Biclique in Global Bank Shareholder Networks

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Extended Abstract

The global banking system acquires information both from its environment and from its own adaptive responses to external conditions. Given the highly dynamic nature of global banking and the rapid adaptability of its agents, the system often escapes regulatory constraints, allowing institutions to continue operations with considerable flexibility. Although the large-exposures regime was established to mitigate systemic risks arising from the interdependence of financial institutions, shareholder structure and dynamics—traditionally not considered risk factors—have increasingly emerged as significant contributors to interdependence among global banks.

In response to the 2008 financial crisis, the Basel Committee on Banking Supervision (BCBS) introduced a series of reforms designed to strengthen the resilience of banks and the broader financial system. These reforms addressed weaknesses revealed by the crisis and introduced updated assessment methodologies, together with additional requirements for Global Systemically Important Banks (G-SIBs). The BCBS reforms complemented the initiatives of the Financial Stability Board (FSB), which has worked since 2012 to reinforce global financial stability. A central feature of the BCBS framework is the indicator-based measurement approach, which evaluates systemic importance across several dimensions, including cross-jurisdictional activity, size, interconnectedness, substitutability, and complexity. Each of these dimensions contributes to determining a bank's systemic significance and its potential impact on global stability. Despite these advances, regulatory frameworks remain largely static, in contrast to the rapidly evolving economic, technological, and institutional environment in which banks operate. This mismatch presents a persistent challenge, as rigid regulation may hinder the sector's ability to adapt to new risks. Accordingly, the reforms seek to enhance both adaptability and resilience, ensuring that banks can absorb losses and maintain stability under changing contexts.

Some studies have identified features that illuminate the dynamic behavior of the global banking system. These features vary across markets and are strongly shaped by the high connectivity and diversity of global bank interactions. Network science methods are frequently employed to analyze the structure, topology, and interaction patterns of the global banking network [1–3].

Nevertheless, the Financial Stability Board (FSB) has not incorporated shareholder structure as a factor in assessing systemic stability, despite evidence that many global banks share common shareholders. As a result, the current ranking of G-SIBs may be incomplete and, in extreme cases, may overlook critical sources of systemic vulnerability when shareholder concentration is excessive. Ownership concentration is particularly significant because large shareholders often maintain stakes in multiple global banks. Such cross-ownership increases systemic fragility, as instability may arise not from the dynamics of large institutional structures but from vulnerabilities within smaller, highly interconnected ownership networks.

To formalize this issue, let G denote a bipartite graph with vertex partitions U and V and edge set E. A biclique in G is a complete bipartite subgraph that includes all permissible edges. Identifying maximal bicliques in such graphs provides valuable insight into relationships

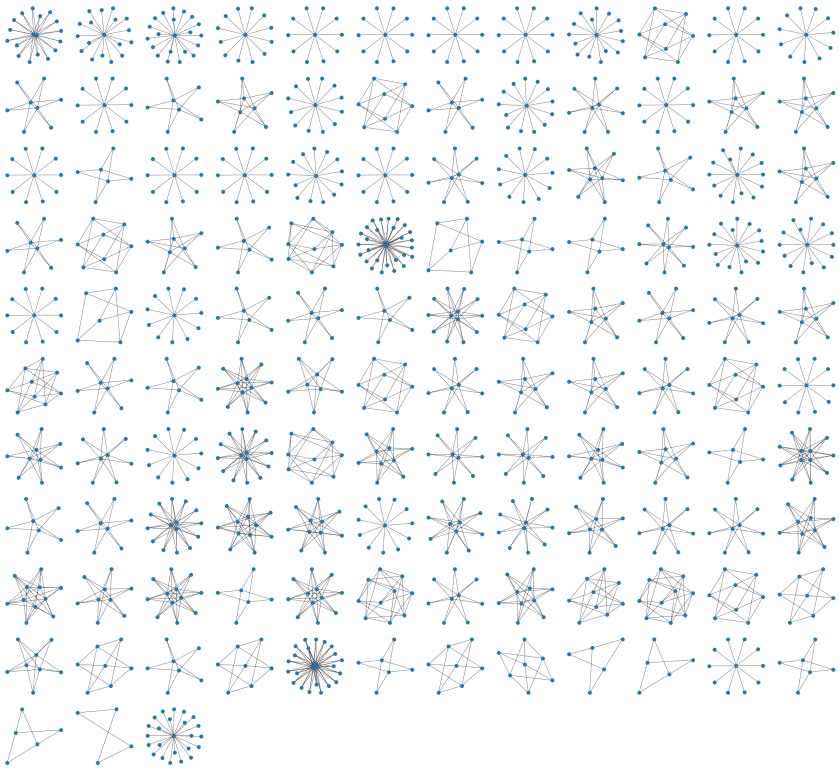

Figure 1: **Maximal Bicliques.**

between banks and their shareholders. This approach can also support case-control studies involving categorical features, such as risk exposures in the global banking system (Figure 1).

This study makes several contributions. First, an examination of shareholder structures across multiple global banks revealed no significant differences among Western institutions, suggesting that while banks operate across countries, they maintain a centralized shareholder base. The consistency of this pattern underscores the need to integrate shareholder concentration into systemic risk frameworks. Second, the study provides an analysis of the effect of shareholder structure on the performance of the FSB in identifying systemic risk. The findings indicate that common ownership of three or more banks can materially amplify systemic vulnerabilities, thereby guiding the FSB toward more accurate identification and verification of risk parameters.

References

[1] João Barata Ribeiro Blanco Barroso, Thiago Christiano Silva, and Sergio Rubens Stancato de Souza. "Identifying systemic risk drivers in financial networks". In: *Physica A: Statistical Mechanics and its Applications* 503 (2018), pp. 650–674. URL: `https://doi.org/10.1016/j.physa.2018.02.144`.

[2] Roy Cerqueti, Gian Paolo Clemente, and Rosanna Grassi. "Systemic risk assessment through high-order clustering coefficient". In: *Annals of Operations Research* 299.1 (2021), pp. 1165–1187. URL: `https://doi.org/10.1007/s10479-020-03525-8`.

[3] Eduard Baumöhl et al. "Measuring systemic risk in the global banking sector: A cross-quantilogram network approach". In: *Economic Modelling* 109 (2022), p. 105775. URL: `https://doi.org/10.1016/j.econmod.2022.105775`.