Journal of Financial Stability xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfstabil

Network centrality and funding rates in the e-MID interbank market☆

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ARTICLE INFO

Article history:
Received 2 December 2015
Received in revised form 2 November 2016
Accepted 10 November 2016
Available online xxx

JEL classification:
G2

Keywords:
Network centrality
Interbank market
Overnight loans

ABSTRACT

This paper empirically investigates the role of banks' network centrality in the interbank market on their funding rates. Specifically we analyze transaction data from the e-MID market, the only electronic interbank market in the Euro Area and US, over the period 2006–2009 that encompasses the global financial crisis. We show that interbank spreads are significantly affected by both local and global measures of connectedness. The effects of network centrality increased as the financial crisis evolved. Local measures show that having more links increases borrowing costs for borrowers and reduces premia for lenders. For global network centrality, borrowers receive a significant discount if they increase their intermediation activity and become more central, while lenders pay in general a premium (i.e. receive lower rates) for centrality. This provides evidence of the 'too-interconnected-to-fail' hypothesis.

1. Introduction

Network positioning could affect interbank interest rates by different mechanisms. First, in line with Acemoglu et al. (2015), dense interconnections serve as a mechanism for the propagation of shocks, leading to a more fragile financial system. As such, banks that are more connected may be perceived by the market as fragile. Second, the same banks can be perceived as 'too-interconnected-to-fail' such that rather than fragile those banks are perceived as more likely to be bailout. This is similar to the 'too-big-to-fail' effect observed in other interbank markets (see for instance Battiston et al. (2012a,b)). Third, as argued by Booth et al. (2014), financial institutions with more extensive and strategic financial networks acquire and process information more efficiently due to their better access to order flows. Fourth, as stressed by Gabrieli and Georg (2014), banks with higher centrality within the network have better access to liquidity and are able to charge larger intermediation spreads.

Previous empirical evidence (see Angelini et al. (2011), Gabrieli (2011), Gabbi et al. (2012), Bech and Atalay (2008), Akram and Christophersen (2010) and Gabrieli (2012)) suggests that being systemically more important, in term of size or connectedness, explains part of the cross-sectional variation in banks' borrowing costs before and during the 2008 global financial crisis. Our paper contributes to the recent literature that investigates the determinants of banks' borrowing costs in unsecured money markets and how network characteristics of interbank market participants affect their funding rates. In particular, we empirically study bank network centrality measures as determinants of interbank interest rates.

The centrality indicators used in the analysis are constructed from measures of distance of a bank from the other banks in the network, where distance is expressed in terms of: (1) paths of length one, i.e. the number of incoming or outgoing links, for degree centrality; (2) geodesics (shortest) paths (no vertex is visited more than once), for betweenness; (3) walks (vertices and edges can be visited/traversed multiple times) for eigenvector centrality, Pagerank, Sinkrank and Katz. We evaluate each measure in a quarterly panel data regression set-up of bank pairs, i.e. lender and borrower, fixed-effects for the period 2006–2009 and separately for three sub-periods that encompass the latest 2007–2008 financial crisis: phase I (1 January 2006–30 June 2007, using the key date of the Bear Stearns hedge fund bankruptcy was 31 July 2007), phase

☆ We are grateful to the Editor, Dr. Iftekhar Hasan, to two anonymous referees and to participants at the FEBS 2015 conference for helpful comments and suggestions for improving this article. The research leading to these results has received funding from the European Union, Seventh Framework Programme FP7/2007-2013 under Grant agreements FET Open Project FOC, Nr. 255987, and ICT Project CRISIS, Nr. 288501.

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http://dx.doi.org/10.1016/j.jfs.2016.11.003
1572-3089/

II (1 July 2007–30 September 2008, using the key date of Lehman Brothers collapse was 15 September 2008) and phase III (01 October 2008–31 December 2009).

In this paper we focus on interbank lending networks on the e-MID overnight (O/N) interbank market, an electronic platform, based in Italy, that offers a fully transparent trading system with 'buy' and 'sell' proposals available on screens of the participating banks, along with the identity of the banks quoting them. Information on the terms (prices and amounts) of executed trades are available to banks in real time. Search frictions, thus, should not affect the matching process in the e-MID market. Furthermore lack of information on rates offered by alternative lenders cannot be responsible for the observed cross-sectional dispersion of O/N rates in this market.

Our results show that network measures are significant determinants of funding rates in the e-MID O/N market. Local measures show that having more links increases borrowing costs for borrowers and reduces premia for lenders. However, for global measures of network centrality borrowers receive a significant discount if they increase their intermediation activity and become more central, while lenders pay in general a premium (i.e. receive lower rates) for centrality, thus providing some evidence about the 'too-interconnected-to-fail' hypothesis. That is, banks perceived to be better inter-connected could borrow at discount rates. This effect is higher in phase II when systemic risk was the highest. Lenders do not benefit from network centrality, and as such, it could be that the market perception about their network positioning (i.e. fragility) dominates their strategic location for intermediation (as in Gabrieli and Georg, 2014). The regression analysis also highlights that there is heterogeneity across different measures of network centrality on how they affect interbank spreads.

Our findings have implications for systemic risk assessment. Network analysis of the degree of interconnectedness in the financial system can inform policymakers on optimal bank resolutions mechanisms and how regulation can help to reduce instability. Empirical networks have been used for (deterministic) stress test exercises (see Upper (2011) for a comprehensive review). Of critical importance in macro prudential policy is the identification of key players in the financial network, which, according to the International Monetary Fund, the Bank for International Settlements and the Financial Stability Board, should be determined in terms of their size, connectedness and substitutability. Network centrality measures, developed to assess centrality in other contexts and adapted to the context of financial networks, can guide national authorities in their assessment of the systemic importance of financial and non-financial institutions. Our results show that borrowers that are more central benefit from lower funding rates. We argue that this effect could be driven by the market perception that more central banks will be bailed out if in distress, because 'too-connected-to-fail'. However, the expectation of implicit subsidies could create moral hazard and provide incentives for banks to become systemically important, exacerbating system fragility. While we do not demonstrate in the paper that banks actively try to occupy a central position in the network by strategically forming links with each other, we do believe that monitoring how funding cost advantages evolve over time can act as an effective early warning indicator of systemic risk and provide a way to measure the effectiveness of regulatory policy to reduce the market perception that systemically important institutions will not be allowed to default.

The remainder of this article is organized as follows. Section 2 discusses previous findings in the literature and how they relate to our paper. Section 3 describes the data and variables. Section 4 provides methodology of the empirical analysis. In Section 5, we present and discuss the results of the regression analysis. Section 6 discusses the results and concludes.

2. Network centrality and interbank markets

In the financial economic literature network analysis has mostly been applied to payment systems, interbank lending markets, and more recently extended to capture the mutual exposure of financial institutions to other asset classes, including derivatives contracts, in a multilayer networks framework (Bargigli et al. (2015), Leon et al. (2014), Molina-Borboa et al. (2015), Aldasoro and Alves (2015), Poledna et al. (2015)).

A number of papers investigate the interplay between financial distress and topological characteristic of interbank networks, focusing on the network resilience to different kinds of shocks (Iori et al. (2006), Nier et al. (2007), Gai et al. (2011), Battiston et al. (2012a,b), Anand et al. (2012), Lenzu and Tedeschi (2012), Georg (2013), Roukny et al. (2013), Acemoglu et al. (2015)). While some authors argue that a more interconnected architecture enhances the resilience of the system to failure of an individual bank because credit risk is shared among more creditors, others suggest that a higher density of connections may function as a destabilizing force, facilitating financial distress to spread through the banking system. The overall picture that emerges from this body of work is that the density of linkages has a non-monotonous impact on systemic stability and its effect varies with the nature of the shock, the heterogeneity of the players and the state of the economy. Thus no optimal network structure that is more resilient under all circumstances can be identified (see Chinazzi and Fagiolo (2013) for a recent survey on systemic risk and financial contagion).

The structure of interbank networks has been mapped for several countries, the topology of interbank markets has been characterized and the stylized facts and regularities have been identified. Examples include Boss et al. (2004) for the Austrian interbank market, Soramaki et al. (2007) and Bech and Atalay (2008) for the US Federal funds market, de Masi et al. (2006), Iori et al. (2008) and Fricke and Lux (2015) for the Italian based e-MID, Degryse and Nguyen (2007) for Belgium, Craig and von Peter (2014) for the German interbank market, Langfield et al. (2014) for the UK and in 't Veld and van Lelyveld (2014) for the Dutch market. Poledna et al. (2015) studied the multi-layer network of exposure among Mexican banks including interbank credit, securities, foreign exchange and derivative markets. Billio et al. (2012) studies the time-series properties of interconnectedness measures in financial markets. The most common findings reported in this literature are: (i) interbank networks are sparse; (ii) degree and transaction volume distributions are fat tailed, revealing heterogeneous players characteristics; (iii) the networks show disassortative mixing with respect to the bank size, so small banks tend to trade with large banks and vice versa; (iv) clustering coefficients are usually quite small; (v) interbank networks satisfy the small-world property[1]; (vi) interbank networks have a tiering structure with a tightly connected core of money-center banks to which all other periphery banks connect.

In particular for the e-MID market, while early studies (Iori et al., 2008) have revealed a fairly random network at the daily scale, a non-random structure has been uncovered for longer aggregation periods. Monthly and quarterly aggregated data show that since the 1990s a high degree of bank concentration occurred (Iazzetta and Manna, 2009), with fewer banks acting as global hubs for the whole network. The hubs tend to cluster together and a significant core-periphery structure has been observed (Finger et al., 2013). Hatzopoulos et al. (2015) have investigated the matching mechanism among lenders and borrowers and its evolution over

[1] A network is small-world if the mean geodesic distance between pairs of nodes is small relative to the total number of nodes in the network, that is, this distance grows no faster than logarithmically as the number of nodes tends to infinity.

Please cite this article in press as: Temizsoy, A., et al., Network centrality and funding rates in the e-MID interbank market. J. Financial Stability (2016), http://dx.doi.org/10.1016/j.jfs.2016.11.003