Effects of Credit-backed Currency in Decentralized Markets

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Intro

- Currency is often credit backed and virtual
- Yet, there is not one world currency
- Decentralized, discrete markets provide a potential answer
  - We currently best understand commodity money in decentralized markets
  - Credit is more studied in highly centralized markets
- We seek to understand the effects of credit-backed currency issuance on decentralized markets

Literature Review

- Circular trade and commodity currencies
  - Kiyotaki and Wright (1989)
- Agent-based bargaining
  - Goad and Sunder (1993)
- Agent-based spatial modeling
  - Epstein and Axtell (1996)

Overall Design

- We employ an agent-based model of a microeconomic system with distinct agents and institutions
  - Main institutions: Travel, Bargaining, Currency
- We test two hypothesis:
  - H1: As a highly decentralized world becomes more concentrated, delinquencies will decrease and money will become less distortionary
  - H2: A global credit-backed money will lead to less distortions in a smaller world

Results Preview

- We fail to find evidence of a distortionary effect of a global currency issuance
  - May be an artifact of the way currency or reputation is implemented
- We fail to find evidence of lower delinquencies in smaller worlds
  - But we find delinquencies decrease over time

Environment

- Our world is a hard-bordered grid with agents randomly dispersed upon it
  - This allows us to manipulate the size of the world
- Have several time-steps: Weeks, travel periods, and bargaining rounds
- We record several metrics of interest for our hypotheses
  - Efficiency: (Prices - seller’s costs) + (buyer’s valuations - prices)
  - Delinquencies: Number of agents failing to repay their loans
  - Concentration index: Shares of individuals at particular points

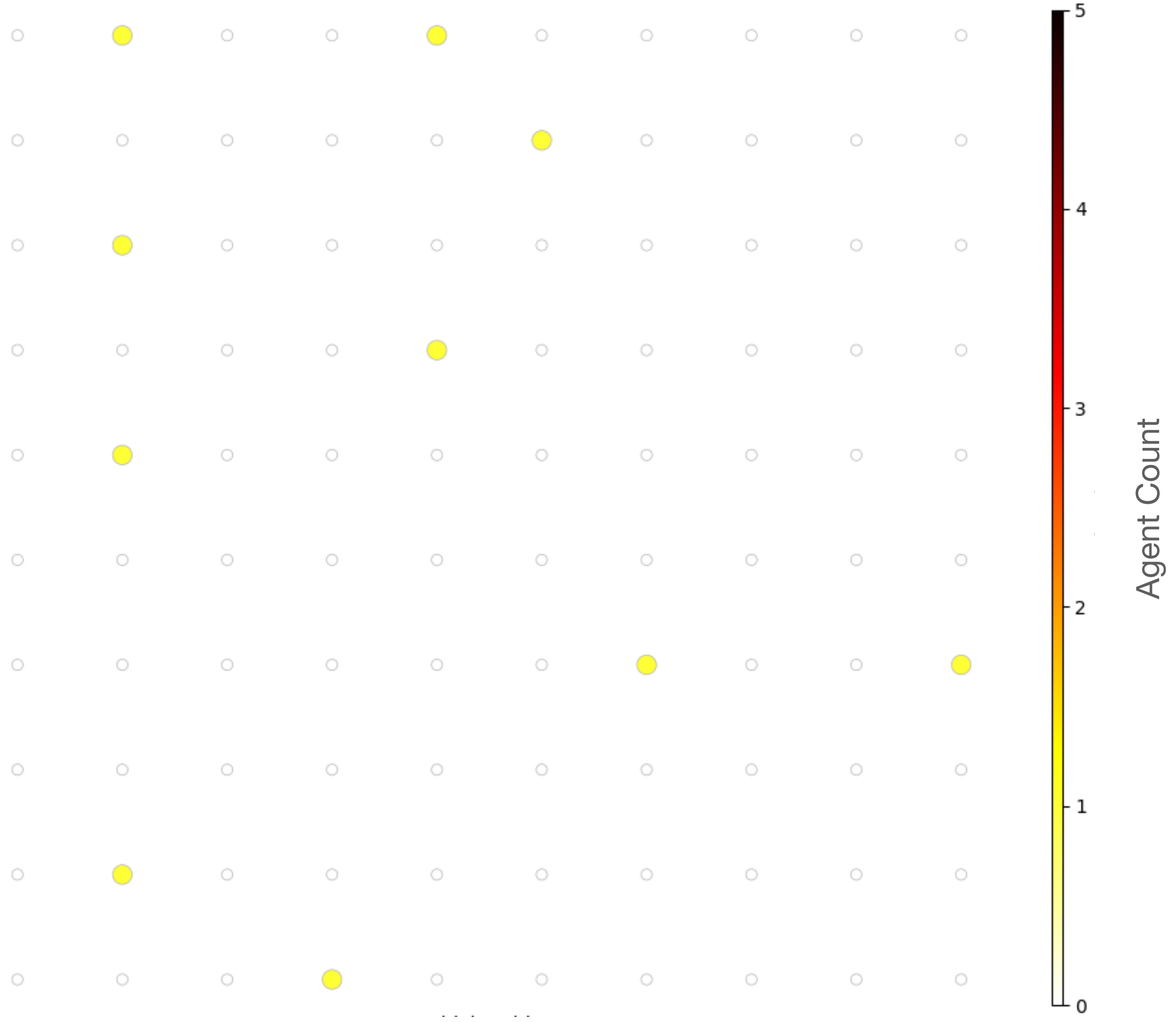
Agents

- Agent strategy
  - Extend upon zero-intelligence traders
    - They bargain within a range, are bound by valuations and credit
  - Move in random direction, unless they made a trade last period
    - This simple strategy leads to accretion at points
- Agents are given valuations for two types of consumption items
  - One they produce and sell, one they buy and consume
- Agents interact with the world through institutions

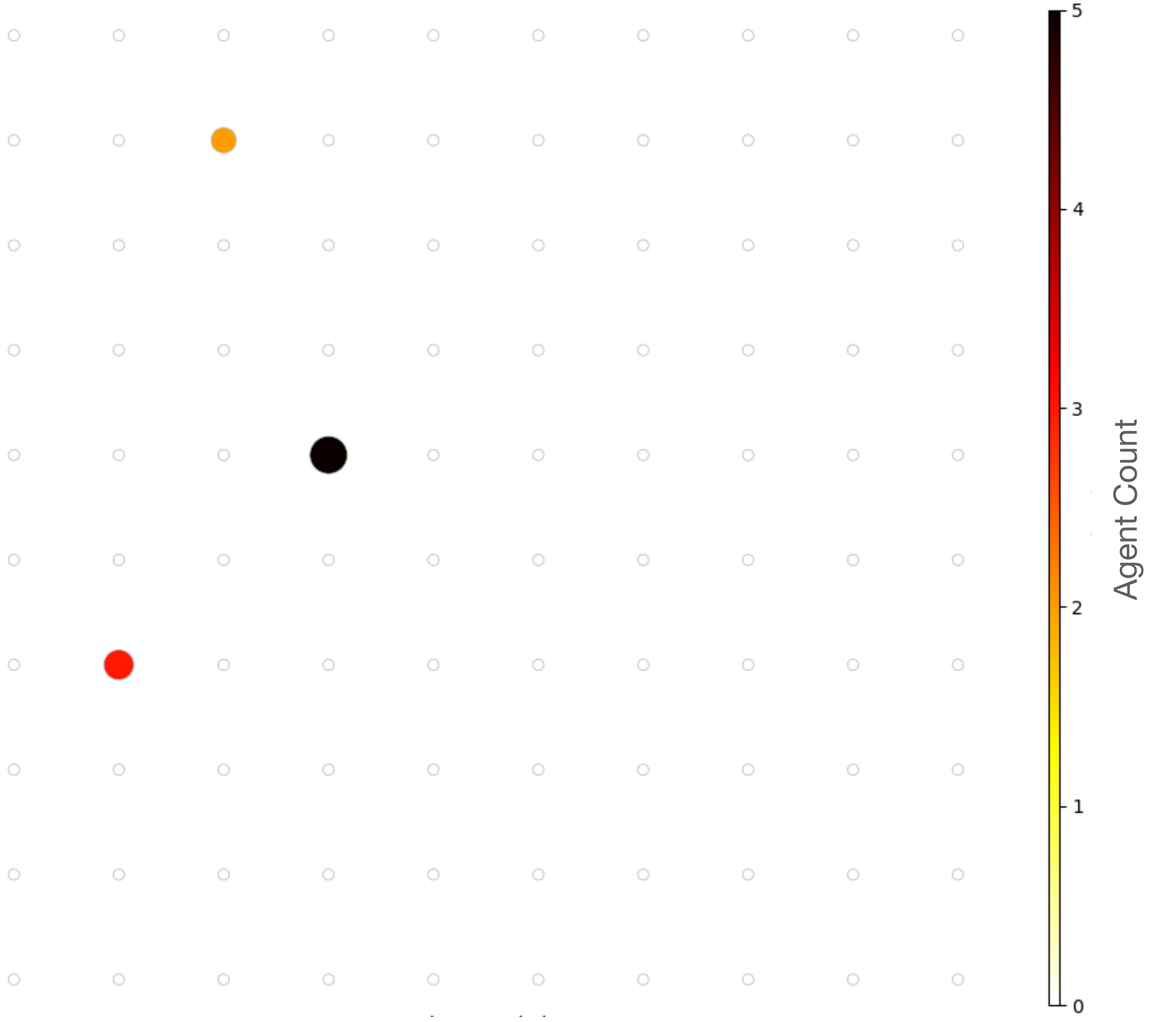
Travel Institution

- Governs the way in which agents more around the grid
- Agents provide it with cardinal directions each period deciding where to go
- Gives the agent their new location if it is a legal location, otherwise rejects

Agents Accreting Onto Discrete Points



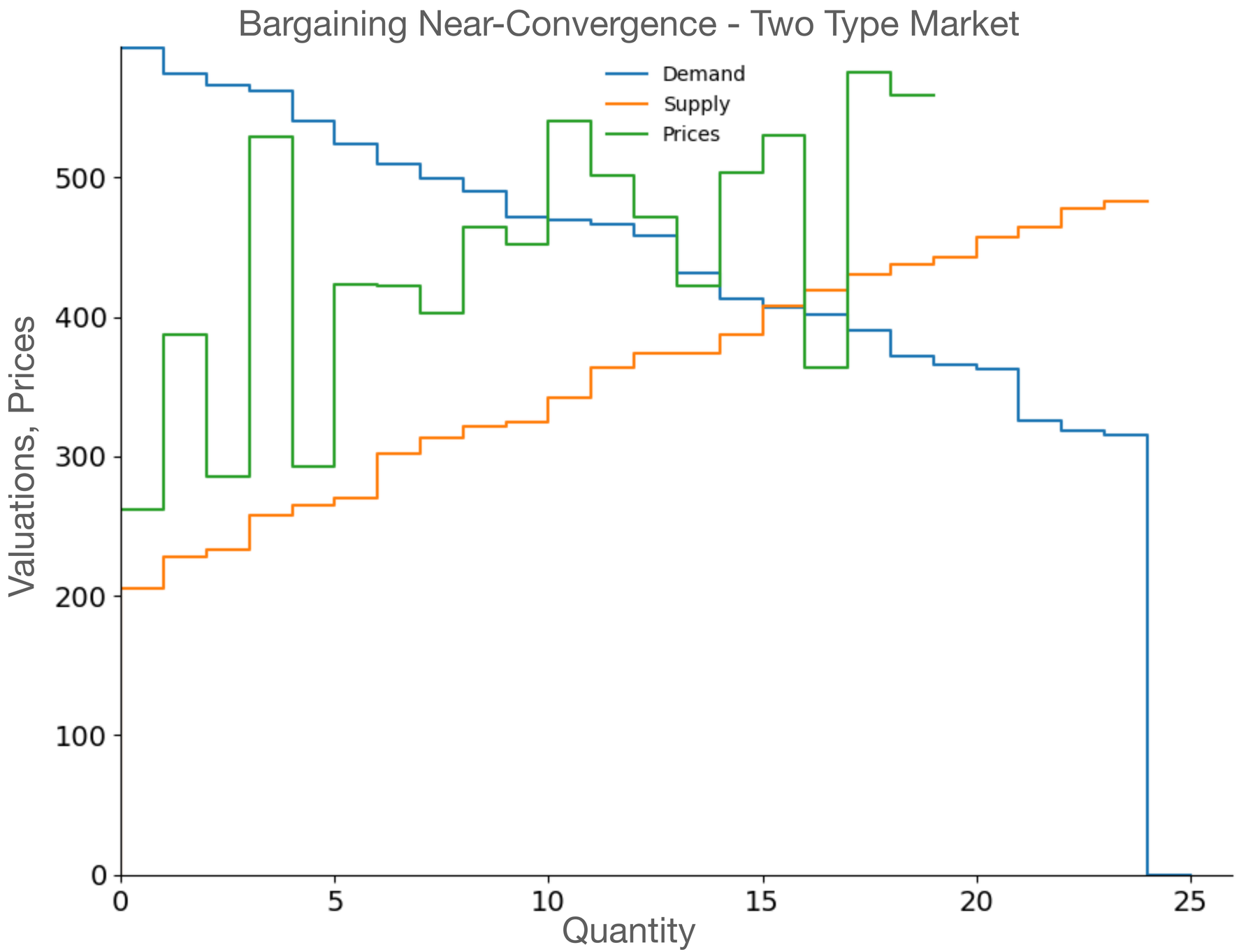
Start Position



End Position

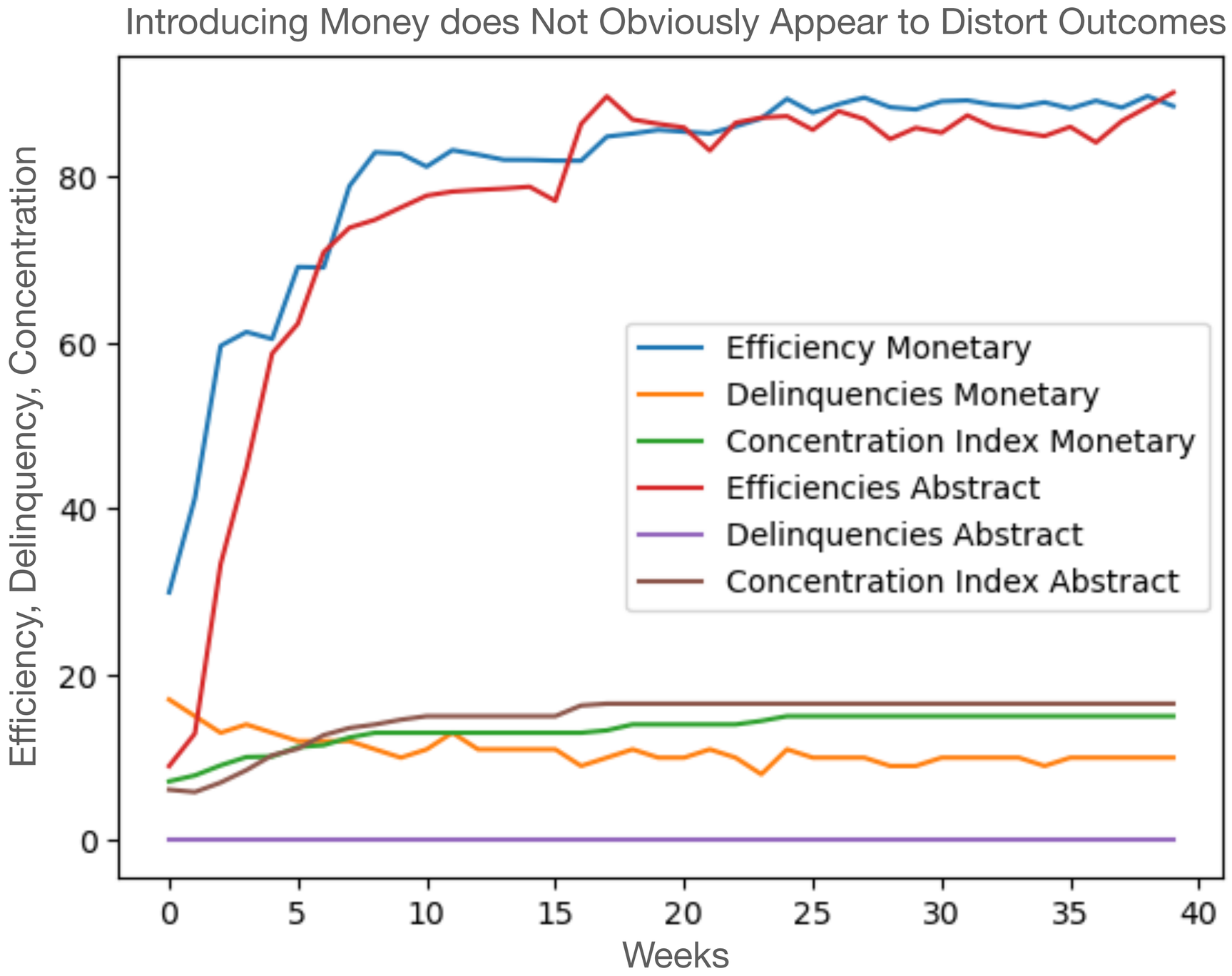
Bargaining Institution

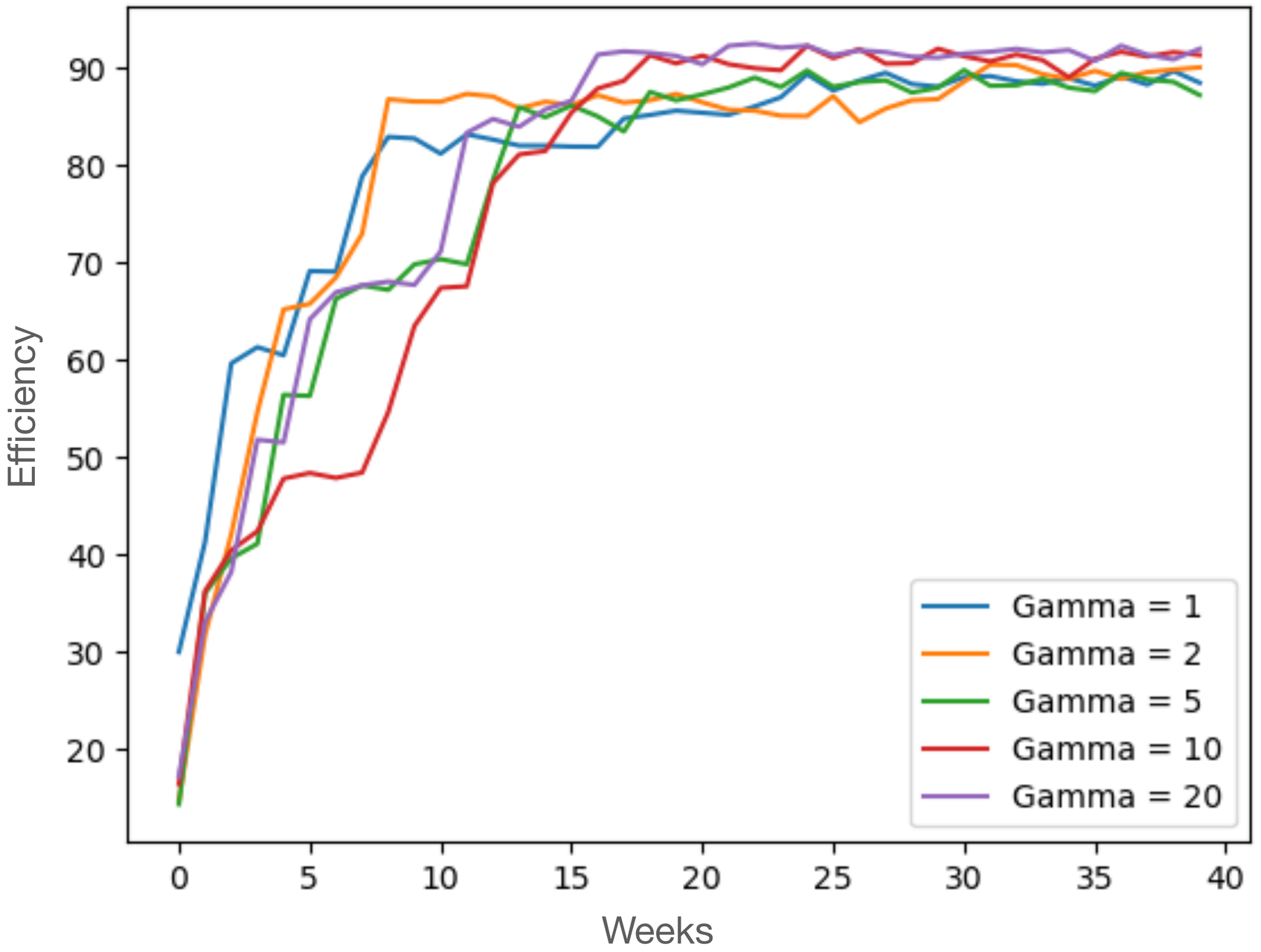
- Created when two or more agents that can trade meet at a point
- Agents first submit bids for their consumption good and asks for their production good
- Agents then choose whether to accept any of the bids or asks of other traders
- The process continues for the number of bargaining rounds specified
- Can be ran in an “abstract” or “monetary” mode
  - Abstract: agents can use utils as a faux-currency
  - Monetary: agents are required to use the credit currency to settle trades

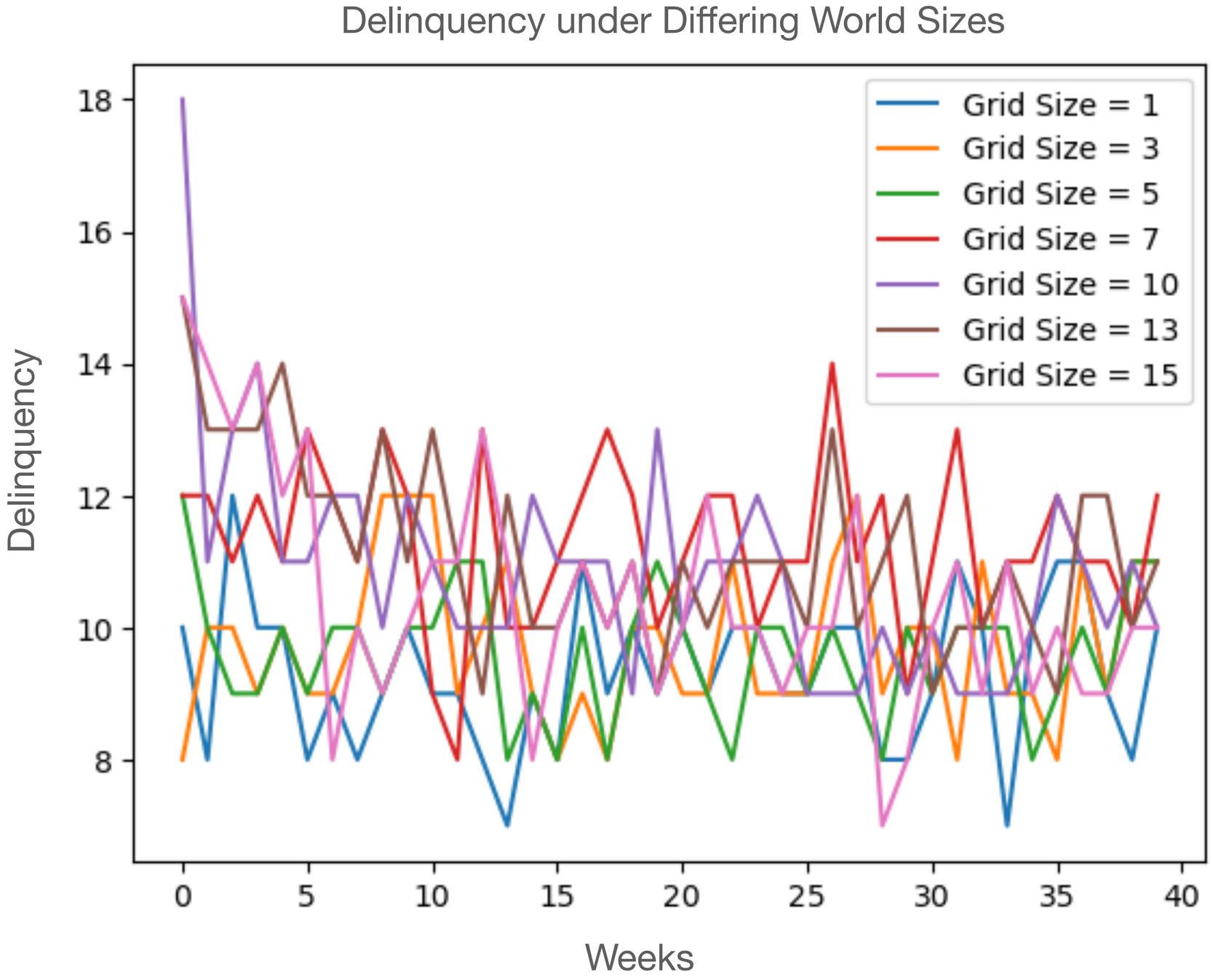

Bargaining Near-Convergence - Two Type Market
Demand
Supply
Prices
Valuations, Prices
0
100
200
300
400
500
0
5
10
15
20
25
Quantity

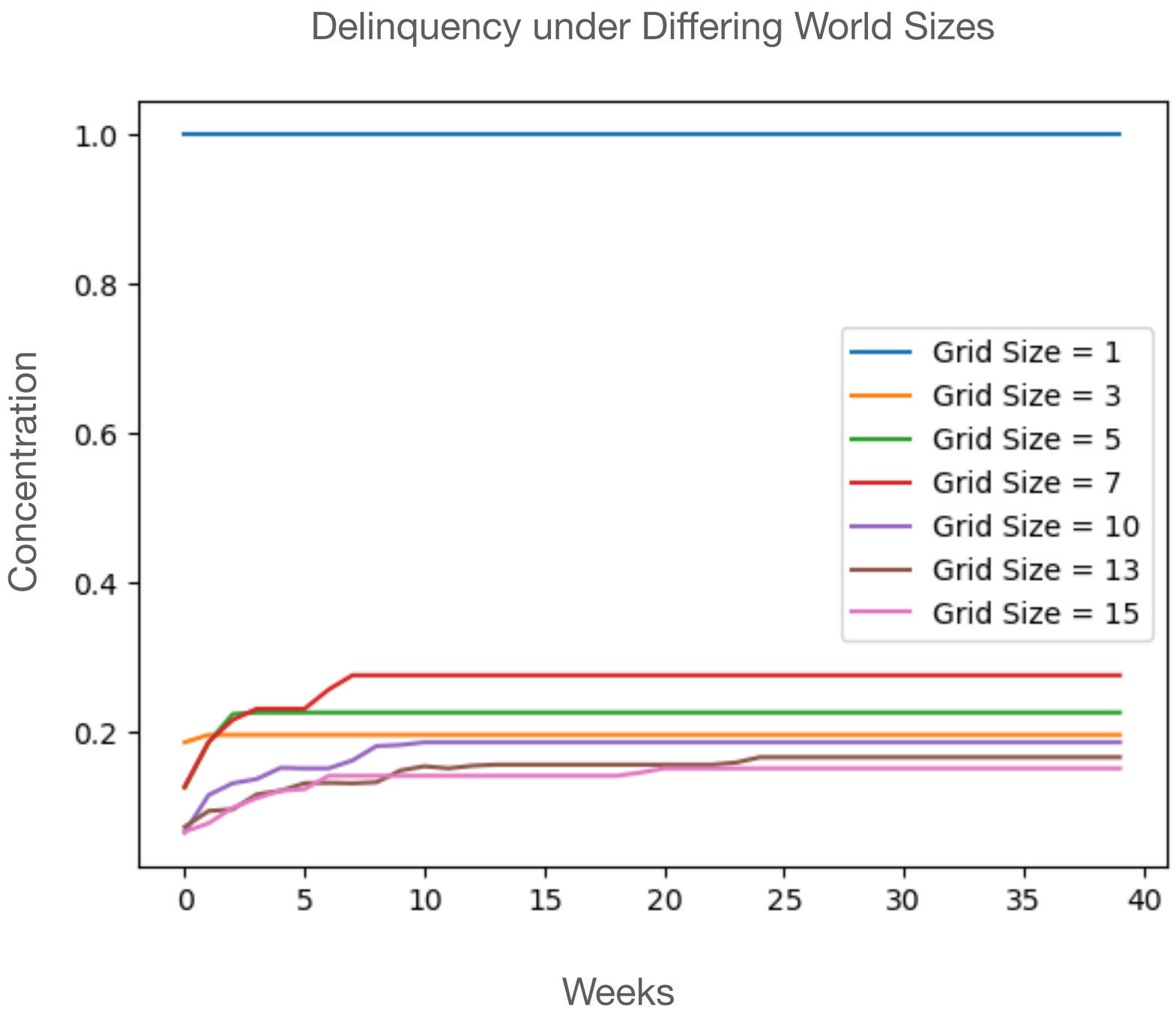
Currency Institution

- There is a single currency issuer for the world
- The amount of currency issued is affected by valuations and reputation
  - If all agents have perfect reputation, it is the sum of valuations
  - If some agents have lower reputation, they get less currency
- Agents start with a perfect reputation
- Failure to repay loans leads to reputation erosion, at a rate of γ
- Agents are issued currency and repay loans every week


Introducing Money does Not Obviously Appear to Distort Outcomes
Efficiency, Delinquency, Concentration
0
20
40
60
80
0
5
10
15
20
25
30
35
40
Weeks
Efficiency Monetary
Delinquencies Monetary
Concentration Index Monetary
Efficiencies Abstract
Delinquencies Abstract
Concentration Index Abstract


Efficiency under Differing Levels of Reputation Loss from Delinquency
Efficiency
Weeks
90
80
70
60
50
40
30
20
0
5
10
15
20
25
30
35
40
Gamma = 1
Gamma = 2
Gamma = 5
Gamma = 10
Gamma = 20


Delinquency under Differing World Sizes
Delinquency
Weeks
18
16
14
12
10
8
0
5
10
15
20
25
30
35
40
Grid Size = 1
Grid Size = 3
Grid Size = 5
Grid Size = 7
Grid Size = 10
Grid Size = 13
Grid Size = 15


Delinquency under Differing World Sizes
Concentration
Weeks
1.0
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
Grid Size = 1
Grid Size = 3
Grid Size = 5
Grid Size = 7
Grid Size = 10
Grid Size = 13
Grid Size = 15

Conclusions

- Lack of distortionary effects of money can be supported by self-regulation of the money supply through the reputation system
  - Agents who take extra-marginal trades are likely to lose reputation and thus be credit-constrained to make extra-marginal trades in further periods
  - Notably: reputation is permanent here, so allowing for some “bankruptcy” or other restitution of reputation may lead to distortion
- Excessive symmetry may be causing problems in the model
  - All agents draw valuations from the same distribution
  - Only asymmetries come from delinquency (self-correcting)