



# Network topology and systemic risk in Peer-to-Peer lending market

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## HIGHLIGHTS

- Modeling and analyzing the systemic risk in P2P lending market in the perspective of complex network.
- Network topology characteristics have been investigated, such as degree, betweenness centrality, network density, network efficiency, etc.
- These network topology indicators correlate with the default loans' influences significantly.

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## ABSTRACT

Peer-to-Peer lending market is presented as a complex network and its topology characteristics, such as the ratio of brokers' connections, degree, ratio of available node pairs, betweenness centrality, network density, network efficiency and edges' loading ability have been investigated in this paper. The main contribution of this paper is that modeling and analyzing the systemic risk in P2P lending market in the view point of complex network based on these topology characteristics. And the empirical research has been carried out by using the real data from one of the largest online platforms in China ([www.renrendai.com](http://www.renrendai.com)). Result shows that the relationship between lending–borrowing network topology and the default loans is significant, which implies that these factors have strong relations to systemic risk in the network.

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## 1. Motivation

With the development of Internet technology, Peer-to-Peer (P2P) lending market has become a kind of new form of private lending, which is an important market type in the Internet financial industry. In P2P lending market, borrowers and lenders complete their matching process of financing and investment without the participation of traditional financial intermediaries. Borrowers submit their credit materials to the online P2P lending platform, and then the platform will give them a credit evaluation based on these materials. Borrowers release the capital demand orders in keeping with their own credit score and acceptable financing cost (interest rate) and lenders bid for orders through interest-rate bidding referring to their own risk preference and borrower's credit level. Lenders can diversify investment by lending multiple orders to avoid credit risk. If the bidding is completed, a relationship has been established between lenders and borrowers. The emergence of P2P lending market improves the financing efficiency of folk micro-finance as well as solves the financing needs of some small and micro enterprises. However, as the bias of credit evaluation and incomplete regulation, there are some serious

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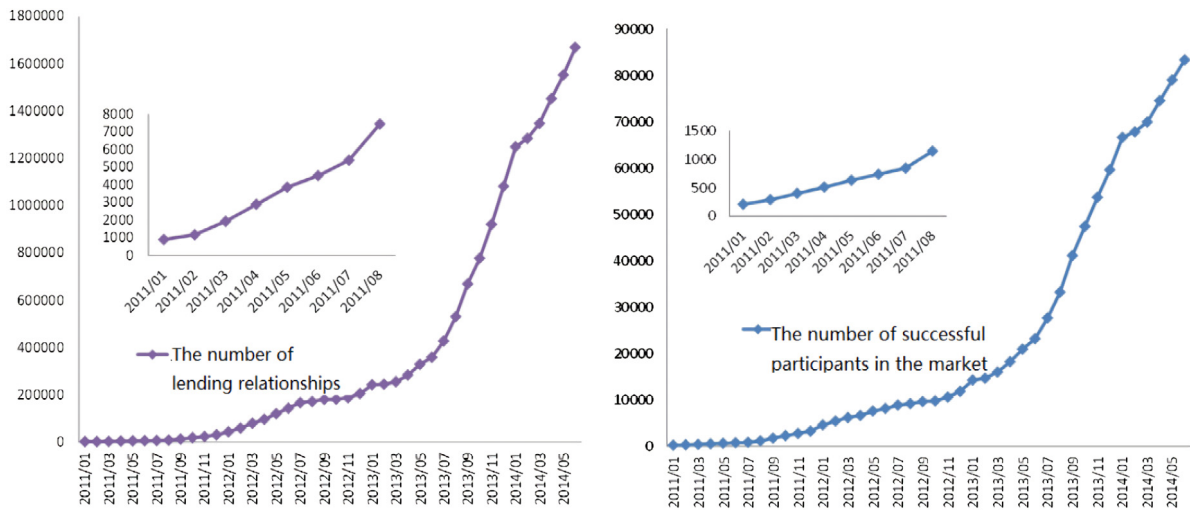


Fig. 1. The development of renrendai.com.

defaults. Further, individual credit risk may lead to the occurrence of systemic risk events across the market (even the P2P industry). At present, the management of systemic risk in China pays more attention to the spread of risk events and the impact on the whole market or society than the evaluation of individual credit risk. For example, there are 2076 platforms generating operational issues in Chinese P2P industry at the end of September 2016 (about 48.53% of the total platforms). The current Chinese market environment does not have the personal credit system like FICO in U.S, so it is very important to find a systemic risk regulation method for P2P market, which is good for the healthy development and market stability of P2P industry.

Taking market of renrendai.com ([www.renrendai.com](http://www.renrendai.com)) as an example, the monthly statistics of the lending–borrowing network from January 1st 2011 to June 30th 2014 show that the number of people who successfully participated in the lending network monthly (i.e. the number of borrowers still existing in the network at the end of each month) rose from 209 people in January 2011 to 83,256 in June 2014, monthly lending relationships (i.e. the number of edges in the network) increased from 892 to 1,670,427 (see Fig. 1). From these data, we can conclude that whether the lending–borrowing network formed by current P2P participants is large or not. Up to June 30th 2014, from the overall scale of lending, demand orders issued by renrendai.com has been researched 13,801,115,500.00 yuan in total. However, only 3,084,068,100.00 yuan in total orders formed 2,218,021.00 loan relationships, and the successful loan rate was 22.87%. In these successful orders, 734,392,100.00 yuan had been paid off, 2,318,852,100.00 yuan were in the payment process, and the default advance funds were 27,792,900.00 yuan. It shows that the demand for money in this market is huge, and defaults always exist. The proportion of default is about 0.9% and the lending–borrowing relationships affected by the default orders are 28,605, accounting for about 1.28%. Thus, it can be seen that the scope of impact by default orders is higher than the number of default rate measured by cash amount.<sup>1</sup> And the current analysis is only at the statistical data level, not considering about the contagion effect of complex market structures in specific situations (such as financial crisis, or the P2P industry crisis). In the view of information transmission, the systemic risk of P2P lending market will be very significant. Because the P2P lending model forms a complex network of lending relationship, we should not only consider the credit default risk of participants, but also consider the systemic risk of the whole platform or market caused by the risk contagion of individual credit risk. In that, the systemic risk is different from the individual credit risk. Credit risk is the risk that only suffered by lenders, while the systemic risk caused by credit risk is the risk of the whole platform or market system. So the creative work in this paper is that we build loan connection network based on the actual individual lending–borrowing relationships and find the correlation between risk indicators with the network's structures.

Since the establishment of Zopa in 2005, the P2P lending market has been rapidly developed in the countries of the world. The model of P2P lending market entered the Chinese market in 2006, and has been developed rapidly in recent years. P2P market in China has made many innovations against the trading patterns, which is totally different from U.S or European, including on-line, off-line and mixed trading patterns. Moreover, there are some tentative innovation in bidding and guarantees. For example, renrendai.com provides financial products, the principal protection and other patterns. With

<sup>1</sup> renrendai.com currently carries out the principal protection model and establishes the risk reserve system. At the same time, platform only allows borrowers to hold one loan during the same period, so the proportion of default is not very high. However, from the initial stage of the development of renrendai.com to the first half of 2011, according to monthly statistics, the loan relationships affected by default is about 2%–3%. In addition, considering the uneven of P2P industry and the risk management of many P2P platforms are not perfect, they have not established a risk control system like renrendai.com. So, from the whole of the industry, the impact of systemic risk on market and society is very important.

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