Are Socially Responsible Investments beneficial for systemic risk?

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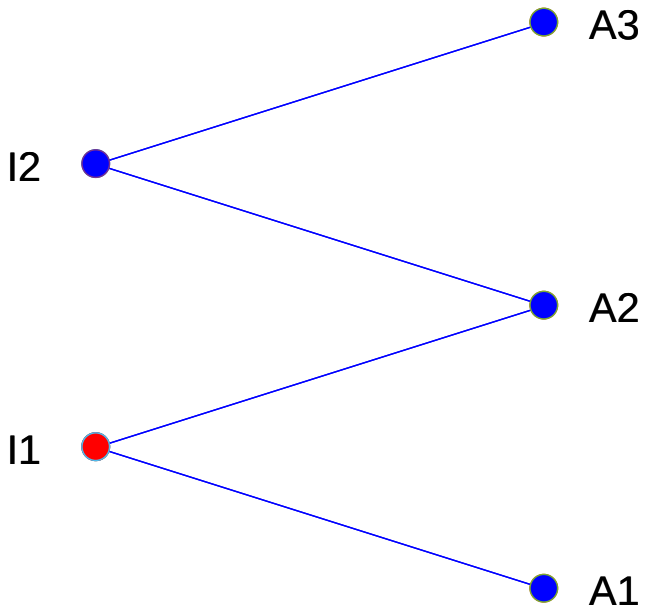
Systemic risk

- "Systemic risk is the risk of collapse of an entire financial system"
- Systemic risk spread out in the financial system through a network
- Different mechanisms of propagation:
  - Exposure to common risk factors
  - Direct contagion due to counterparty risk
  - Indirect contagion due to common asset holdings: Price-mediated contagion (Cont et al. 2019, Flori et al. 2018)

Price-mediated contagion

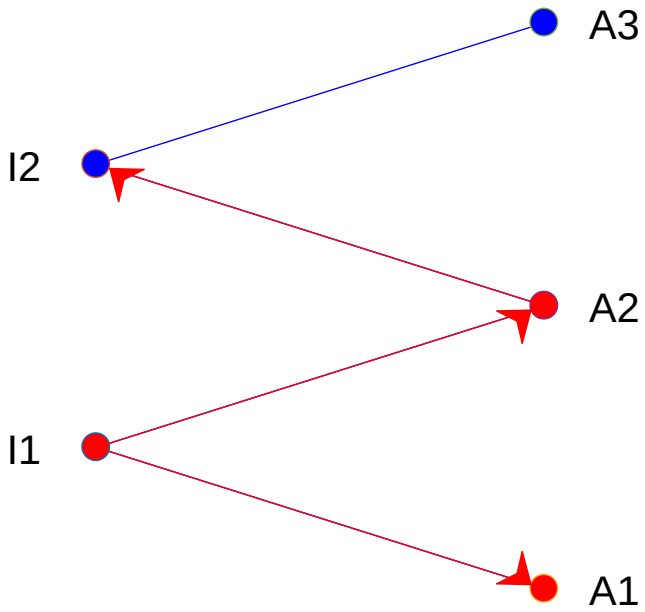


*I*1 undergoes a large loss due an exogenous shock

$\Downarrow$

*I*1 is forced to liquidate part of its portfolio

Price-mediated contagion

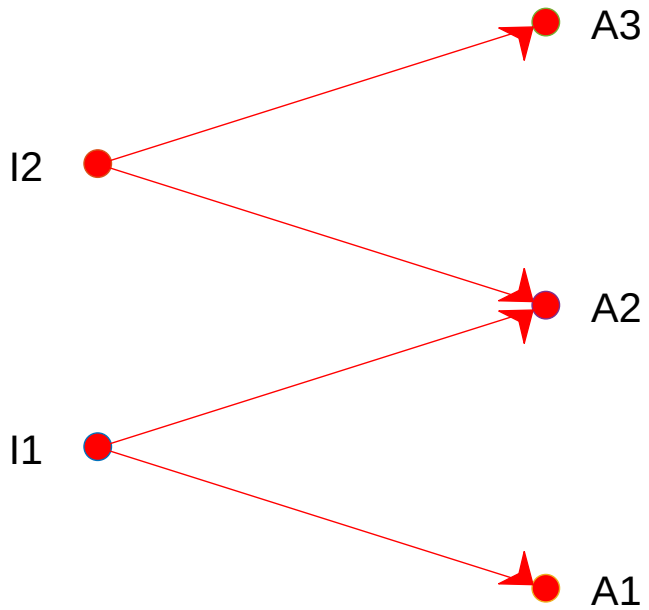


Liquidation has an impact on $A1$ and $A2$ prices

$\Downarrow$

Portfolio value of $I2$ drops because of common assets

Price-mediated contagion



$I2$ has to liquidate part of its assets

$\Downarrow$

Distress spreads to $A3$, and the value of $A2$ further drops

Why SRI should reduce systemic risk?

- Long-term investors
- Reduction of stakeholder risk (Becchetti et al., 2018)
- Both SRI and conventional portfolios diversify idiosyncratic risk but they differ in part of the assets they hold. In particular SRI portfolios exclude some assets and include new (not mainstream) ones

$$\Downarrow$$

- This may have a beneficial effect on systemic risk

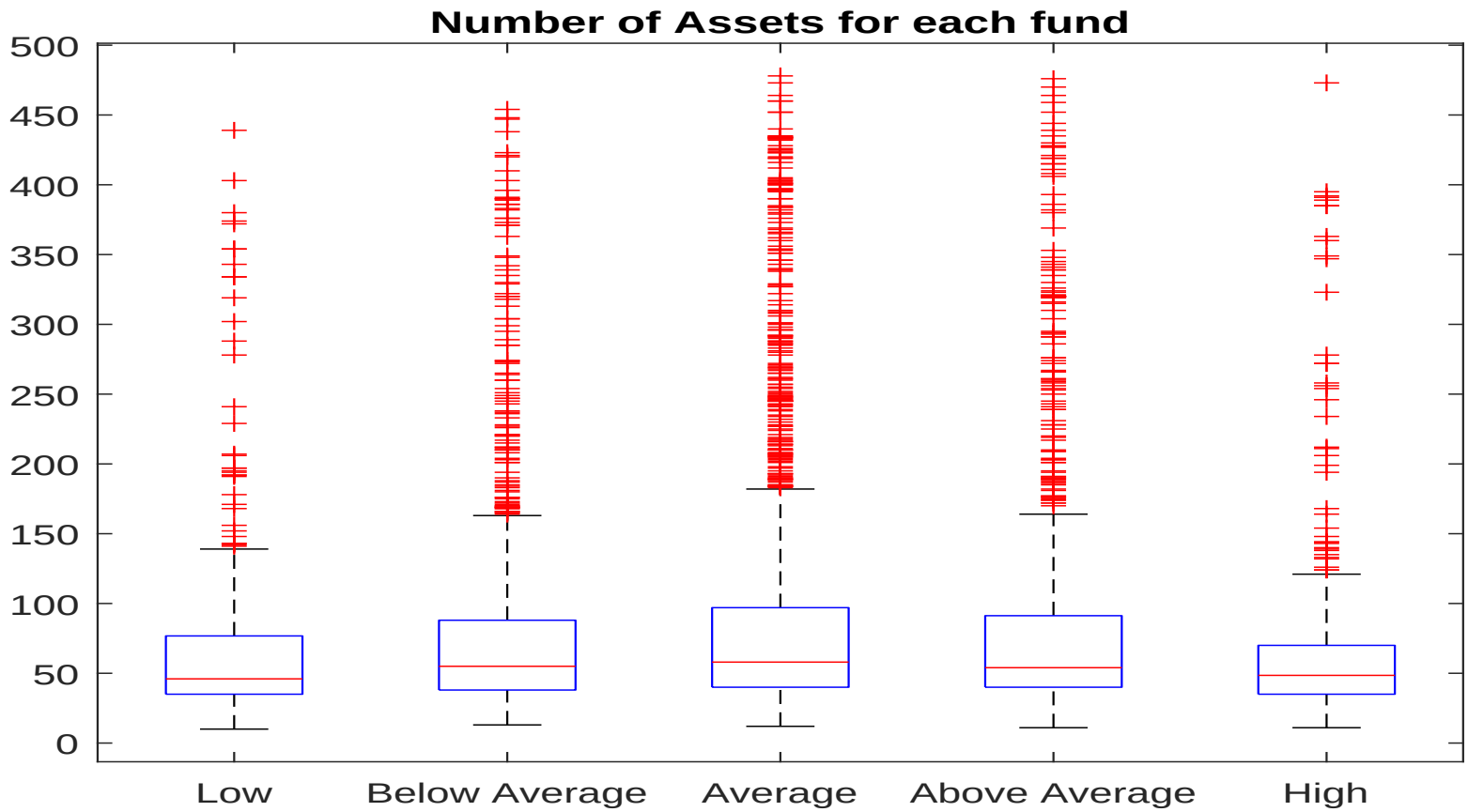
Dataset

- Open end equity mutual funds from Morningstar database
- Cross section at the third quarter of 2016
- After cleaning: $NF = 5108$ funds, $NA = 14090$ assets
- The network of funds is dense: 37% of connections between portfolios out of $(NF \times (NF - 1)/2) \simeq 13 \times 10^6$ of possible links

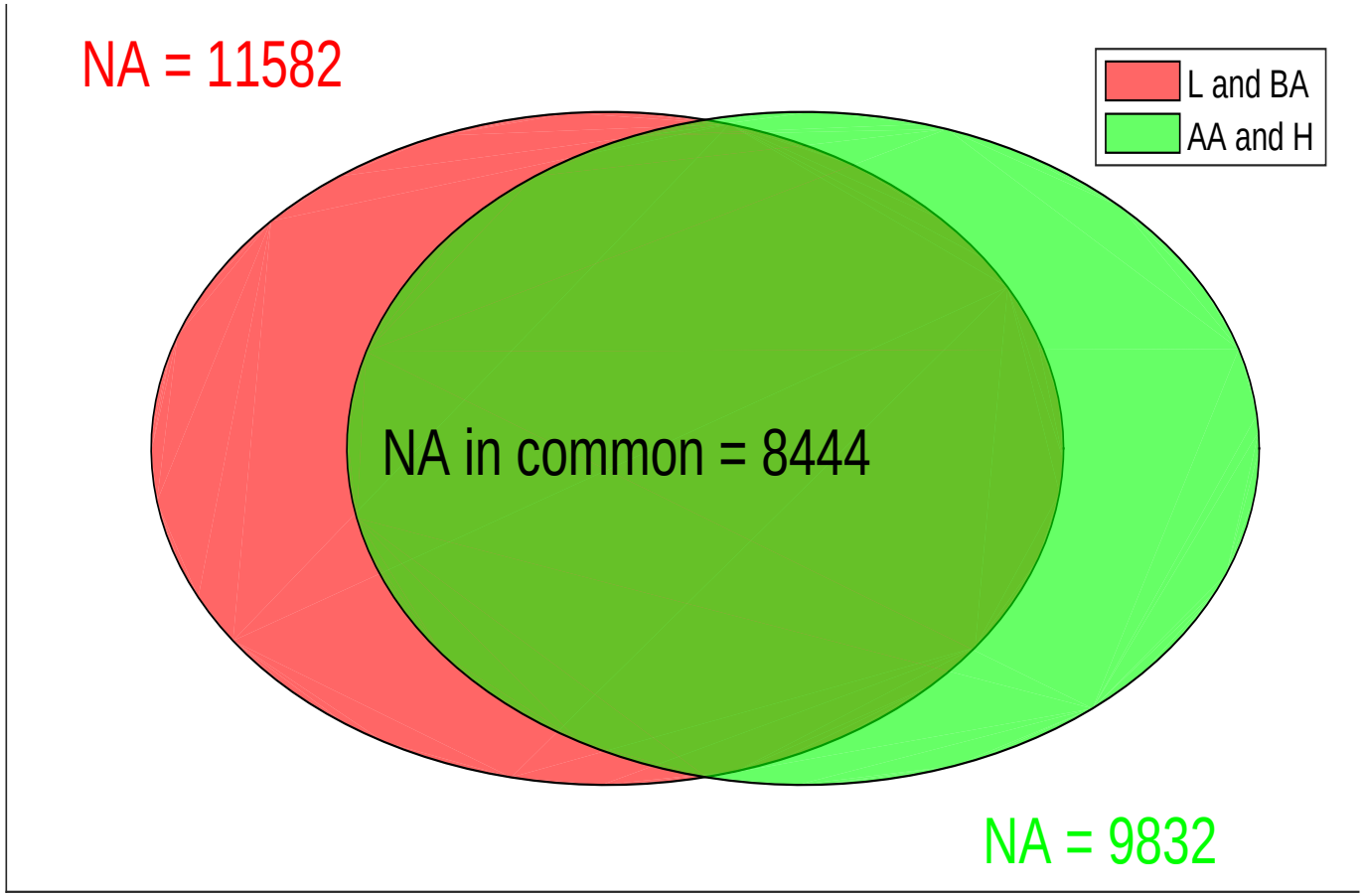
Morningstar sustainability rating system

- It is a rating system for 20,000 mutual funds
- It is based on company-level ESG scores developed by Sustainalytics and on ESG controversies
- At least half of a portfolio's assets under management (AUM) must have a company ESG score for the portfolio to obtain a sustainability score
- Five ratings: Low (1 Globe), Below Average (2 Globe), Average (3 Globe), Above Average (4 Globe), High (5 Globe)

Fund diversification

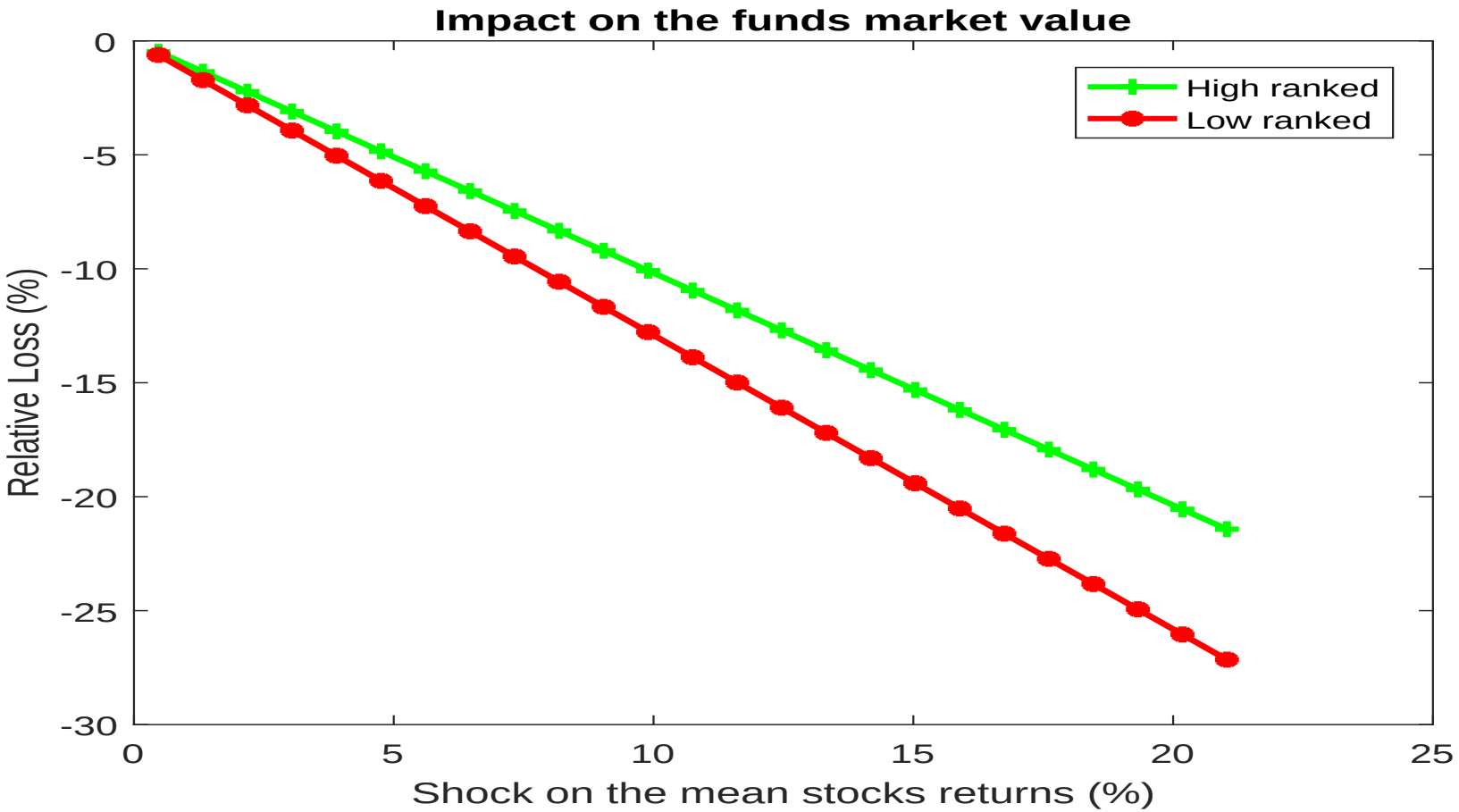


Global diversification



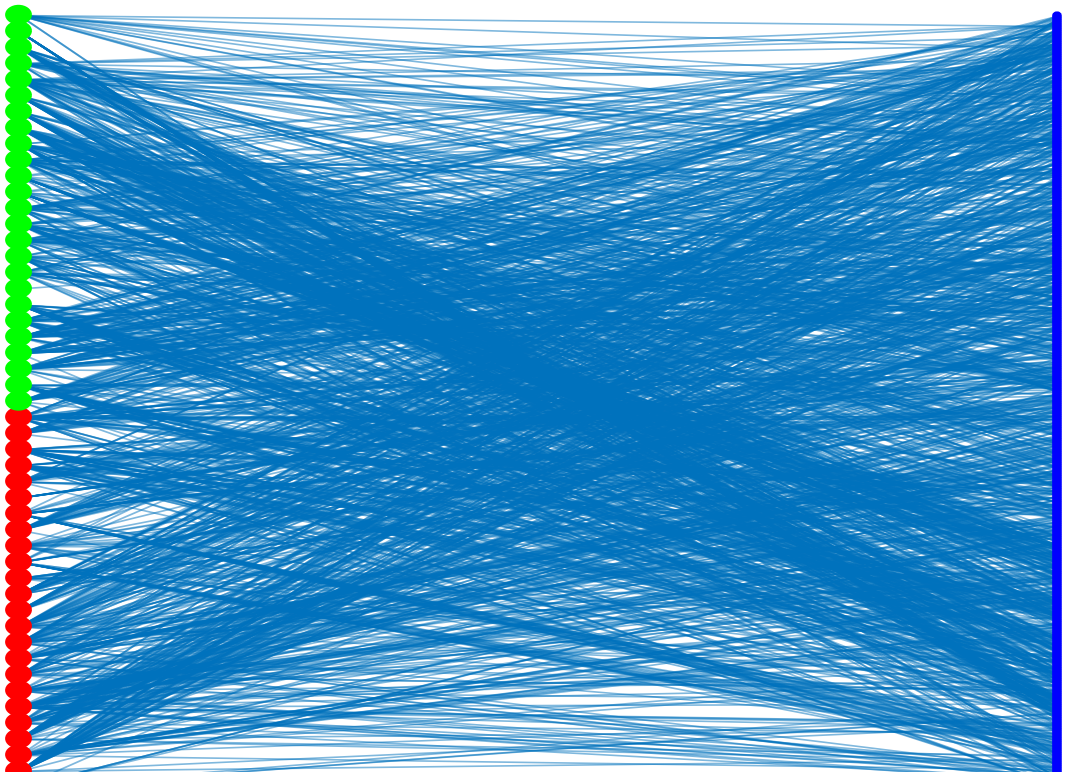
Shock to common factors

Shock to common factors on assets returns (PCA) $\Rightarrow$ Funds loose market value



The bipartite network

Systemic risk spread out in the financial system through a network



The figure shows the connections only of the top 5%-size of high an low ranked funds

Linear market impact model

- We assume that selling x shares of the stock k will drop the asset price S_k by

$$\Delta S_k = \frac{S_k}{D_k} x$$

- where D_k is the market depth of stock k. We assume that (Almgren et al (2005))

$$D_k = c \frac{ADV_k}{\sigma_k}$$

- where ADV_k is the average daily trading volume and σ_k is the standard deviation of daily returns of stock k

- c is a proportionality constant (very difficult to calibrate)

The liquidity weighted portfolio overlap

- Let α_{kj} be the number of shares of asset k in portfolio j
- When portfolio j liquidates a fraction ϵ of its shares of asset k, the asset price drops by

$$\Delta S_k = \frac{S_k}{D_k} \alpha_{kj} \epsilon$$

- Then the value of fund i (MV_i) will drop by

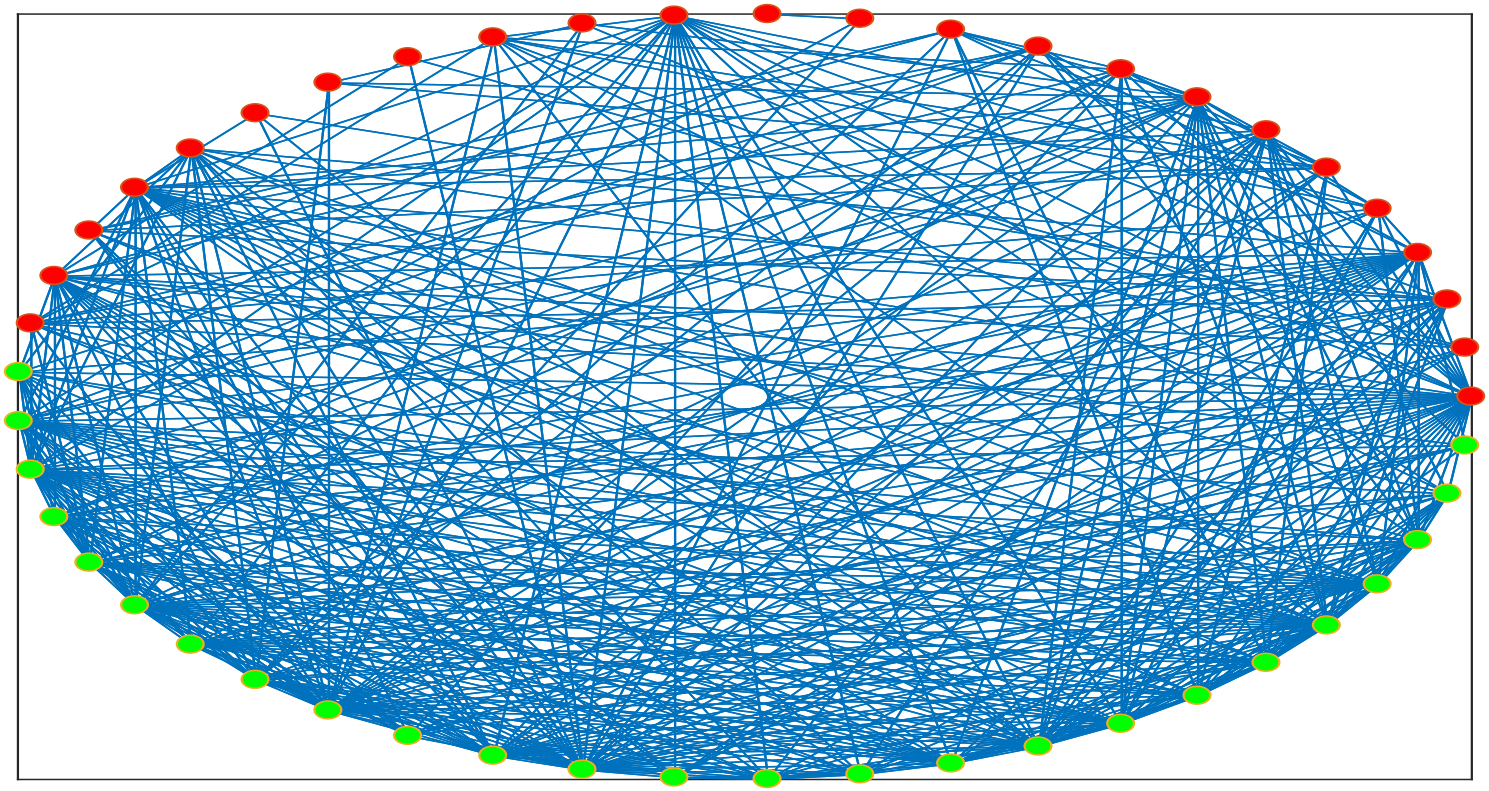
$$\Delta MV_i = \alpha_{ki} \Delta S_k = \alpha_{ki} \frac{S_k}{D_k} \alpha_{kj} \epsilon$$

- The key quantity is the adjacency matrix

$$\Omega_{ij} = \sum_k \alpha_{ki} \frac{S_k}{D_k} \alpha_{kj}$$

representing the overlap between portfolios

The network of funds

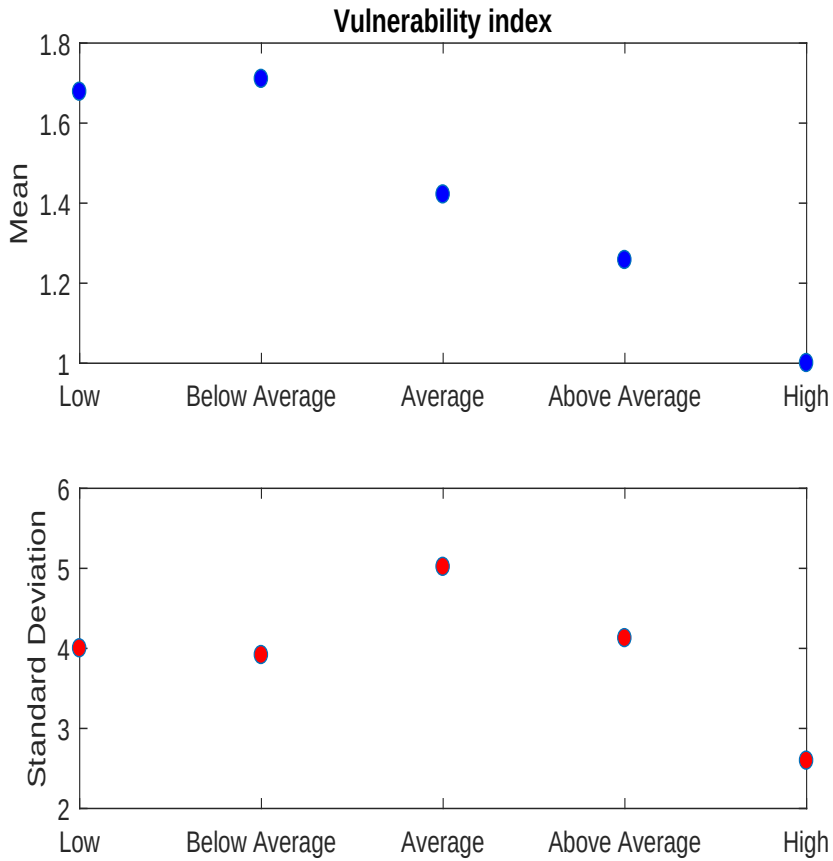


Fund vulnerability index

- The vulnerability index is (Braverman and Minca 2018)

$$VI_i = \frac{1}{MV_i} \sum_{j \neq i} \Omega_{ji}$$

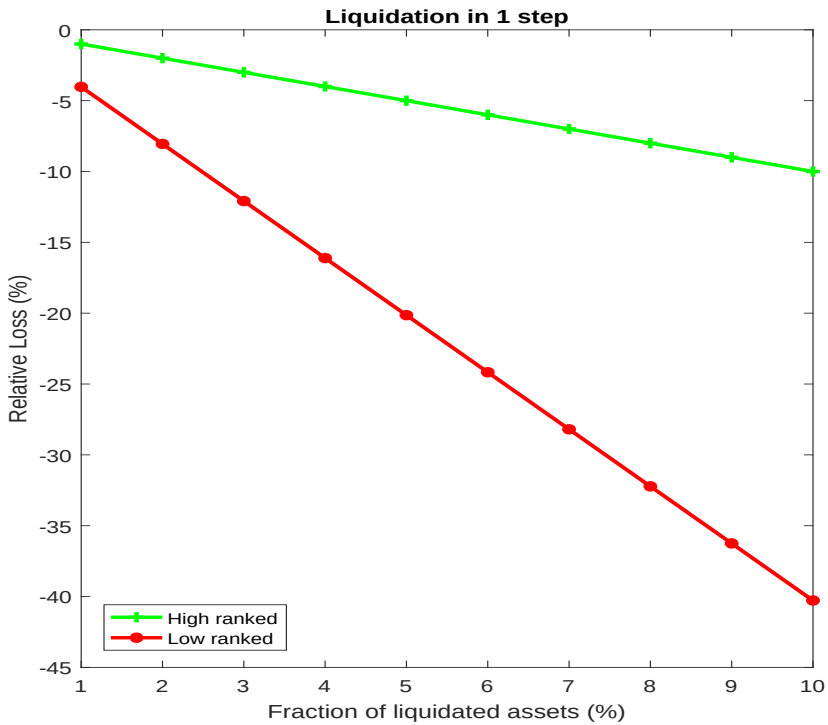
- ϵVI_i represent the relative loss of market value of fund i (MV_i) when the other funds liquidate a fraction ϵ of their assets

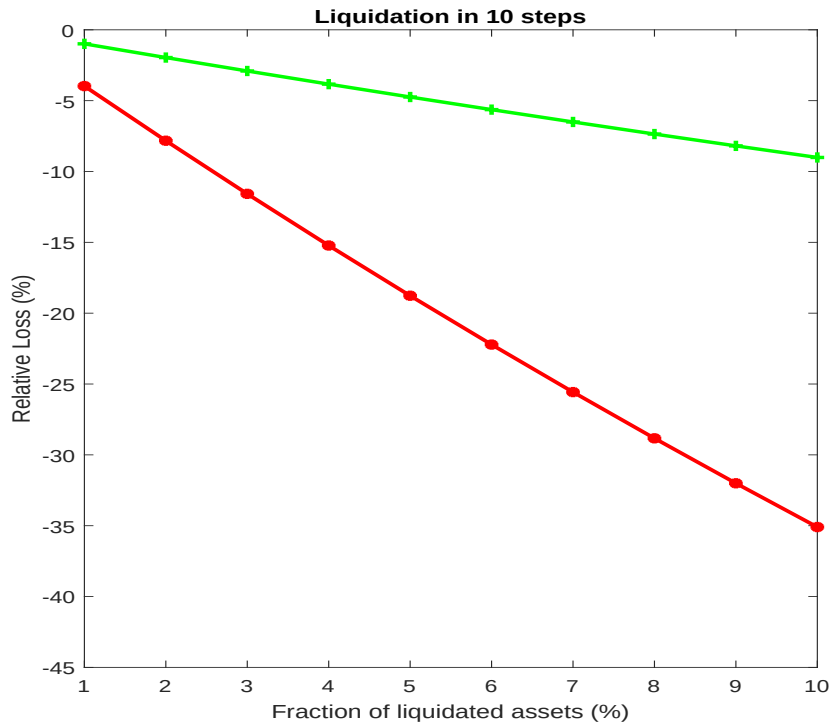


Market value loss due to indirect contagion

- If any fund j liquidates a fraction ϵ_j of its assets, then the relative total market value (MV) loss is

$$\frac{\Delta MV}{MV} = \frac{\sum_{i,j} \Omega_{ij} \epsilon_j}{\sum_i MV_i}$$





Square root market impact model

- Following Bouchaud (2010) we assume that selling x shares of the stock k will drop the asset price S_k by

$$\Delta S_k = S_k \, c\sigma_k \sqrt{\frac{x}{ADV_k}}$$

- Then when portfolio j liquidates a fraction ϵ of its shares of asset k, the asset price drops by

$$\Delta S_k = S_k \, c\sigma_k \sqrt{\frac{\alpha_{kj}\epsilon}{ADV_k}}$$

- Hence the value of fund i (MV_i) will drop by

$$\Delta MV_i = \alpha_{ki}\Delta S_k = c\alpha_{ki} S_k \sigma_k \sqrt{\frac{\alpha_{kj}}{ADV_k}} \sqrt{\epsilon}$$

Market loss in the square root model

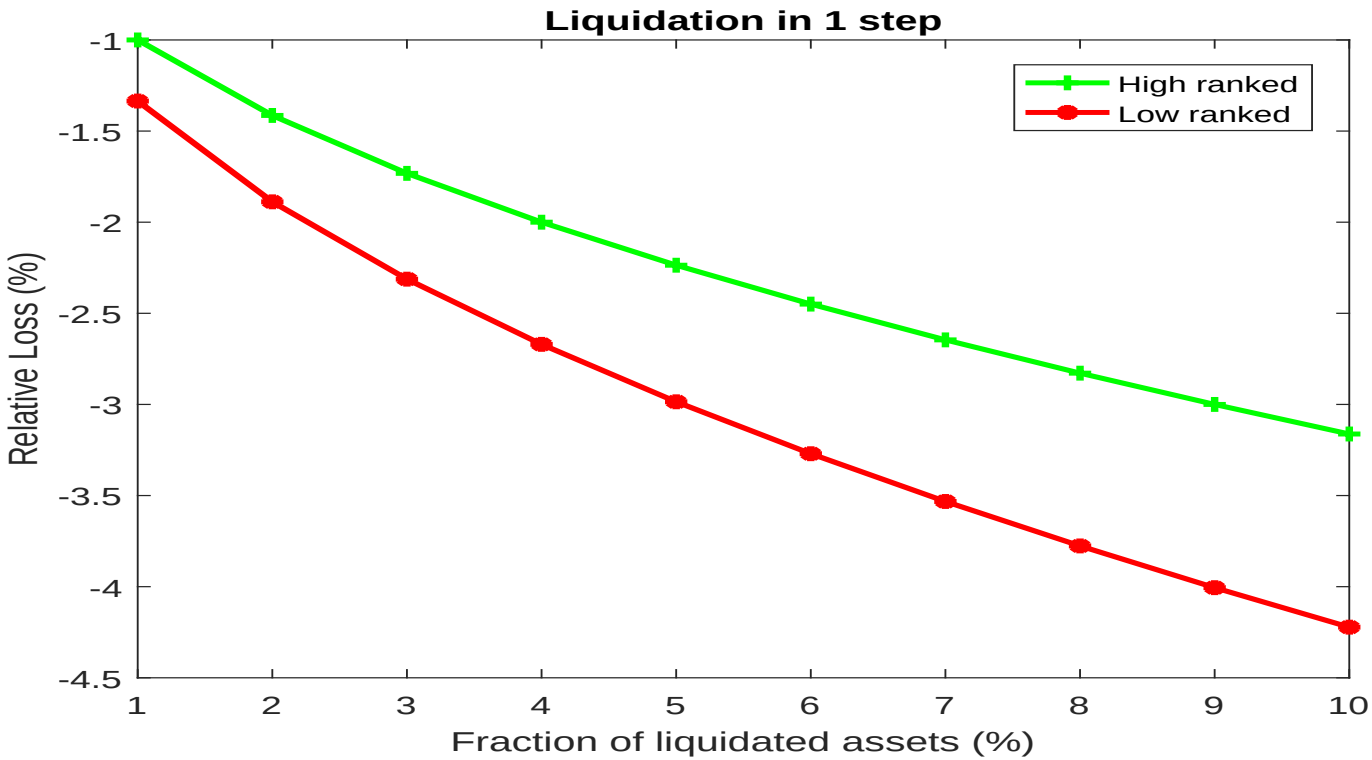
- We define the new adjacency matrix

$$\widetilde{\Omega}_{ij} = \sum_k c\alpha_{ki} S_k \sigma_k \sqrt{\frac{\alpha_{kj}}{ADV_k}}$$

- Then if any fund j liquidates a fraction ϵ_j of its assets, the relative total market value (MV) loss is

$$\frac{\Delta MV}{MV} = \frac{\sum_{i,j} \widetilde{\Omega}_{ij} \sqrt{\epsilon_j}}{\sum_i MV_i}$$

Market loss in the square root model



Conclusions

SRI may improve the state of market health by making the market more resilient to extreme shocks

However results should be tested in different directions:

- time (different cross sections)
- SRI rankings (Asset4)
- Calibration

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