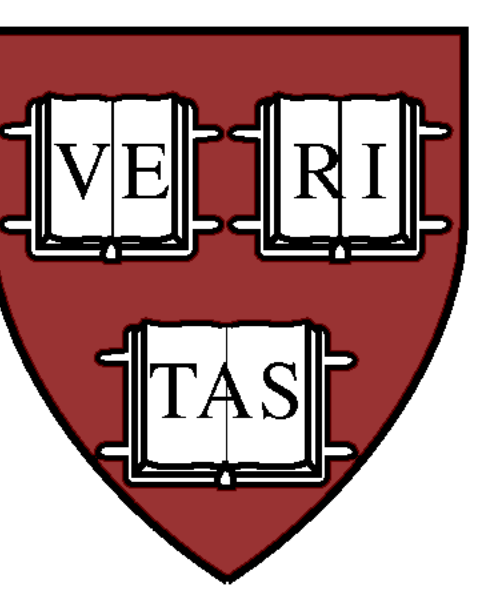




# Hybrid Transitive Trust Mechanisms



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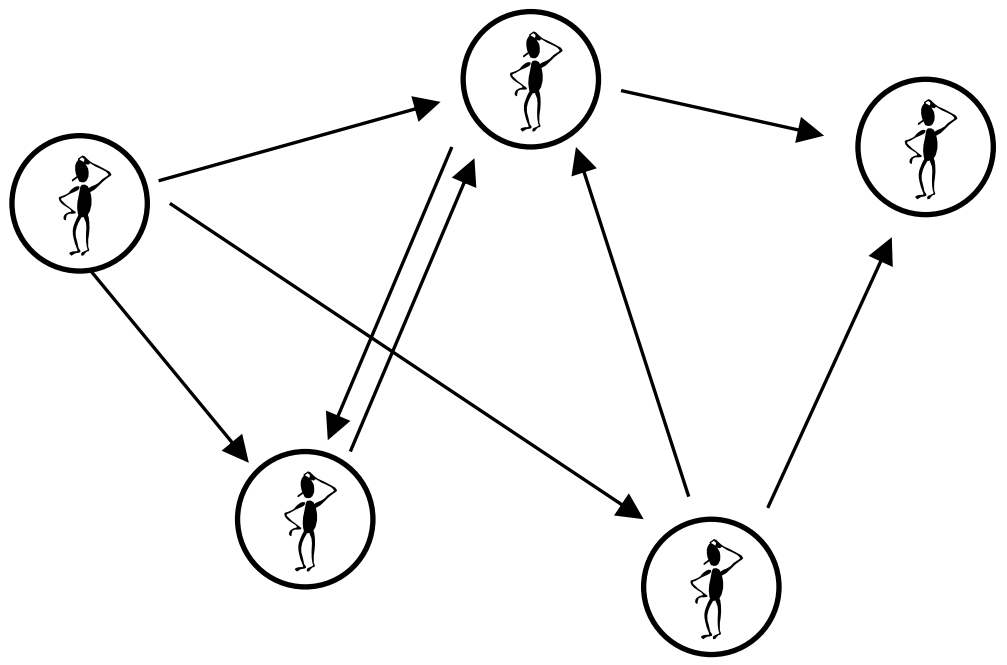
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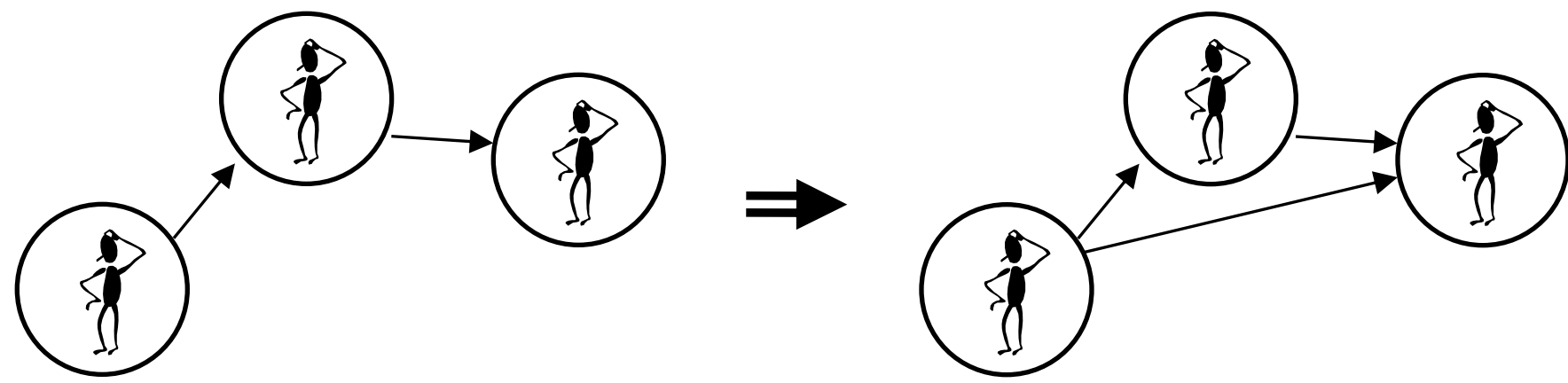
## Motivation

- Large multi-agent systems must deal with fraudulent behavior
  - eBay auctions
  - P2P file sharing
  - Web surfing
- Pool collective experience
- Need mechanisms for aggregating trust

## Model



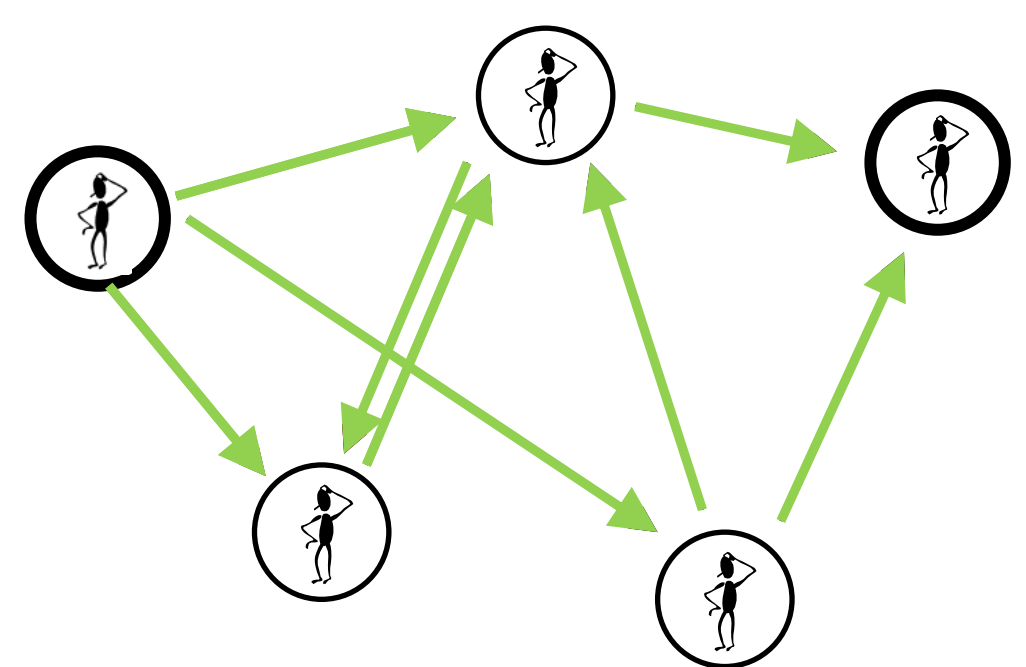
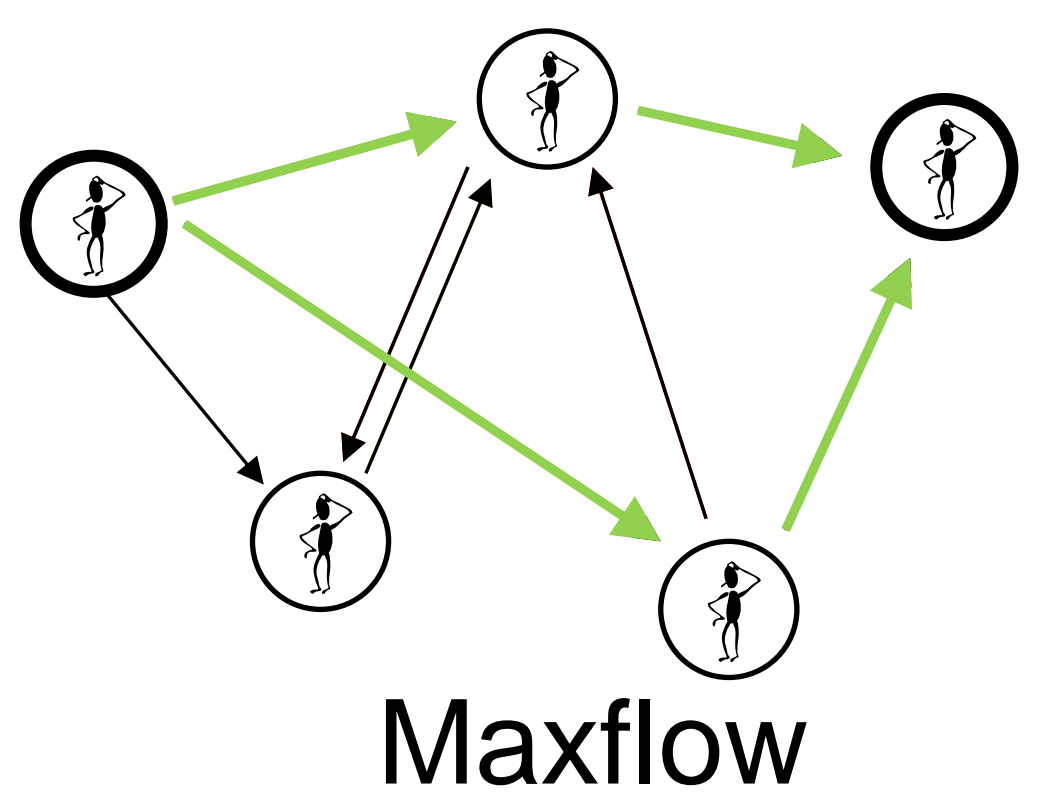
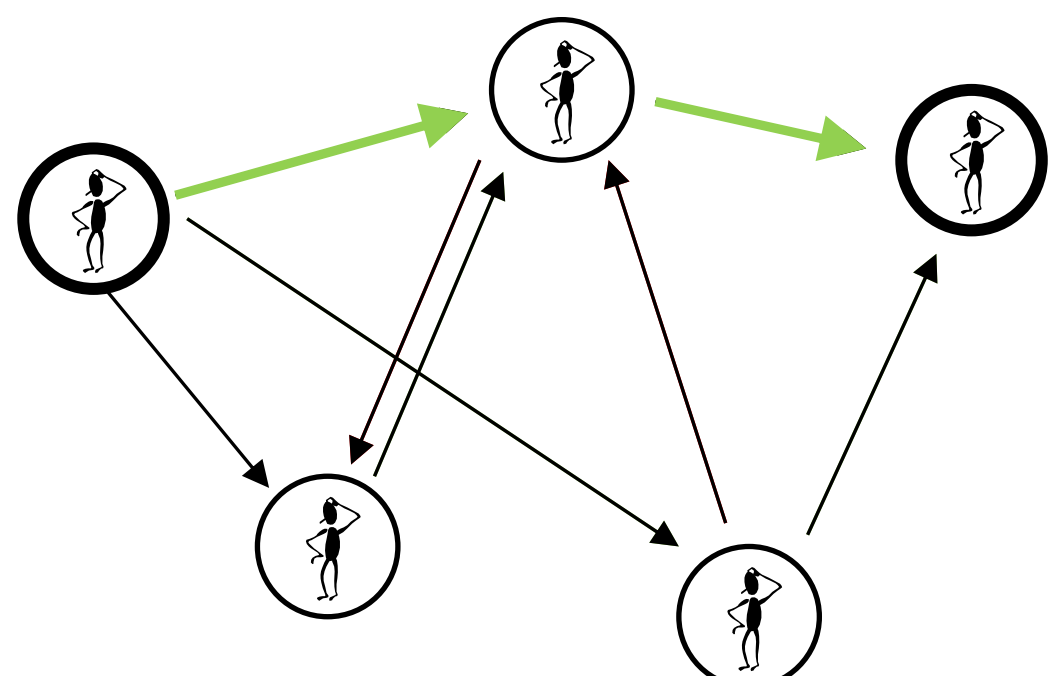
- Goal: Figure out who is trustworthy.
- Goal: Keep agents from lying.
- Use transitive trust



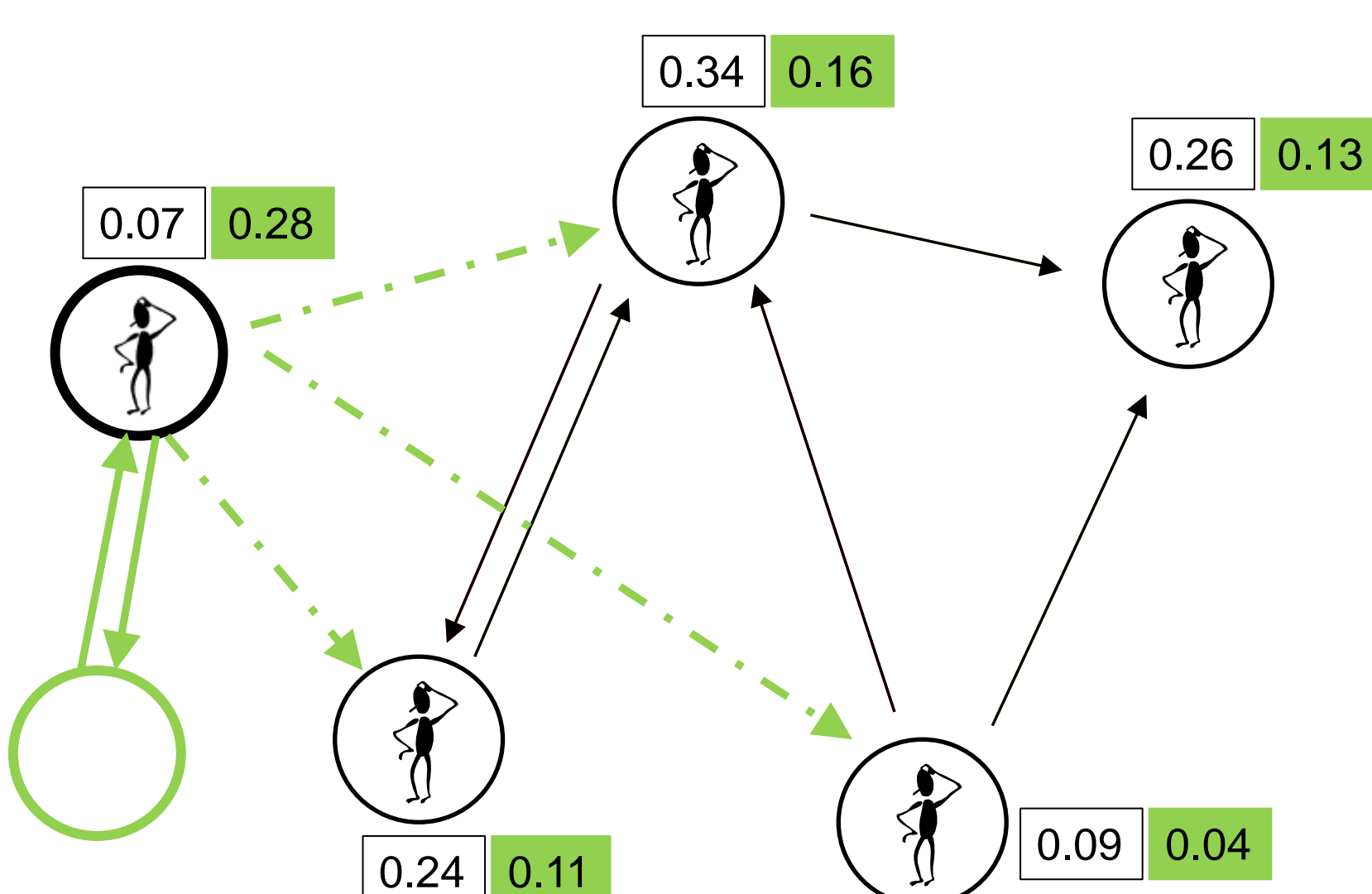
## Problem

- Trade-off between informativeness and strategyproofness
- Prior work generally focuses on one or the other
- This work addresses tradeoff explicitly

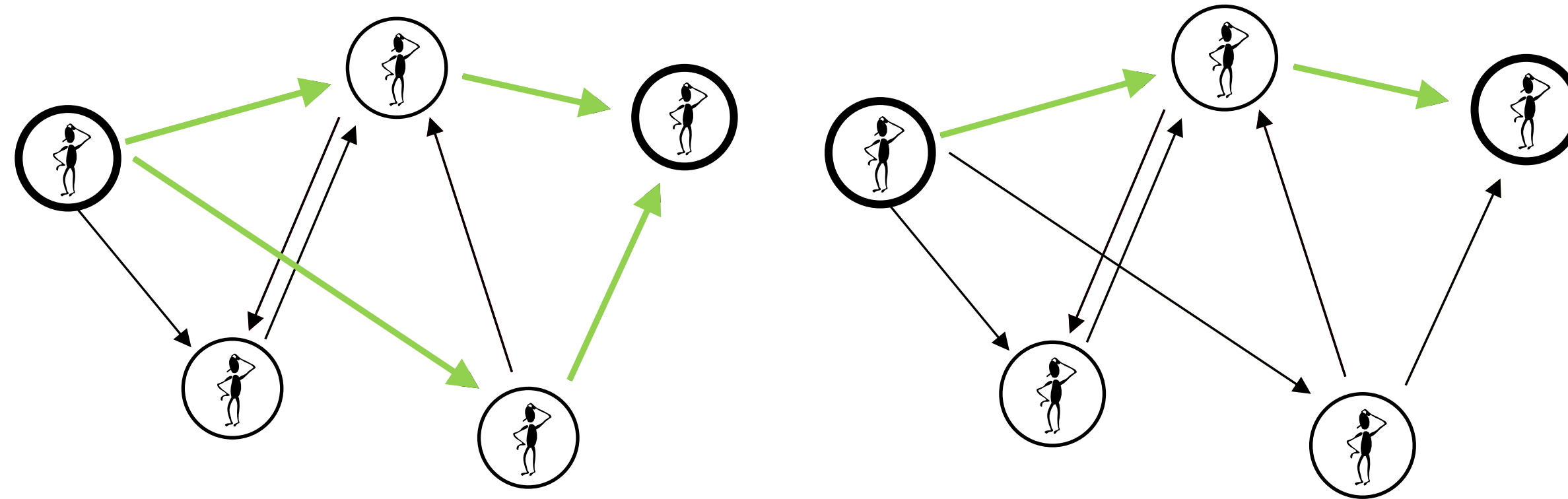
## Example Mechanisms



## Manipulations

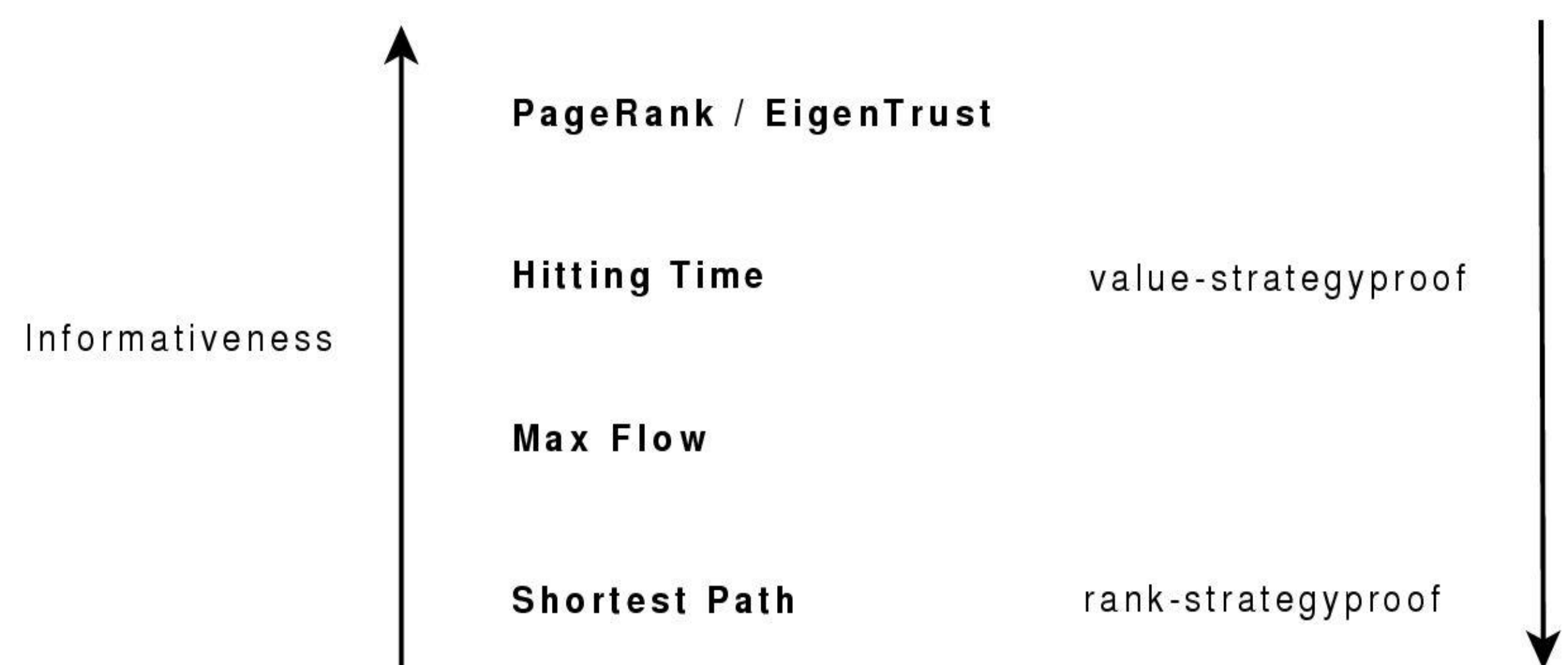


## Strategyproofness



Generalize  $\epsilon$ -value- and  $\epsilon$ -rank strategyproof

## Tradeoffs

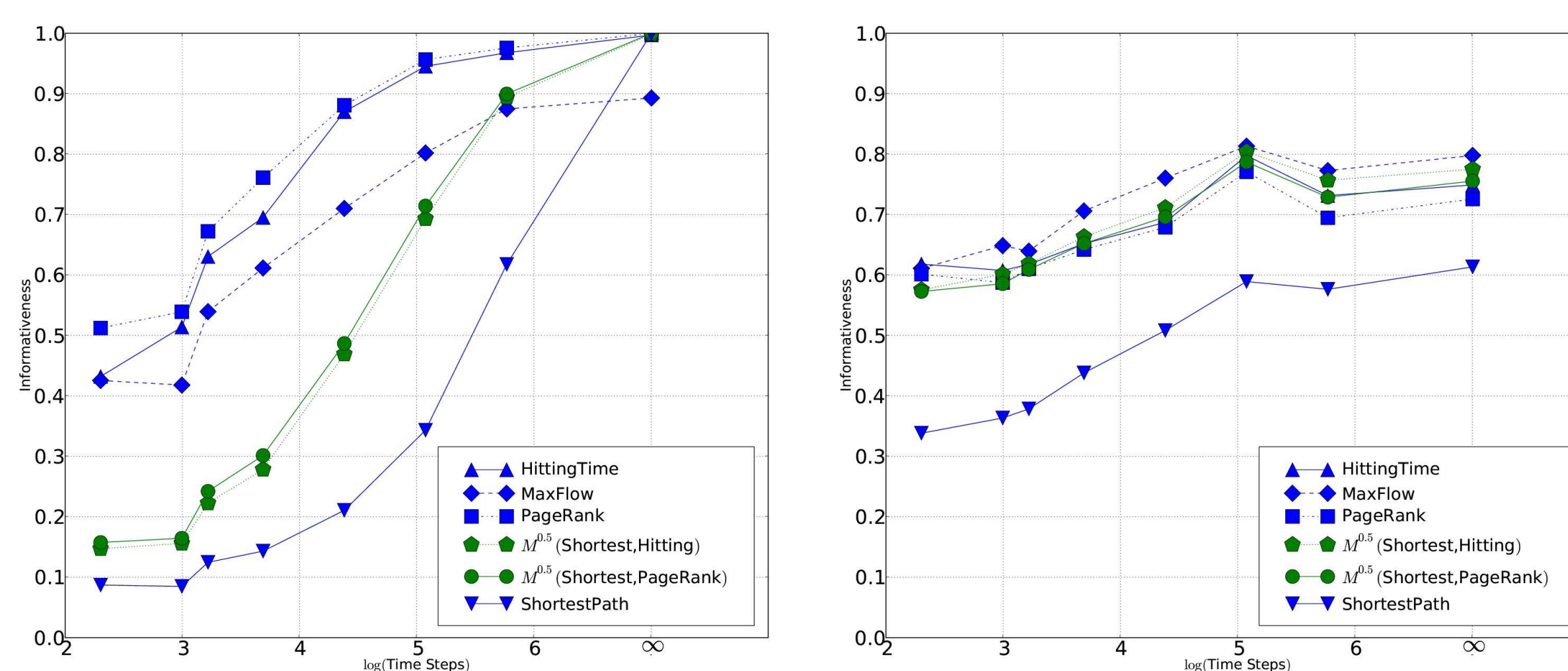


## Hybrid Mechanisms

$$\alpha \left( \text{Shortest Path} \right) + (1-\alpha) \left( \text{PageRank} \right)$$

- Combine existing reputation mechanisms
  - Use convex weighting
- Intermediate informativeness, strategyproofness
- Better efficiency than either base mechanism

## Empirical Informativeness



• Informativeness is the correlation between true agents' types and final trust scores the mechanism produces

## Theoretical Results

**THEOREM 2.** *If transitive-trust mechanisms  $M^1$  and  $M^2$  are value-strategyproof and  $M^1$  satisfies upwards value-preservation, then  $M^\alpha(M^1, M^2)$  is  $\alpha$ -rank-strategyproof.*

• Shortest Path Hitting Time hybrid is  $\alpha$ -rank strategyproof

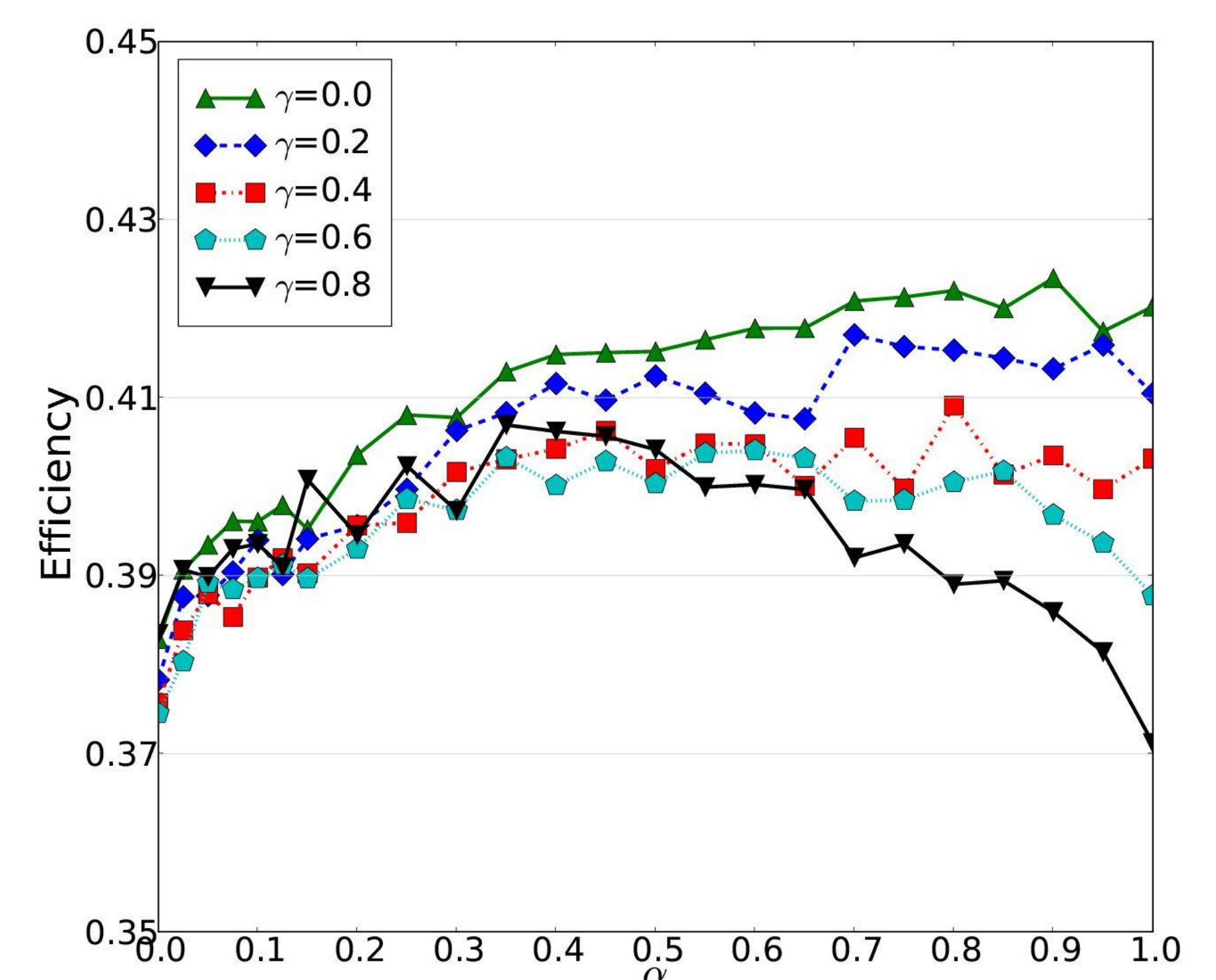
**THEOREM 1.** *If transitive-trust mechanisms  $M^1$  and  $M^2$  are  $\epsilon_1$  and  $\epsilon_2$ -value-strategyproof respectively, then  $M^\alpha(M^1, M^2)$  is  $((1-\alpha)\epsilon_1 + \alpha\epsilon_2)$ -value-strategyproof.*

• Maxflow PageRank hybrid is  $0.5\alpha$ -value strategyproof

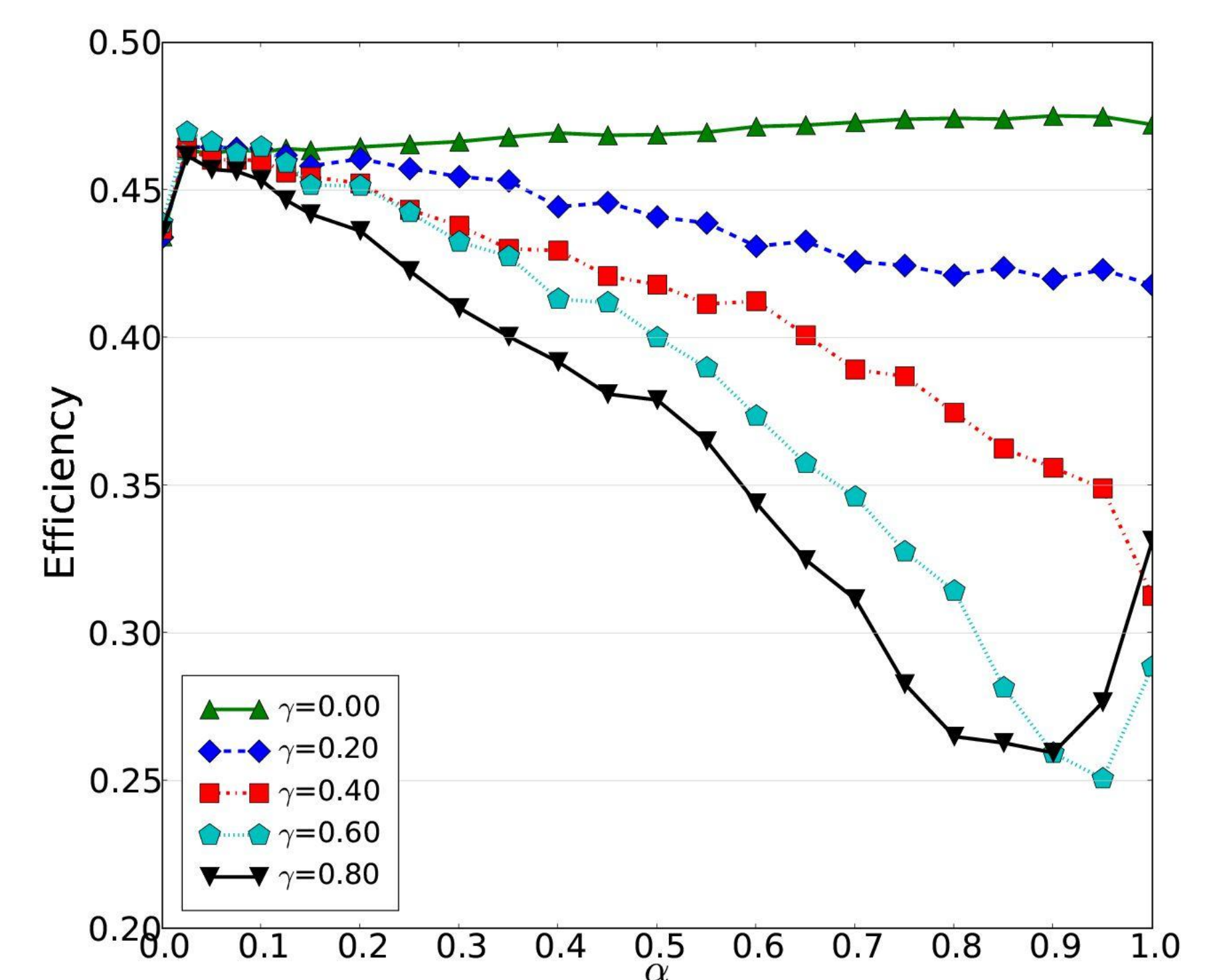
## Experiment Setup

- Two application domains: P2P file sharing and web surfing
- Setup
  - N agents, each with type  $\theta_i$
  - Cooperative, lazy free-rider, strategic
  - Agents choose interactions using hybrid trust mechanism
  - Report results of interactions
- Measure efficiency as fraction of good interactions for cooperative agents

## Virus Distribution Experiment



## Website Ranking Experiment



## Conclusions

- Analyzed informativeness and strategyproofness trade-off theoretically and experimentally
- Hybrid mechanisms have intermediate informativeness, strategyproofness
- For some domains the hybrids produce better efficiency than either base mechanism
- Future Work:
  - Explicit modeling of strategic agent behavior
  - Considering computational requirements