A Strategic Analysis of Portfolio Compression

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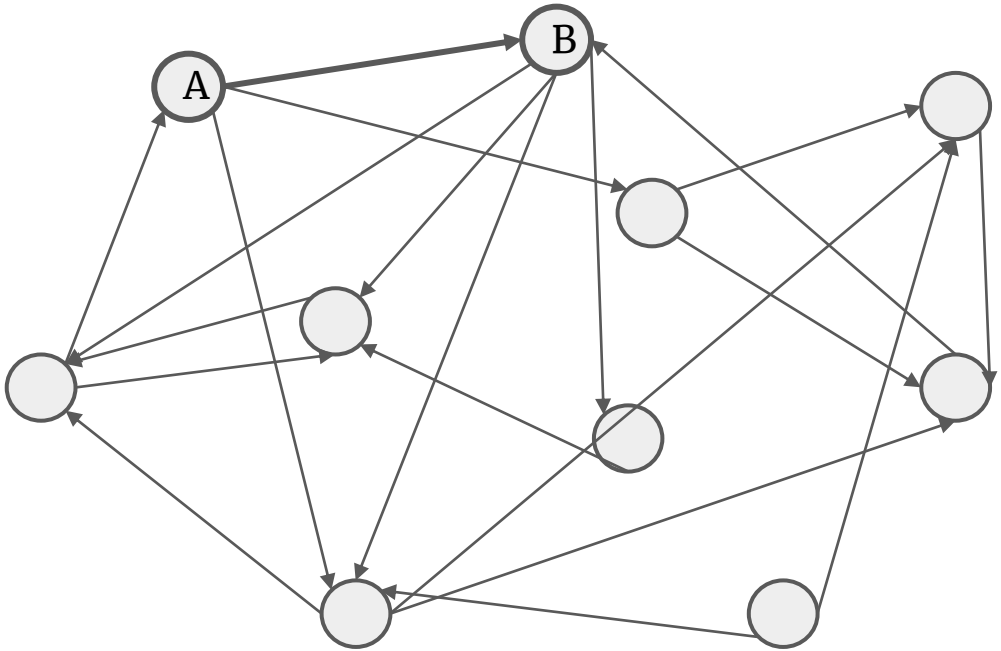
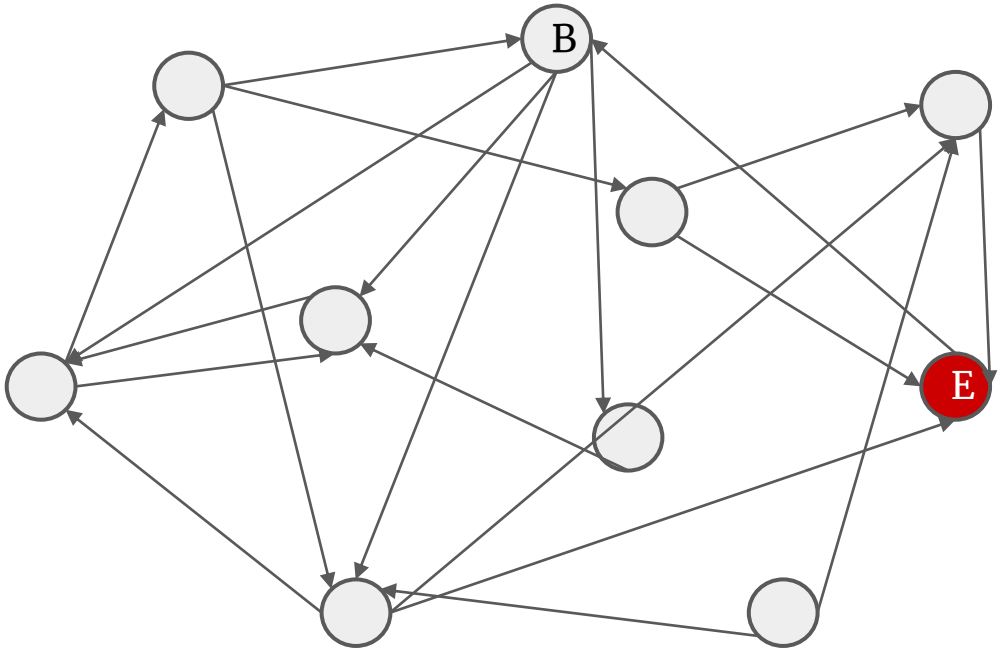
The relationships between financial institutions as a result of their debt obligations form the *financial network*.



The interconnectedness of this network can lead to *financial contagion*, where insolvency of one institution can lead to the insolvency of others.



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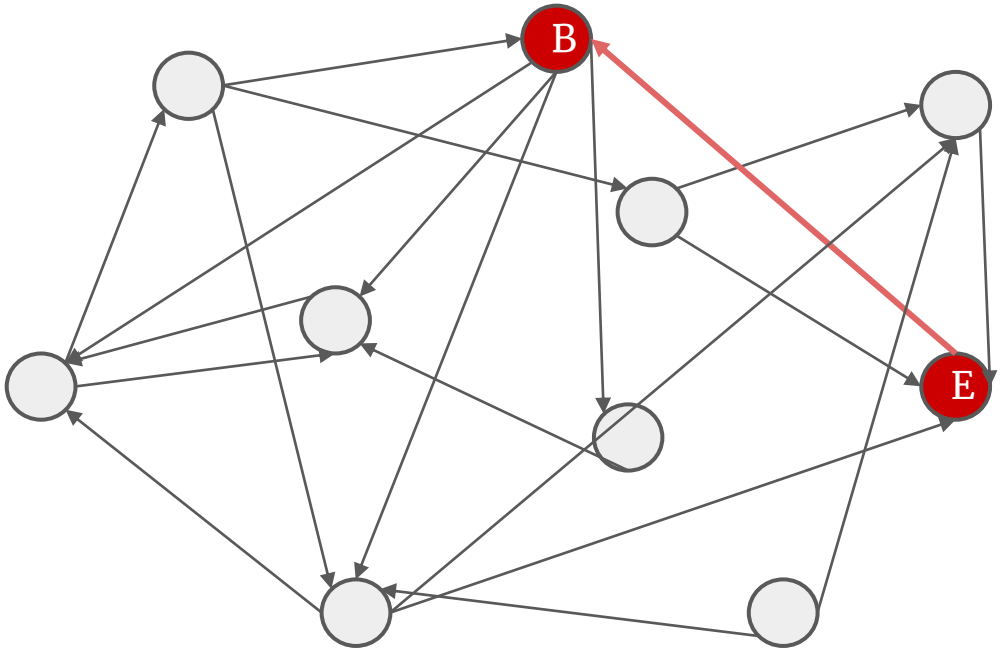

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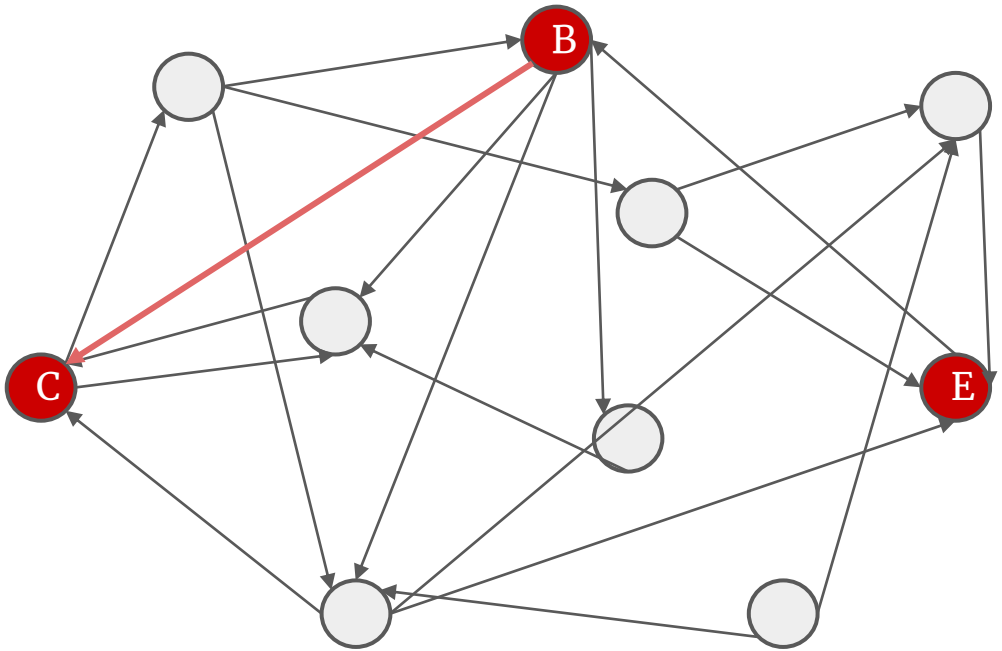

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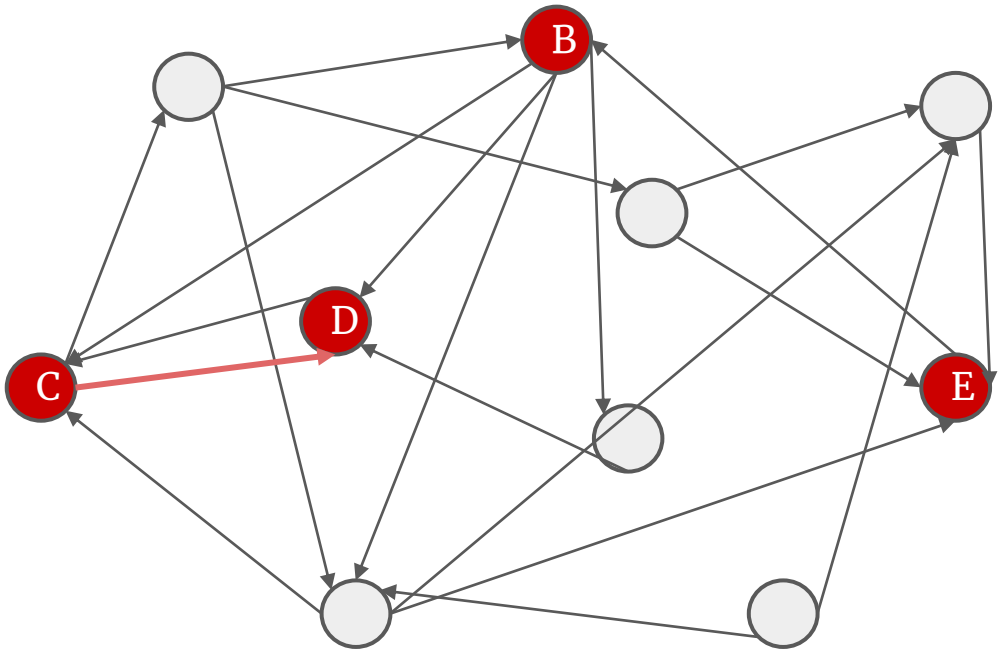
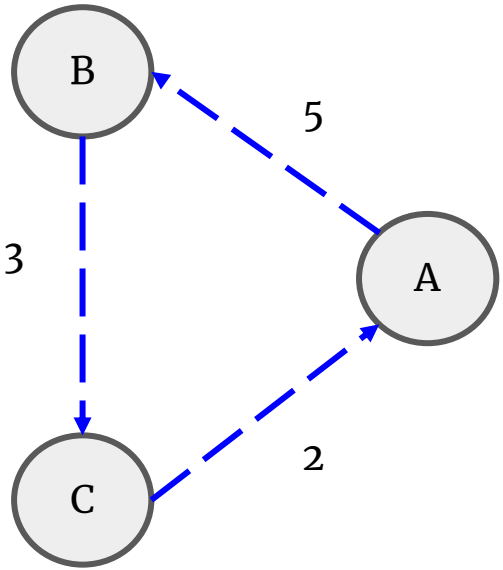


Portfolio compression eliminates a cycle of debt in a manner that leaves each institution's net position the same.



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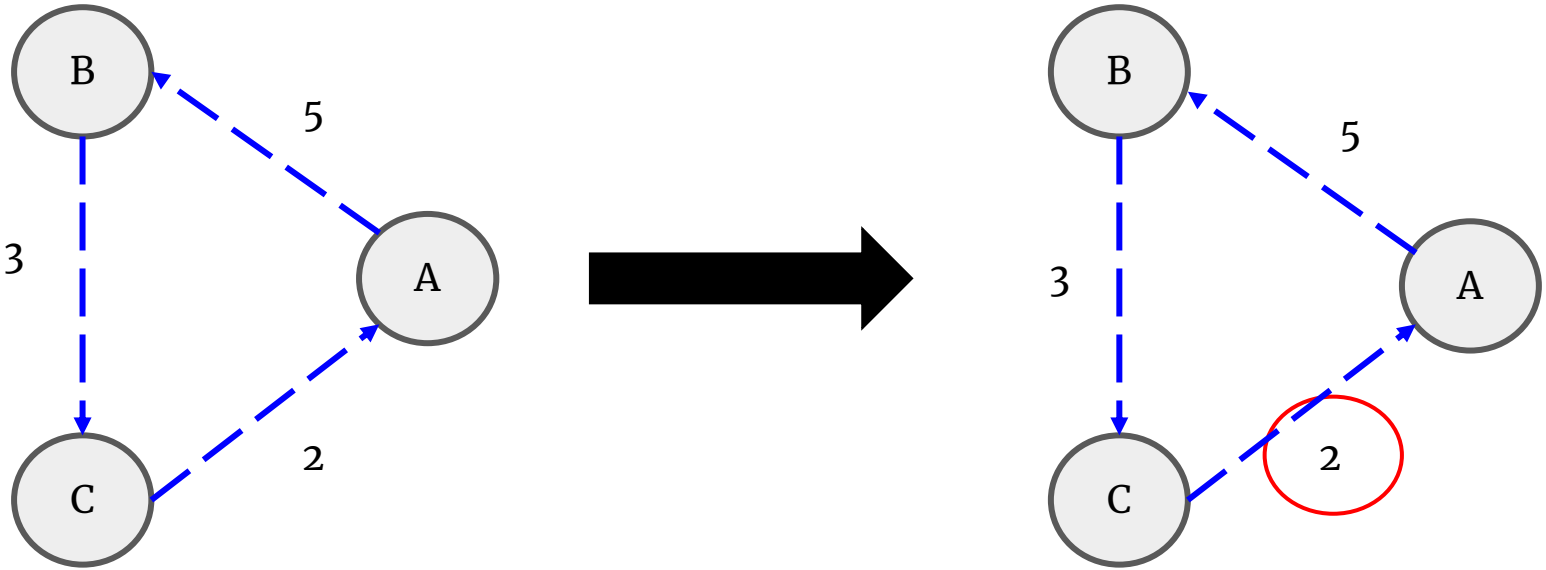

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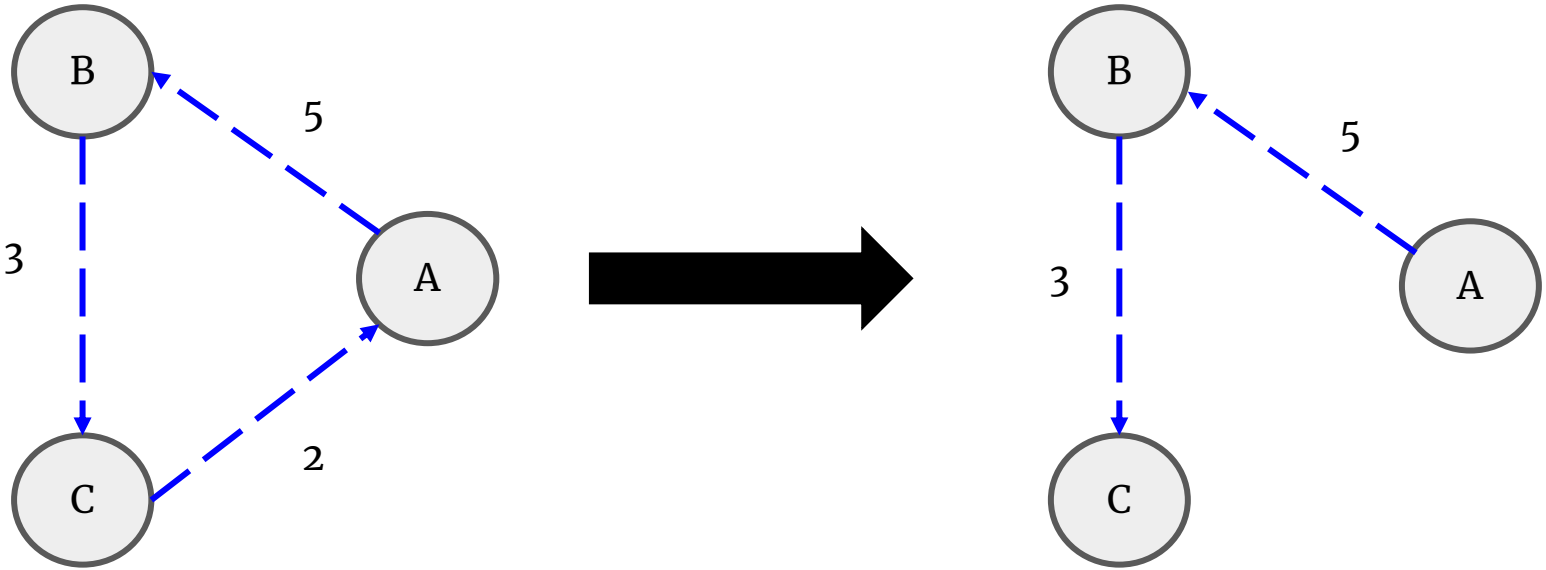

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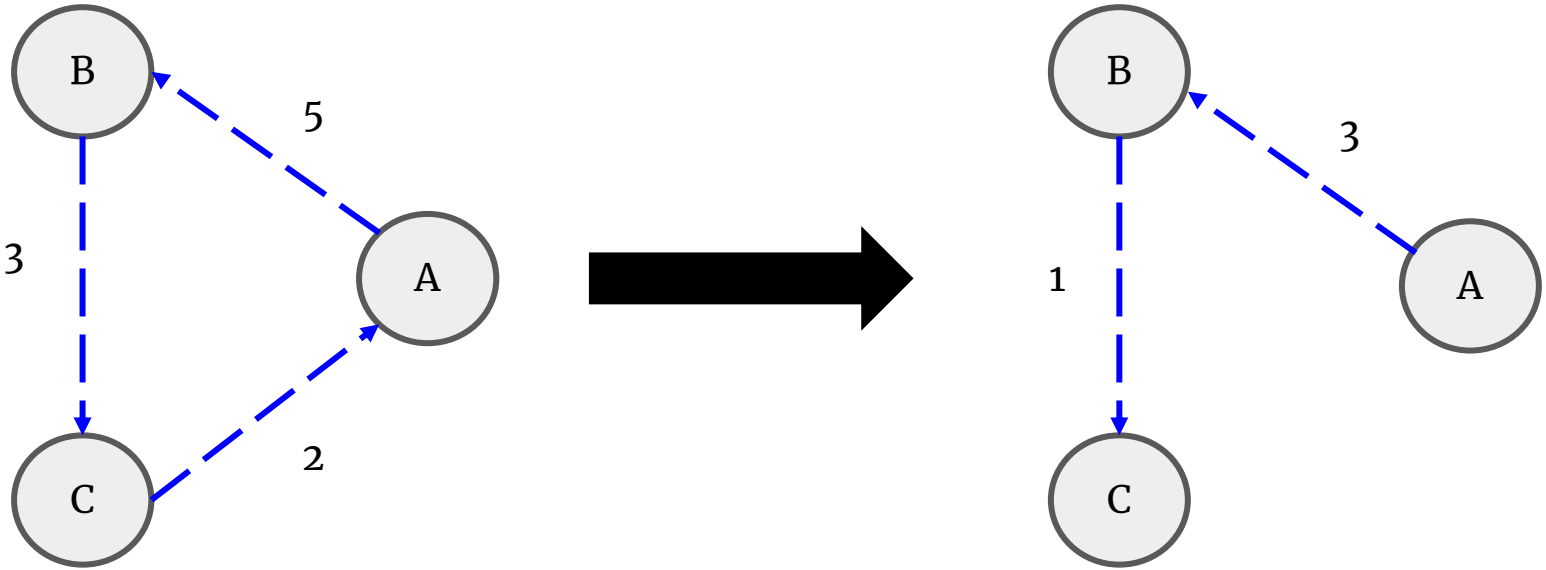

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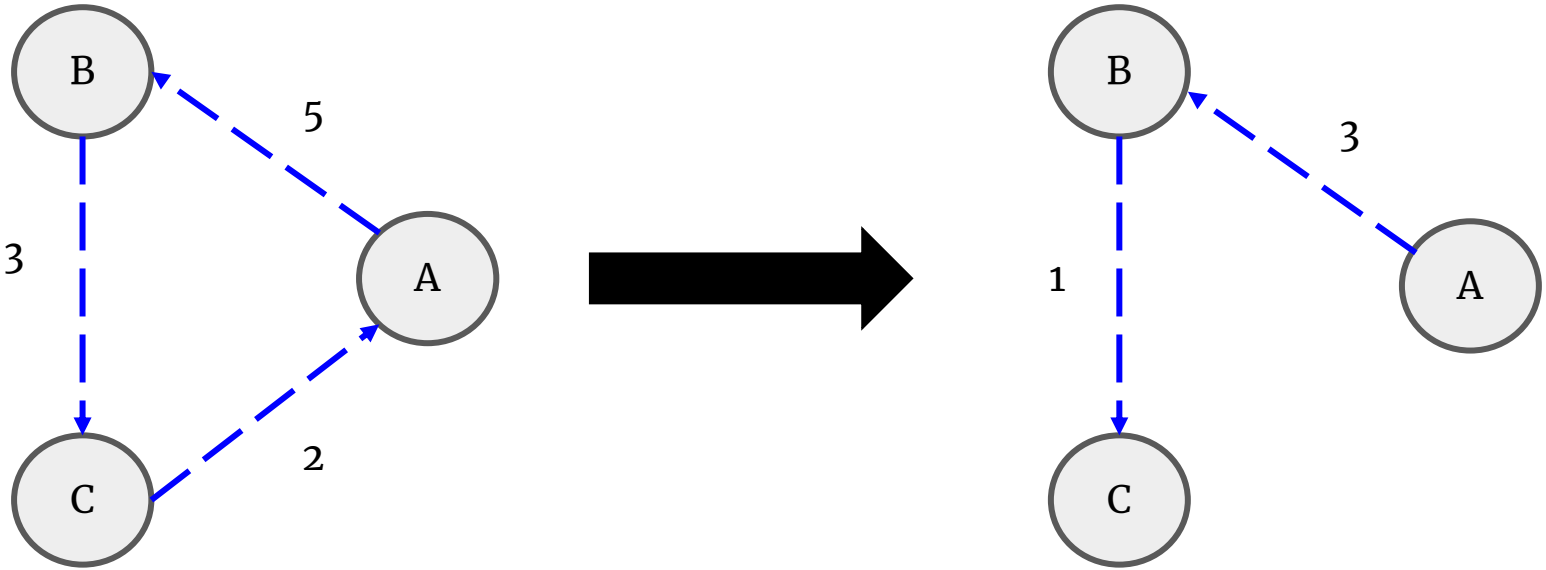
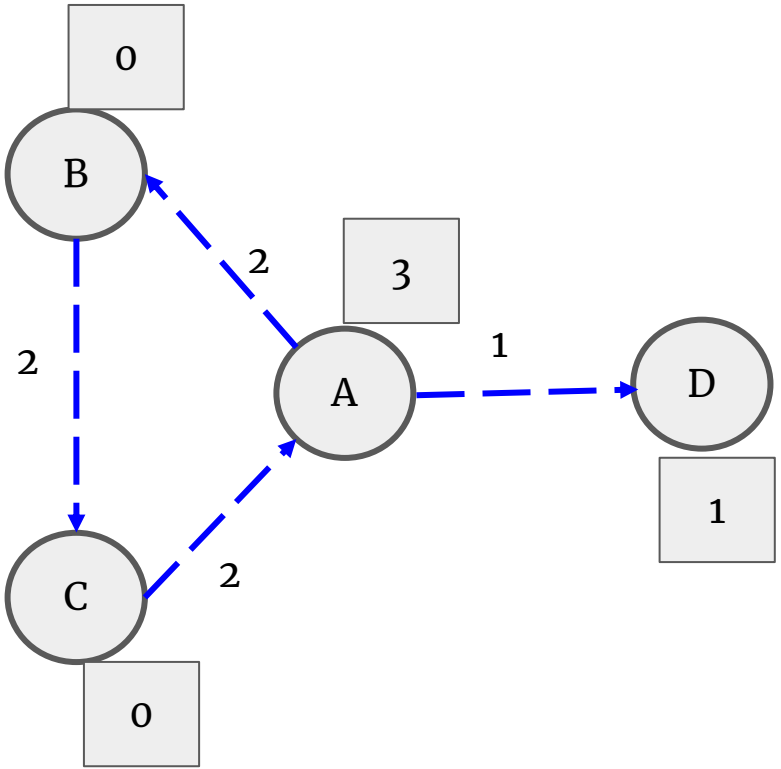


With the threat of insolvency in the network, the effects of compression may not be neutral.

Without Compression



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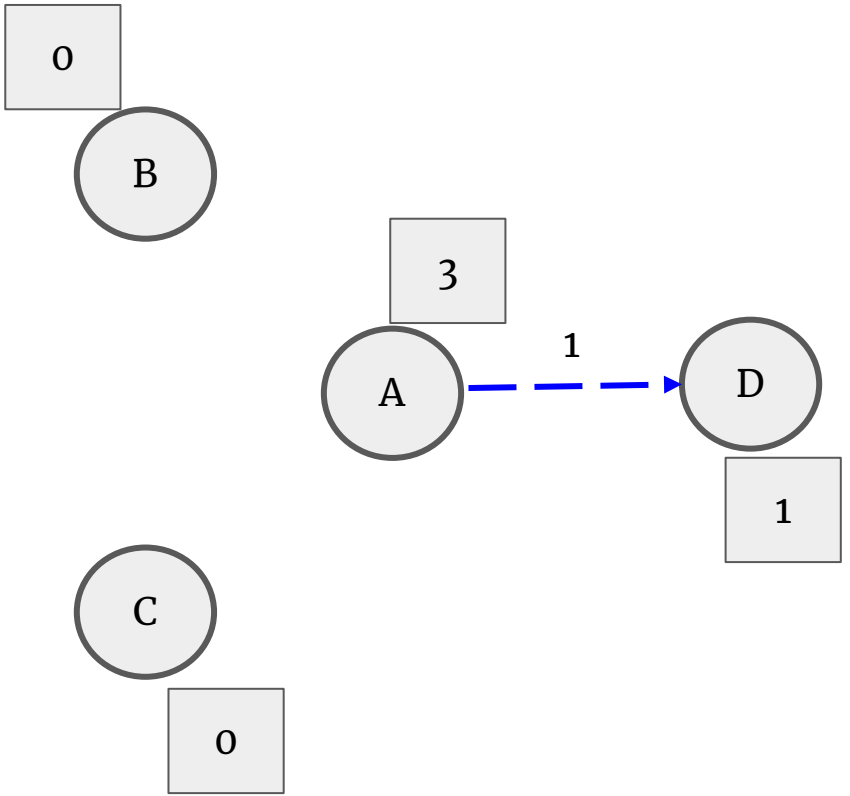

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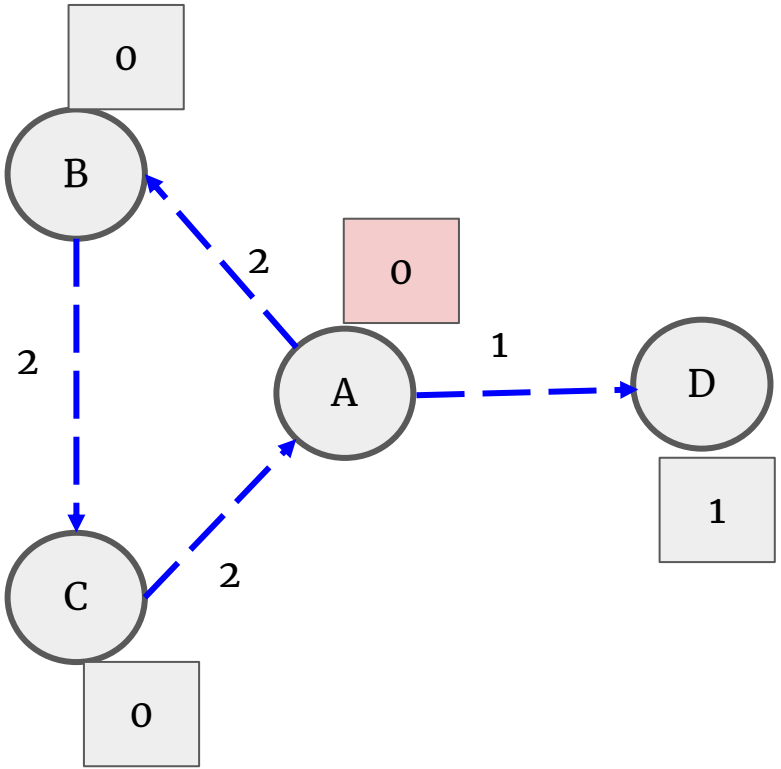

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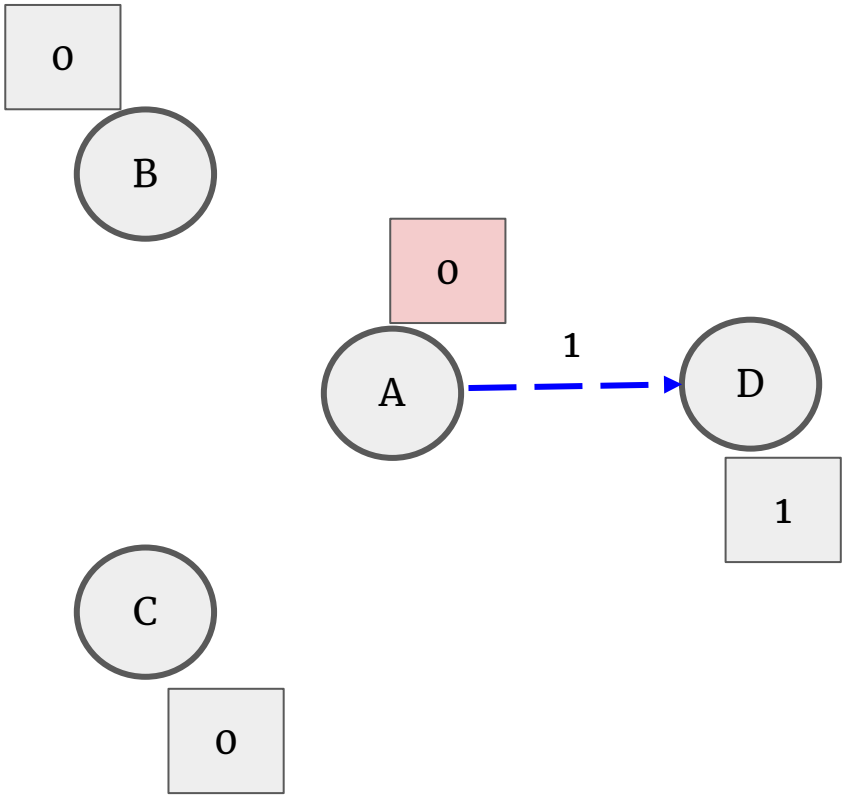

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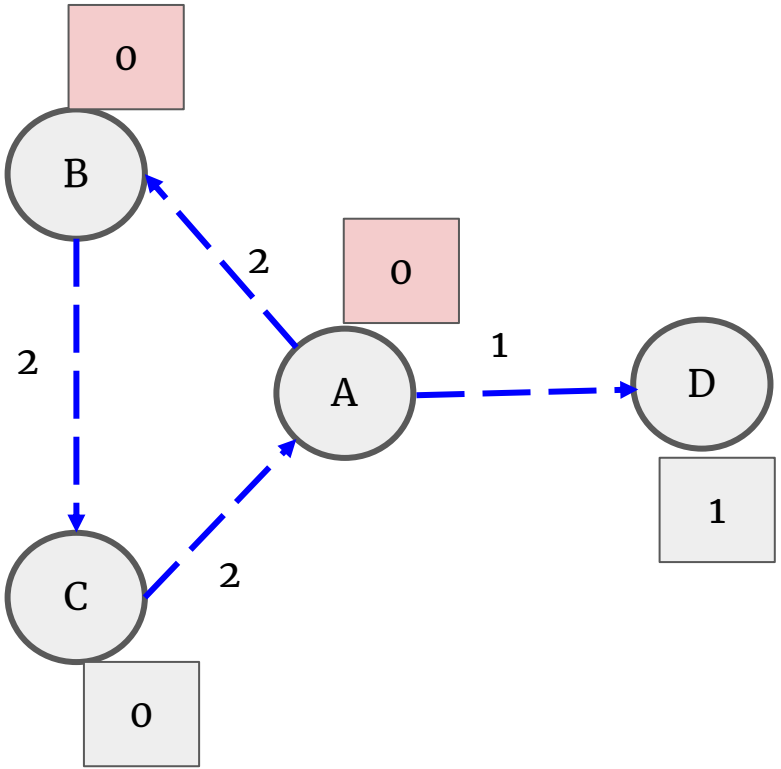

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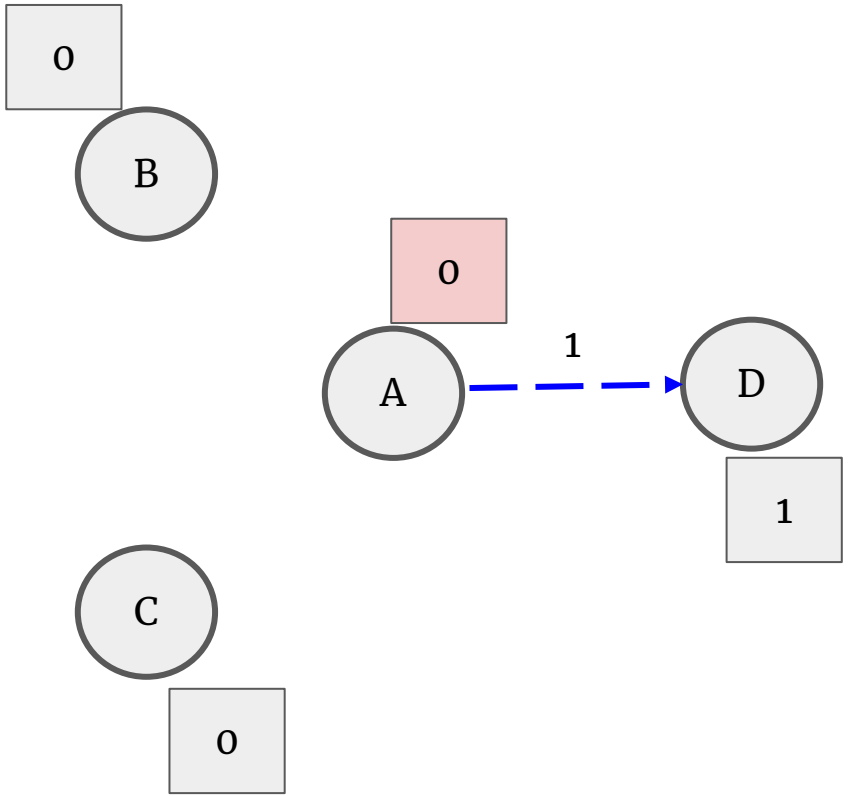

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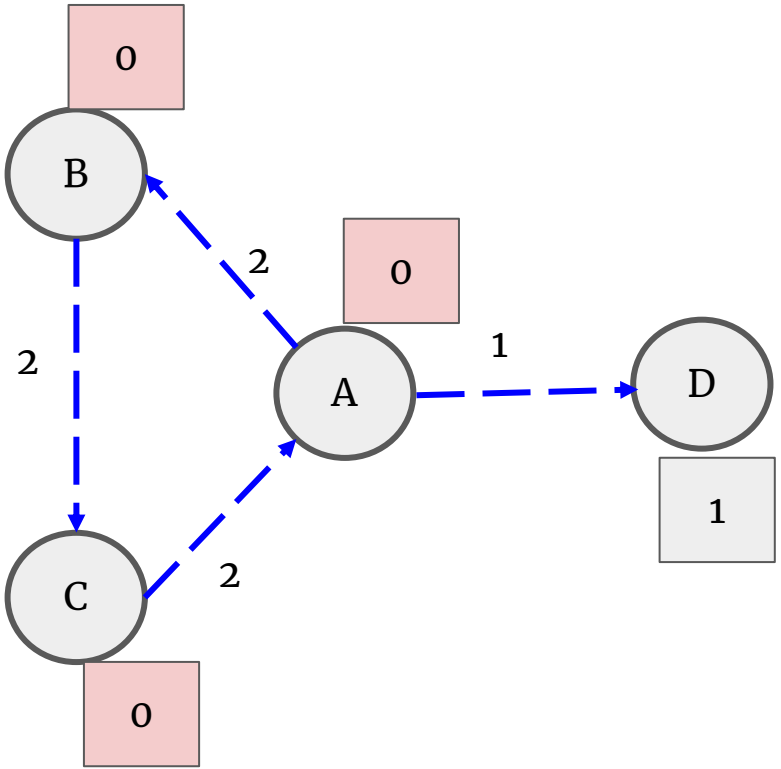

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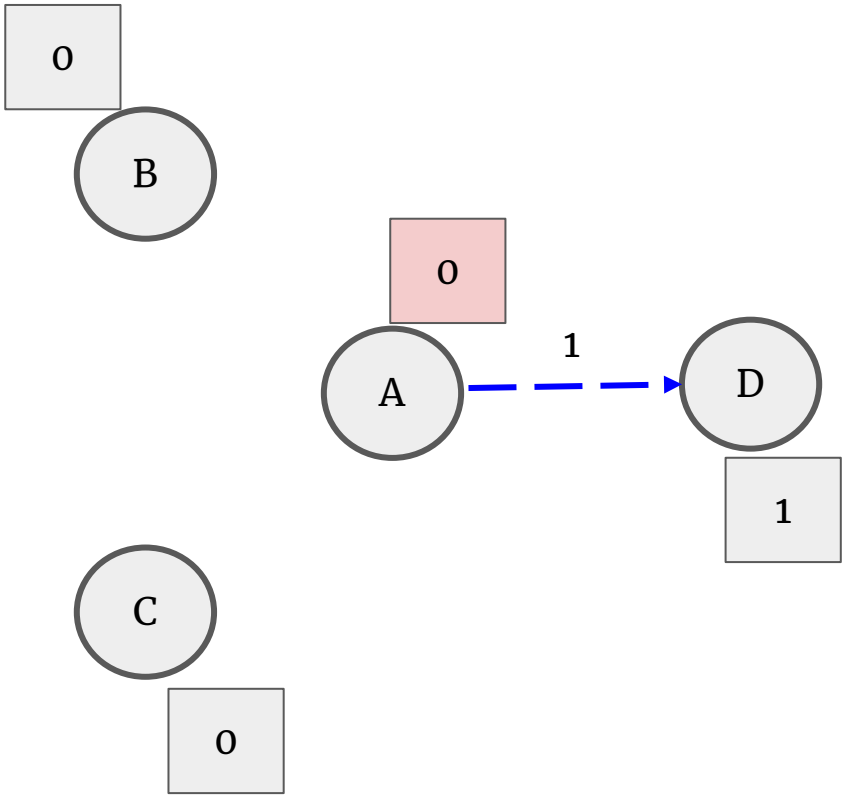

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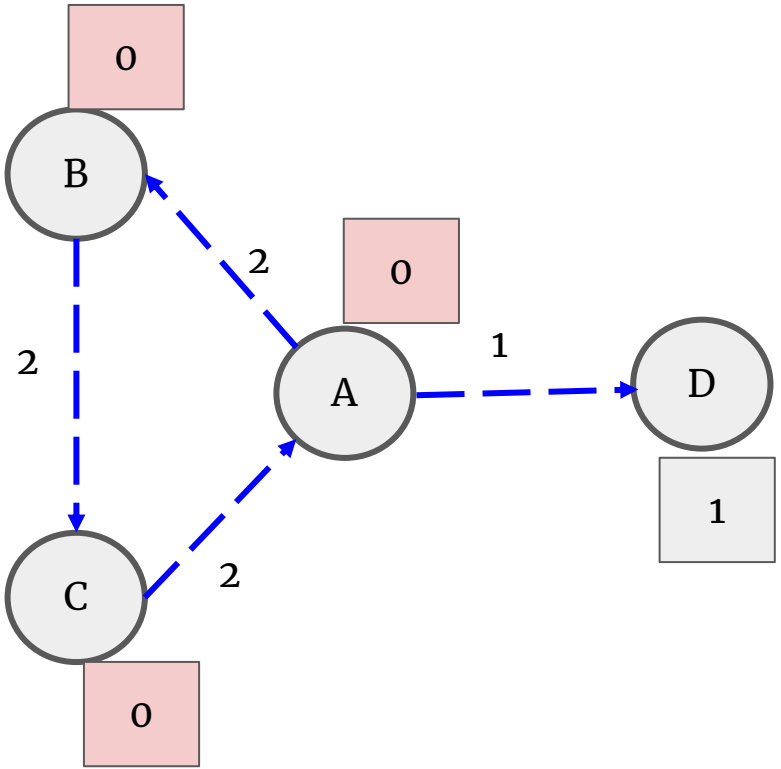

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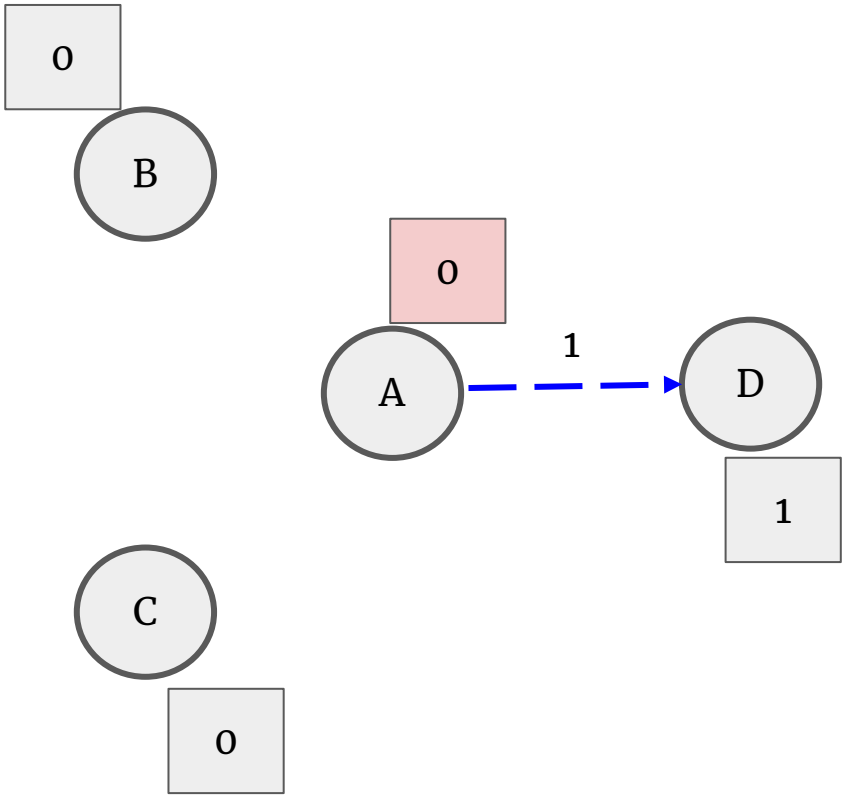
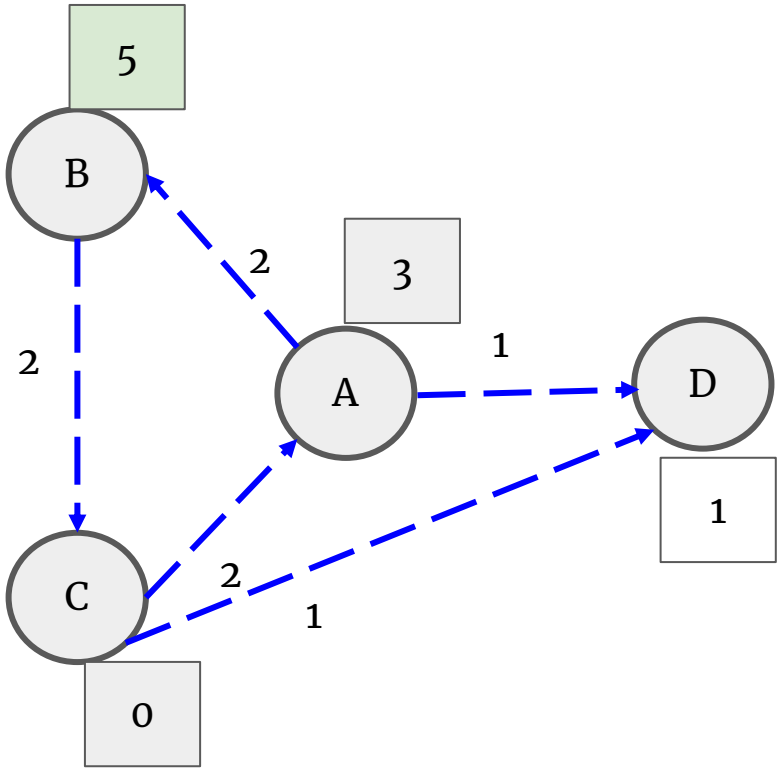


Compression helps limit paths on which financial contagion can spread.

Without Compression



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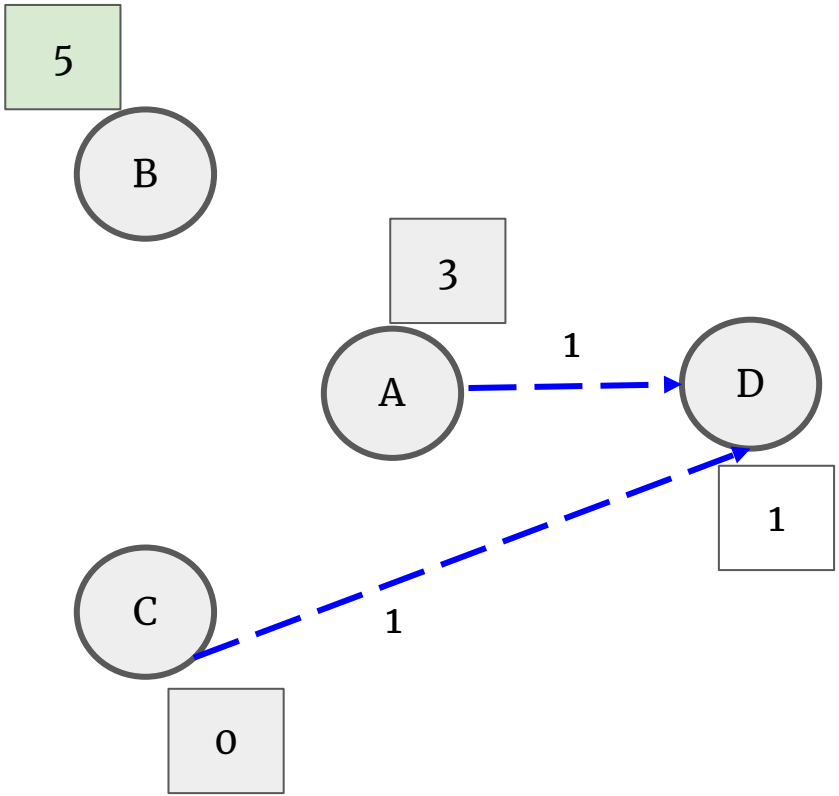

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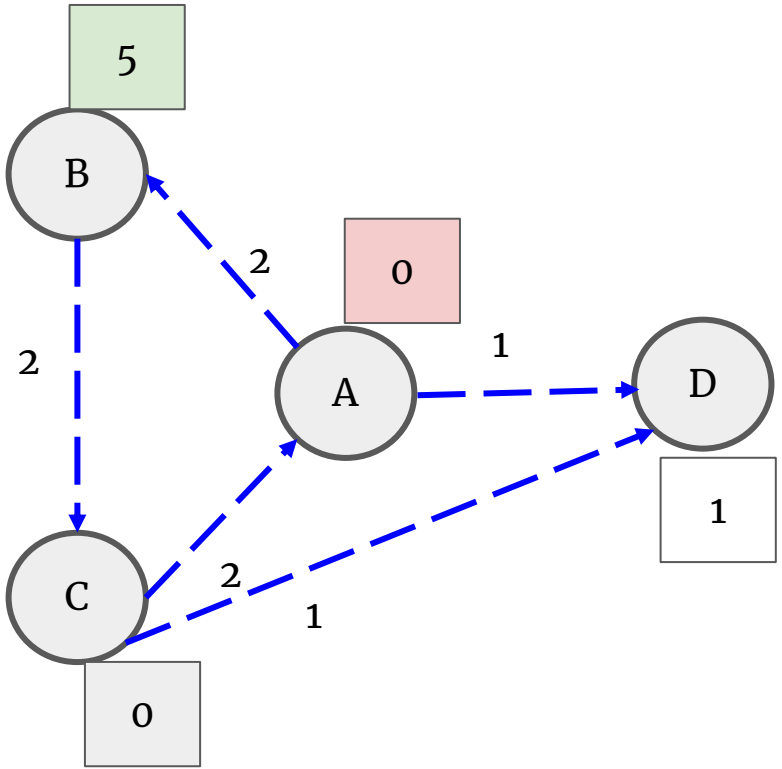

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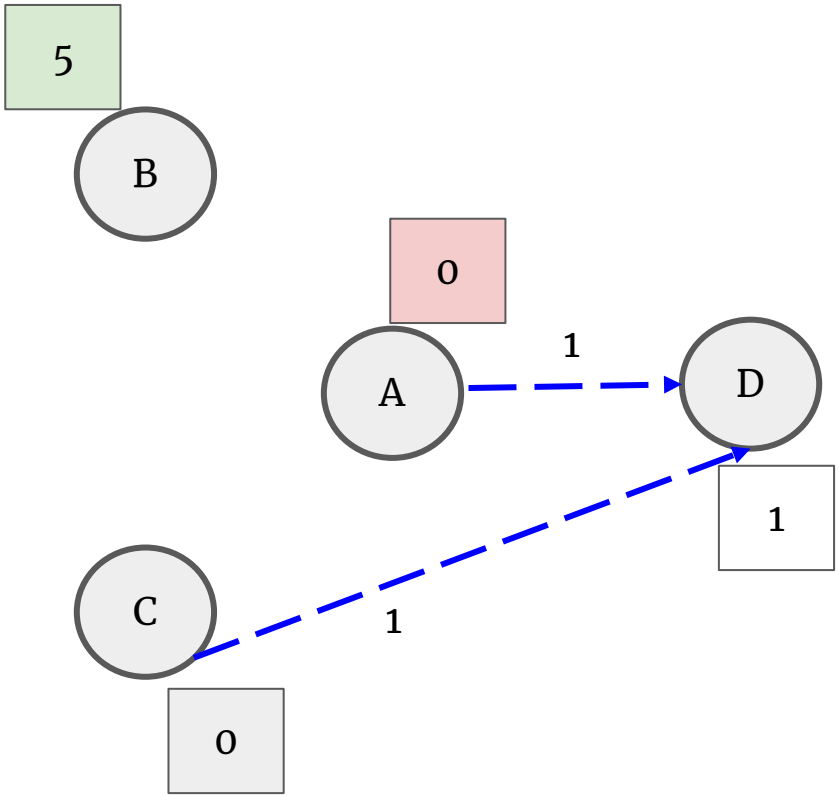

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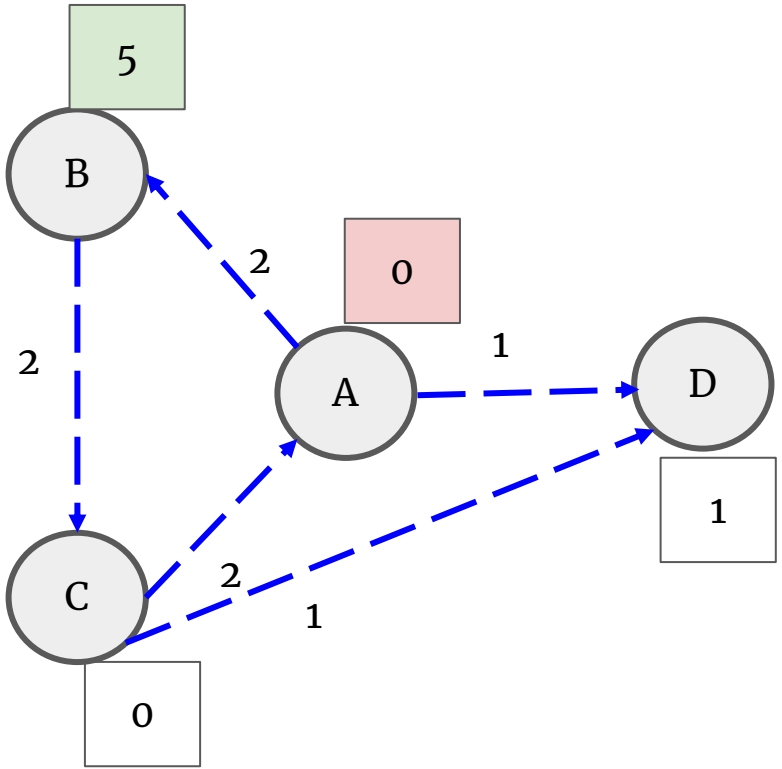

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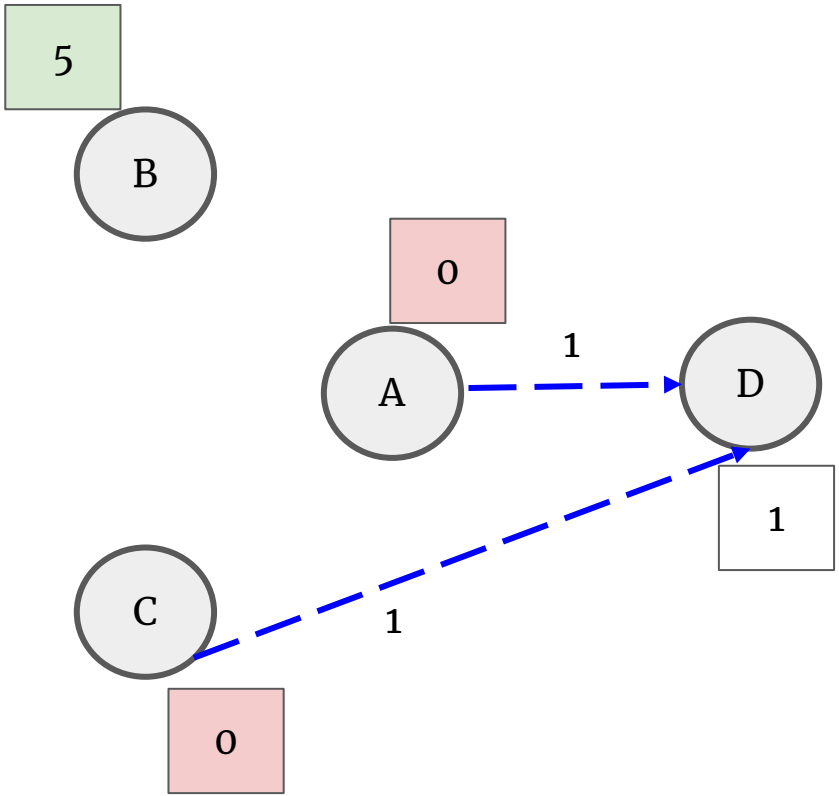

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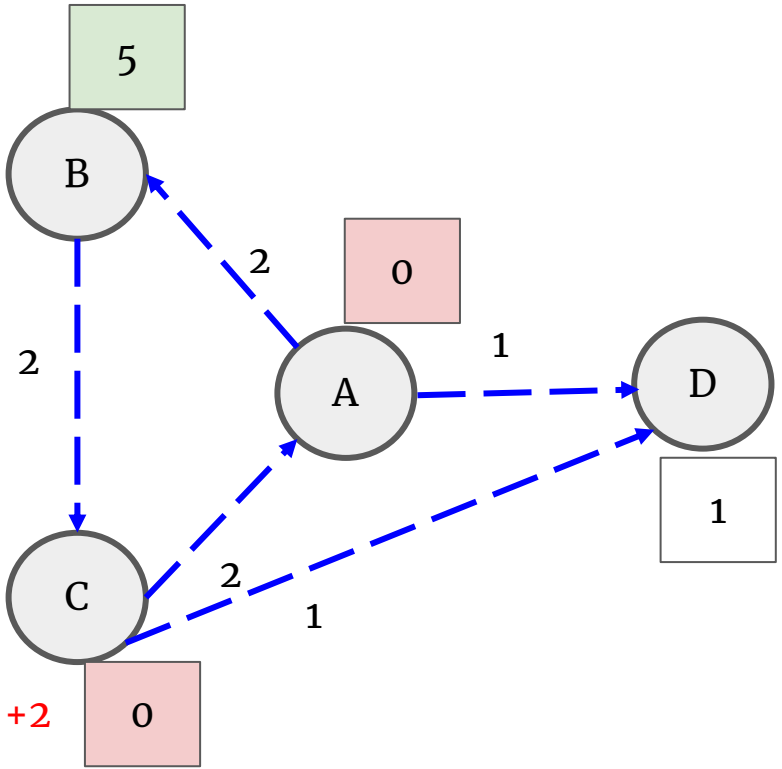

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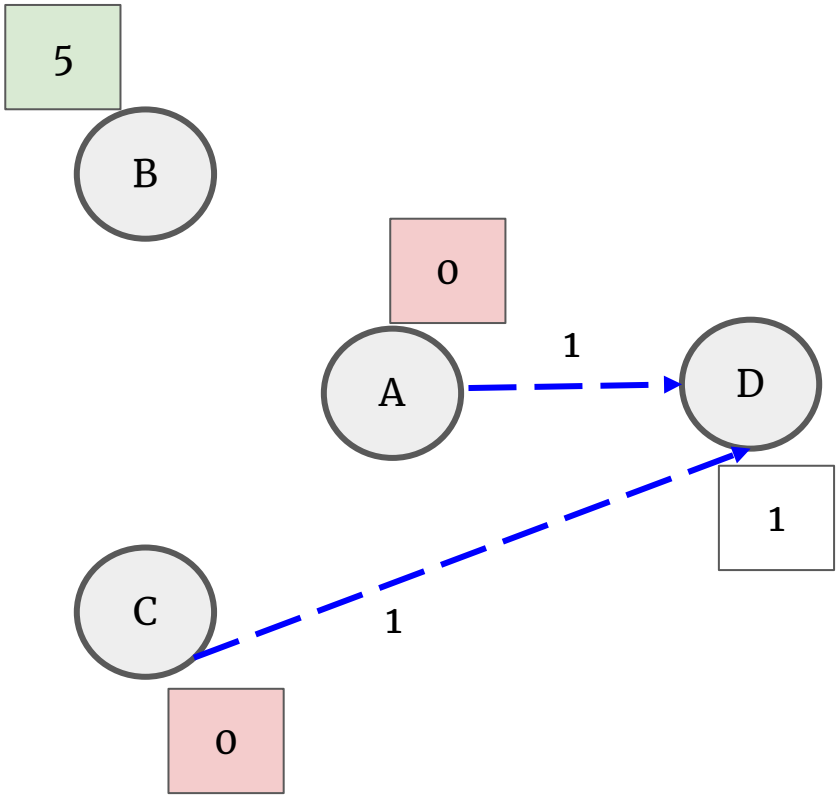

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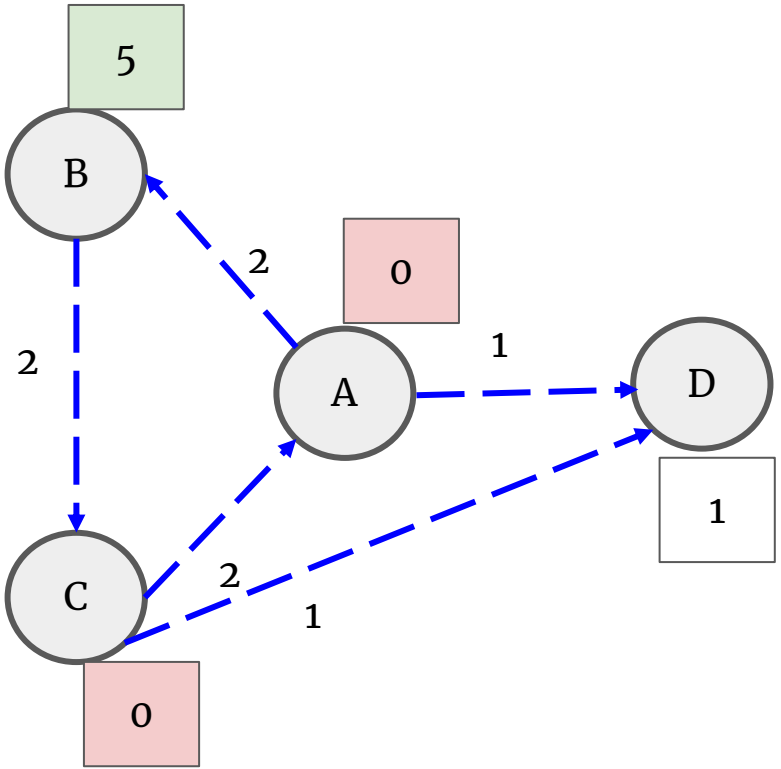

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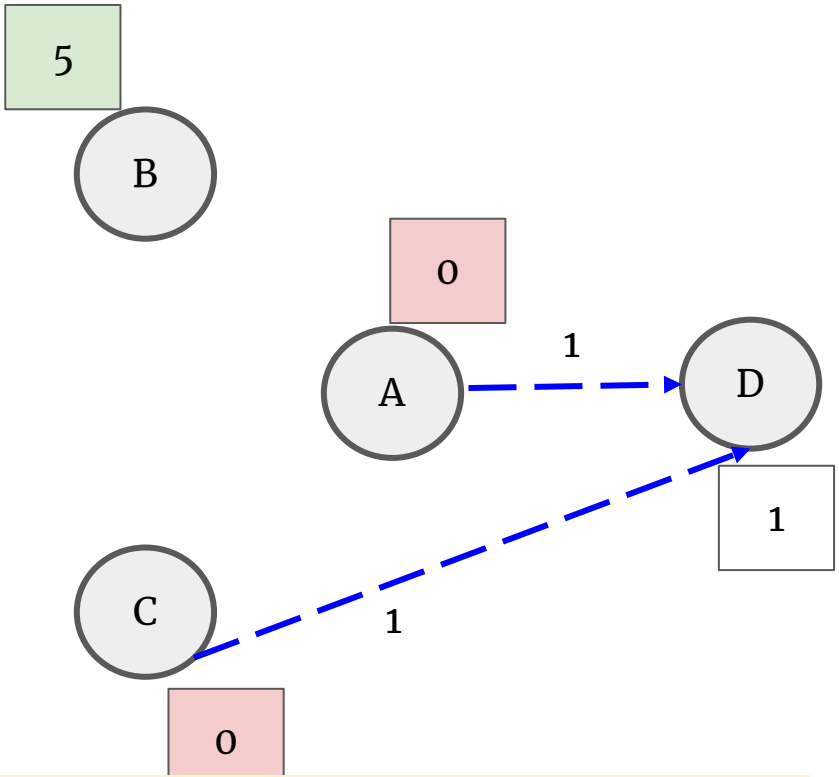


Without compression, node B is able to provide a cushion to the network from A's insolvency, making the network better off than had compression occurred.

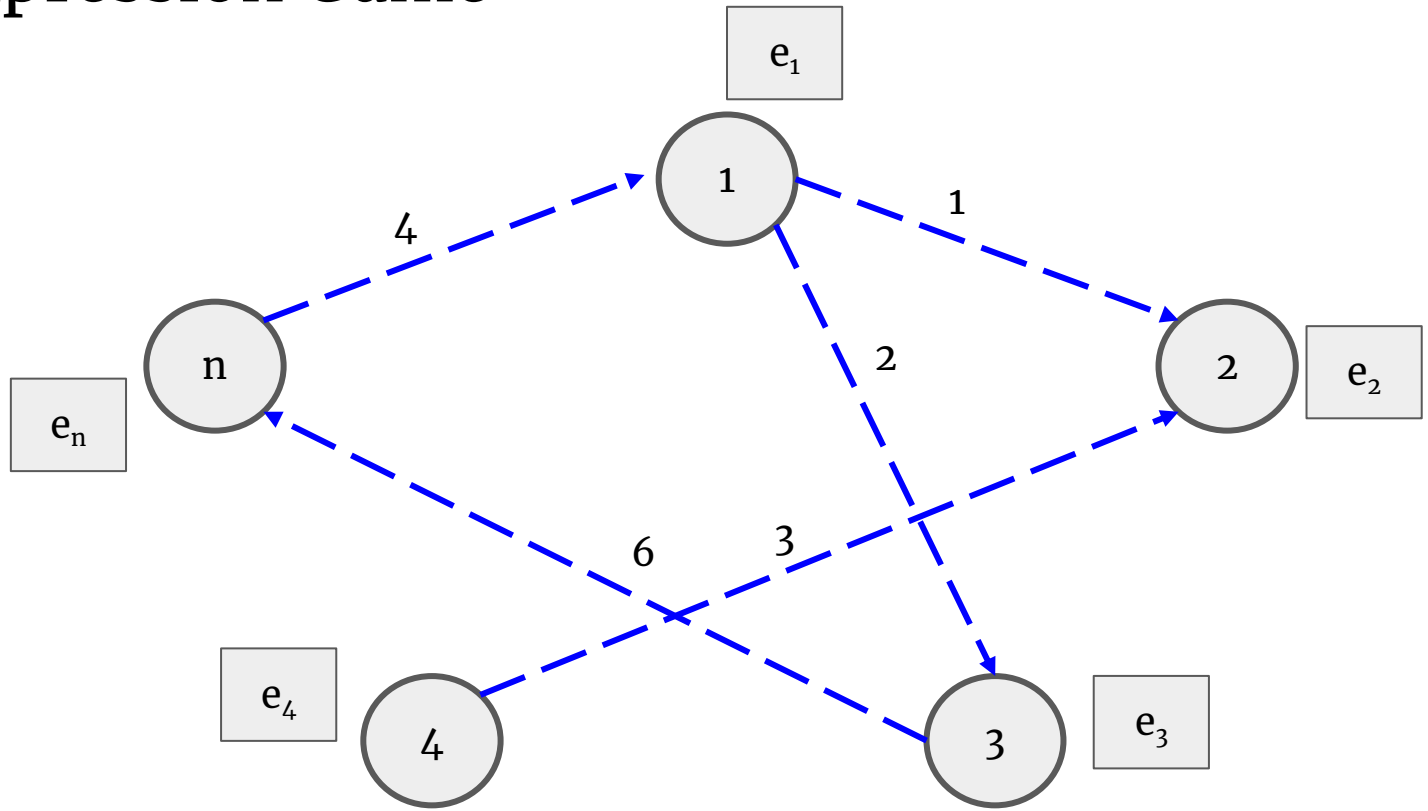
Prior Work

- Veraart (2019):
  - Relationship between systemic risk and recovery rate
    - Recovery rate: portion of assets recovered by an insolvent node
    - Compression cannot be harmful to the network when recovery rate is zero
- Schuldenzucker and Seuken (2020):
  - Relationship between various network characteristics and compression effects on systemic risk
- Both works perform their analysis with
  - An ex-post perspective, with details of the negative shock
  - A global view of the network

Contributions

- Framing compression as a strategic decision made by individual agents with incomplete information
  - Before a negative external shock
  - Partial view of the network
- Introducing an agent-based simulation framework for modeling this strategic interaction
- Analyzing the effects of strategic compression on the network

Compression Game



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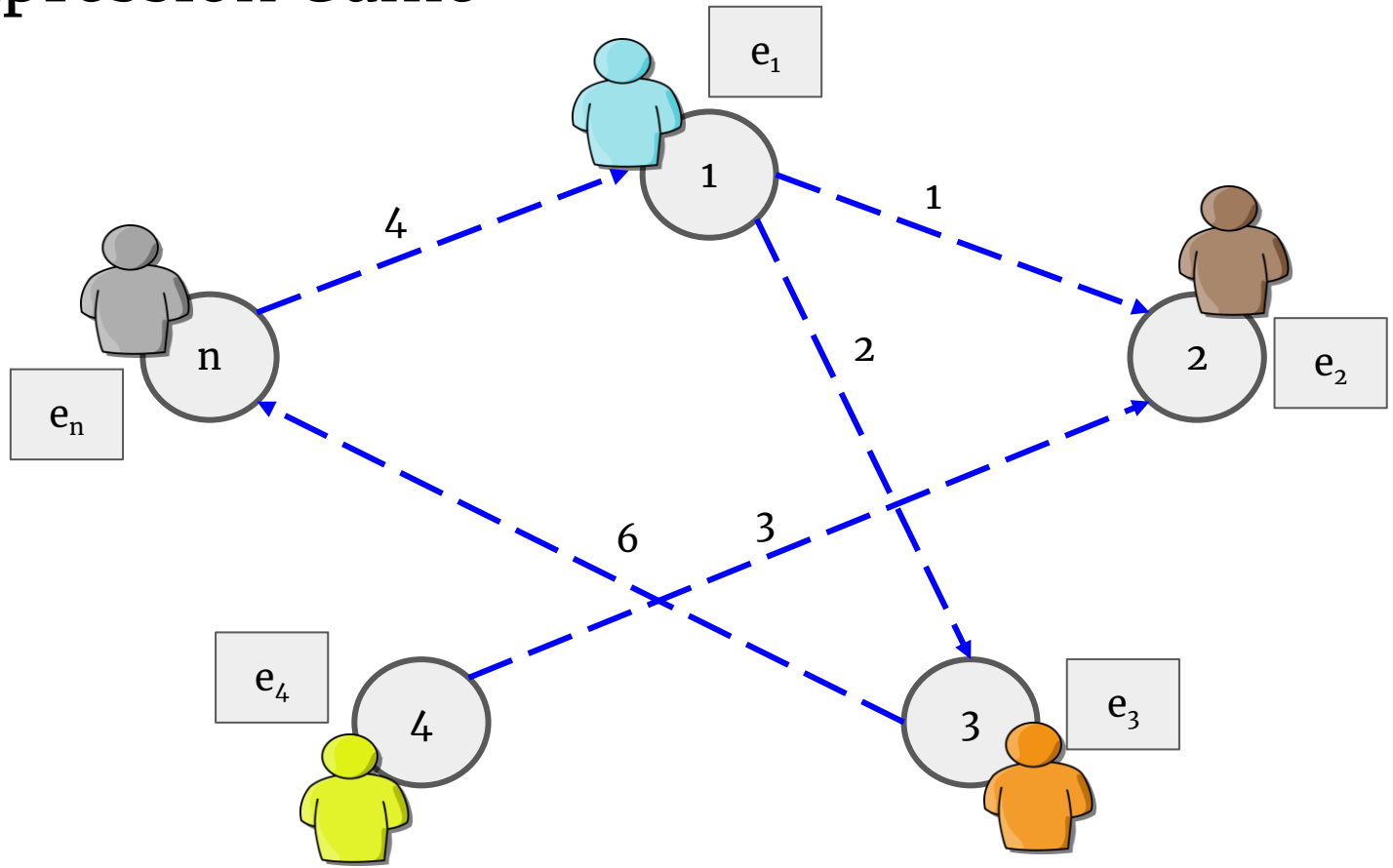
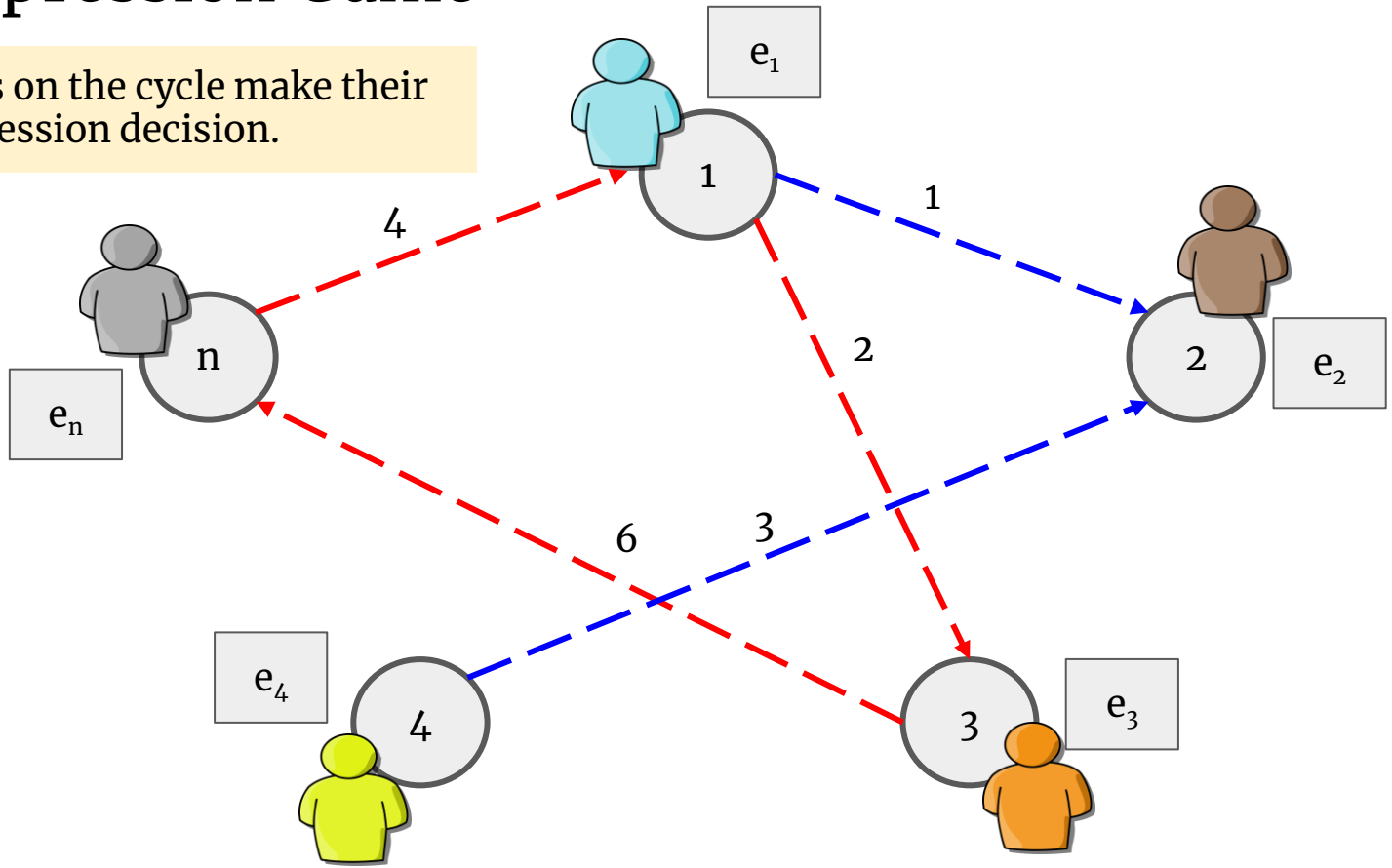


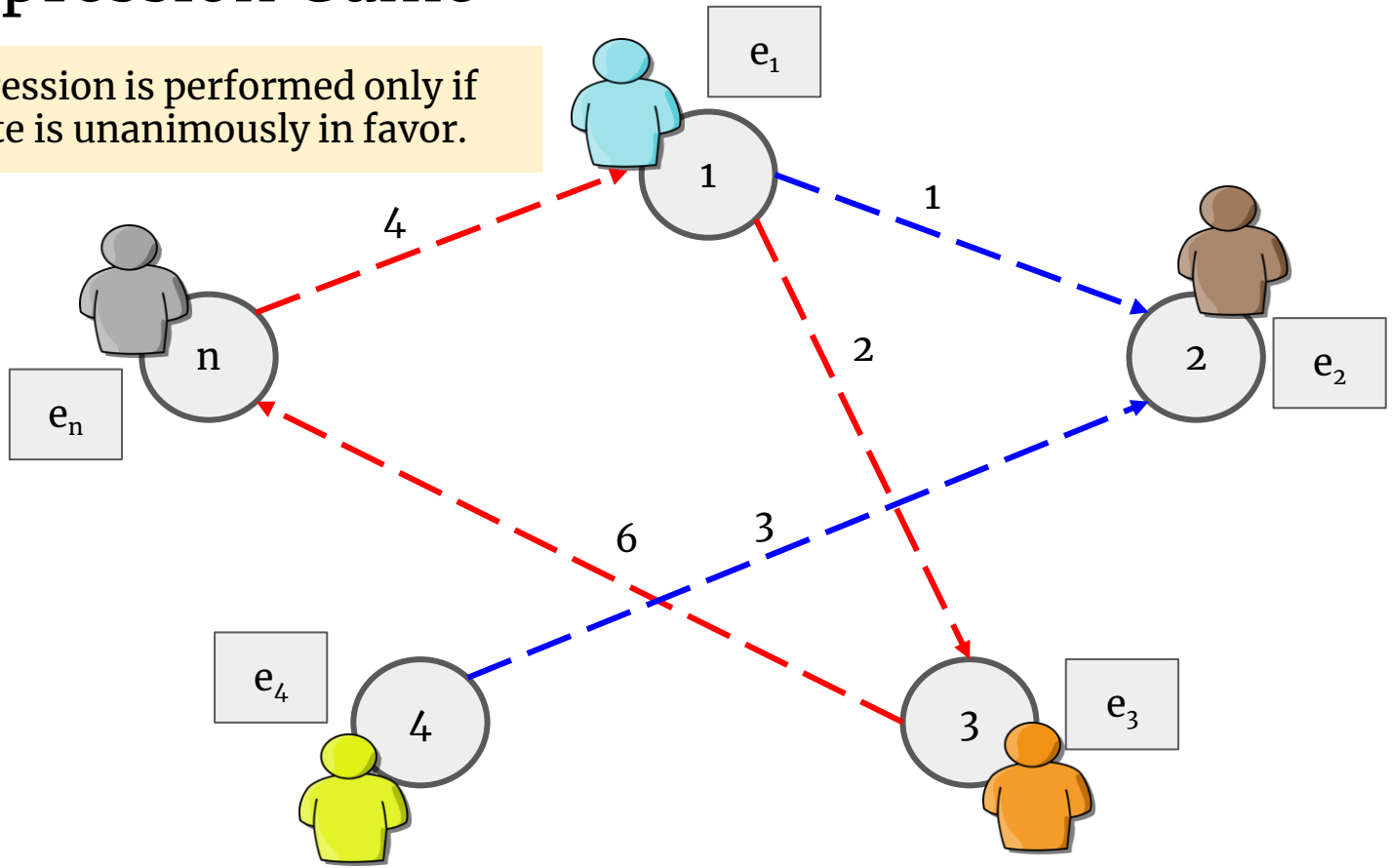
Compression Game

Agents on the cycle make their compression decision.



Compression Game

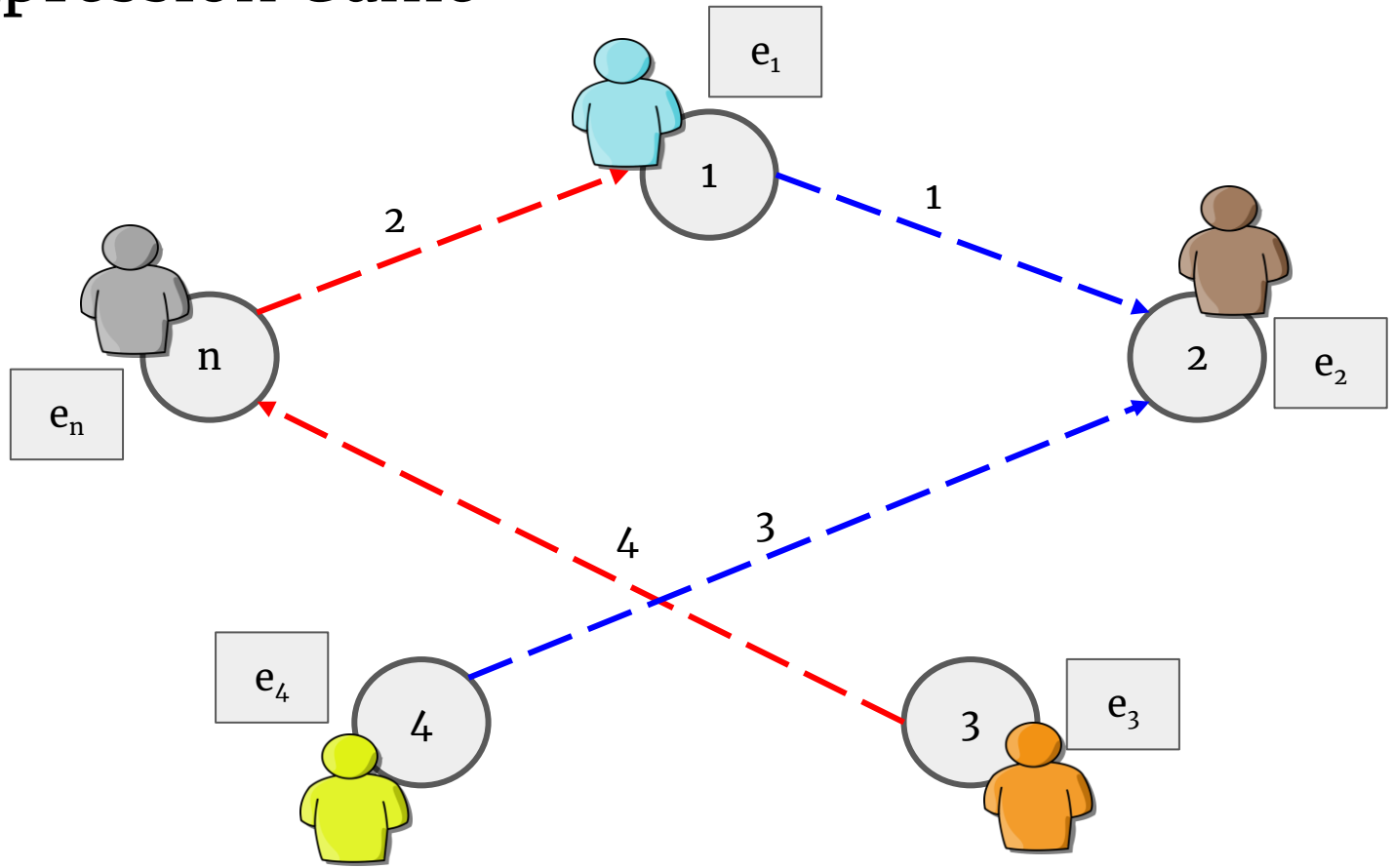
Compression is performed only if the vote is unanimously in favor.



Heuristic Strategies

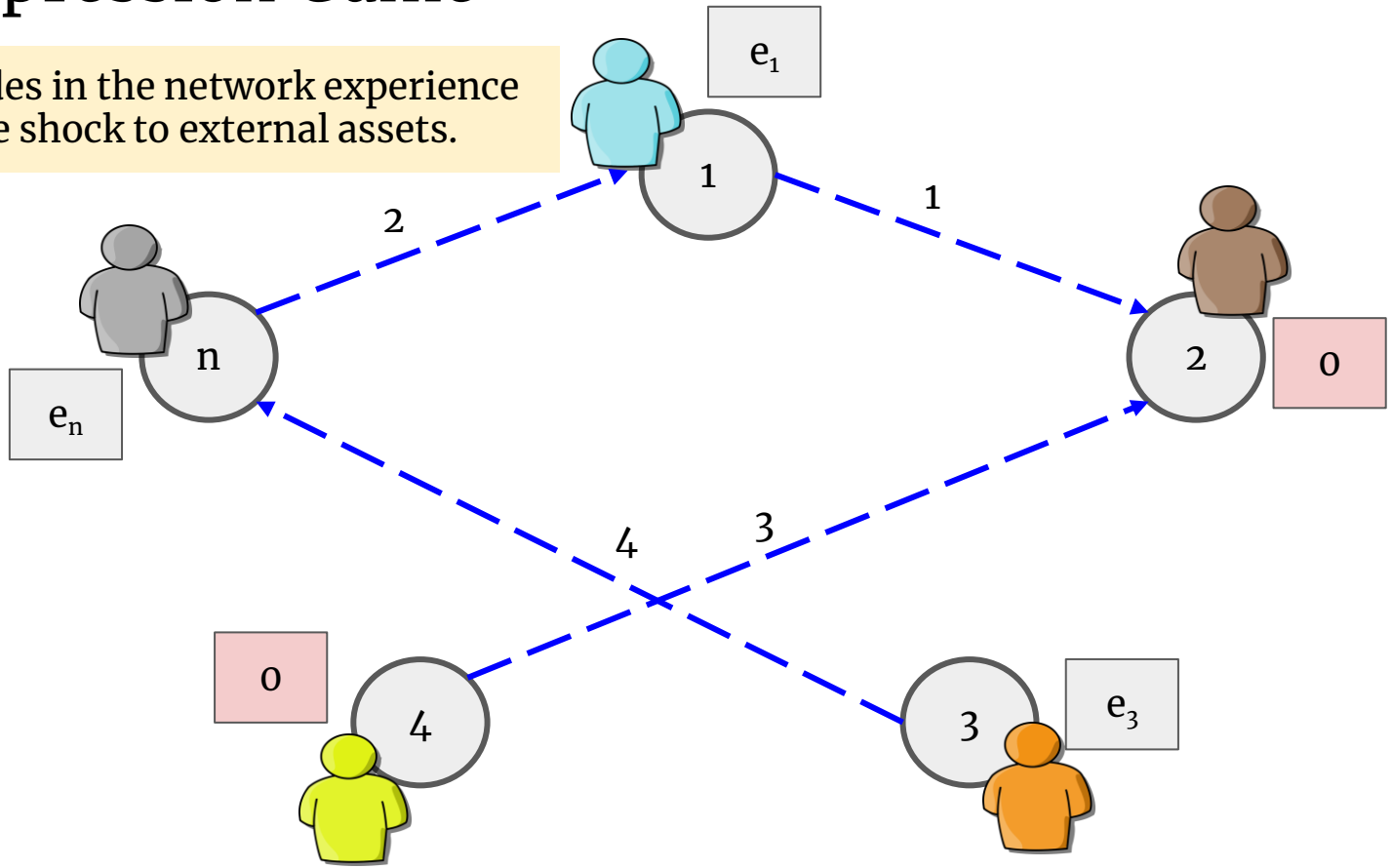
- 14 strategies each considering different forms of information available to agents in the network
  - Asset holdings, liabilities, amount cycle will be compressed by
- Unconditional accept and reject strategies

Compression Game



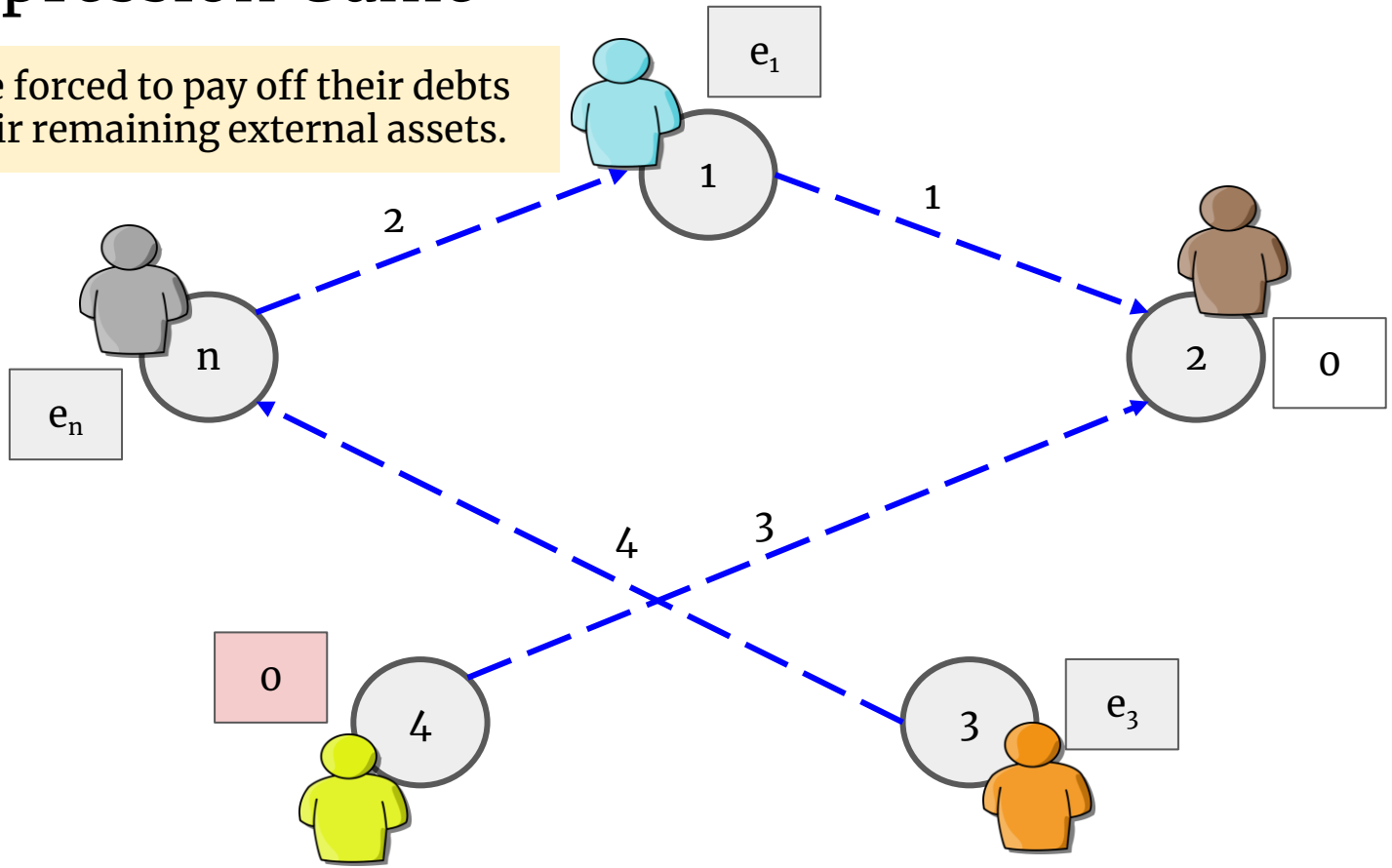
Compression Game

Some nodes in the network experience a negative shock to external assets.

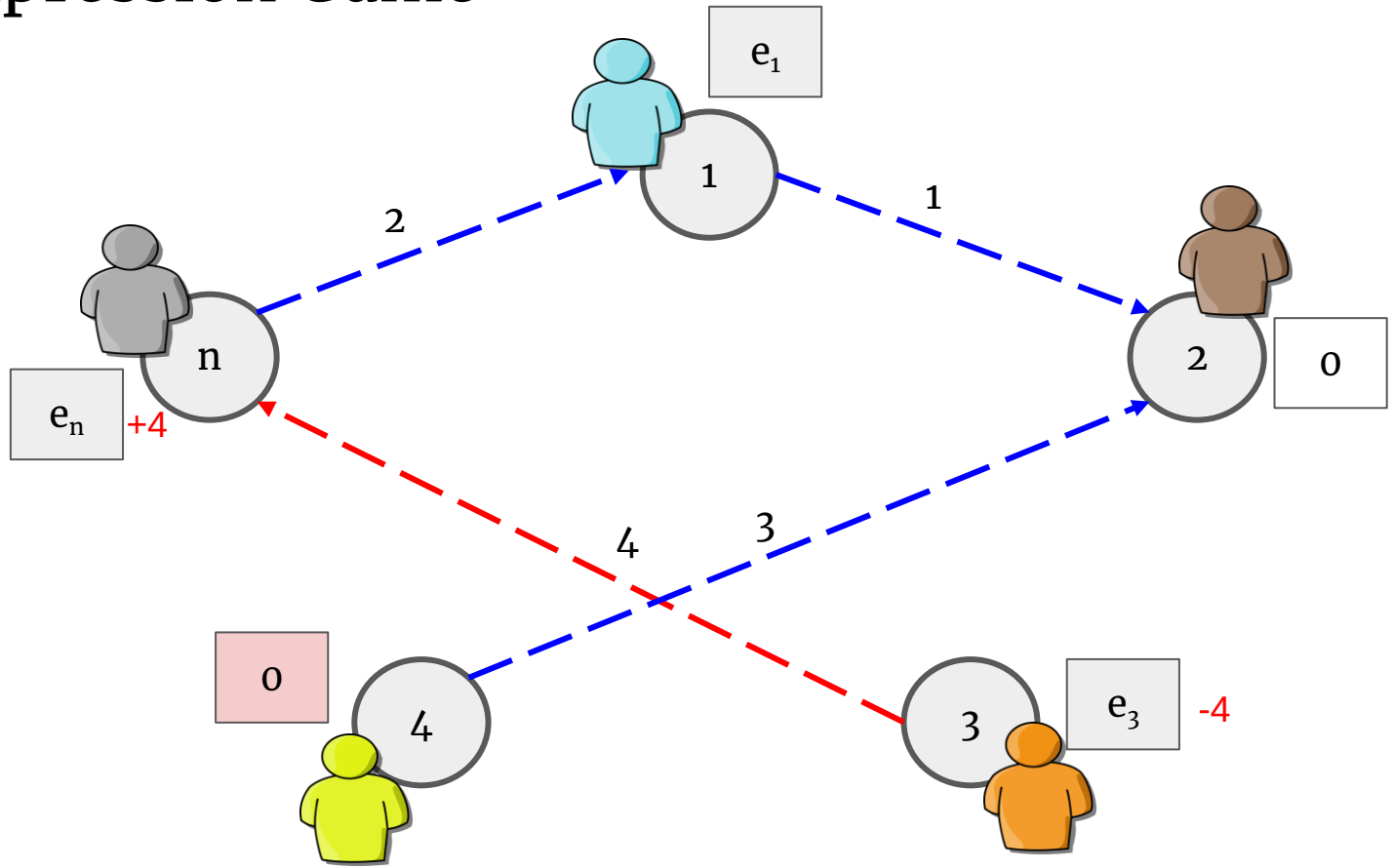


Compression Game

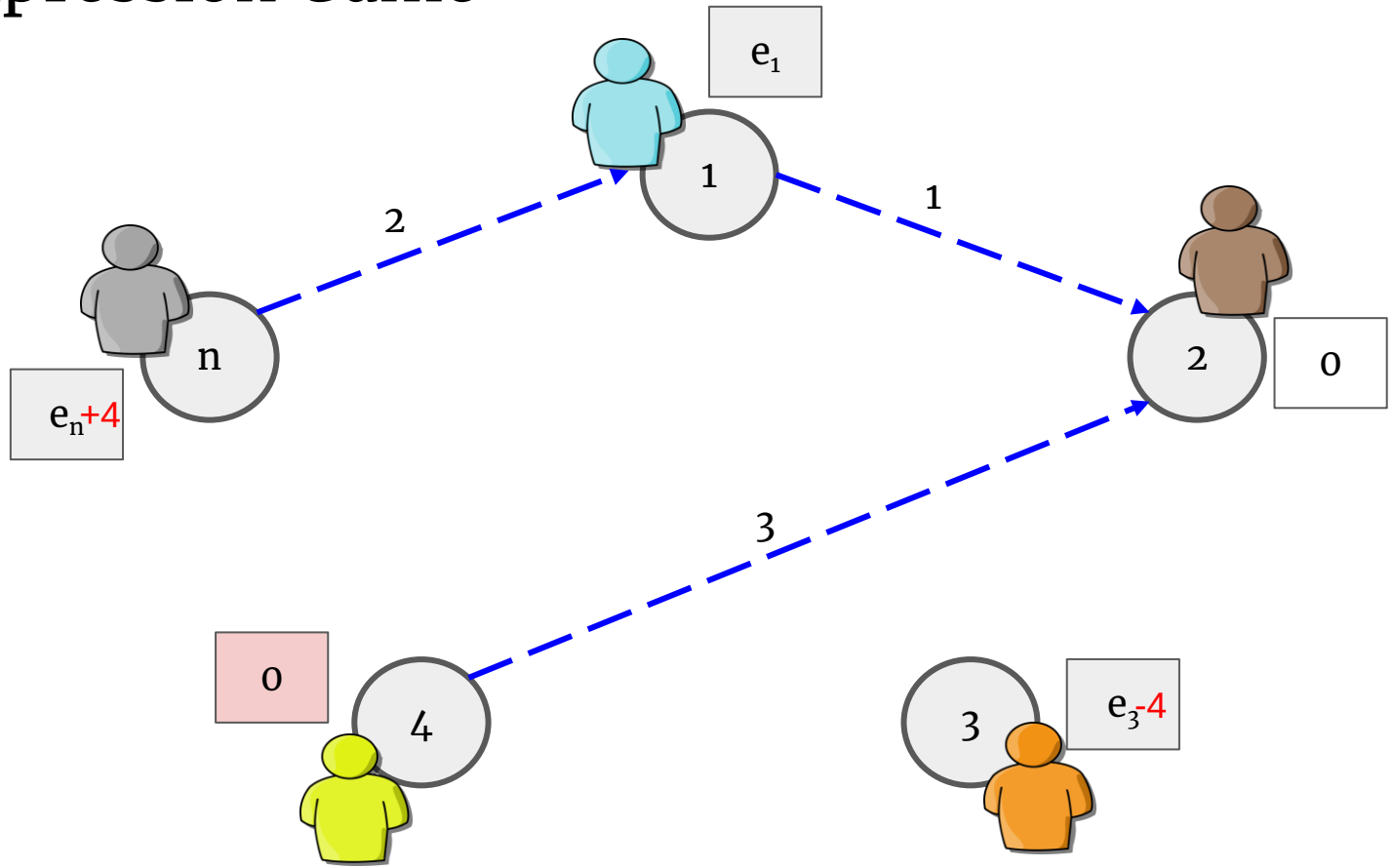
Nodes are forced to pay off their debts using their remaining external assets.



Compression Game

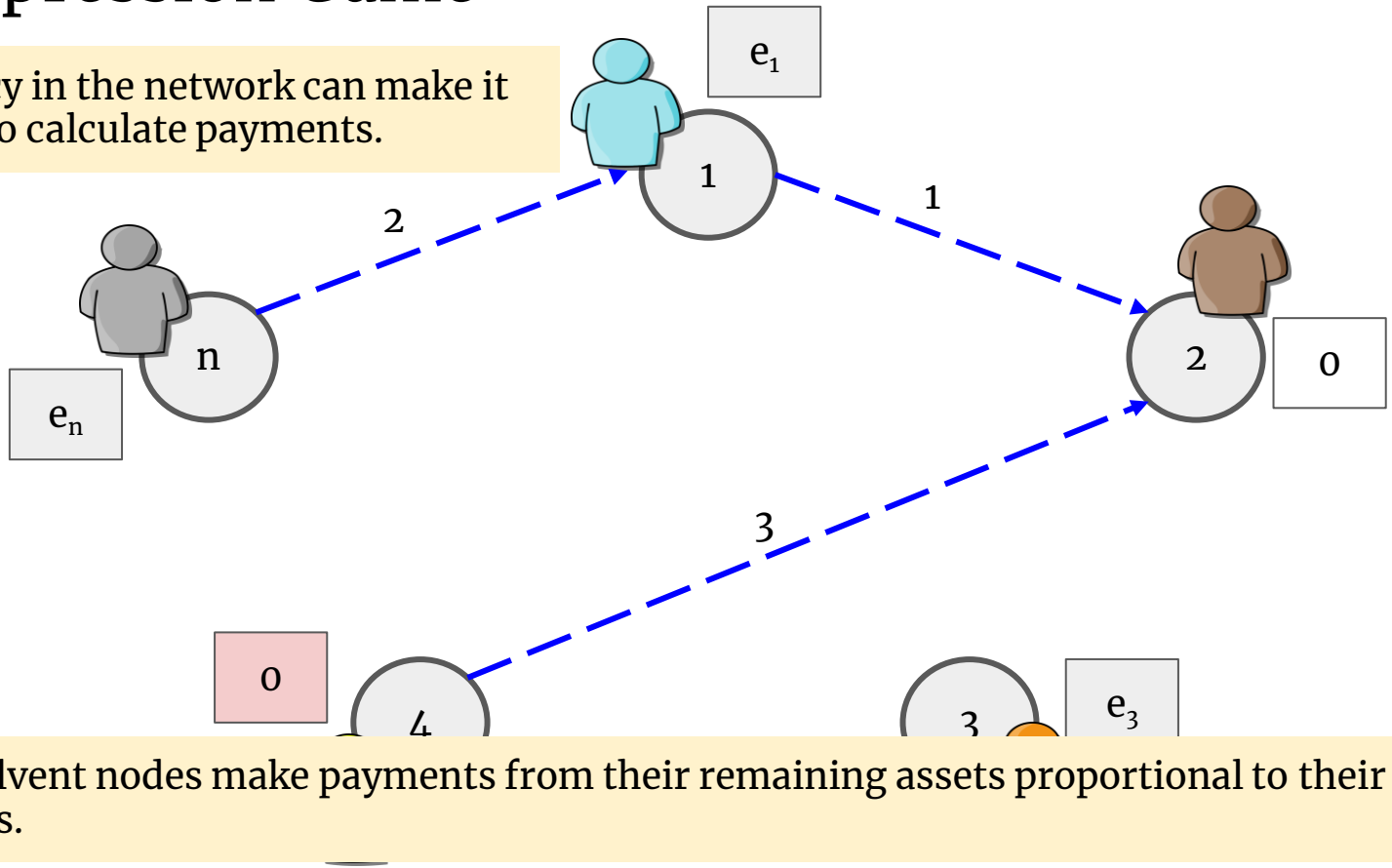


Compression Game



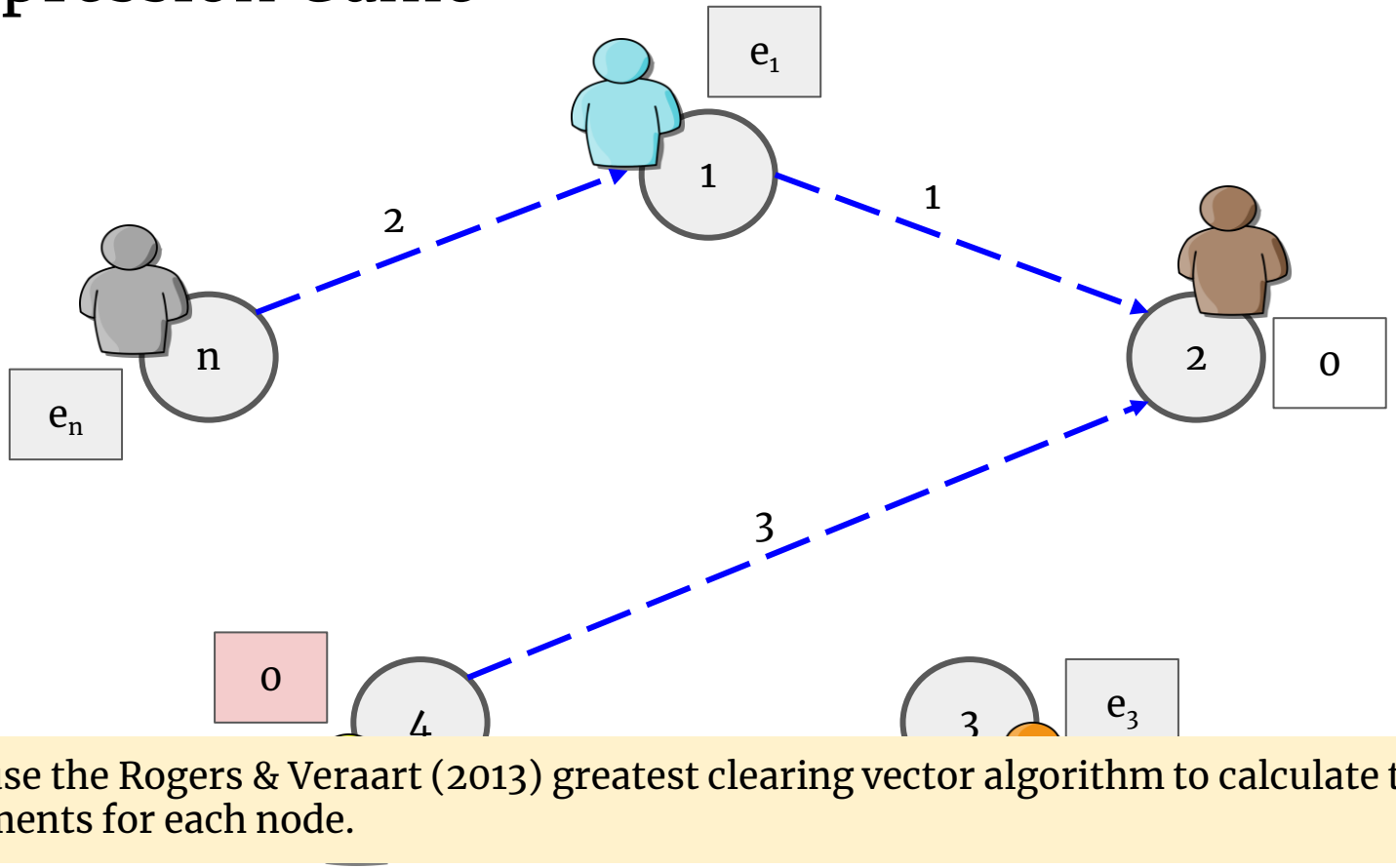
Compression Game

Insolvency in the network can make it difficult to calculate payments.



Insolvent nodes make payments from their remaining assets proportional to their debts.

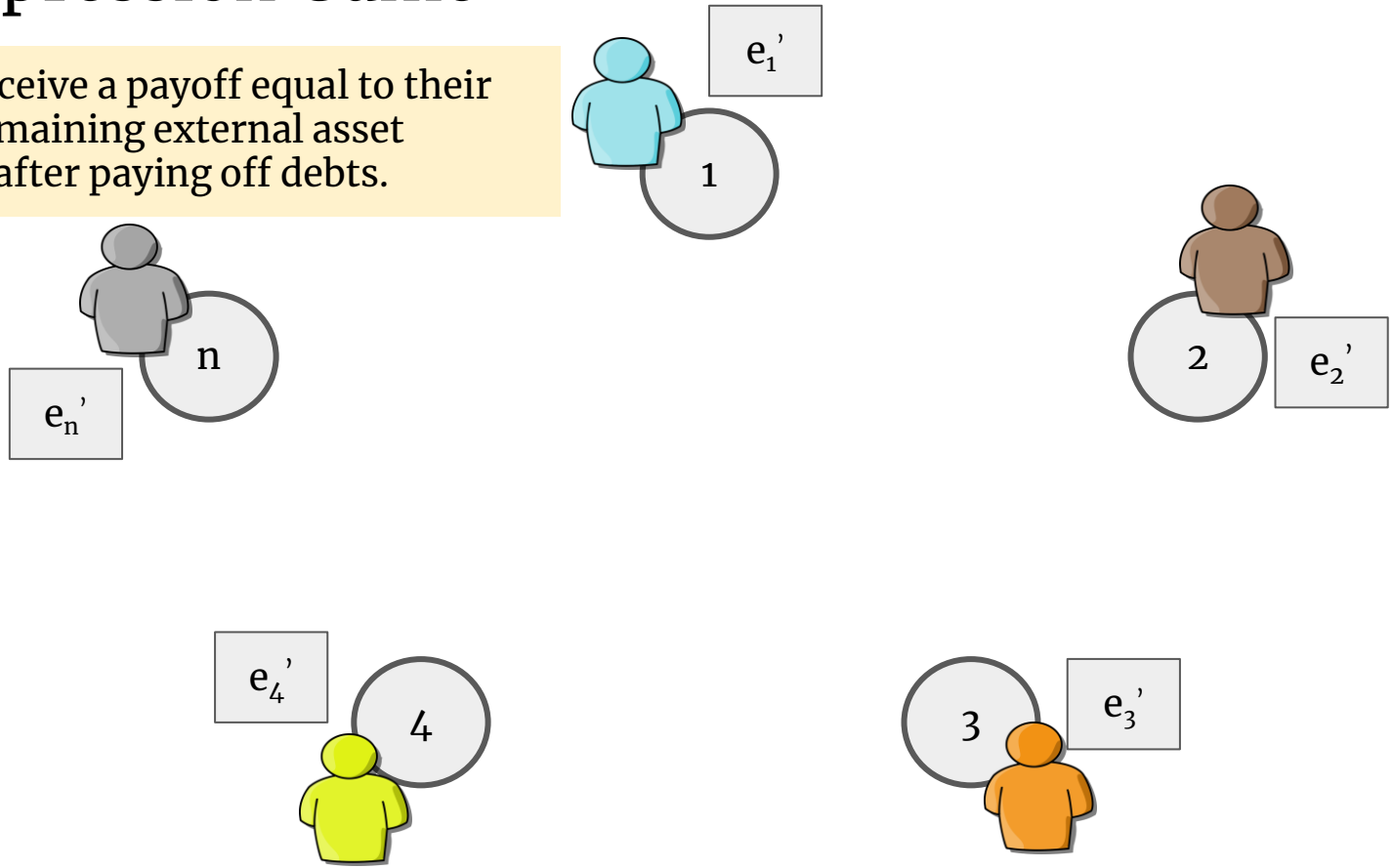
Compression Game



We use the Rogers & Veraart (2013) greatest clearing vector algorithm to calculate the payments for each node.

Compression Game

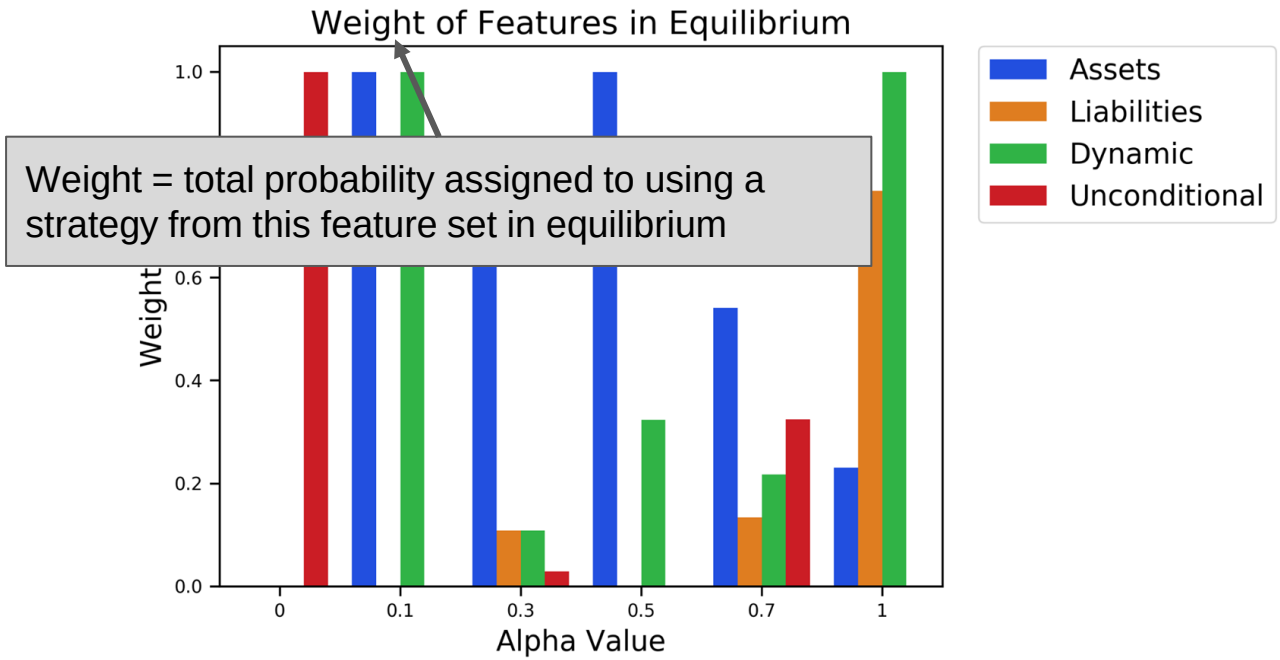
Agents receive a payoff equal to their node's remaining external asset holdings after paying off debts.



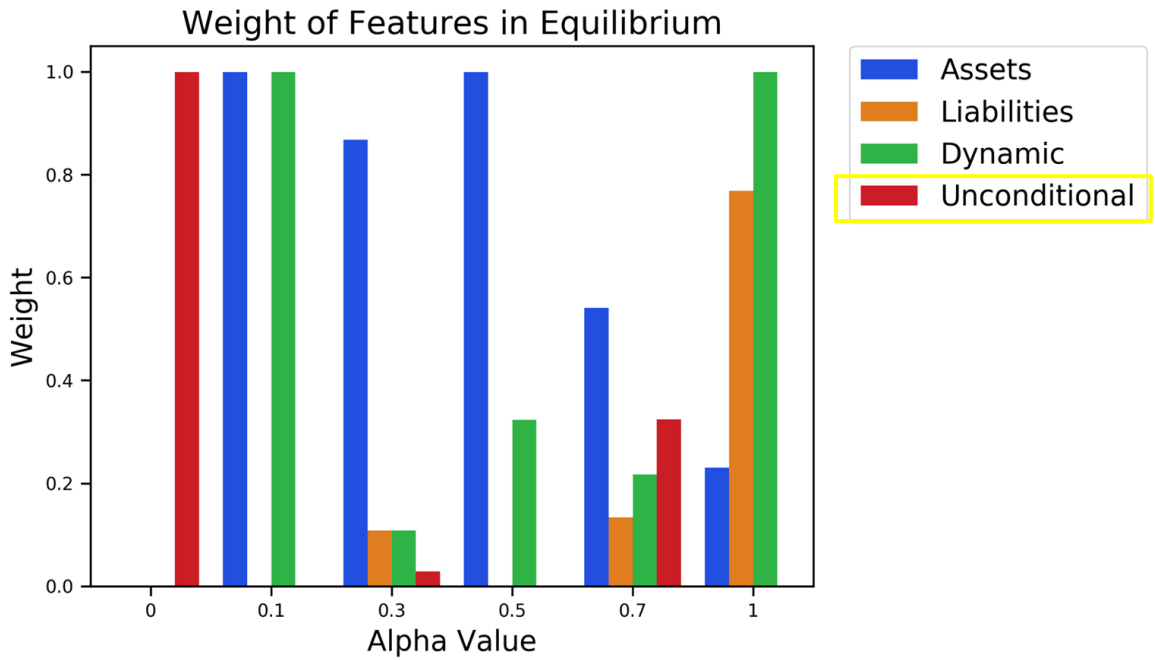
Experiments

- Use empirical game-theoretic analysis to find Nash equilibria
- n = 10 players
- 6 game configurations based on the recovery rate of insolvent nodes
  - $\alpha = \{0, 0.1, 0.3, 0.5, 0.7, 1\}$
- For analysis, the 16 strategies are grouped based on similar characteristics into sets of features
  - Assets: strategies that focus on the asset holdings of the node
  - Liabilities: strategies that focus on the liabilities of the node
  - Dynamic: strategies that consider how compression or negative external shock will affect the node
  - Unconditional: unconditional accept and unconditional reject strategies

Results

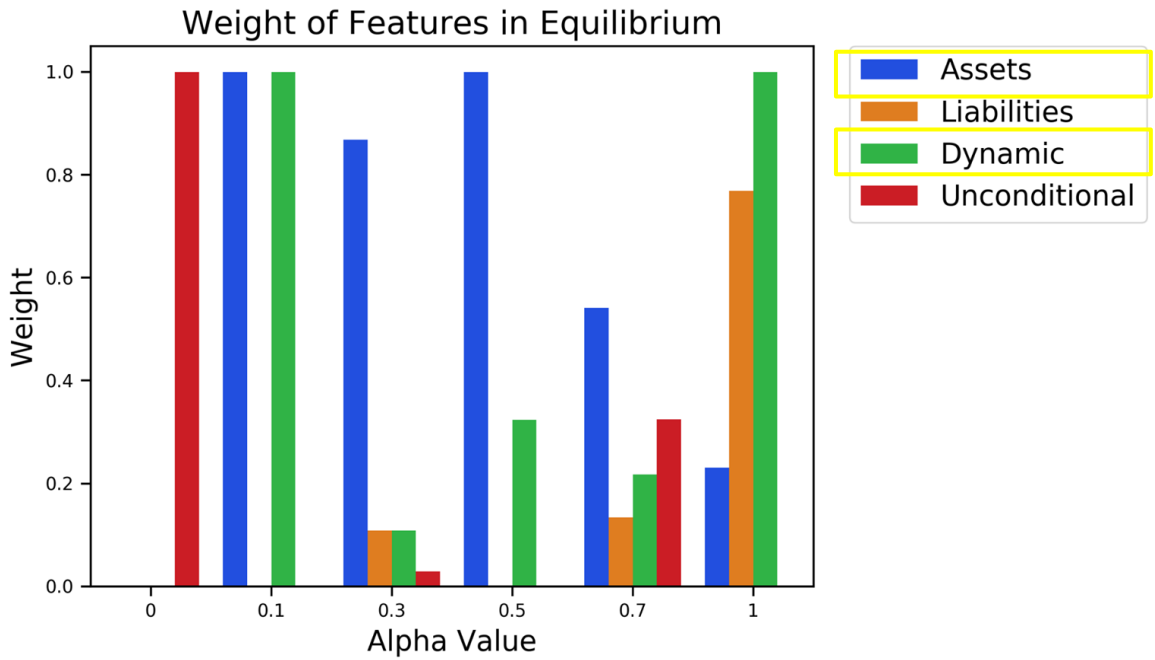

Weight of Features in Equilibrium
Weight = total probability assigned to using a strategy from this feature set in equilibrium
Weight
1.0
0.6
0.4
0.2
0.0
0
0.1
0.3
0.5
0.7
1
Alpha Value
Assets
Liabilities
Dynamic
Unconditional

Results



Strategies employing simple, local network information are preferred to the unconditional strategies for making the compression decision when $\alpha > 0$.

Results



The Assets and Dynamic features tend to be the most useful when $\alpha > 0$.

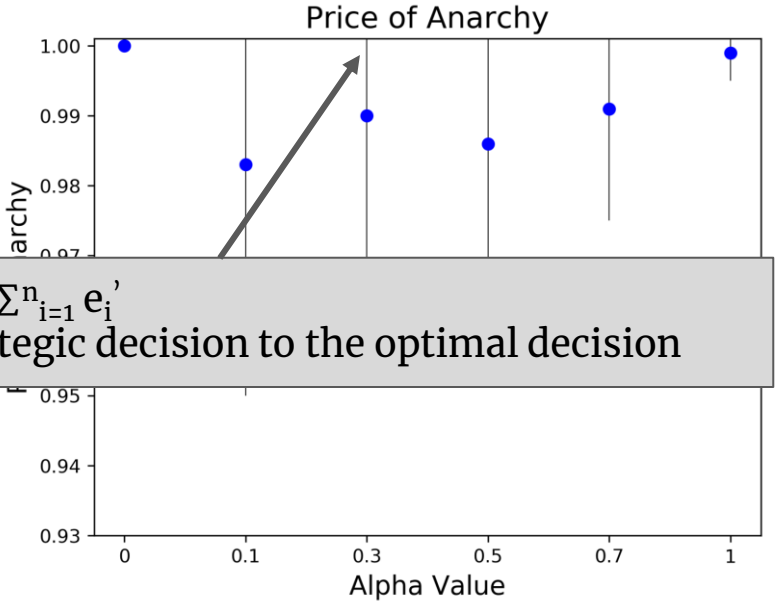
Results

alpha	% cycles compressed
0	100
0.1	32
0.3	56
0.5	12
0.7	30
1	36

When the compression decision is made strategically, most cycles are not compressed.

Results

alpha	% cycles compressed
0	100
0.1	32
0.3	
0.5	12
0.7	30
1	36



- Calculated using $\sum^{n}_{i=1} e_i'$
- Compare the strategic decision to the optimal decision

Results

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0.1	32
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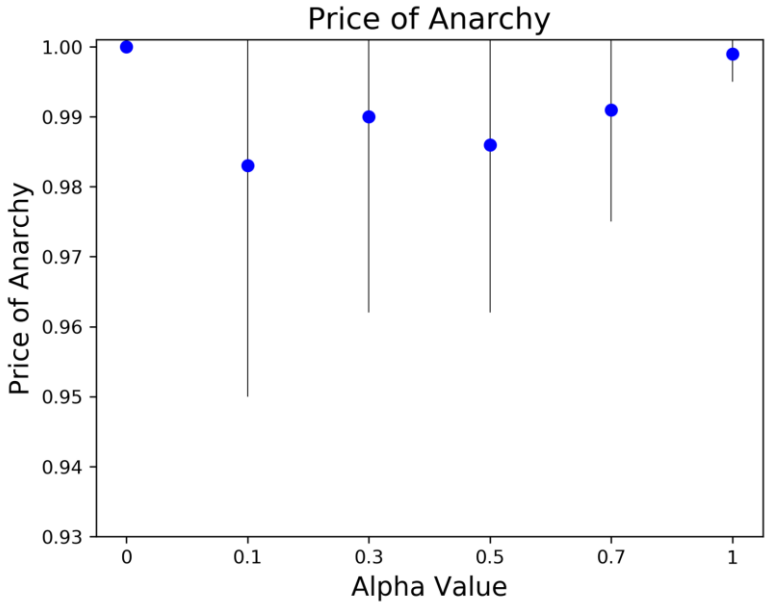
1	36



In all game configurations, the price of anarchy is high indicating the cost to the network for allowing a strategic decision remains low.

Questions?