

# *Research on the 2008 Financial Crisis Regarding Financial Network*

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**Abstract:** The rapid withdrawal in the financial market due to the collapse of Silicon Valley Banks in 2023 brought reflections on the 2008 financial crisis. Past research has focused on modeling different types of financial networks that help explain bankruptcy's contagion process. This paper discusses how these networks help to explain the 2008 financial crisis, followed by shedding light on the global impacts (European, Latin American, and Asian markets) of the crisis in terms of networks. The last section further discusses potential policies that could be used to prevent or predict severe contagion depending on different network structures, including adjusting the level of portfolio diversification for international investment, for example. This paper sheds light on the importance of financial networks regarding their contagion channel and wide application in the real economy.

**Keywords:** network, financial crisis, interbank, contagion

## 1. Introduction

The recent failure of the Silicon Valley Bank and Signature Bank, followed by the First Republic Bank, ranked within the top 30 by total assets among the biggest U.S. banks, signaled an alarm to the global economic participants. Russell and Zhang [1] found that the total assets of these banks surprisingly surpassed the total assets of defaulted federally insured U.S. banks in the 2008 financial crisis after adjusting for inflation. The rapid withdrawal of banks for both cases indicates the underlying network among financial institutions may help to explain the spread of global contagion.

To briefly introduce the 2008 financial crisis, two hedge funds owned by The Bear Stearns Company (BSC) collapsed, leading to the Lehman Brothers (LB) stock price plummeting by 93% in July 2007 [2]. As a heavily mortgage-backed securities US bank, LB faced bankruptcy with the Reserve Primary Fund holding about \$785 million in debt from it [3], making the prominent safe short-term investment funds in the money market risky to invest. At that point, consumer confidence in the money market had crashed, followed by the interbank lending market drying up because the banks were highly unsure of the solvency of each other (incomplete information). At the same time, the housing bubble burst due to the significant mortgage defaults and fall in mortgage-backed securities that drove the housing price down. Moreover, by 2009, this recession had spread worldwide, affecting economies such as Australia, Canada, the UK, Hong Kong, India, and China [4-11].

To define, a basic network consists of nodes and the links between them [12]. Albeit there is a broad acknowledgment of rich existing network models and theories in the field of this network [13-16], its complexity is worth further investigation to assist in the explanation of underlying



Moreover, it noticed that vertex  $\{7\}$  and vertex  $\{25\}$ , for example, are indirectly connected, but  $\{25\}$  was still affected by the insolvency of  $\{7\}$ . Recalling the interbank contract structure, the indirect interaction between the financial institution, regarding the complexity of the network and irresistible feedback mechanism, could lead to a greater effect in the financial market compared to the initial shock for one bank [18]. Moreover, empirical research found the contract network to be sparse, heavily tailed degree distributed, high clustering, and short average path length, suggesting a surge in the speed of contagion in reality [19-21]. Thus, the banks are less likely to mitigate the systematic risk they face, especially when facing a financial crisis, which could lead to a high social cost [17].

### 2.3. Three Layers Contagion Channel

Bookstaber and Kenett provided a multiplex model to demonstrate how the collapse of the two subprime mortgage-backed hedge funds of Bear Stern in 2007 impacted the financial market [22]. The three dimensions of the multilayer network consist of funding, collateral, and asset layers, as shown in Figure 3. Bear Stern represents the Trading Desk Dealer labeled  $\{T\}$  in lilac, which it plays in more than one financial activity, and its Hedge funds are presented as  $\{HF\}$  in yellow. On the funding level, Bear Stern invested a significant amount in commercial paper and repurchase agreement (repo) provided by Cash Provider  $\{F\}$ , which were both short-term fundings; plus, the two hedge funds held as high as \$18 billion assets from prime brokers  $\{PB\}$ . On the collateral level, the two hedge funds received a \$16 billion repo loan after the collateral to the prime brokers. On the asset level, a remarkable amount of essential assets were traded through the desk of Bear Sterns (lilac shaded in Figure 4.) Therefore, the collapse caused a wide disruption in the financial market within all three layers affecting other institutions.

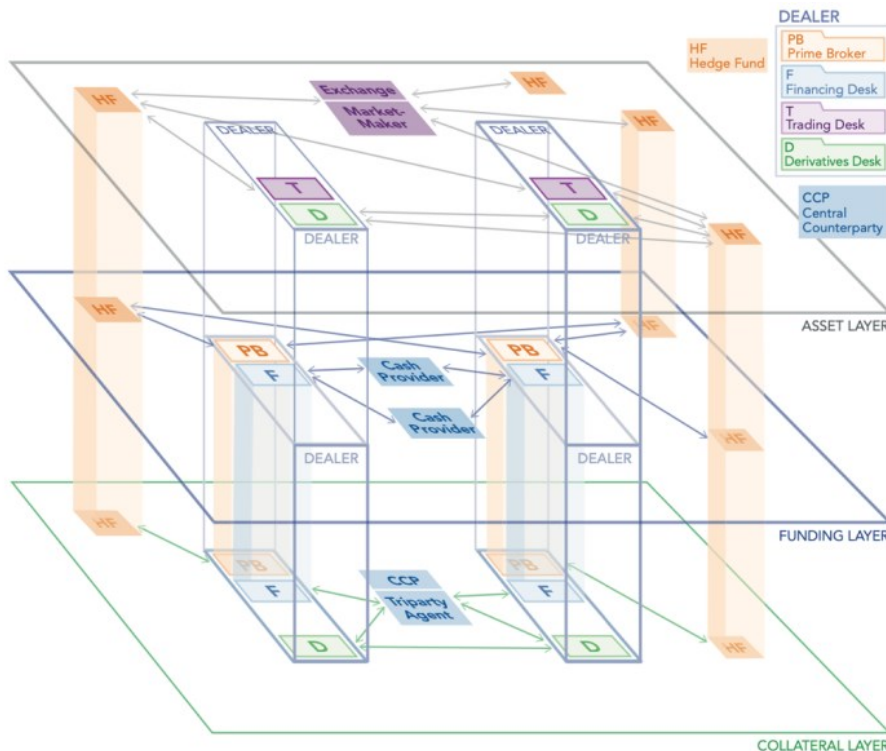


Figure 3: Three-dimensional Multilayer Network [22].

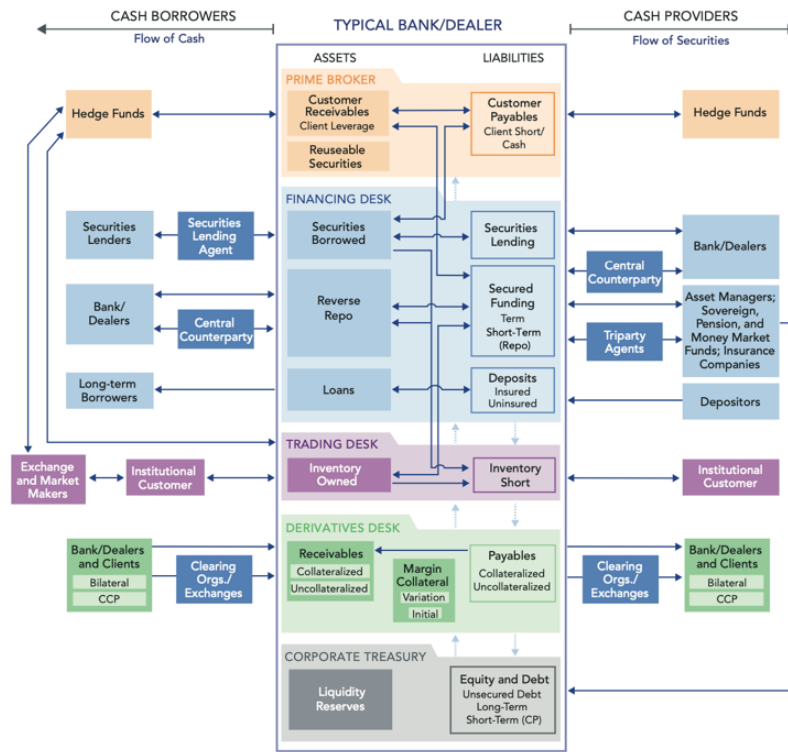


Figure 4: Financial Network Map Showing Relationships among Market Participants [22].

## 2.4. Topology: the Core-Periphery Model

Characterizing the underlying topology of interbank networks is one of the mainstays in the financial network investigation. The majority of the research suggested a core-periphery structure, which consists of the core, containing highly connected banks, and the periphery, including the other banks that are connected to the core but not internally [23-26]. The core banks were further identified as money-centered banks [12] and intermediary banks [24]. Moreover, Kojaku et al. suggested a transition from a pure core-periphery model to a bipartite structure, and they discovered that the eMID financial market had multiple pairs of core-periphery structures [26].

One key feature of this structure is a relatively higher clustering coefficient in the core compared to the periphery layer (see Figure 5.) Bear Stern was classified as one of the core banks during the 2008 financial crisis, so its contagion could be widespread. Adding to it, an active decrease of links from core banks to the other banks reduced the solvency of banks to face bankruptcy, aggregating to the severe situation [24]. Moreover, the systematic risk level in this type of structure was found to be high [25].

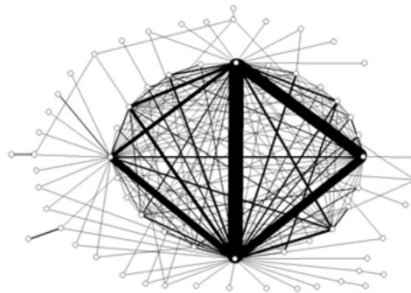


Figure 5: Core of Fedwire Interbank Payment Network [12].

### 3. Global Impact

#### 3.1. European Market

Empirical research on the core-periphery structure in the European market found a clear downward trend of active banks in 2008 [24, 27]. This is because foreign bank interactions with the Italian banks, for instance, had significantly dropped during the crisis.

Furthermore, McGuire and Von Peter suggested that solely evaluating the balance sheet data for the European financial market during the crisis could be misleading [28]. Figure 6 shows that the European banks funded subprime portfolios using a “bidirectional” method. As the cash inflow and outflow from Europe to the US and vice versa were in a similar amount, the net cash flow would be almost negligible. In this case, the emerging market investors were not significantly impacted by the subprime mortgage securities [28]. However, European countries were highly dependent on US dollars in trading, so they were directly impacted during the crisis. Other European countries, such as Spanish and Greece, had experienced severe recessions from the contagion.

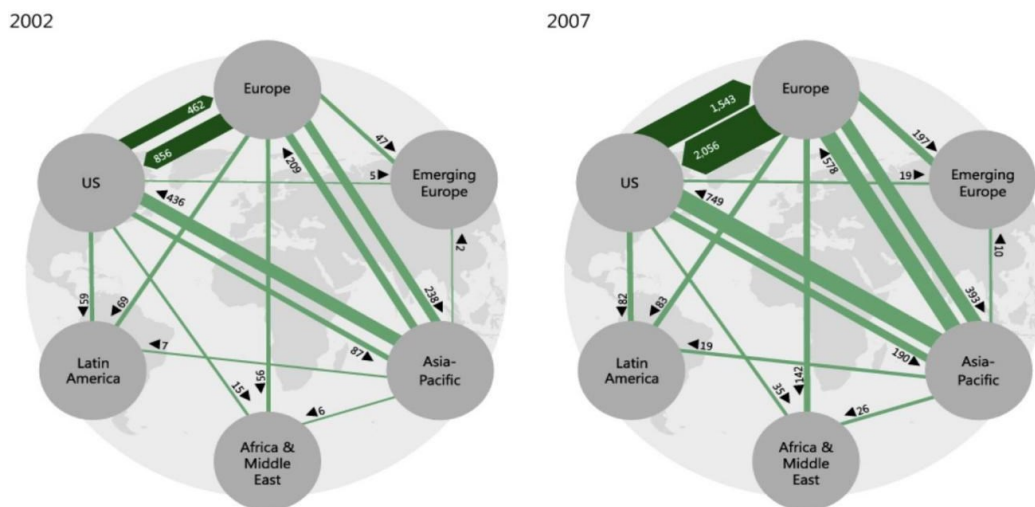


Figure 6: US dollar-denominated cross-border claims (billions of US dollars) [28].

#### 3.2. Latin America

Empirical evidence suggested a noticeable change within the Latin American financial networks before and after the crisis [29]. The pair-wise conditional correlations between the US and the Latin American stock markets (Argentina, Brazil, Chile, and Mexico) helped explain this alternation and its impact [29]. In addition, studies have shown, in contrast with the other countries, that the financial crisis led to several significant positive effects on the Latin American stock market. This includes reducing the volatility of the stock market and consumers gaining higher expected utility during their investments [30].

#### 3.3. Asian Market

The tree network diagram in Figure 7 helps explain the contagion spread from the US stock market to the Asian stock market [31]. It demonstrated a chain reaction. Hong Kong was first affected by the collapse in the US because of its highly active and liberal stock market. Followed by a rapid fall in the Shanghai Stock Market index, then to Korea and other smaller markets in countries such as the Philippines, Japan, and India.

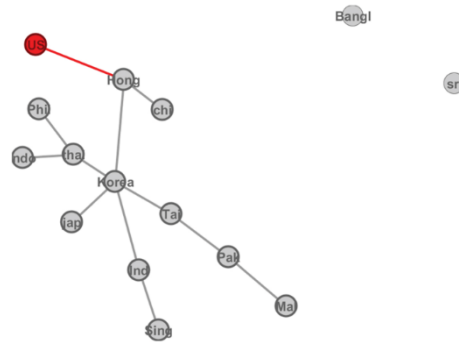


Figure 7: Spread of crisis from the US stock market to the Network of ASMs [31].

Moreover, Aswani suggested the density of the Asian financial market connection increased from the pre-crisis period to the post-crisis (see Figure 8, Figure 9, and Figure 10) [31]. This proves, contrary to the European market, the connectivity between Asian financial institutions had increased pre- to post-crisis.

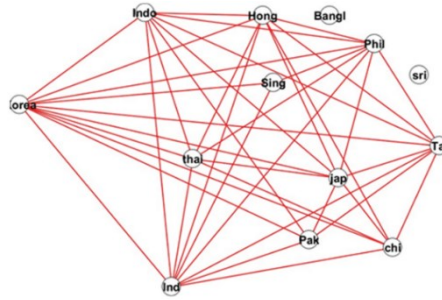


Figure 8: Network of Asian Stock Market Pre-crisis Period [31].

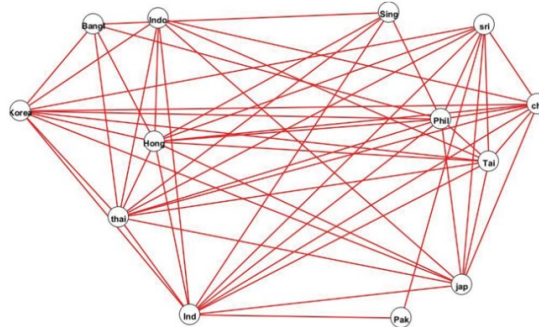


Figure 9: Network of Asian Stock Market in Crisis Period [31].

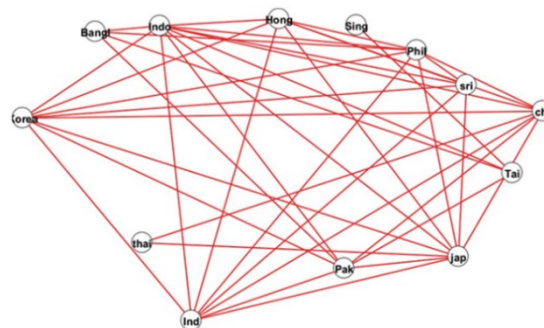


Figure 10: Network of Asian Stock Market post-crisis [31].

## 4. Discussion

For further discussions, the financial network could be useful for financial regulators and the government to evaluate, predict, and prevent future crises. Moreover, they could adjust their international portfolio diversification based on their network structures [29]. For example, for a low level of portfolio diversification, banks could be more resilient to systematic risk if the diversification is low; while for a high level of portfolio diversification, banks could be more resilient to systematic risk if the diversification is high [32]. The subtle level to determine whether it was a higher or lower level may be difficult.

However, this suggests that it is essential for the government of related policymakers to implement policies according to different financial networks in that area or otherwise lead to a greater risk of failure. This research is similar to the idea of adjusting the clustering coefficient for the interbank credit contract network; for example, it would be suitable to decrease the clustering coefficient so that the contagion would spread slower, and financial institutions may have time to act.

Moreover, research has suggested network fragility had decreased post-crisis, which means it became more resilient [33]. However, this signals to the financial regulators that the network is dynamic over time, so paying attention to the network evolution is also vital.

Alternatively, the government could utilize other methods to mitigate financial crisis damage to the economy. For example, the US government applied significant quantitative easing (QE) and provided short-term loans to banks through the Federal Reserve Discount Window Program (FRDW).

Furthermore, Turnbull & Pirson showed the possibility of avoiding the 2008 financial crisis if network governance is presented hypothesis, which emphasizes the high potential application of financial network structures [34].

## 5. Conclusion

In conclusion, this paper discussed how the network between financial institutions helped explain the 2008 financial crisis by reviewing the literature on the 2-D lattice model, three layers contagion channel, core-periphery model; and In the global impact section, this paper discussed the 2008 financial impacts on mainly European and Asian financial markets regarding networks. Overall, this essay provides a general analysis of the financial networks, but the research gap in investigating the underlying mechanism of financial decisions is still worth further discussion.

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