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Financial networks, bank efficiency and risk-taking☆

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ABSTRACT

Networks with a core–periphery topology are found in many financial systems across different jurisdictions. Though the theoretical and structural aspects of core–periphery networks are clear, the consequences that core–periphery structures bring for banking efficiency stand as an open question. We address this gap in the literature by providing insights as to how the structure of financial networks can affect bank efficiency. We find that core–periphery structures are cost efficient for banks, which is a characteristic that encourages the participation of banks in financial networks. On the downside, we also show that core–periphery structures are risk-taking inefficient, because they imply higher systemic risk levels in the financial system. In this way, regulators should be aware of the excessive risk inefficiency that arises in the financial system due to individual decisions made by banks in the network.

1. Introduction

Bank efficiency has been on the top of the research agenda in the past decades (Berger et al., 2009; Duygun et al., 2013; Tabak et al., 2013). Though it has been extensively studied in the literature, little is known on the role financial networks play in promoting bank efficiency. Considering that banks interconnect through a diversity of complex financial operations in modern financial networks, it is imperative that banks understand where they stand inside the network and also how the financial network can influence their day-to-day operations. In this work, we address this gap in the literature by providing an empirical study on how financial networks and their structure can affect bank efficiency.

We study the Brazilian financial network that comprises more than 120 unsecured and secured financial instruments between banking institutions. We consider the most representative financial instruments in terms of trading volume, which are: interfinancial deposits, repos with federal securities, onlending, credit assignment and loans. In this way, our financial network encompasses the notion of interbank market, but is not limited to the classical operations that banks often perform in this market, which are mainly to deal with liquidity issues due to unexpected cash outflows or regulatory restrictions associated with reserve requirements. In the next paragraphs, we discuss some operations that banks may perform in the financial network with the goal of minimizing costs or of obtaining profit, thus affecting their overall efficiency.

In the Brazilian jurisdiction, though the compulsory deposit requirements are employed mainly as a macroprudential tool by the central bank, banks can obtain reductions on their deposit requirements by channeling their credit to the financial operations on mortgage loans, rural credit, and microfinance. In addition, banks can still enjoy this incentive by outsourcing these types of financial operations to other banks whose activities are specialized towards those financial operations. In this way, they avoid the costs of creating an internal framework to enter these markets that are not related to their business lines, in which they do not enjoy comparative advantage. Thus, banks may decide that outsourcing these obligations to specialized counterparties via the financial network is optimal in terms of cost minimization and hence profit maximization.

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In credit assignment, banks sell part of their investment portfolios to other counterparties to raise funds and fulfill liquidity issues. Banks can group together and use these financial instruments to obtain mutual benefits with cost savings and increased profits. For instance, banks that are competitive in lending to the non-financial sector and do not have the same ability as fundraisers can borrow funds from banks with excess of liquidity, thus obtaining the necessary fund to supply credit to the non-financial sector. In light of this association, both banks would be acting in their business lines that they possibly enjoy comparative advantage and would therefore have increased credit portfolios. In any case, banks would establish these operations at the cost of having to incur or transfer to counterparties substantial risks.

Financial bills are a fixed income instrument with minimum maturity of two years that allows fundraising term extension for banks. Since they are long-term financial operations that are non-redeemable, they provide means for reducing the liquidity shortage vulnerability of the issuer. Furthermore, banks have incentives to obtain funds using these financial instruments because they are exempt from additional reserve requirements. Consequently, they reduce liquidity maintenance costs and hence improve their cost and profit management over the raised funds.

The hypothesis that financial network and its structure can affect bank efficiency is also shared across jurisdictions. For instance, Iori et al. (2008) report changes in the network structure of the Italian interbank market during the pre-crisis period, in which banks gradually increase the number of banks from which they borrow funds while at the same time they are willing to supply credit to a smaller number of banks. The authors attribute this behavioral change to the liquidity shortage that non-large banks were facing due to the increase of credit demand by the non-financial sector. In other macroeconomic conditions, such as in the introduction of the Euro currency, Italian banks seemed to prefer lending liquidity to the European market rather than to the non-financial sector. In a related work, Monticini and Ravazzolo (2014) find that frictions in the interbank market, such as a consequence of liquidity crises, permit banks to obtain positive intraday interest rate spreads, leading to economic gains due to arbitrage. These works corroborate our claim that banks, besides adjusting liquidity and regulatory constraints, can make use of connections in the financial networks to improve their efficiency levels.

Banks engage in financial networks in diverse ways. For instance, large banks normally have better investment opportunities outside the financial network and may not have incentives to lend to non-large banks. Thus, they may demand a large spread to maintain financial operations with non-large banks in case they decide to forgo external options and accept opportunities in the interbank market. Creditor banks can also charge an extra spread in case the debtor is in stressed positions or during operations that occur at the end of the day, period at which banks have little room to adjust to their daily reserve requirements at the Central Bank. In turn, non-large banks with excess of liquidity may prefer to lend in the financial network given the low risk levels associated with these operations.

Considering the broad range of financial operations that the Brazilian data set captures and the evidence found so far in the literature, it is then reasonable to assume that banks use, among other factors, other counterparty banks that are participants in the financial networks as input resources to improve efficiency. In this respect, this paper explores the role that the network structure brings to bank efficiency. To the best of our knowledge, there is virtually no research linking network theory to bank efficiency.

One of the trends that has been documented in the banking literature is the emergence of core–periphery networks in several financial systems. Core–periphery structures present two perceptible mesoscale structures: the core and the periphery. Core members intermediate financial operations between members of the periphery and are also strongly connected to other core members. In contrast, periphery members can only establish a few connections with core members and not among similar peers. Reports in the literature converge to the fact that the core–periphery structure is the usual network structure found in financial networks. Among the evidences, we can highlight the financial networks in the UK (Langfield et al., 2014), the Netherlands (in 't Veld and van Lelyveld, 2014), Germany Craig and von Peter (2014), among others. Though the theoretical and structural aspects of core–periphery networks are clear, the consequences that core–periphery structures bring for the banking efficiency stand as an open question that we investigate in this work.

Lux (2015) supplies a theoretical model that attempts to explain the recurrent emergence of core–periphery in financial networks. He claims that the core–periphery structure is a natural consequence of a banking system with heterogeneous balance sheet size as we historically find in industrialized economies. Lux (2015) also shows that non-observability of the full network structure along with the existence of relationship lending are ingredients that reinforce the existence of core–periphery structures.

Our hypothesis is that it is costly for banks to engage in operations with different counterparties in the financial network due to, among other factors, monitoring costs. It is expected that large banks with large amounts of cash surplus will engage in financial operations with many counterparties as they would benefit from diversification. In addition, banks may need to transact with more counterparties because a single one may not be able to fulfill their needs. In both cases, banks will engage in financial operations with many counterparties as long as the marginal benefits of diversification are higher than the associated marginal costs of these transactions. Given that real financial networks have strong bank size heterogeneity distributions with the presence of few large banks and several small banks, we should therefore expect the emergence of a core–periphery topology in these networks. The core would be composed of a small fraction of banks – mainly large banks – that has many counterparties and the periphery would comprise banks with a small number of interconnections. Our first hypothesis to be tested is then:

Hypothesis 1. The core–periphery structure contributes to better efficiency levels of banks.

We can test efficiency from two different perspectives: cost and profit efficiencies. Banks can engage in financial operations in the financial network to manage their costs or to boost their profits. Traditionally, the literature has focused on the cost efficiency side of banks. The main goal of banks, however, is to maximize profits, which may be achieved not only by minimizing costs but also by maximizing revenues as well. The computation of profit efficiency thus supplies bank management with more information than just the cost efficiency evaluation. Our results will provide some insights on whether the financial network topology (core–periphery structure) has an effect on cost or profit efficiency. Our main hypothesis can then be split into two:

Hypothesis 1a. The core–periphery structure contributes to better cost efficiency levels of banks.

Hypothesis 1b. The core–periphery structure contributes to better profit efficiency levels of banks.

In this work, we also explore how the network structure affects the risk-taking efficiency levels of banks. In this respect, we expect that the participation of banks in interbank funding and investment decisions is a factor that explain not only bank cost and profit efficiency but also more importantly the risk-taking efficiency. We