Interconnectedness, G-SIBs and network dynamics of global banking

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\textbf{ABSTRACT}

This study shows that interconnections in the global banking network decreased due to the global financial crisis and subsequent regulatory initiatives. It also proves the effectiveness of the regulations of global systemically important banks in inducing these banks to contain their systemic nature.

\section{1. Introduction}

In recent years, global financial markets have increasingly been modeled and studied by means of network analysis. Its powerful capacity to describe the architecture of the financial system and related interbank links helps improve our understanding of how systemic risk rises and is propagated through an interconnected banking system (see Upper, 2011; Hale, 2012; Battiston et al., 2012; Minoiu and Reyes, 2013; Acemoglu et al., 2015; Brunetti et al., 2015; Tasca et al., 2017; Giudici et al., 2017). We follow this stream of literature and study the global banking network using data on cross-border banking claims for about 200 countries between 2005 and 2016, focusing on the interconnections between financial institutions. The aim of this study is to investigate whether the level of connectedness of the global banking system has changed and how so, in response to both, the recent financial crisis, and related changes in regulations proposed by the Financial Stability Board (FSB) to tackle the issue of systemic risk and systemic financial institutions (SIFIs). Our analysis confirms evidence of global banking connectedness as an effect of the cutback in cross-border lending, triggered by the subprime crisis and the subsequent sovereign debt crisis in the Euro area. Its novel contribution is to show that regulatory changes concerning systemically important banks have also contributed to this retrenchment. To this end, we obtained the network by using the Bank of International Settlements (BIS, 2009) dataset. It is designed so that the resulting network structure is characterized by core and periphery countries,\textsuperscript{1} where the former group includes countries whose banking systems report data to the BIS in the analyzed time-period, and the latter group includes those countries in which the counterparty of the BIS reporting banks resides (for which only information on inflows is available). Thus, the selection of the core is strictly dependent on

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\textsuperscript{1}In network theory, a Core-Periphery structure identifies a well-designed network model such that some nodes are densely connected, whereas others are sparsely connected, in a peripheral position (Borgatti and Everett, 1999).

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the data structure provided by the BIS. Despite these potential drawbacks in the available data, we are able to distinguish and analyze the behavior of four different types of networks: i) Core-Periphery network (full network); ii) Core-Core network; iii) GS-Periphery network; and iv) GS-GS network. The core comprises the 24 countries that reported data to the BIS about incoming and outgoing exposures of international financial claims. Periphery countries are those banking systems for which only information on inflows is available. GS-Periphery and GS-GS networks underline that only a subset of the core countries host global systemically important banks (G-SIBs). We consider the subset of countries in which at least a G-SIB is present. Since November 2011, the FSB releases the list of G-SIBs each year, based on the Basel Committee on Banking Supervision (BCBS) score of systemic risk. These banks are asked to hold more capital (on top of Basel 3) and are subject to regulations that are more stringent. Our contribution to the growing literature on systemic risk and network analysis is therefore threefold. First, we extend the timeframe under investigation in previous contributions (e.g. Minoiu and Reyes, 2013) to include more recent data to depict an entire boom-bust cycle (2005–2016). Second, to capture the temporal evolution of systemic risk better, we expand the set of network indicators that are typically used in the literature. Third, we design the structure of the network in such a manner that we are able to disentangle the role of systemically important banks within the network itself. Indeed, our framework helps investigate whether the global banking network reduced its level of connectedness not only in response to the financial crisis (Hale, 2012; Minoiu and Reyes, 2013; Chinazzi et al., 2013), but also because of the new regulations for systemically important banks.

2. Research design

Following Minoiu and Reyes (2013), we designed a global banking network using BIS consolidated statistics, which measure bank exposures to different countries. These statistics capture worldwide-consolidated claims of internationally active banks headquartered in BIS reporting countries. In particular, we consider international claims by a reporting country toward banks in counterparties countries. In this way, we focus on the lending activity of international banks. Here, nodes correspond with countries, and weighted directed edges represent positive cross-border exposures.

We model each quarter of the year over the sample period (from the first quarter of 2005 to the end of 2016) as a separate network, and we analyze four different types of networks:

1. The full one (Core-Periphery), which refers to links between banks of approximately 212 countries;
2. The Core-Core network, which refers to links among the 24 core countries (see Table 1);
3. The GS-Periphery network, which is limited to the countries where at least one G-SIB is headquartered and to countries that have an incoming exposure with them;
4. The GS-GS network, which is obtained considering only links among the 12 GS countries.

Fig. 1 depicts the four networks at the end of 2016. Each node represents a country and a directed edge measures the total exposure of banks in that country to banks in another country. Weights catch the intensity of cross-border exposures. It is noticeable that the Core-Core network is denser (in terms of the number of transactions) than the GS network. This can be ascribed to both, the inclusion of a larger number of countries and to the fact that core countries with no G-SIBs are more involved in cross-border banking linkages.

We examine several network indicators to deepen our understanding of the structure of these relationships. Both binary and weighted network indicators are analyzed. Local indicators (computed at the node-level) are aggregated using the average value in order to have a network global view.

The topological indicators used in our analysis are as follows:

1. **Degree**: Node degree is the number of links starting or ending in a node (Newman, 2010). It captures the number of connections for lenders (out-degree) and borrowers (in-degree).
2. **Strength**: Node strength is the sum of weights of links connected to the node (Barrat et al., 2004). It captures the intensity of financial relationships among countries.
3. **Clustering Coefficient (CC)**: In weighted and directed networks, the clustering coefficient of a node measures the percentage of pairs of adjacent nodes of the node that are themselves adjacent, detecting four different patterns of CC (Fagiolo, 2007). In-clustering and cycle-clustering are specifically relevant to analyze systemic risk (for details on both coefficients and their use in this context see Tabak et al., 2014; Clemente and Grassi, 2018).
4. **Assortativity**: It is computed by the Pearson coefficient of the degree-degree correlation vectors (Newman, 2002). Being the network directed and weighted, we focus on the correlation between out and in-strength. This helps highlight the connections between “heavy lenders” and their borrowers.

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2 See the FSB website for the updated list of G-SIB banks (http://www.fsb.org/2017/11/fsb-publishes-2017-g-sib-list/) and the BCBS website for more information on how to assess systemically important banks (https://www.bis.org/bcbs/gsib/).

3 Number of countries varies according to different time-periods. Few isolated nodes are indeed present at specific times.

4 BIS indicates the list of countries included in the core.

5 We define heavy lenders as those countries with the higher out-strength measure.
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