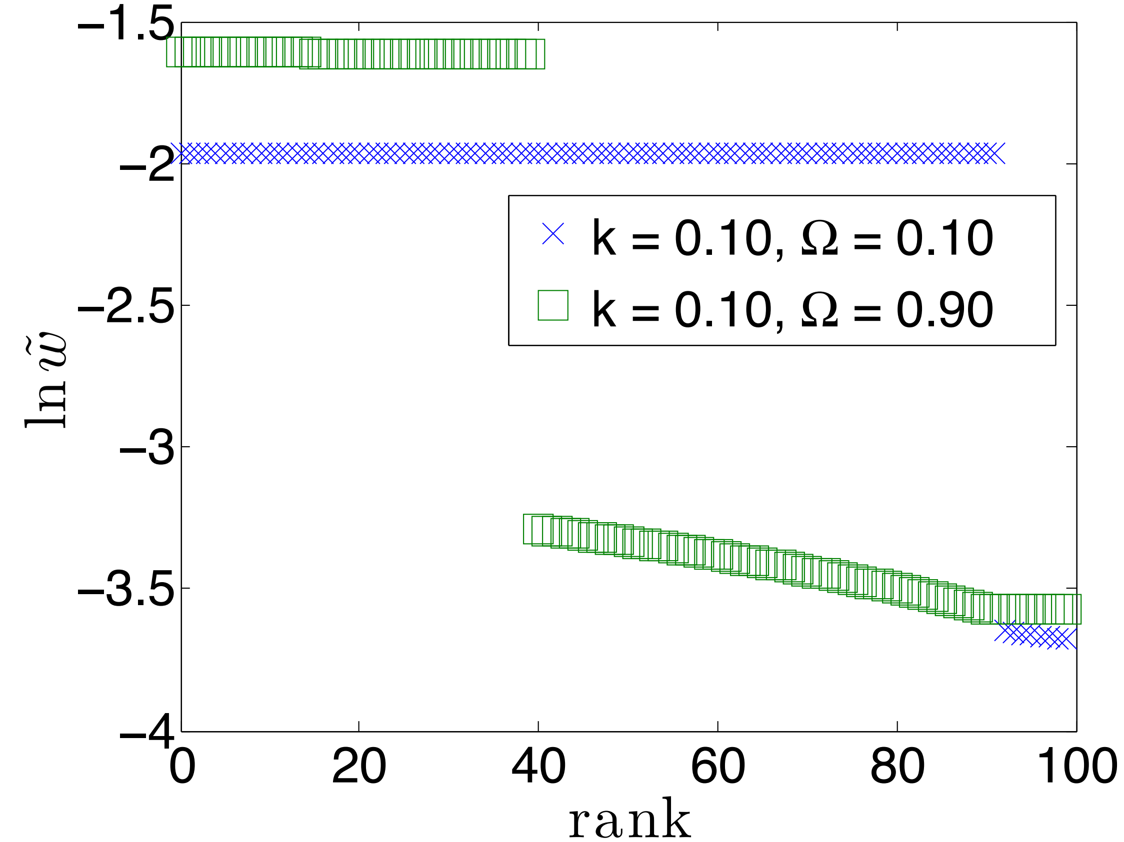
Constant Growth

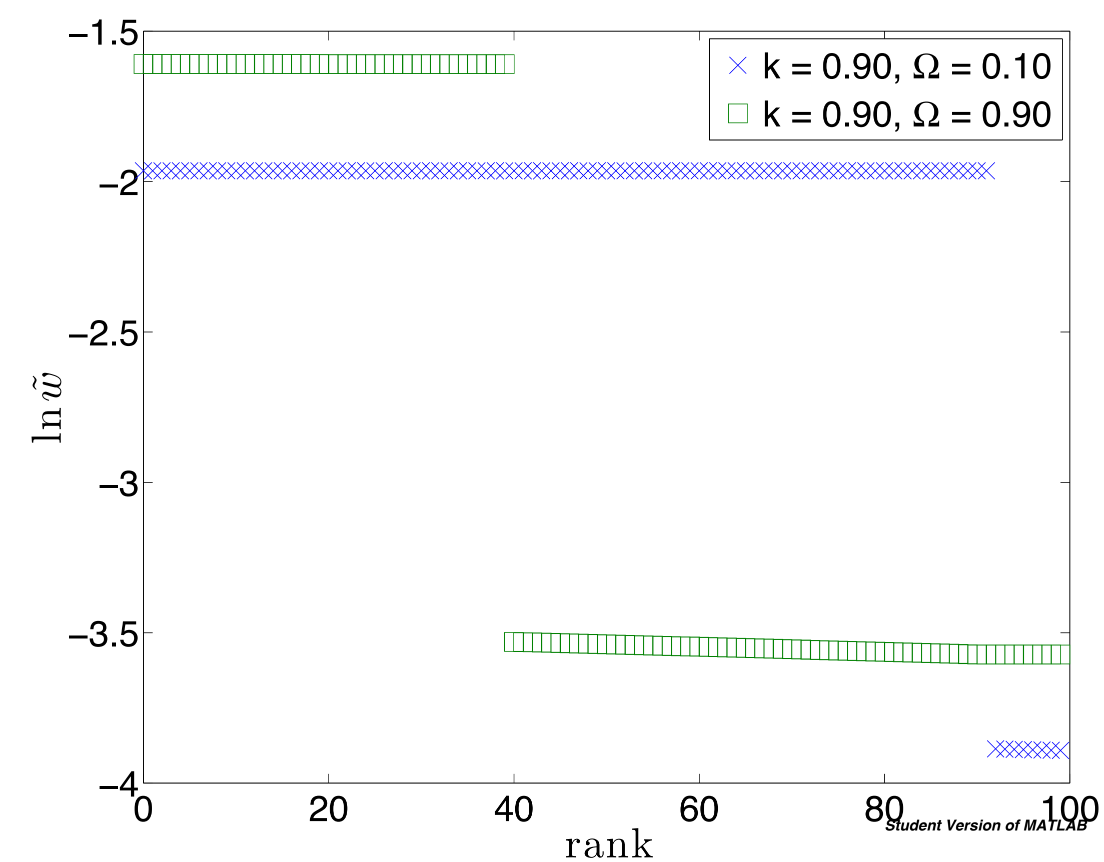
- What if we add trading?
- Same qualitative behavior holds
- $\alpha = 1.00$



Constant Growth

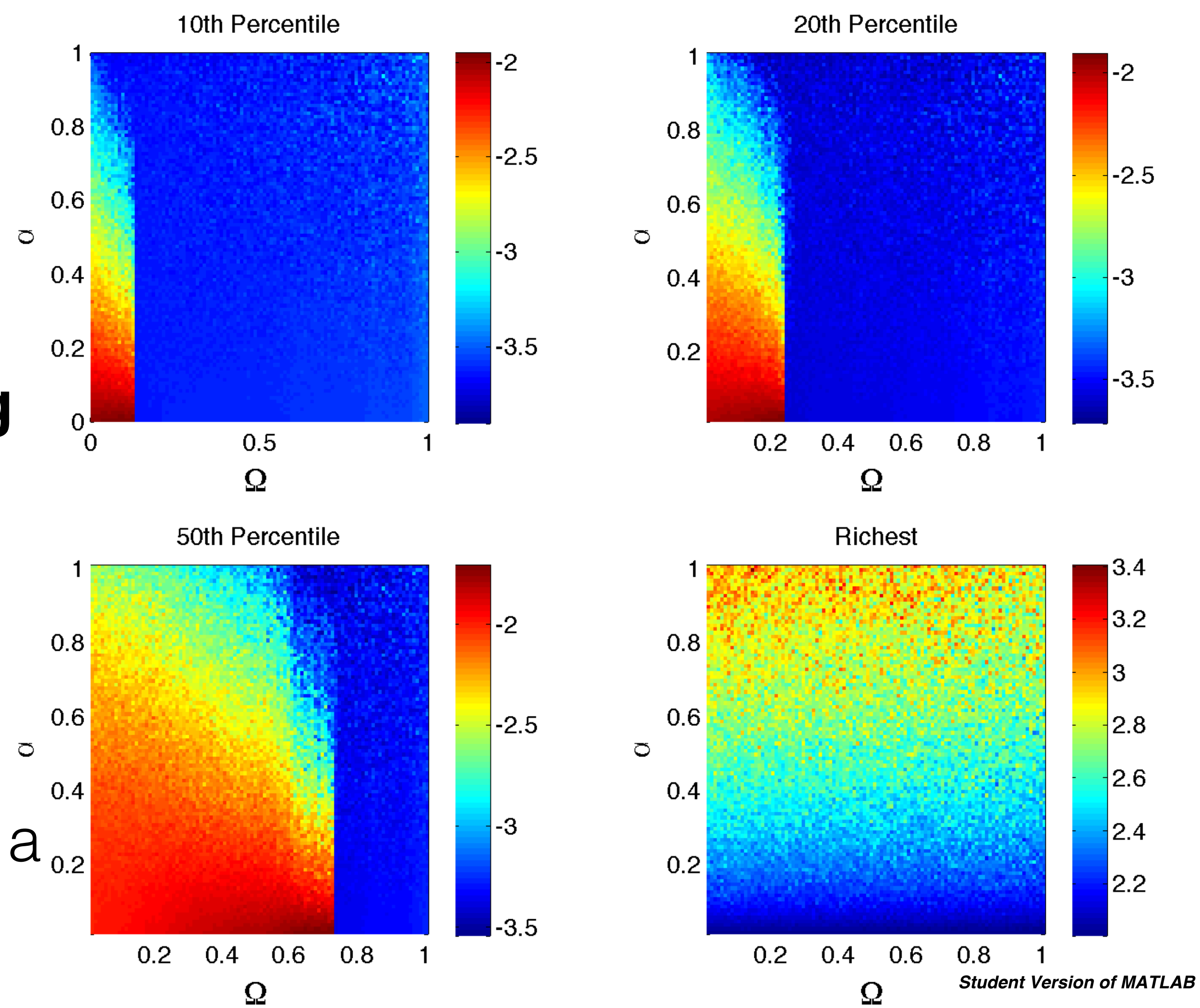
- We are interested in the results in the **extremes**.
- We see that increasing the failure rate **increases** the number of poor agents.
- **Dichotomy** in wealth. Especially for high growth systems.





Constant Growth

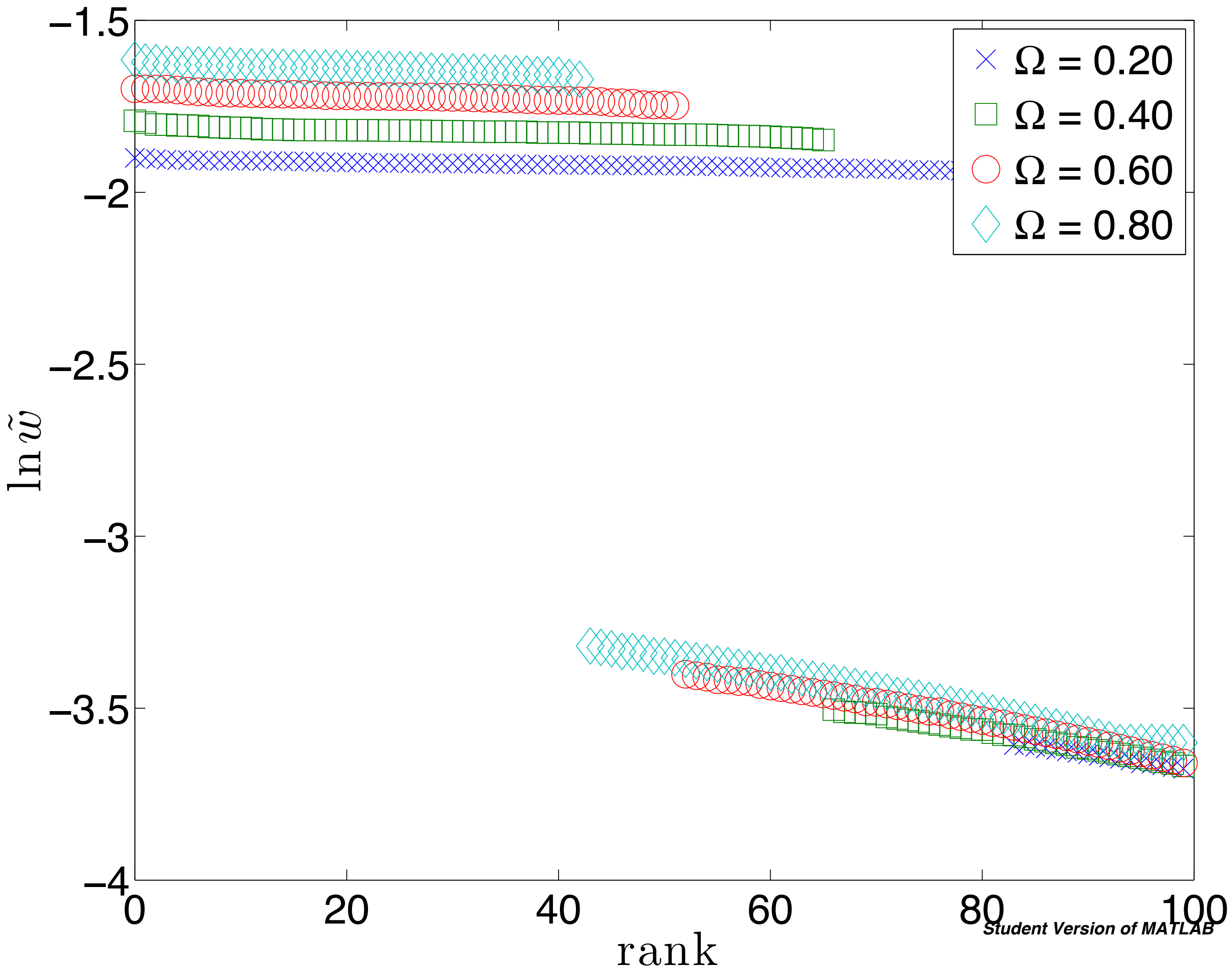
- Reintroduce **trading**
- Fixed growth **k = 0.10**.
- Relationship between **trading** percent and **failure** percent.
- Rich agents don't care about failure! They want high α.
- Poor agents really don't want a high failure rate.



Flat Tax

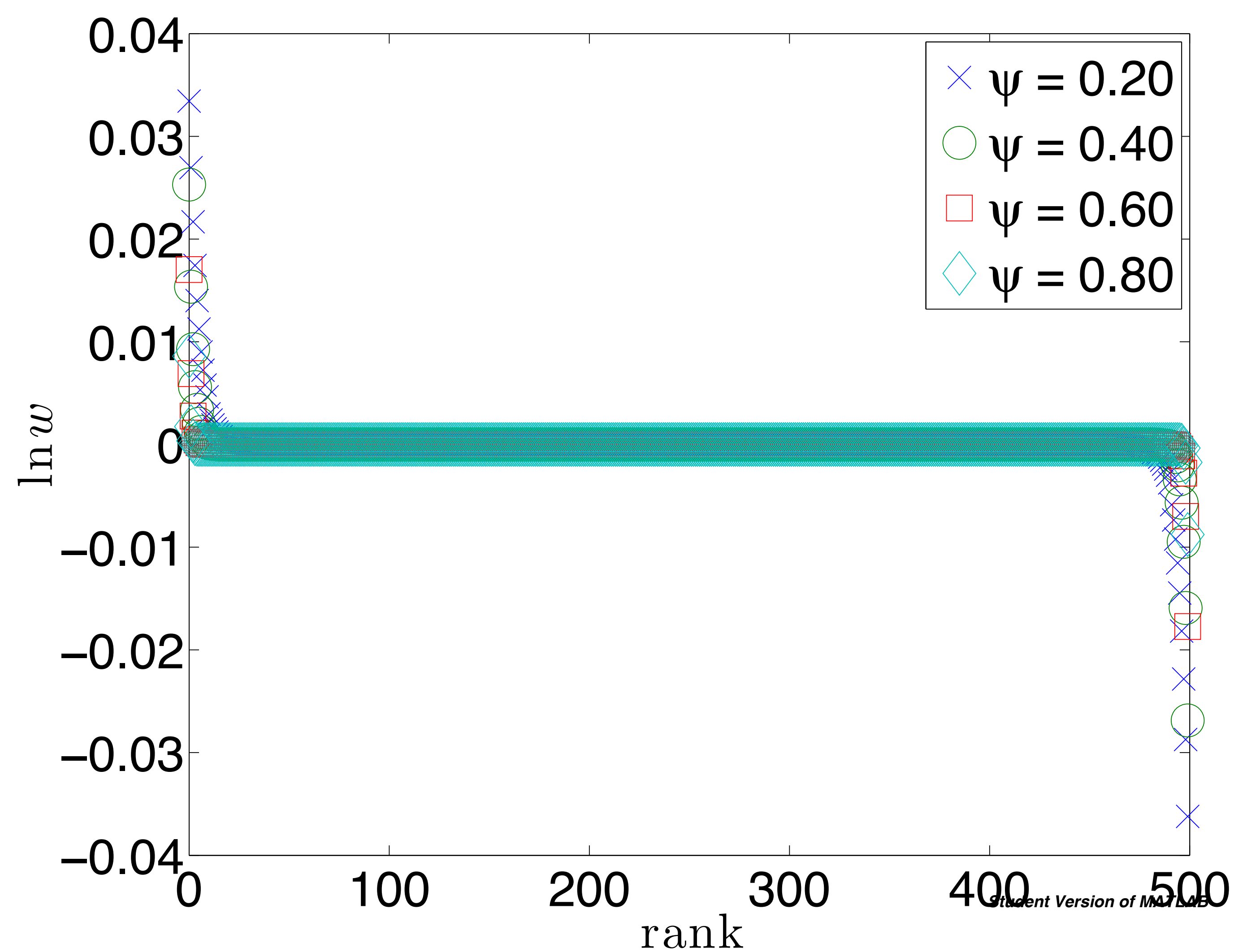
- Fix $\boldsymbol{k}$ = 0.1. α = 0.01. What does the wealth distribution look like?

- Introduce a flat tax, take a percent ψ from all agents, redistribute equally.



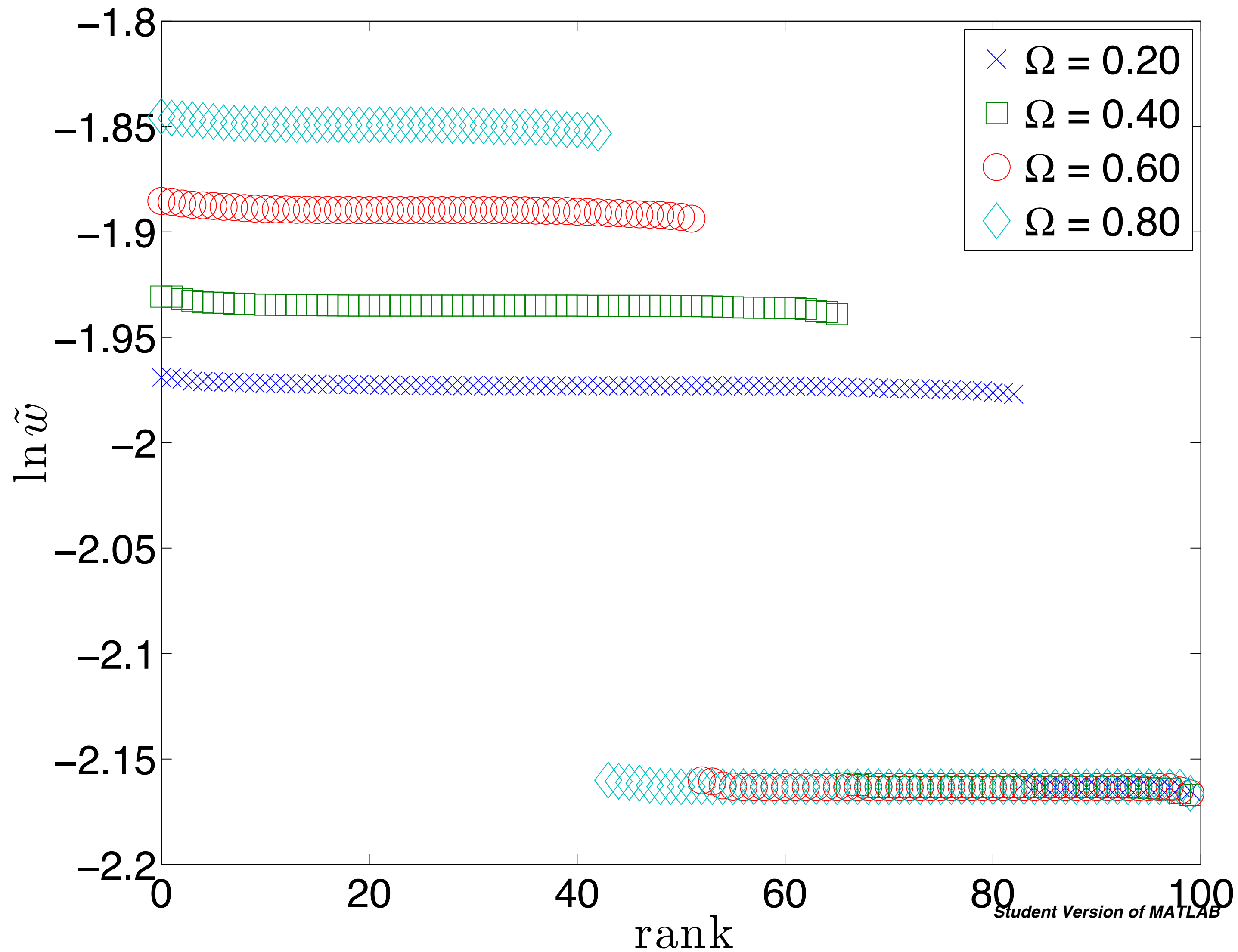
Flat Tax

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



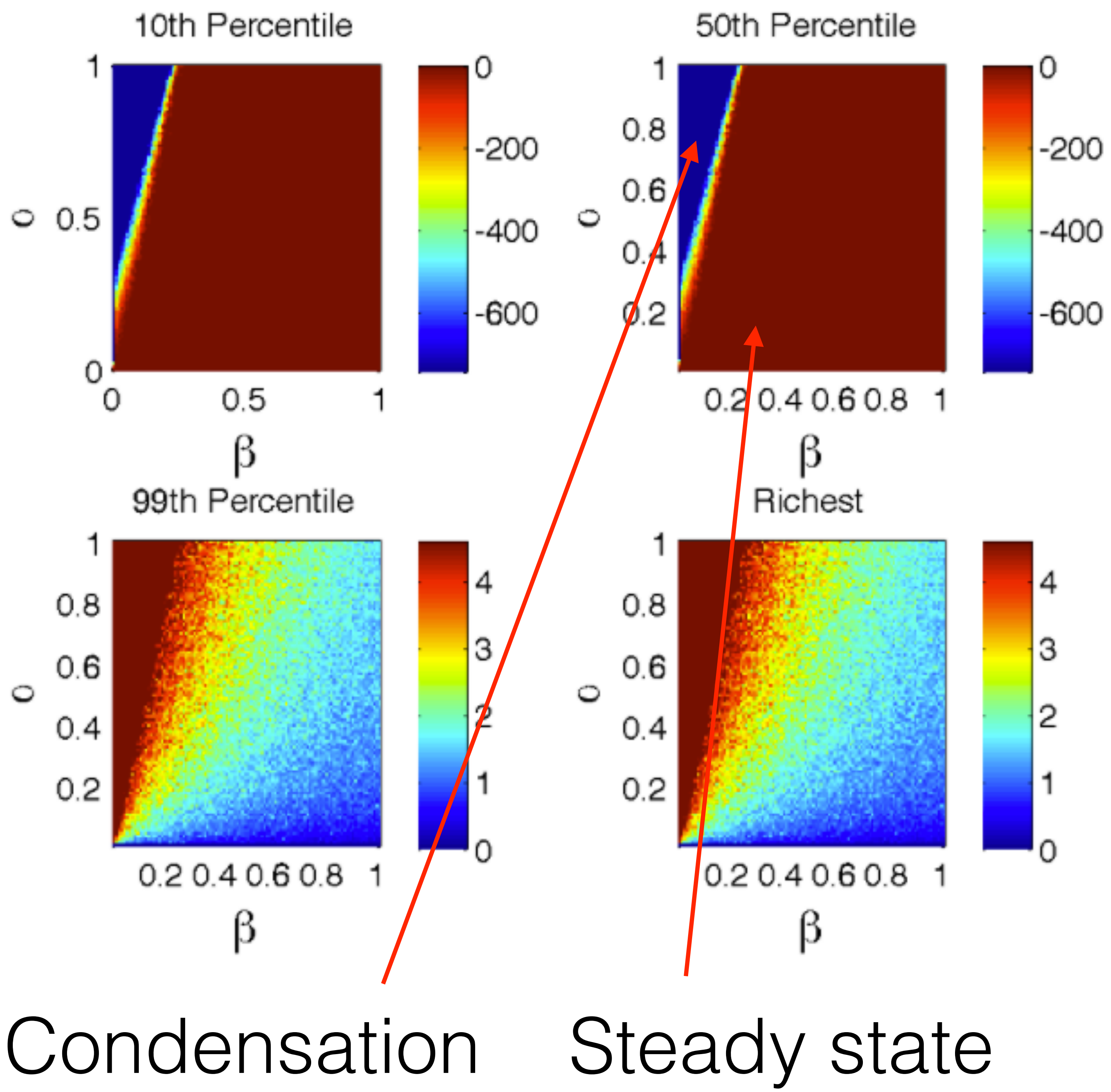
Flat Tax

- Let $\psi = 0.10$. $\boldsymbol{k} = 0.10$, $\alpha = 0.01$
- Shrinks the dichotomy by lowering the wealth of the richer agents.
- Evens out the wealth.



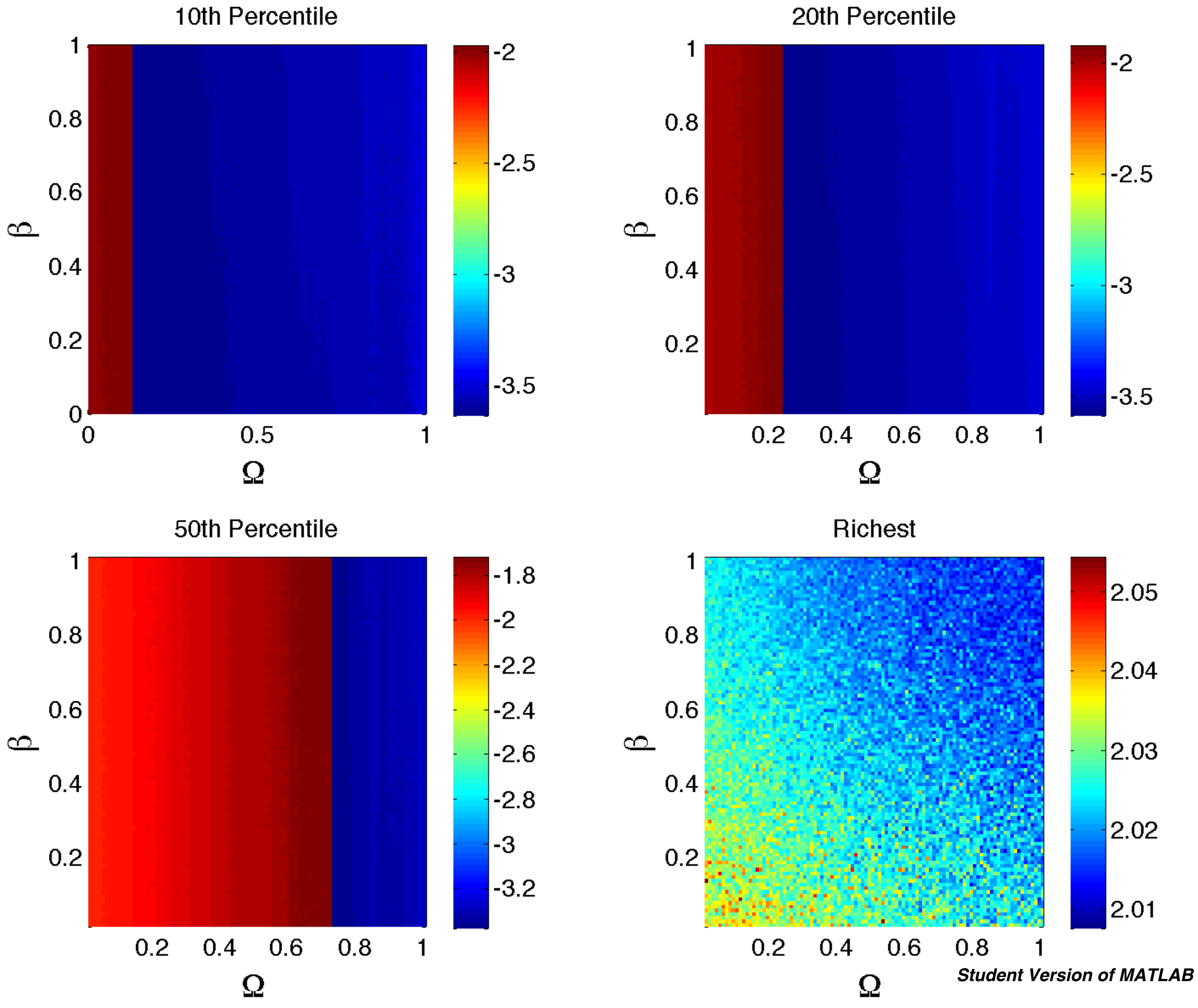
Sales Tax

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



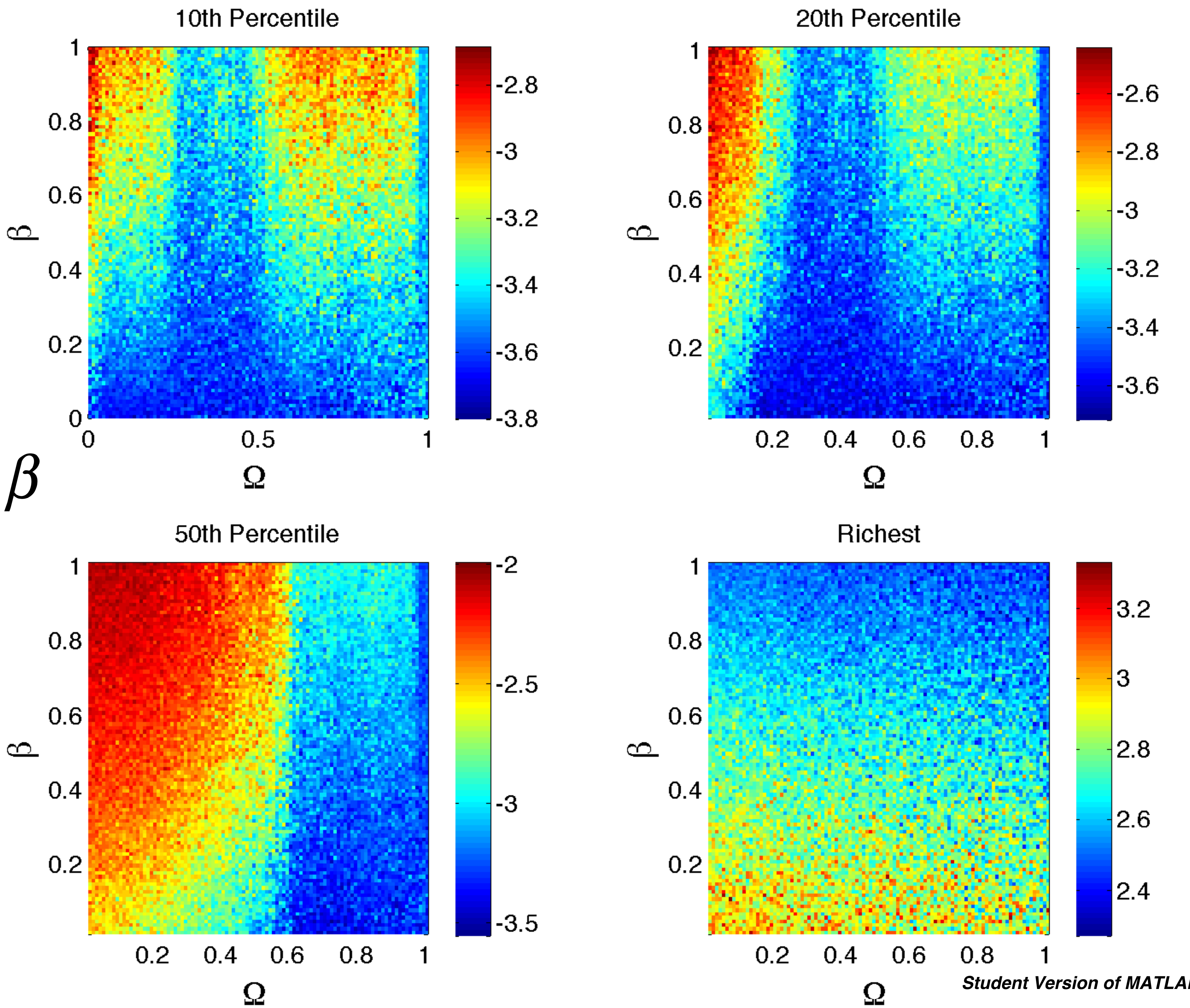
Sales Tax

- 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.



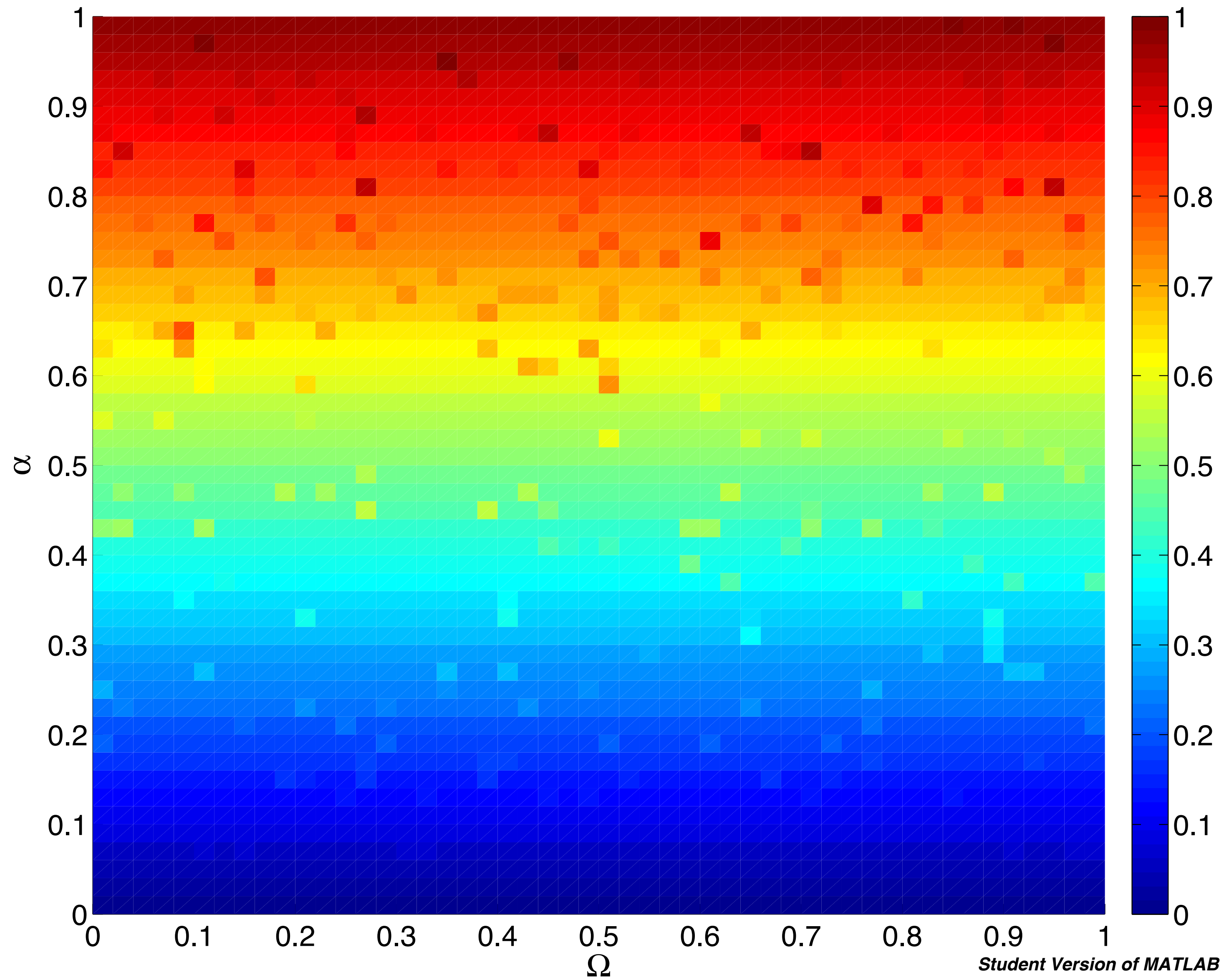
Sales Tax

- No failed sites or growth: Phase transition.
- α = 0.99 here.
- Rich agents: Little β dependence, but they would prefer less.
- Poor agents want high β, want high or low failure rate.



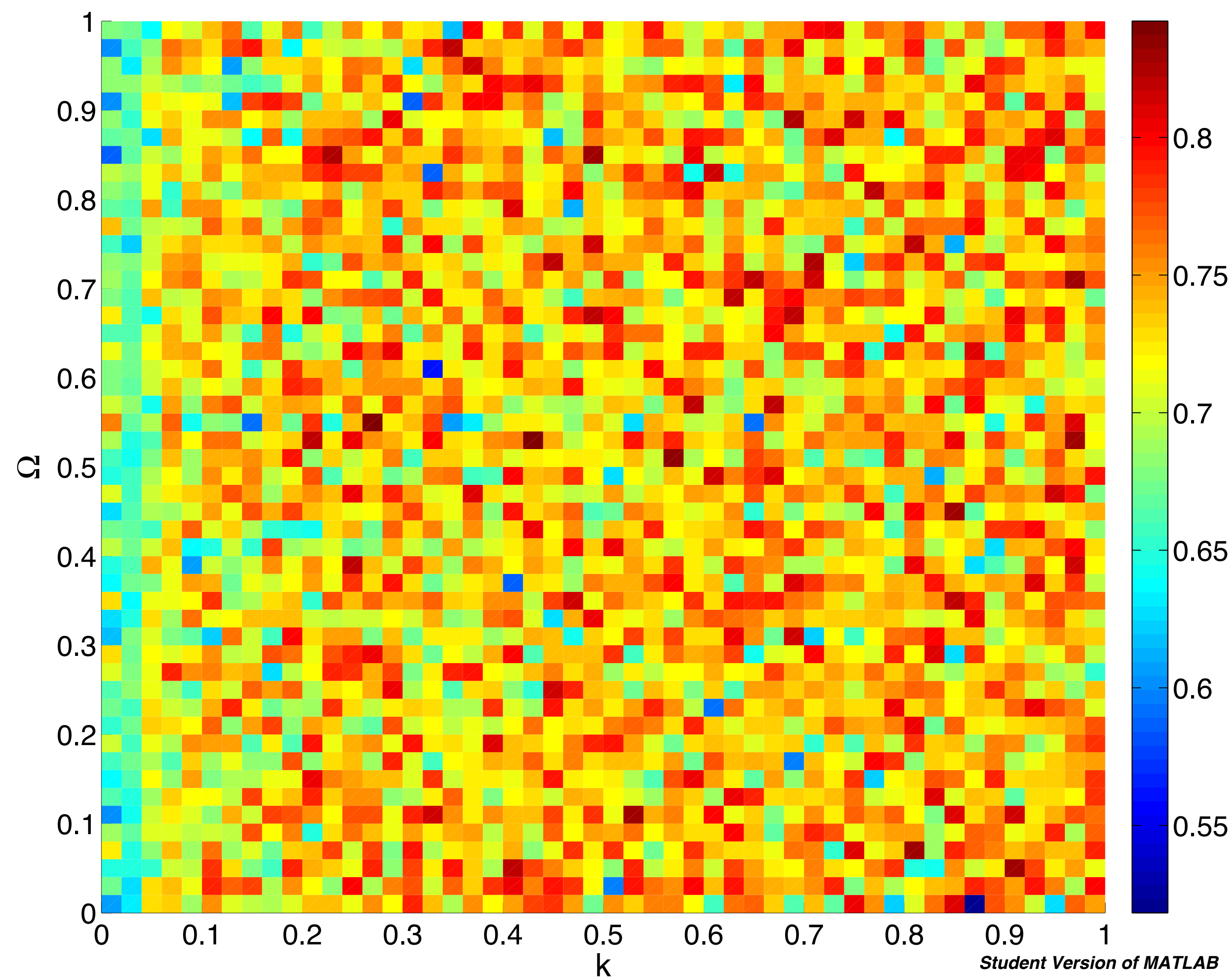
Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely equal
- ***G*** = 0 —> Completely unequal.
- Measure 5 trades after shock.
- No growth: α / Ω



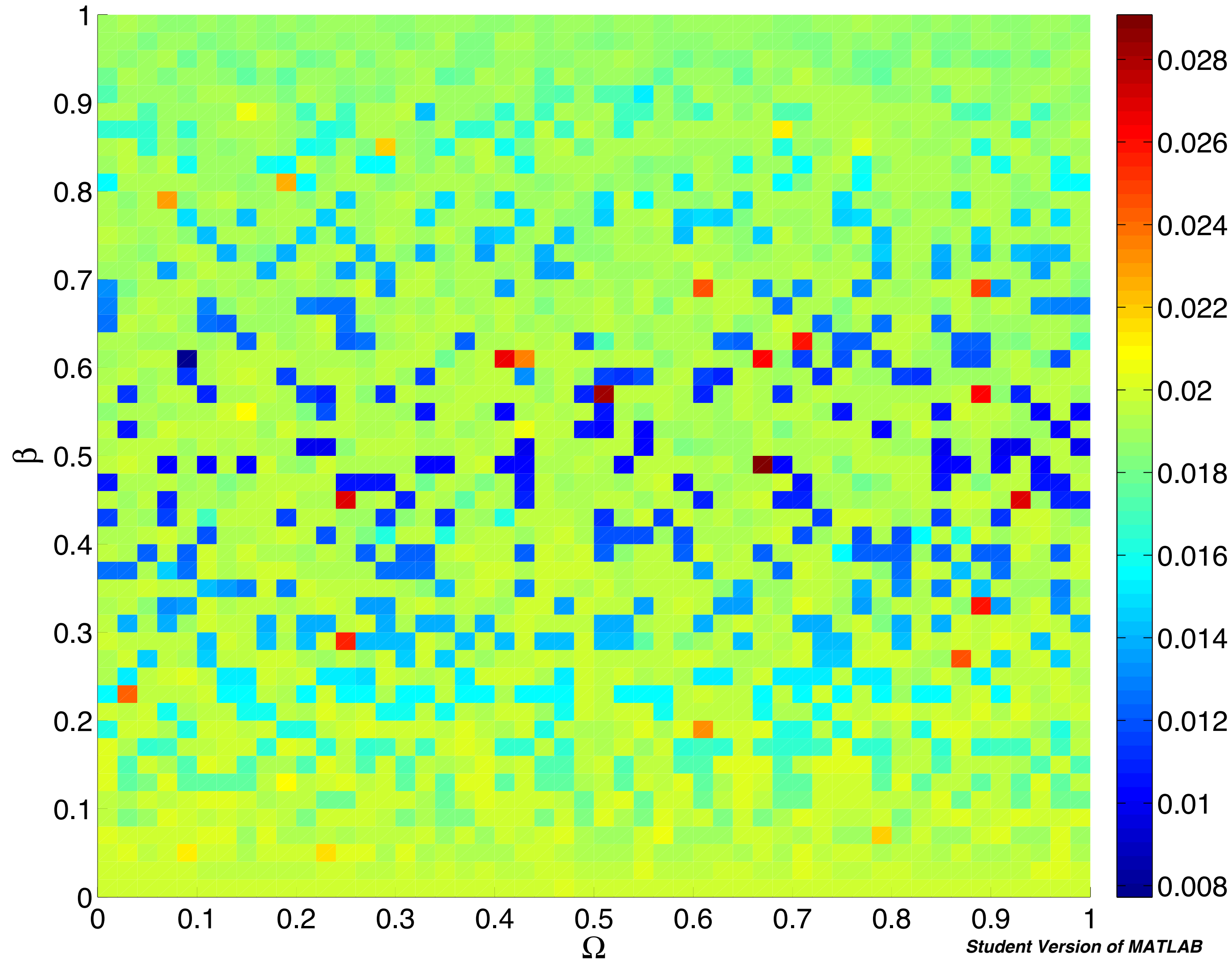
Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely unequal
- ***G*** = 0 —> Completely equal.
- α = 0.99, Growth/ Omega
- Low α —> Almost completely equal.



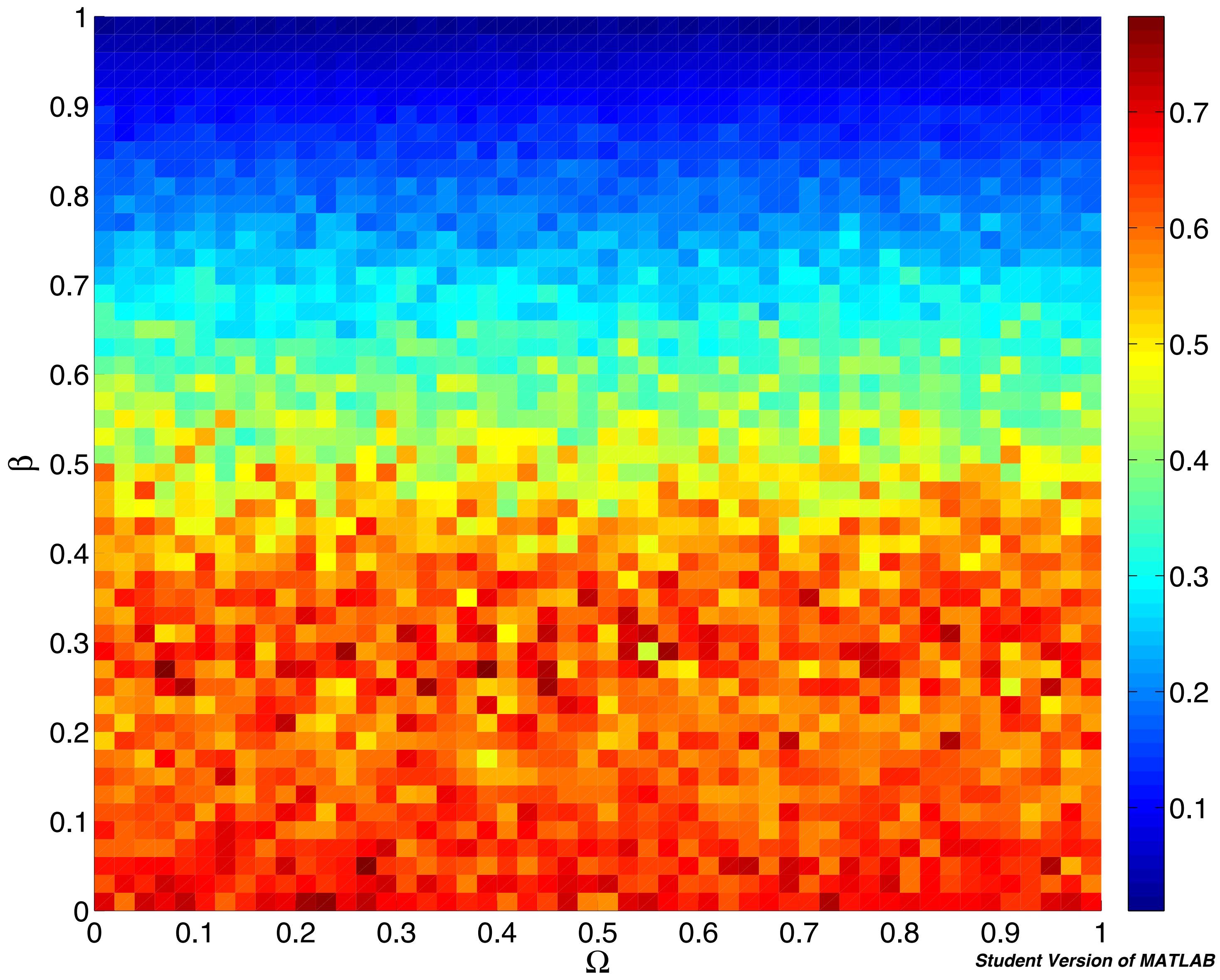
Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely unequal
- ***G*** = 0 —> Completely equal.
- α = 0.01, β / Ω



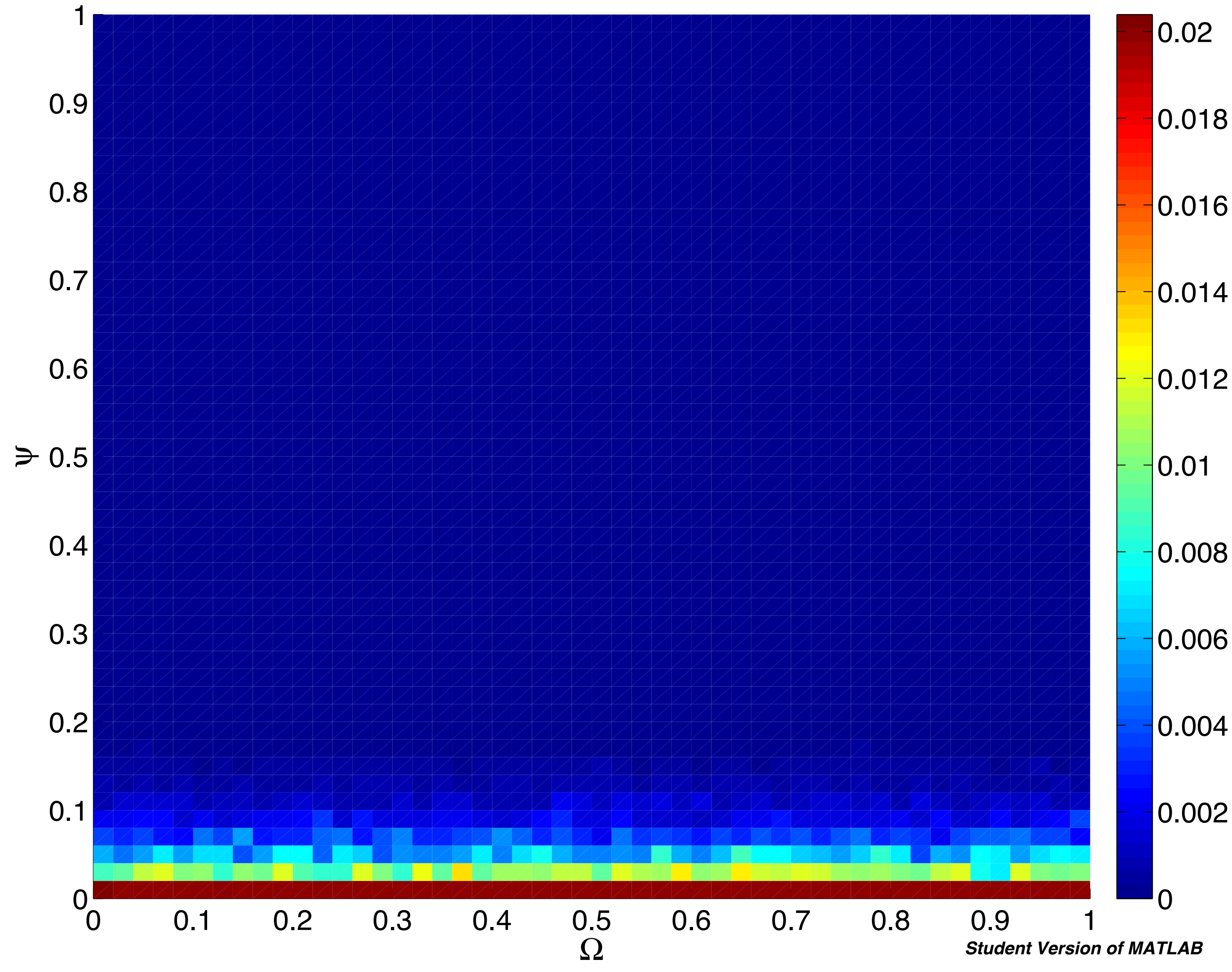
Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely unequal
- ***G*** = 0 —> Completely equal.
- α = 0.99, β / Ω



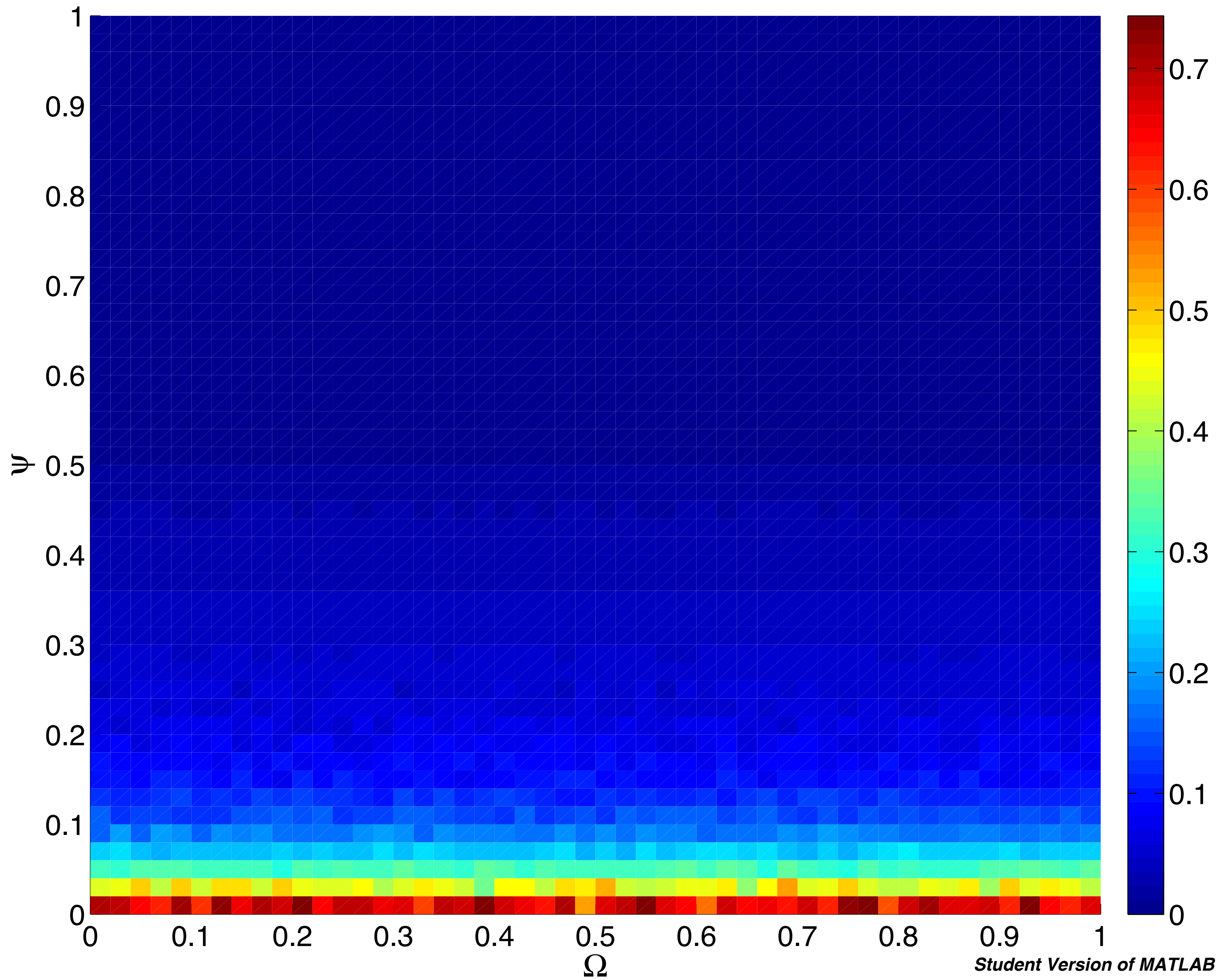
Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely unequal
- ***G*** = 0 —> Completely equal.
- $\alpha = 0.01, \ \psi / \Omega$



Gini Coefficient

- Used to measure economic inequality.
- ***G*** = 1 —> Completely unequal
- ***G*** = 0 —> Completely equal.
- $\alpha = 0.99, \ \psi / \Omega$



Conclusions:

- Ω , α , β , ψ, ***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 α even with growth. Depends on β only for high α .

Questions?