Networking with Peers: Evidence from a P2P Lending Platform

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1. Motivation and Introduction

Overview of P2P lending

P2P lending is carried out directly between borrowers and lenders without intermediation of a traditional credit institution.

- Borrowers request loans online
- Investors can then invest in pieces of these loans or whole loans through an online marketplace
- P2P companies organize the entire process from start to finish, screening loan applications, evaluating the risk of borrowers, providing the online marketplace for buying loans, and eventually overseeing repayments back to lenders. They make money by charging fees to both borrowers and lenders but does not take any risk itself. No government guarantee.

Social network

Social networks shape the judgment and decision-making of firms (Khanna *et al.* 2015; Bajo *et al.* 2016), banks (Iyer & Puri 2012; Grullon *et al.* 2014), venture capital (VC) (Hochberg *et al.* 2007, 2010), individual investors (Ozsoylev *et al.* 2014; Hong & Xu 2019), mutual fund investment (Hong *et al.* 2005; Cohen *et al.* 2008) and financial analysts (Fang & Huang 2017).

- spur information flows across individuals and organizations
- provide channels and bridges for individuals to interact with each other, exchange information and resources
- reinforce existing relationships
- establish new relationships

- A new type of social network has emerged through the interaction among the participants of P2P lending, whose effects on market outcome still remain under explored.

Existing research on P2P lending

- Information asymmetry on P2P lending is more exaggerated than that in the traditional credit market
  - Borrowers and lenders are anonymous
  - No financial intermediation
- Screening and Signaling mechanisms on P2P lending
  - Duarte *et al.* (2012): borrowers appearing more trustworthy are more likely to have their borrowing requests funded
  - Sanchez-Gonzalez and Palomo-Torres (2014): beautiful applicants have higher probability of getting loans and paying lower rates, but have similar default rates in comparison to average looking borrowers.
  - Pope and Sydnor (2011): blacks are less likely to receive funding than those of whites with similar credit profiles
  - Lin et al. (2013): online friendships of borrowers act as signals of credit quality
  - Herzenstein et al. (2011a); Dorfleitner et al. (2016); Gao and Lin (2017); Chen et al. (2020): loan description and information disclosure

Our Research Question

- What's the value of network and its impact on P2P lending when hard information is unavailable?
  - Apply the social network analysis method to map the interactions among the participants
  - How the position of lenders in the P2P network affects the investment behavior?
  - How the position of borrowers in the P2P network affects funding probability, default probability and interest rate?
  - How the shape of network affect the market outcome?

Main Takeaway

A lender who is in the center of a P2P network not only invests by a larger amount but also bids more quickly for a loan than his or her peers, suggesting that the network centrality influences lenders' investment decision by increasing the flow of information and encouraging risk-taking

Borrowers with higher centrality are more likely to borrow at lower interest rates, but less likely to default, indicating that

- central borrowers accumulate richer knowledge and experience in raising funds through P2P lending platforms
- the borrowers at the center of the network care more about their reputation and have lower moral hazard than their peers

Main Takeaway

Our research discovers a new network where the arbitragers play a crucial role. Without the agents like banking institutions, the participants at the P2P lending can be borrowers and lenders simultaneously, which allows them to collect rich information through the connections with various market participants.

2. Data and key variables

Renrendai.com

Founded in 2010, it now has over 1 million members located in more than 2,000 cities and counties across the country

Transaction volume: 13.21bn in 2015; one of the largest peer-to-peer lending platforms in China.

The transaction taking place at Renrendai is a typical P2P lending, akin to Prosper

- borrowers post loan request or listing with the required information of loan title, borrowing amount, interest rate, description of loan usage and personal characteristics such as education, income, age, marital status, length of work experience, etc.
- lenders may place bids by stating the amount they want to fund with a minimum bid amount of RMB 50

Data

Sources: RenRenDai.com 2011.1.1-2015.12.31

We match the borrower and lender IDs and calculate the network centrality variable based on their investment and financing activities at the platform.

Final Sample:

- From the lenders' perspective, we obtain 13,295,330 loan bidding records, placed by 164,860 lenders
- From the borrowers' perspective, we obtain 58,291 loan requests, posted by 24,851 borrowers
- Among 23,374 all listings that are successfully funded, 3,618 default.

Measurement of centrality

Lenders:

- OutDegree: the number of people that a lender has been invested in
- InDegree: the number of people who have been invested in a lender

Borrowers:

- InDegree: the number of people that a borrower has been borrowed from
- Out Degree: the number of people that a borrower has invested in

Betweenness captures a node's potential to control the information and resources exchanged between any other pair of nodes.

Eigenvector reflects the idea that the centrality of a node does not only depend on the number of its linked nodes, but also on the centrality of the linked nodes.

Measurement of lending activity

MONEY, the amount of money invested by a lender in each loan listing

FSTB_M, defined as the time interval between a loan listing being posted on the platform and when it receives a lender's bid

Measurement of borrowing activity

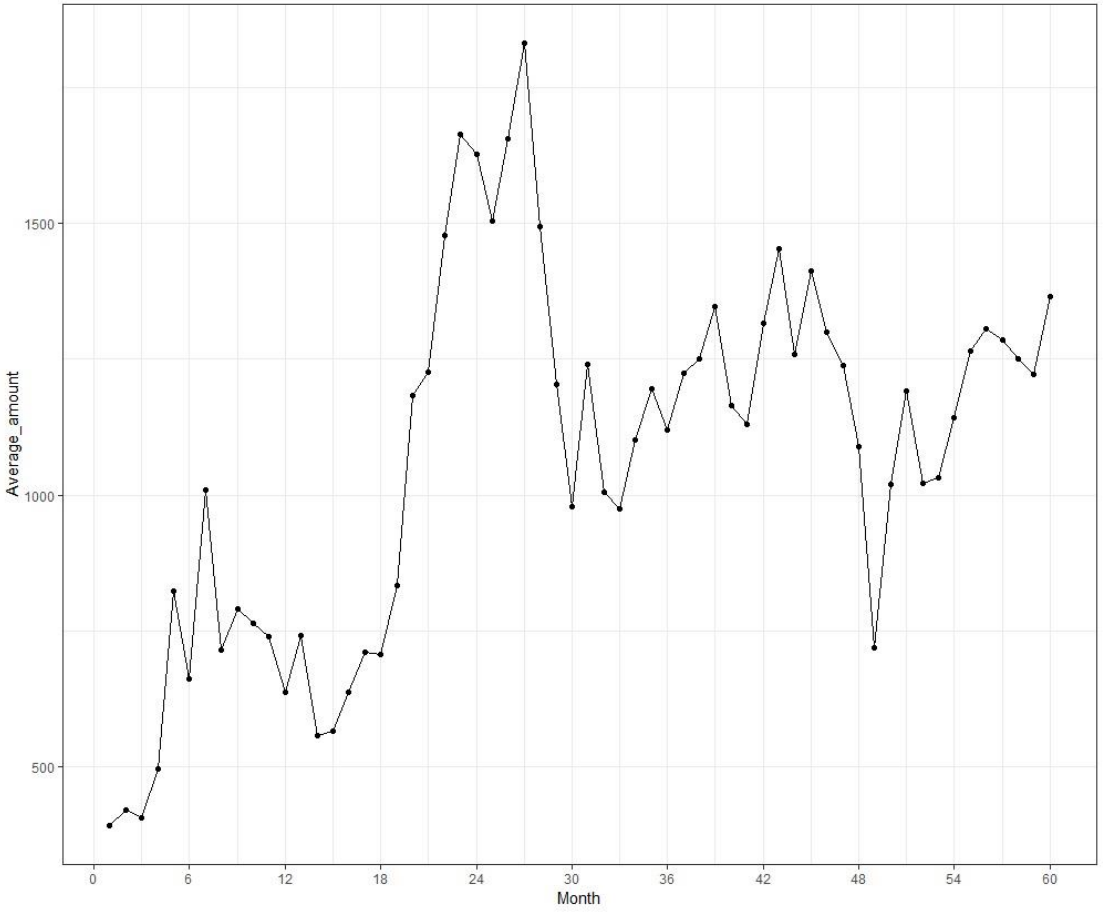
INTEREST, the interest rate that a borrower offers for the loan application

SUCCESS, a binary variable that is equal to 1 when the listed loan is funded and 0 otherwise

DEFAULT, a binary variable that is equal to 1 when a loan listing is delinquent or defaults, and 0 otherwise

3. Empirical Results

Average Amount of lending



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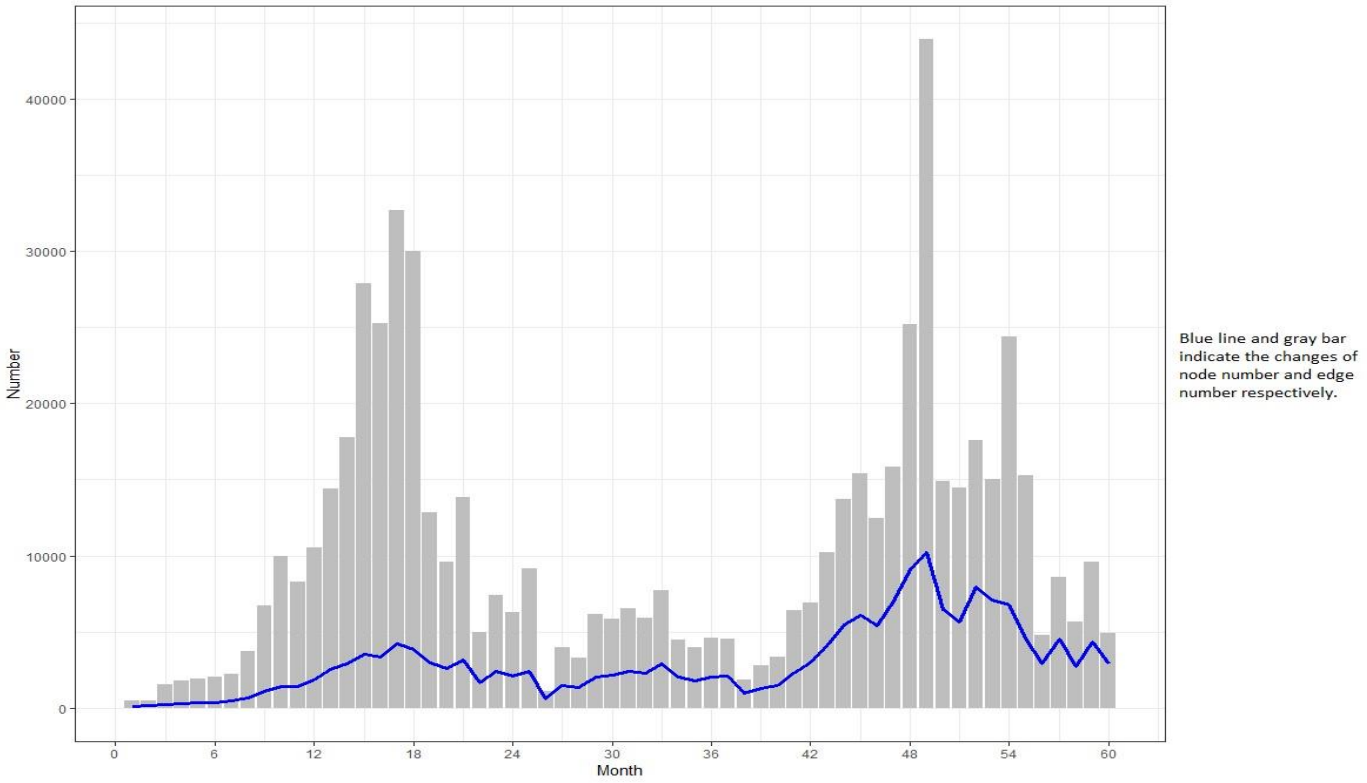
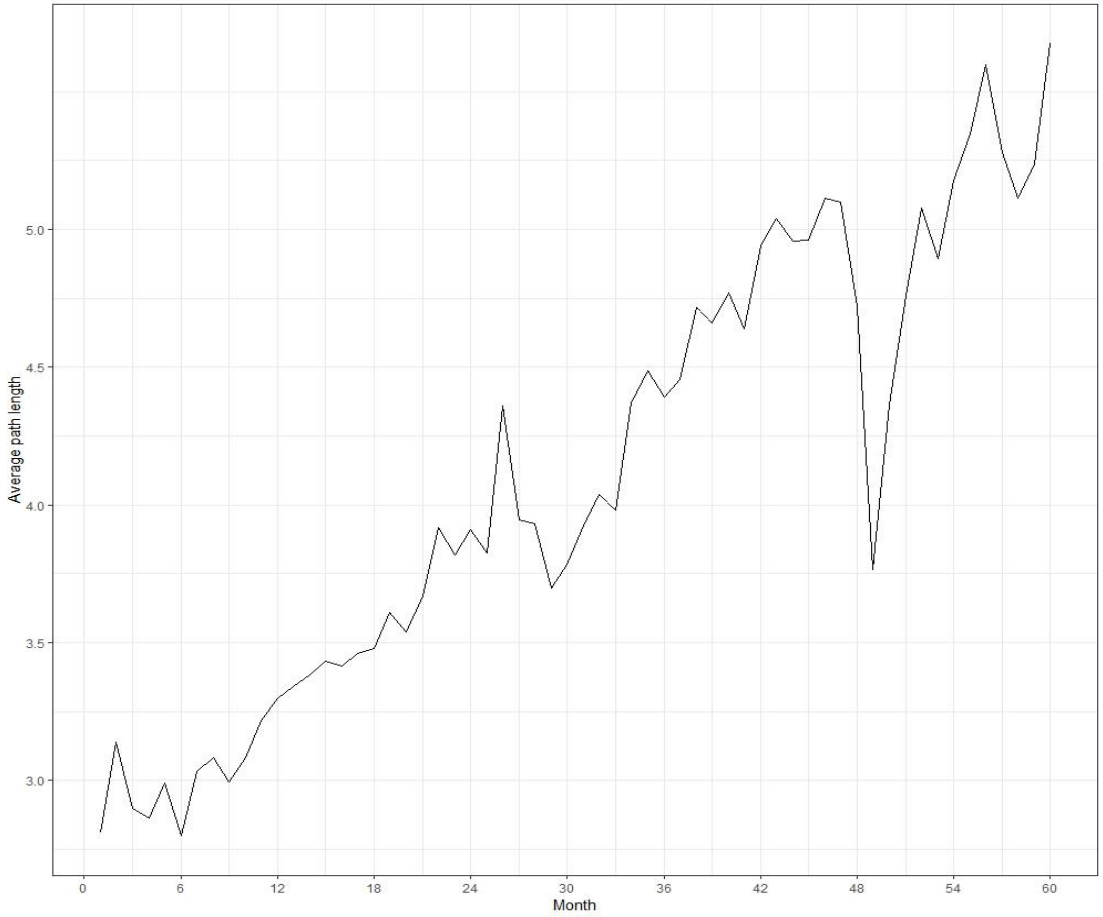
Edge and Node Numbers



Node: number of active market participants (blue line)

Edge: the number of bids for all successfully funded loan listings (grey bar)

Average path length



Average distance between any two platform participants

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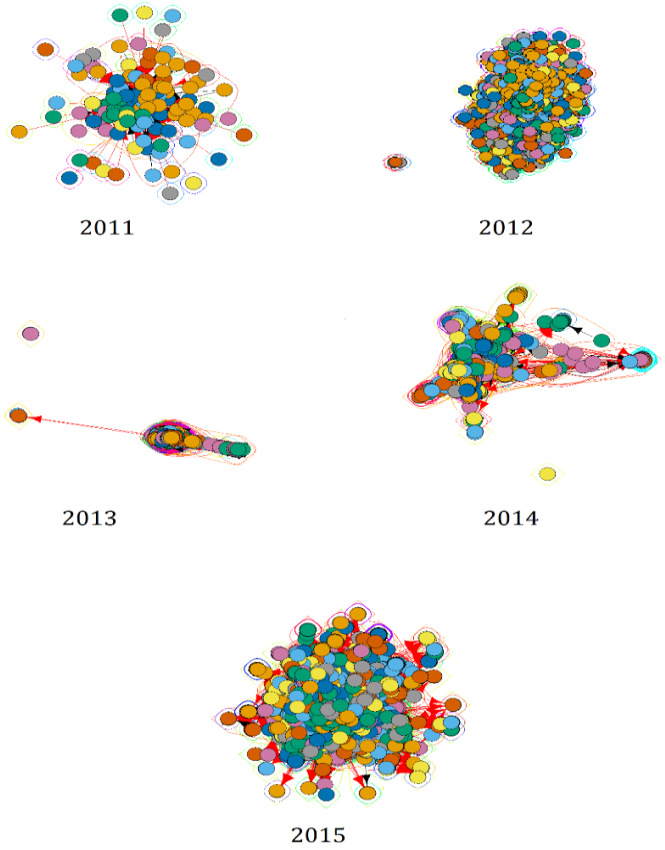
Time evolution of the Rerendai network



Each node is colored according to the community to which is attributed by the community detection algorithm. Starting from 602 in 2011, they grow to 1070 in 2012, 3284 in 2013; 6602 in 2014, and finally the largest number of communities of 8492, covering 7827 borrowers in 2015.

Network and Lending Behaviour

	(1)	(2)	(3)
	MONEY	MONEY	MONEY
Indegree		0.2270***	
		(14.00)	
Outdegree			0.0644***
			(80.29)
_cons	923.0199***	927.4454***	900.1641***
	(47.44)	(47.65)	(46.30)
Loan Fixed Effects	YES	YES	YES
Year	YES	YES	YES
Day of Week Fixed Effects	YES	YES	YES
Hour of Day Fixed Effects	YES	YES	YES
N	13,295,330	13,295,330	13,295,330
r2_a	0.1312	0.1312	0.1317

Money: the amount invested by a lender in each bid

Network and Lending Behaviour

	(1)	(2)	(3)
	FSTB_M	FSTB_M	FSTB_M
Indegree		-0.5302***	
		(-36.40)	
Outdegree			-0.0057***
			(-48.44)
_cons	2.6e+03***	2.6e+03***	2.6e+03***
	(212.38)	(213.19)	(212.63)
Loan Fixed Effects	YES	YES	YES
Year	YES	YES	YES
Day of Week Fixed Effects	YES	YES	YES
Hour of Day Fixed Effects	YES	YES	YES
N	13295330	13295330	13295330
r2_a	0.9987	0.9987	0.9987

FSTB: time interval between a borrower's post and a lender's bid

Network and Borrowing Behaviour

	INTEREST	INTEREST	INTEREST
Indegree		-0.0021***	
		(-25.41)	
Outdegree			-0.0016***
			(-10.41)
lnAMOUNT	0.1370***	0.1793***	0.1319***
	(10.94)	(14.24)	(10.52)
MONTHS	0.0614***	0.0593***	0.0610***
	(39.35)	(38.00)	(39.24)
CREDIT	-0.4637***	-0.3589***	-0.4139***
	(-46.81)	(-33.96)	(-41.14)
T_length	0.0287***	0.0295***	0.0279***
	(16.69)	(17.19)	(16.30)
N_length	-0.0125***	-0.0155***	-0.0160***
	(-3.10)	(-3.87)	(-4.00)
D_length	0.0002	0.0003**	0.0002
	(1.29)	(2.03)	(1.63)
_cons	10.6560***	10.1024***	10.7462***
	(69.32)	(65.43)	(70.19)
Personal Characteristics	YES	YES	YES
Year	YES	YES	YES
Region	YES	YES	YES
Industry	YES	YES	YES
Purpose	YES	YES	YES
N	58293	58293	58293
r2_a	0.3067	0.3126	0.3124

Network and Borrowing Behaviour

	SUCCESS	SUCCESS	SUCCESS
Indegree		0.0055***	
		(20.25)	
Outdegree			-0.0005***
			(-5.18)
lnAMOUNT	-0.7011***	-0.8382***	-0.7043***
	(-56.43)	(-61.52)	(-56.57)
INTEREST	-0.1176***	-0.1103***	-0.1202***
	(-32.09)	(-29.76)	(-32.45)
MONTHS	0.0045***	0.0099***	0.0046***
	(3.45)	(7.38)	(3.52)
CREDIT	0.4068***	0.2667***	0.4189***
	(42.14)	(24.00)	(42.25)
T_length	0.0186***	0.0170***	0.0185***
	(14.51)	(13.15)	(14.40)
N_length	-0.0428***	-0.0436***	-0.0437***
	(-11.77)	(-11.87)	(-12.01)
D_length	0.0014***	0.0013***	0.0014***
	(12.41)	(11.57)	(12.48)
Personal Characteristics	YES	YES	YES
Year	YES	YES	YES
Region	YES	YES	YES
Industry	YES	YES	YES
Purpose	YES	YES	YES
N	58293	58293	58293
r2_p	0.1883	0.2120	0.1891

Network and Borrowing Behaviour

	(1) DEFAULT	(2) DEFAULT	(3) DEFAULT
Indegree		-0.0008**	
		(-2.39)	
Outdegree			-0.0160
			(-1.37)
lnAMOUNT	0.1683***	0.2081***	0.1659***
	(4.49)	(5.22)	(4.42)
INTEREST	0.1233***	0.1219***	0.1210***
	(9.64)	(9.50)	(9.43)
MONTHS	0.0646***	0.0639***	0.0647***
	(23.16)	(22.74)	(23.13)
CREDIT	-2.0661***	-2.0605***	-2.0640***
	(-25.07)	(-25.06)	(-25.05)
T_length	0.0070**	0.0074**	0.0067**
	(2.34)	(2.46)	(2.23)
N_length	0.0081	0.0086	0.0083
	(1.01)	(1.07)	(1.04)
D_length	0.0006**	0.0006**	0.0006**
	(2.34)	(2.33)	(2.36)
Personal Characteristics	YES	YES	YES
Year	YES	YES	YES
Region	YES	YES	YES
Industry	YES	YES	YES
Purpose	YES	YES	YES
N	23374	23374	23374
r2_p	0.3155	0.3159	0.3162

Addressing Endogeneity Concerns

As default depends on success, we can only observe the defaults among the borrowers who have successfully obtained their loan requests funded but cannot observe defaults by those who fail to raise the fund

- Heckman Selection Model

Unobservable or omitted variables may contaminate our estimation results

- An exogeneous shock is introduced to investigate the effect of network centrality on lending behavior

Heckman Selection Model

An instrument that can be included in the first stage regression on funding success but excluded from the second stage regression on default (see e.g. Little, 1985)

We employ the total number of bidders for a loan (*BIDS*) as an instrument for model identification.

- the higher the number of lenders bidding for a loan, the more likely for it to be successfully funded.
- the number of bidders should not directly affect the actual default rate of a loan.

Heckman Selection Model

	(1) SUCCESS	(2) SUCCESS	(5) DEFAULT	(6) DEFAULT
BIDS	0.080***	0.080***		
	(33.96)	(33.51)		
Indegree	0.000***		-0.001**	
	(2.77)		(-2.06)	
Outdegree		-0.000		-0.016
		(-1.45)		(-1.39)
IMR_Indegree			0.110	
			(1.51)	
IMR_Outdegree				0.149**
				(2.10)
Loan characteristics	YES	YES	YES	YES
Year	YES	YES	YES	YES
Region	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Purpose	YES	YES	YES	YES
N	58293	58293	23374	23374
r2_p	0.494	0.494	0.316	0.316

Exogeneous shock

On July 18, 2015, the People's Bank of China, together with ten ministries, jointly issued “the Guiding Opinions on Promoting the Healthy Development of Internet Finance”. This is the first time that the Chinese government showed a positive signal to support the development of P2P lending. It strengthens the network advantage of lenders and encourage them to be more active in making investments.

$$Lending\ Behavior_i = \beta_0 + \beta_1 Treat_i \times \mathrm{POST}_t + \beta_2 Control_{i,} + \varepsilon_{i,}$$

Treated group: lenders who have investment records in Renrendai platform before July 18, 2015. These sophisticated lenders are bound to have a higher network centrality.

	(1)	(2)	(3)
	MONEY	LENDTIME	FSTB_M
Treat_POST	582.79***	0.05***	49.36***
	(9.08)	(3.37)	(14.91)
POST	-608.79***	0.92***	-60.81***
	(-4.53)	(41.40)	(-4.21)
Treat	-842.31***	-0.07***	-49.67***
	(-13.13)	(-4.30)	(-15.01)
_cons	1743.82***	0.45***	2623.84***
	(22.33)	(26.95)	(221.99)
Loan Fixed Effects	YES	YES	YES
Year	YES	YES	YES
Day of Week Fixed Effects	YES	YES	YES
Hour of Day Fixed Effects	YES	YES	YES
N	13295330	13295330	13295330

4. Conclusion

Summary

Employing data from Renrendai, a leading lending platform in China, we first gauge the position of each lender and borrower in the network

Lenders who are more central in the network not only invest by larger amounts but also invest more swiftly than their peers, reflecting the advantage arising from their position in the network.

Borrowers who are more central in the network are able to borrow at lower interest rates, and with higher success rates. At the same time, they are less likely to default.

Implications

Our data-driven results echo the existing literature that underlines the importance of a social network in shaping investment decisions and facilitating financial transactions.

Our findings also suggest that centrality measures could be used to infer the creditworthiness of borrowers.

More attentions shall be paid to the borrowers and lenders who are at the core of the network because their behavior and strategies have remarkable impacts on the market equilibrium.

Thank you very much for your attention!