‘Too central to fail’ firms in bi-layered financial networks

Abstract

The paper examines the correlation between network-based vulnerability measures of firms in the US stock and corporate bond markets. The results show a positive but not very large relationship between the vulnerability measures across markets. Additionally, the vulnerability of firms in the stock market is negatively related to firm size, indicating that 'too-big-to-fail' firms tend to be 'too-central-to-fail'. The findings are robust across different asset classes, model selection, and time length of the data, as well as controlling for return sensitivities to market-level factors.

Key Words

- Network centrality: Refers to the measure of a node's importance or influence within a network. It quantifies the position of a node based on its connections to other nodes.
- Risk management: The process of identifying, assessing, and prioritizing risks in order to minimize or mitigate their impact on an organization. It involves implementing strategies and measures to reduce the likelihood and severity of potential risks.
- Vulnerability: Refers to the degree of susceptibility or exposure to potential harm or risk. In the context of the paper, it specifically relates to the vulnerability of firms in the stock and bond markets.
- Stocks and bonds: Refers to the two primary types of financial instruments. Stocks represent ownership in a company, while bonds represent debt obligations. The paper examines the linkages and vulnerabilities of firms in both the stock and corporate bond markets.[1]
- 'Too central to fail': Refers to the concept that certain firms are so central or interconnected within a financial network that their failure could have significant systemic consequences. The paper explores the

relationship between firm size and vulnerability, suggesting that 'too-big-to-fail' firms tend to be ‘too-central-to-fail'

Mathematical Formulae

2.2. Return series construction

Each bond/stock price is denoted by $\{p_{it}^{b/s}\}_{i\in N}$. Return series is defined as the first difference of the log price series:

$$r_{i,t}^{b} = \ln(p_{i,t}^{b}) - \ln(p_{i,t-1}^{b}) \quad \text{and} \quad r_{i,t}^{s} = \ln(p_{i,t}^{s}) - \ln(p_{i,t-1}^{s}) \tag{1}$$

$$PageRank(i) = \frac{(1-d)}{N} + d\sum_{j\in\mathcal{N}^i} \hat{\omega}_{ij} PageRank(j), \tag{3}$$

$$Bond\ returns_{it} = \beta_0 + \beta_i Y_t + \epsilon_{it}, \quad i = 1,\ldots,N;\ t = 1,\ldots,T \tag{4}$$

$$Stock\ returns_{it} = \beta_0 + \beta_i Z_t + \epsilon_{it}, \quad i = 1,\ldots,N;\ t = 1,\ldots,T \tag{5}$$

$$\log(bond\ PageRank)_i = \beta_0 + \beta_{sr} \log(stock\ PageRank)_i + \beta X_i + \epsilon_i, \quad i = 1, \ldots, N \tag{6}$$

Interpretation of Data Tables

- Table 1: Provides descriptions of all variables used in the analysis, along with their data sources .
- Table 2: Presents summary statistics for the baseline specification, including various variables related to vulnerability measures and firm characteristics
- Table 3: In the paper presents the regression results related to the relationship between vulnerabilities of firms in the stock and bond markets.It shows the coefficients and statistical significance of the relationship between the vulnerability measures in the two markets.
- Table 4: In the paper presents the results of robustness checks on the relationship between vulnerabilities of firms in the stock and bond markets with respect to varying time-length of the sample.The analysis examines the relationship for different time windows, ranging from three to six years.

Section Wise Breakdown

Introduction:

- The paper aims to analyze the correlation and magnitude of vulnerabilities of firms across different asset markets, specifically the stock and bond markets.

- It highlights the importance of understanding vulnerabilities in multiple markets due to firms' simultaneous activities in these markets .

Methodology:

- The paper constructs a measure of firm-level vulnerability based on interlinkages inferred from asset return data using a graph-theoretic construct called Granger Causal Network (GCN).
- The vulnerability measure is quantified using the PageRank algorithm, which captures the relative importance of a firm in the network.
- Instrumental variable regressions are used to analyze the relationship between vulnerabilities across markets

Results:

- The results show a positive relationship between vulnerabilities of firms in the stock and bond markets, with a quantitatively small but significant magnitude.
- The vulnerability measure in the stock market is negatively related to firm size, indicating that larger firms tend to be more central and less vulnerable

Robustness Checks:

- The paper conducts robustness checks to ensure the validity of the results.
- The relationship between vulnerabilities is found to be robust across different choices of asset classes, maturity horizons, model selection, and time length of the data.
- The analysis also controls for return sensitivities to market-level factors, further strengthening the robustness of the results

Conclusion:

- The paper concludes that there is a positive relationship between vulnerabilities of firms in the stock and bond markets, although the magnitude of the relationship is not very large.

- The vulnerability measure based on the PageRank algorithm captures the importance of firm size and centrality in determining vulnerabilities across markets.
- The findings have implications for risk management and the understanding of systemic risk in financial networks.