“Structure and Dynamics of Trust in Anonymous and Identified Online Networks”

Complex Network Dynamics, CS-484
Project Presentation, Phase A

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Problem Definition and Motivation

- **Central Question:** *How does anonymity affect the structure, stability and diffusion of trust in online signed networks?*
- **Κίνητρο:** Many platforms operate under anonymity. To ensure stability within the network they are forced to develop reputation mechanisms that are not based on external user identities.
- **Hypotheses:**
  - **Polarization:** The anonymous network will have more extreme ratings.
  - **Fragility:** Trust will be concentrated in a few nodes (Hubs).
  - **Structural Balance:** Fewer balanced triangles due to lack of social pressure.

Dataset Overview

- **Bitcoin OTC (Anonymous)**
  - **Source:** P2P trading platform.
  - **Scale:** -10 (for distrust) to +10 (for trust).
  - **Goal:** Protection against fraud.
  - **Key Statistics:**
    - 5.881 nodes
    - 35.592 edges
- **Epinions (Pseudo-Identified)**
  - **Source:** Consumer review site.
  - **Scale:** -1 (for distrust) or +1 (for trust).
  - **Goal:** Web of Trust for filtering reviews.
  - **Key Statistics:**
    - 131.828 nodes (x22 BTC)
    - 841.372 edges (x23 BTC)

Both networks are directed and signed.

First Findings (1)

- **Cleaning Process:** Remove NaN, Self-Loops, Duplicates
- **After Cleaning:**
  - 131.580 nodes (-248) in Epinions and 840.799 edges (-573), due to self-loops
  - 0.001029 density of Bitcoin OTC
  - 0.000049 density of Epinions
- **Observation:**
  - Bitcoin OTC is **20 times denser** than Epinions.
  - Thus, it is a more “tight-knit” community, despite anonymity.

Rating Distribution Analysis

- **Bitcoin OTC:**
  - Positive ≈ 90%, Negative ≈ 10%
  - **Strong Signaling:** Significant percentages at the extremes (-10, +10). Users are “shouting”. (see Hypothesis 1)
- **Epinions:**
  - Positive ≈ 85%, Negative ≈ 15%

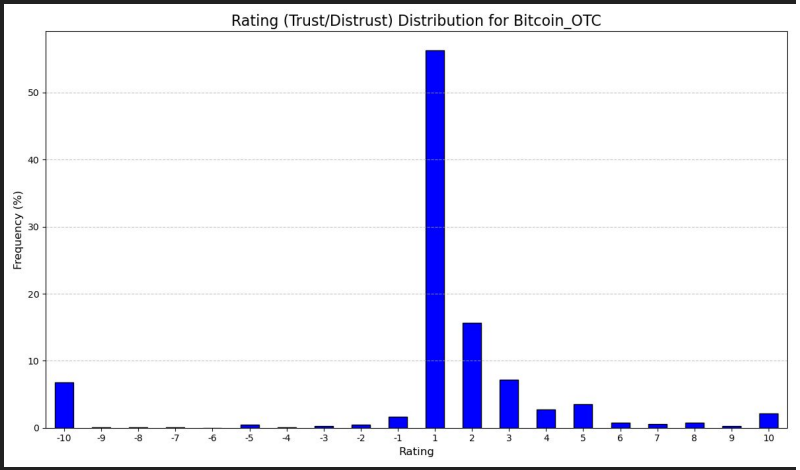
First Findings (2)

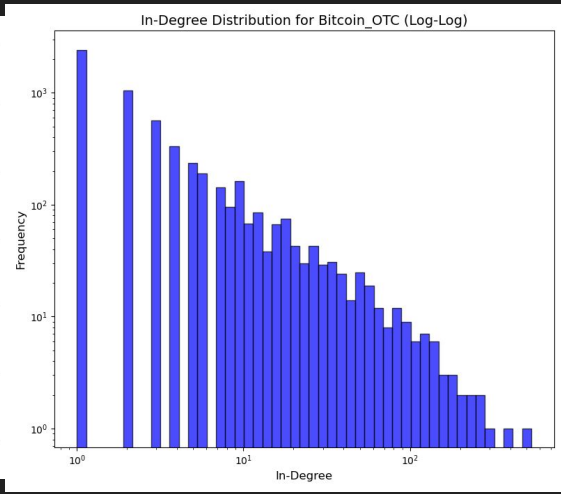
Degree Distribution Analysis

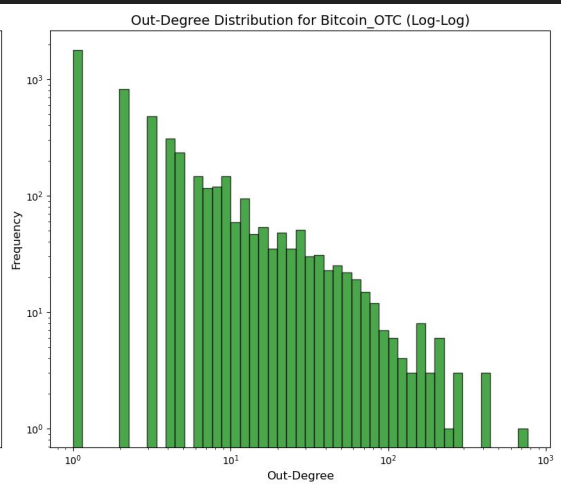
- The majority of nodes have very low In and Out-Degree.
- Few nodes have hundreds of connections, functioning as Hubs.
- The “tail” in Bitcoin OTC drops more steeply compared to Epinions
    - Even if less dense, EPinions has more “active” users.

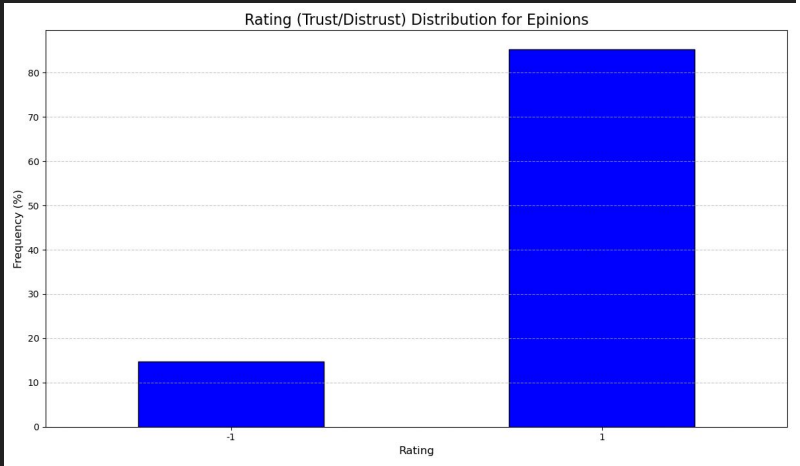
Weighted Degree Distribution Analysis

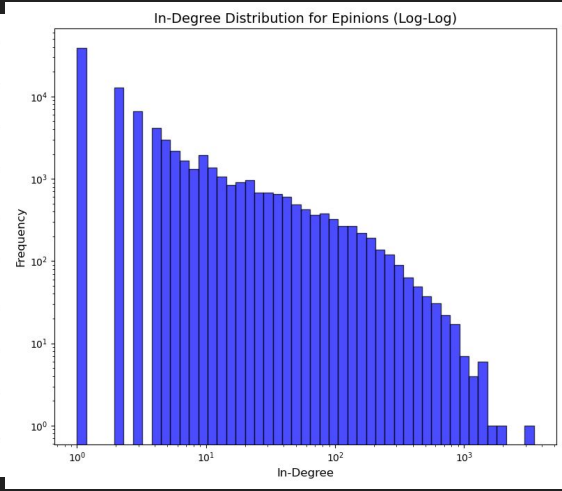
- The majority of nodes have “reputation” close to zero.
- **Bitcoin OTC:** In [-750, 1.000], Out [-1.000, 800]
- **Bitcoin OTC (Normalized):** In [-100, 600], Out [-100, 800]
- **Epinions:** In [-600, 3.000], Out [-1.500, 2.000]

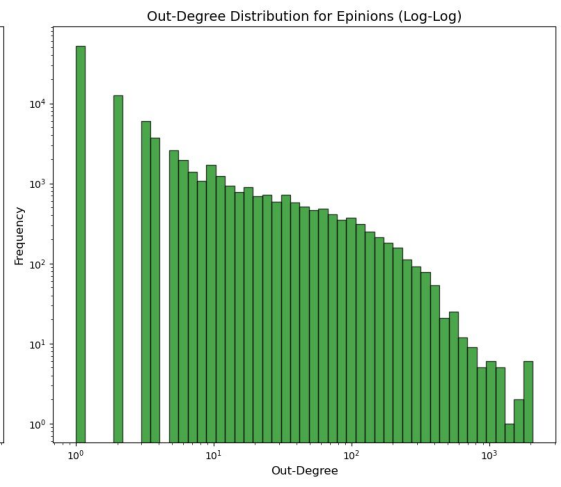

Rating (Trust/Distrust) Distribution for Bitcoin_OTC
Frequency (%)
Rating

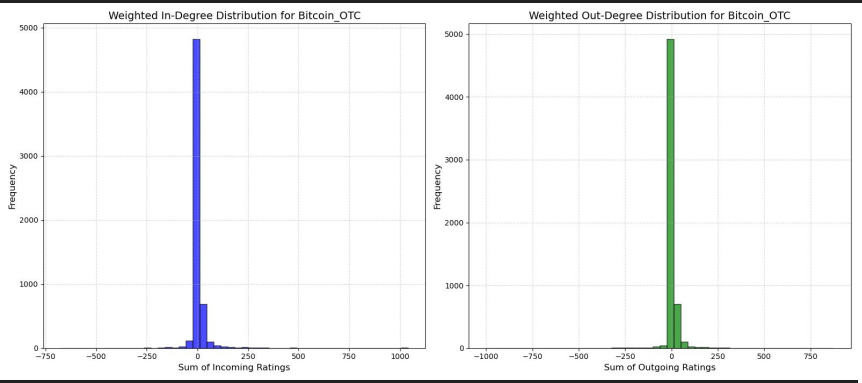

In-Degree Distribution for Bitcoin_OTC (Log-Log)
Frequency
In-Degree


Out-Degree Distribution for Bitcoin_OTC (Log-Log)
Frequency
Out-Degree

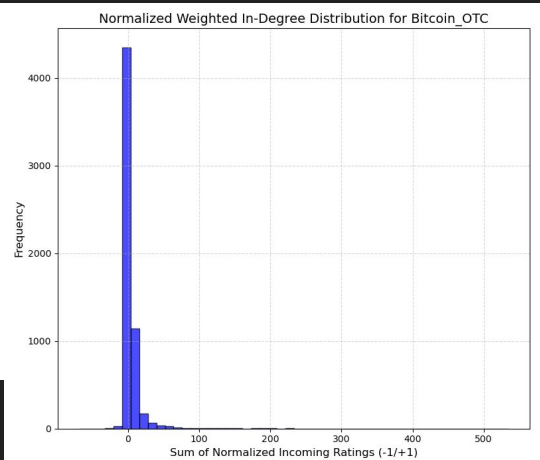

Rating (Trust/Distrust) Distribution for Epinions
Frequency (%)
Rating

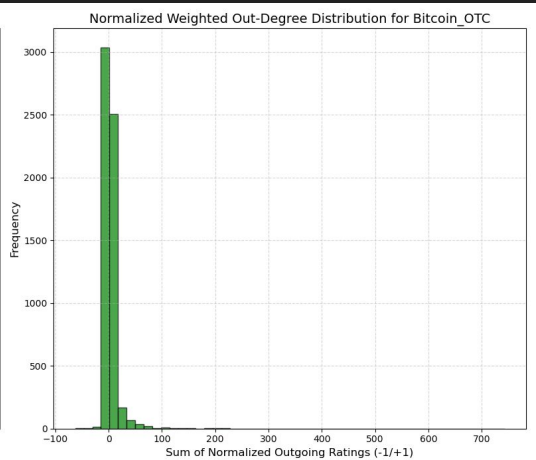

In-Degree Distribution for Epinions (Log-Log)
Frequency
In-Degree

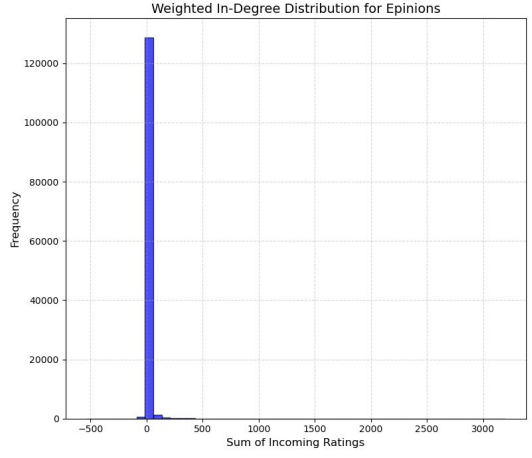

Out-Degree Distribution for Epinions (Log-Log)
Frequency
Out-Degree

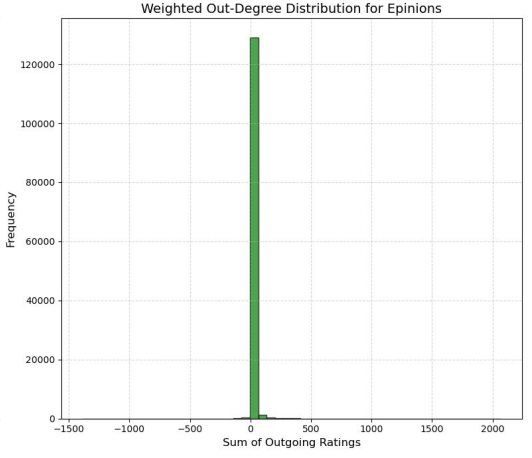

Weighted In-Degree Distribution for Bitcoin_OTC
Frequency
Sum of Incoming Ratings

Weighted Out-Degree Distribution for Bitcoin_OTC
Frequency
Sum of Outgoing Ratings


Normalized Weighted In-Degree Distribution for Bitcoin_OTC
Frequency
Sum of Normalized Incoming Ratings (-1/+1)


Normalized Weighted Out-Degree Distribution for Bitcoin_OTC
Frequency
Sum of Normalized Outgoing Ratings (-1/+1)


Weighted In-Degree Distribution for Epinions
Frequency
Sum of Incoming Ratings


Weighted Out-Degree Distribution for Epinions
Frequency
Sum of Outgoing Ratings

Next Steps and Expected Outcomes

- **Analysis On**:
  - Power Law
  - Clustering Coefficient
  - Average Path Length
  - Reciprocity (Mutuality)
  - PageRank & Eigenvector Centrality
  - Trust Transitivity (if trustworthiness is “contagious”)
  - Structural Balance
  - Robustness Analysis
- **Σύγκριση Ευρημάτων**
- **Συγγραφή Τελικής Αναφοράς και Παρουσίασης**

- I expect to show that anonymity makes networks:
  - more fragile,
  - less structurally balanced,
  - have more polarized rating patterns.