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Shareholding relationships in the Euro Area banking market: A network perspective

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HIGHLIGHTS

- The topology of the network of the Euro Area banking market is analyzed.
- The network displays power law distributions a robust yet fragile structure.
- The SSM aims to quantify systemic importance through banks' total assets.
- Not all the banks with high value of total assets are systemically important.
- A large portion of control flows to a small core of financial institutions.

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ABSTRACT

In this paper we analyze the topological properties of the network of the Euro Area banking market network, with the primary aim of assessing the importance of a bank in the financial system with respect to ownership and control of other credit institutions.

The network displays power law distributions in both binary and weighted degree metrics indicating a *robust yet fragile* structure and a direct link between an increase of control diversification and a rise in the market power. Therefore while in good time the network is seemingly robust, in bad times many banks can simultaneously go into distress. This behavior paves the way for Central bank's actions.

In particular we investigate whether the Single Supervisory Mechanism introduced by the European Central Banks and based on banks' total asset is a good proxy to quantify their systemic importance. Results indicate that not all the financial institutions with high valued total assets are systemically important but only few of them.

Moreover the network structure reveals that control is highly concentrated, with few important shareholders approximately controlling a separate subset of banks.

1. Introduction and literature review

In the wake of the recent crisis it has been argued that network theories can enrich the understanding of financial systems, systemic risk, and the comprehension of all the factors causing failures in financial markets. A growing interest in applying methods from complex networks in financial research has been recently developed. One branch of the literature draws elements from the theory of contagion in networks and simulates default cascades under different network setups (see Refs. [1–3] among others).

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Another field of studies has approached financial systems through the study of connections among banks, exploring the international banking system from the analysis of interbank liabilities and claims. The main findings reported by this branch of literature can shortly be summarized in five main points: (i) the interbank market displays a community structure and disassortative mixing based on the banks' degree[1] (see Refs. [4–9]); (ii) the banks' degree is heavy tailed distributed (see e.g. Refs. [4,6,9–13]); (iii) the network topology of many interbank markets is highly sparse (see Ref. [4,12]); (iv) interbank networks display a small-world characteristic[2] (see Refs. [10,4]); (v) by and large this literature shows that financial networks are *robust yet fragile* (see e.g. Ref. [14]). Indeed in Ref. [14], Haldane, the Executive Director for Financial Stability at the Bank of England, suggested that highly interconnected financial networks may be robust-yet-fragile in the sense that "*within a certain range, connections serve as shock-absorbers [and] connectivity engenders robustness*". However, beyond that range, interconnections start to serve as a mechanism for the propagation of shocks, "*the system [flips to] the wrong side of the knife-edge*", and fragility prevails. In good times the system acts as a mutual insurance device. Instead, in periods of crisis, interconnections function as shock-amplifiers, not dampeners, as losses cascade. The system acts as a mutual incendiary device. The risk that fragility could spread prevails and the extent of the systemic dislocation is often disproportionate compared to the size of the initial shock.

Furthermore, researchers also focused on interconnections among credit institutions through direct interaction networks (or control networks) which are useful tools to detect chains of control (e.g. stock ownership networks or board of directors networks), as in Refs. [15,16]. The topics addressed by this literature can be grouped into three major categories: (i) analyzing the dispersion or the concentration of control (see e.g. Refs. [17,18]); (ii) empirically investigating how the patterns of control vary across countries and what determines them (see Ref. [19]); (iii) studying the impact of complex ownership patterns that were frequently observed (see Ref. [20]) such as the so-called pyramids (see Ref. [21]) and cross-shareholdings, also known as business groups (see Ref. [22]). Moreover, the investigation of the financial architecture is just at the beginning (see Refs. [23–28] among others). In particular, authors in Ref. [28] investigated the transnational corporation network and found that transnational corporations form a giant bow-tie structure and that a large portion of control flows to a small tightly-knit core of financial institutions. This means that network control is much more unequally distributed than wealth, and that the top ranked actors hold a much bigger control than what could be expected based on their wealth.

Among financial systems, the complexity of the interbank network has been analyzed mainly through the study of financial flows but, to the best of our knowledge, the literature has not deeply focused on the study of the shareholding relationships among banks. Few pieces of literature about ownership networks in the literature have essentially focused on the analysis of their small world properties (see Refs. [27,29]. Despite the fact that the topology of a network is known to play a major role in robustness against shocks, no systematic and statistical investigation of the topological properties of the shareholding networks in the banking market, especially the Euro Area, have been carried out yet.

In this work we analyze the topological properties of banks' shareholding network in the Euro Area. Our aim is to systematically analyze the complex structure of the banks' network in the Euro Area, with special attention to edge weights reflecting how ownership is distributed among banks. Moreover, in the hypothesis that the structure of the ownership network constitutes the backbone of the interbank market, this analysis may be helpful to quantify systemic risk as well. Systemic risk refers to the risks imposed by interlinkages and interdependencies in a system or a market, where the failure of a single entity can cause a cascading failure, which could potentially lead to bankruptcy or bring down the entire system or market. Indeed, banks are not all equal in a financial network: some institutions may be special, because they are linked with almost all the others. Those nodes are called Systemically Important Financial Institutions (SIFIs). As stated by the International Monetary Fund (IMF), the Bank for International Settlements (BIS) and the Financial Stability Board (FSB), three main criteria (i.e. size, interconnectedness and substitutability) should serve as the mainstay of any methodological approach to SIFIs (see Ref. [30]). In particular, interconnectedness aims at capturing the impact that institutions' bilateral exposures can have on other institutions. Unfortunately information on these exposures are usually not disclosed due to strategic reasons. However, in various countries, the existence of such financial relationships is linked to the existence of ownership linkages. Thus, in the hypothesis that the structure of the ownership network is a good proxy for skeleton of the financial network, banks controlling a large amount of shares of other financial institutions are also exposed to systemic risk.

We follow the technique presented in Refs. [24,31]. In particular, authors in Ref. [31] present a network description of the financial system formed by the assets traded in a stock market and the corresponding shareholders, underlining that shareholding networks are characterized by power-law distributions, as in other economic networks (see Refs. [32–37] among others).

Here we focus on the banking sector of the Euro Area only, extending the analysis also to non listed banks. We adopt these overtures to understand to which extent the diversification of shareholders in banks' portfolios gives a good estimate of the relevance of a bank in the market, with respect to ownership and control of other banks. This, in turn, allows to establish the way in which banks can acquire control and to understand their weight in the banking market.

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[1] The degree of a bank is the number of partners that every bank has. See Section 2 for further details. Assortative mixing refers to the property by which nodes in a network establish a relationship with similar nodes, according to certain characteristics (size, degree, geographical location, etc.). Disassortative mixing refers to the opposite situation, i.e. nodes connecting to nodes belonging to different groups.

[2] The small world effect refers to the property observed in a large number of social networks by which the distance between any two nodes (n) grows at a speed $\log(n)$ as $n \to \infty$, where n is the number of nodes.