

Determinants of P2P Lending: the Role of Information and Risk

Ester Faia

Goethe Universität

Frankfurt

Monica Paiella

Università Parthenope

Napoli

Peer-to-peer (P2P) lending

- P2P lending is the practice of lending money to individuals or businesses through online services that match lenders directly with borrowers

Market volumes

- P2P emerged in 2005 with UK Zopa
- P2P volumes have grown at 150% since 2010
- In 2015, P2P loans amounted to:
 - US: \$30bln / 2.5% of unsecured loans / 0.13% of GDP
 - EU: \$10bln / 1.8% of unsecured loans / 0.15% of GDP
 - China: \$160bln / 11% of unsecured loans and 1.5% of GDP
- Forecast: \$1trln in 2025 globally (*source*: Foundation capital)

Digital markets and their design

- In P2P platforms borrowers post loans (including rates), which are then sold to atomistic investors
- Direct matching lenders-borrowers: asymmetric information is pivotal
- In equilibrium, pooling price emerges as conditional probability of project success
- Subjective expectations about project success are key for liquidity
- Despite this P2P platforms are growing and feature low default rates and risk premia (Prosper data)

Our paper

- Model with lemons market and traditional banking sector, featuring the risk of runs
- Used to study the role of:
 - risk in the banking sector; and,
 - information on the platform for P2P market liquidity
- Introduce signals that directly affect subjective expectations of project success
- Data analysis: Prosper data

The model

- Risk averse households/lenders who maximize life-time utilities and choose between:
 - bank deposits → risk of run; and
 - investment in P2P loans → information asymmetry
- Borrowers who can borrow:
 - from banks → liquidity shortage, early liquidation, collateral
 - on P2P platform → higher rate due to information asymmetry
- Banks act as delegated monitors
- Signals that reduce the information asymmetry

The problem of lenders

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U(C_t)$$

$$s. t. \quad C_t + r_t X_t + D_t \leq Y_t + X_{t-1} + \overline{\theta}_{t-1} R_{t-1} D_{t-1}$$

$$X_t = \alpha_t W_t; \quad D_t (1 - \alpha_t) W_t$$

The problem of lenders

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U(C_t)$$

$$s. t. \quad C_t + r_t X_t + D_t \leq Y_t + X_{t-1} + \overline{\theta}_{t-1} R_{t-1} D_{t-1}$$

$$X_t = \alpha_t W_t; \quad D_t(1 - \alpha_t) W_t$$

P2P loans

Bank deposits

Price of P2P loans

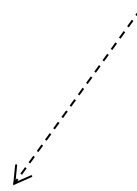
The problem of lenders

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U(C_t)$$

$$s. t. \quad C_t + r_t X_t + D_t \leq Y_t + X_{t+1} + \overline{\theta_{t-1} R_{t-1}} D_{t-1}$$

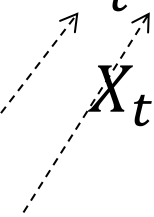
$$X_t = \alpha_t W_t; \quad D_t(1 - \alpha_t) W_t$$

Gross return



s. t.

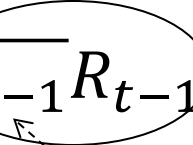
P2P loans



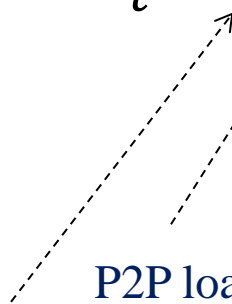
Bank deposits



Rate of discount



Price of P2P loans



The problem of borrowers

- Risky project with success probability p
- Funding through traditional banking system:
 - Risk of liquidity shortage and early liquidation, with probability ζ
- P2P loans:
 - Loans are always brought to maturity, but higher rates due to information asymmetry
 - Can issue signals

Main results (1)

- A pooling price (conditional expectation) of P2P loans:

$$r_t = \frac{\varsigma_t p}{1 - p + \varsigma_t p}$$

Main results (1)

- A pooling price (conditional expectation) of P2P loans:

$$r_t = \frac{\zeta_t p}{1 - p + \zeta_t p}$$

Risk of liquidity shortage

Probability of project success

Main results (1)

- A pooling price (conditional expectation) of P2P loans:

$$r_t = \frac{\zeta_t p}{1 - p + \zeta_t p} < \mathbf{p}$$

Main results (1)

- A pooling price (conditional expectation) of P2P loans:

$$r_t = \frac{\varsigma_t p}{1 - p + \varsigma_t p}$$

- The loan spread:

$$\Psi_t = 1 - r_t = \frac{1 - p}{1 - p + \varsigma_t p}$$

Main results (2)

- Participation decision depending on the rate of discount on deposits:

$$\theta \leq \frac{1}{\zeta_t p R_t} \left[\frac{1 - p + \zeta_t p}{\zeta_t} \right] - \frac{1 - \zeta_t}{\zeta_t}$$

(Haircut tied to losses from defaults in case of run or shortage of bank's liquidity)

The role of signals

- Signals providing **hard** (quantitative and verifiable) and **soft** (more subjective) information reduce the information asymmetry

The role of signals

- Signals providing **hard** (quantitative and verifiable) and **soft** (more subjective) information reduce the information asymmetry
- Assume: $\frac{\partial p}{\partial S} > 0$
- The price of P2P loans becomes:

$$r_t = \frac{\varsigma_t p(S)}{1 - p(S) + \varsigma_t p(S)}$$

Predictions (1)

Loan spread ($1-r_t$)

Subjective probability
that the project is good

1. $\frac{\partial \Psi_t}{\partial p} < 0$

If investors believe that the project is good they will be willing to pay higher prices

Predictions (1)

1. $\frac{\partial \Psi_t}{\partial p} < 0$

If investors believe that the project is good they will be willing to pay higher prices

Prices depend on **signals** through their effect on subjective probabilities

If firms can issue **signals**, a larger share of good firms will fund themselves on the platform

Signals increase liquidity

Predictions (2)

Loan spread ($1-r_t$)

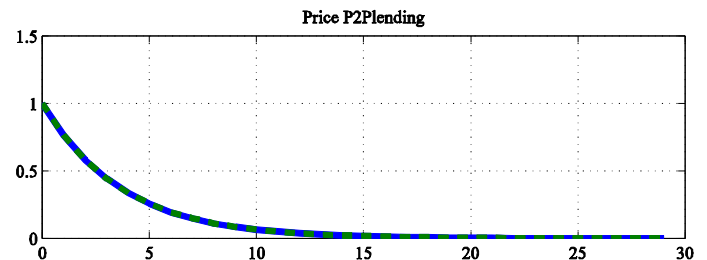
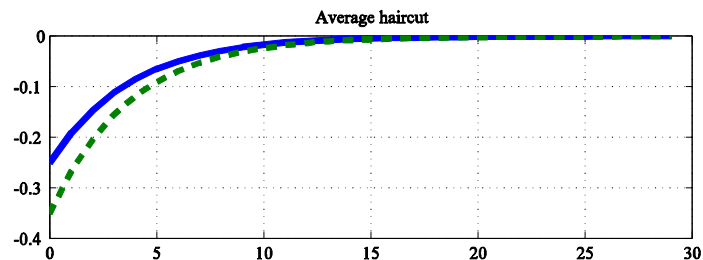
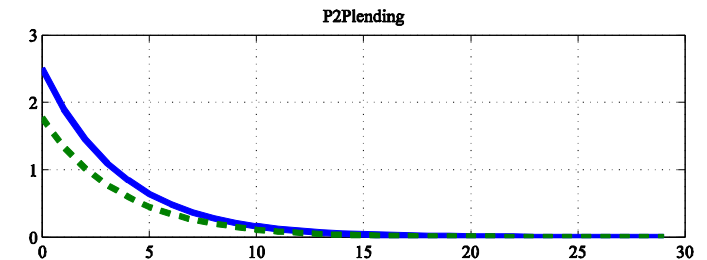
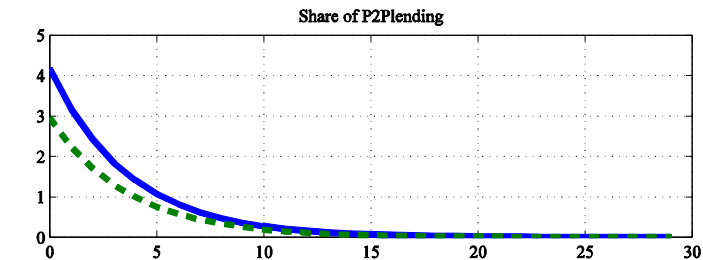
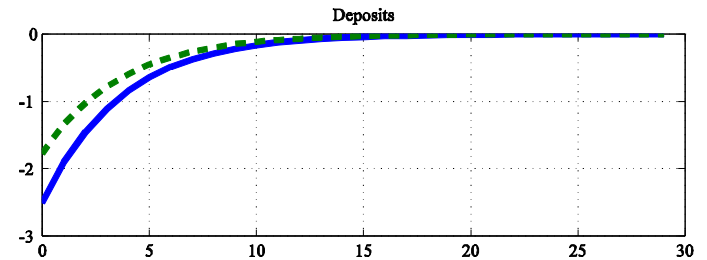
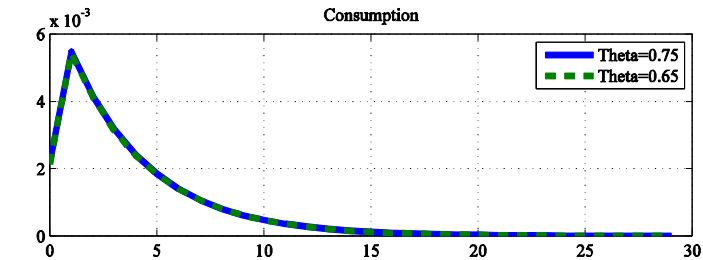
2. $\frac{\partial \Psi_t}{\partial \zeta_t} < 0$

Risk of liquidity shortage
in banking sector

The higher the risk of liquidity shortage, the larger the share of good projects funded on the platform

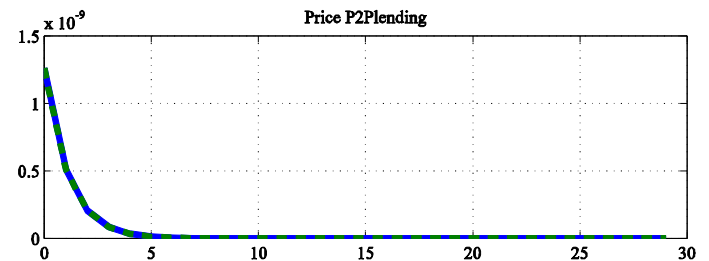
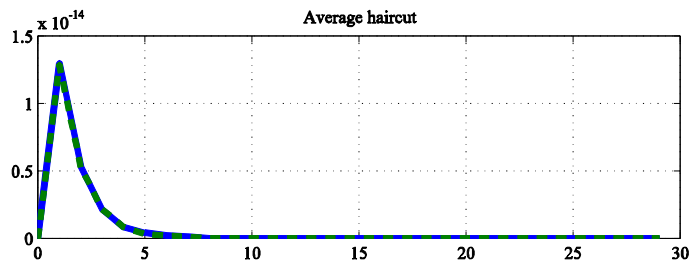
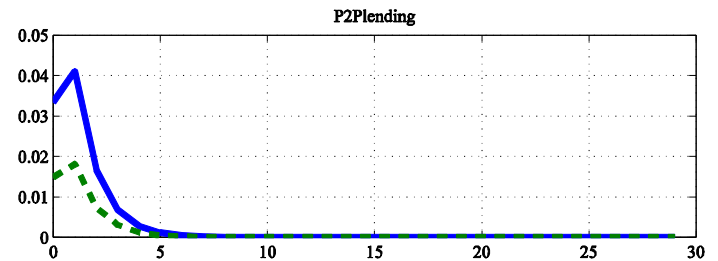
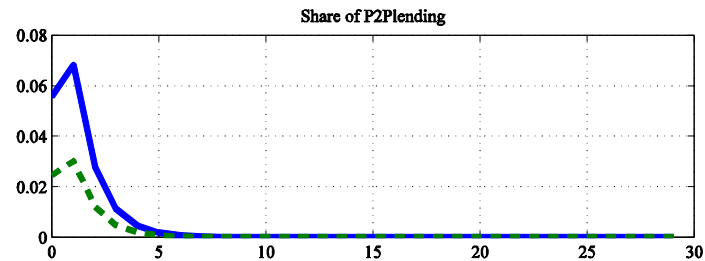
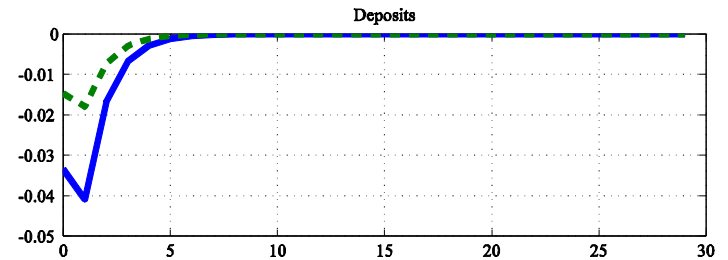
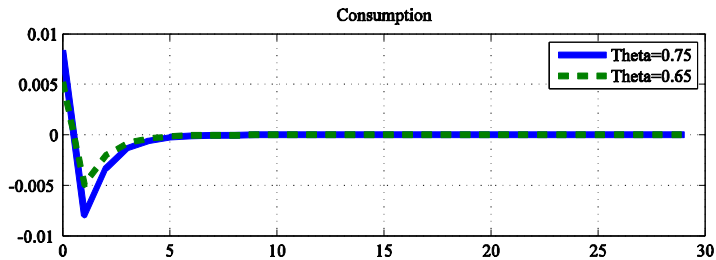
→ higher liquidity

Simulations



Impulse responses of selected variables to 1% liquidity shock

Simulations



Impulse responses of selected variables to 1% increase in p

Prosper Data (2006-2014)

- Borrowers personal profiles: amount requested, interest rate, term and purpose of loan
- Plus independently verified information on his credit history (FICO score, open credit lines, delinquencies), income and other debts
- Prosper creates social networks:
 - links borrowers in groups (tied by geography, common interests, or common loan purpose)
 - collects endorsements of other Prosper members (friends)
- Note: In 2009, Prosper changed its business model from eBay-style auctions to rates determined by proprietary algorithm

Table 1a – Summary statistics

Year of the loan	2006	2007	2008	2009	2010	2011	2012	2013	2014
Borrower lending rate	0.191 (0.069)	0.177 (0.064)	0.186 (0.085)	0.193 (0.091)	0.213 (0.098)	0.230 (0.079)	0.220 (0.077)	0.184 (0.061)	0.153 (0.054)
Borrower APR	0.201 (0.070)	0.186 (0.066)	0.204 (0.089)	0.216 (0.095)	0.239 (0.106)	0.262 (0.086)	0.253 (0.082)	0.214 (0.065)	0.182 (0.059)
Size of loans	4763 (4404)	7050 (6126)	6022 (5400)	4355 (4070)	4767 (3714)	6692 (4273)	7834 (5527)	10545 (6575)	11912 (6684)
Term (months)	36	36	36	36	36	37	43	45	44
Time for funding (median)	9	11	10	14	12	10	8	6	5
Lenders' investment:	23	126	122	98	55	286	381	5,762	9,131
No. of investors: mean/median	57/36	127/92	136/95	146/93	134/103	80/55	82/53	56/1	29/1
Loans funded by one investor (%)	2	1	1	1	<1	1	2	51	75
Loans for debt consolidation (%)			42	46	47	48	48	74	79
home improvement (%)			5	9	10	11	11	6	4
business (%)			16	11	10	11	9	4	3
other (%)			37	34	33	30	32	16	14
# observations	5,906	11,460	11,552	2,047 ⁽¹⁾	5,652	11,228	19,553	33,910	11,734 ⁽²⁾

Table 1b – Loan status

Year of the loan	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Completed	61%	61%	67%	85%	83%	49%	28%	7%	1%	34%
Current	-	-	-	-	-	29%	54%	89%	99%	49%
Past Due (1-120 days)	-	-	-	-	-	3%	4%	3%	-	2%
Chargedoff	16%	26%	24%	11%	14%	16%	12%	1%	-	11%
Defaulted	23%	14%	9%	4%	3%	3%	2%	0%	-	4%
	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>

Table 2 – Hard and soft information about borrowers

Year of the loan	2006	2007	2008	2009	2010	2011	2012	2013	2014
Mean FICO score ⁽¹⁾	609	654	674	715	714	709	711	708	703
# of open credit lines		8	8	9	8	8	8	10	11
# of credit inquiries	11	10	8	6	4	4	4	4	4
Borrowers w/ delinquencies (%)	52	39	23	11	14	21	20	15	10
Prosper credit rating				4.286 (1.937)	3.837 (1.985)	3.552 (1.710)	3.688 (1.829)	4.258 (1.468)	4.718 (1.387)
Estimated loss				0.075	0.093	0.097	0.091	0.073	0.062
Estimated return at issuance				0.103	0.103	0.115	0.110	0.088	0.073
Debt-income ratio	0.249 (0.737)	0.431 (1.318)	0.254 (0.342)	0.228 (0.152)	0.230 (0.299)	0.251 (0.402)	0.264 (0.464)	0.264 (0.243)	0.259 (0.113)
Monthly income	4,744 (5,207)	4,654 (4,711)	4,619 (3,705)	5,092 (3,225)	5,291 (4,099)	5,660 (8,544)	5,710 (13,350)	6,161 (5,664)	6,336 (4,382)
Borrowers in a group (%)	70	51	14	11	9	5	3	1	1
Borrowers with recomm. from friends (%)		17	18	8	6	3	2	1	<1
Borrowers with invest. from friends (%)		6	7	5	4	1	1	<1	<1
\$ investment from friends		939	1017	713	773	572	429	233	298
Borrowers with previous Prosper loans (%)		4	15	43	34	34	28	19	10
# observations	5,906	11,460	11,552	2,047	5,652	11,228	19,553	33,910	11,734

Empirical model

- OLS regressions of lending rates on:
 - loan characteristics (size, term, motive)
 - dummies for quarter of listing and state of address of borrower
 - signals conveying hard information (FICO score, Prosper rating, # of open credit lines, # of credit inquires, dummy for delinquencies, monthly income, and debt-to-income ratio)
 - signals conveying soft information (dummies for participation in a group, for endorsement from Prosper friends w/ or w/out investment, and for previous borrowing on the platform)
 - the ratio of currency to demand deposits to capture the risk of a shock to liquidity (Gorton)

Table 6 – OLS regressions of lending rates on loan characteristics

	All	Pre-SEC ⁽¹⁾	Post-SEC
Loan size (thousands)	-0.090 (0.001)***	-0.078 (0.003)***	-0.102 (0.001)***
Loan size (thousands) ²	0.019 (0.000)***	0.025 (0.001)***	0.020 (0.000)***
Term (months)	0.011 (0.000)***	-	0.012 (0.000)***
Debt consolidation ^(*)	0.004 (0.001)***	0.013 (0.002)***	0.005 (0.001)***
Home improvement ^(*)	-0.003 (0.001)***	-0.006 (0.003)*	-0.003 (0.001)***
Business funding ^(*)	0.008 (0.001)***	0.001 (0.002)	0.010 (0.001)***
<i>Adjusted R</i> ²	0.23	0.12	0.28
<i>N</i>	107,549	23,569	83,980

Table 7 – OLS regress. of lending rates on loan characteristics and signals

	All	Pre-SEC	Post-SEC	Pre-SEC	Post-SEC	Post-SEC
...
FICO score (hundreds)	-0.070 (0.000)***	-0.071 (0.001)***	-0.073 (0.000)***	-0.071 (0.001)***	-0.073 (0.000)***	-0.079 (0.000)***
Open credit lines (tens)	0.003 (0.000)***	0.005 (0.001)***	0.001 (0.001)	0.005 (0.001)***	0.001 (0.001)	0.003 (0.001)***
Credit enquiries (tens)	0.017 (0.000)***	0.009 (0.001)***	0.024 (0.001)***	0.009 (0.001)***	0.025 (0.001)***	0.030 (0.001)***
Current delinquencies	0.012 (0.001)***	0.027 (0.001)***	0.008 (0.001)***	0.028 (0.001)***	0.009 (0.001)***	0.009 (0.001)***
Monthly income (thousands)	-0.001 (0.000)***	0.001 (0.001)	-0.001 (0.000)***	-0.000 (0.000)	-0.001 (0.000)***	-0.000 (0.000)***
Debt/Income	0.012 (0.001)***	0.003 (0.000)***	0.028 (0.002)***	0.004 (0.000)***	0.028 (0.002)***	0.029 (0.002)***
Group dummy				-0.005 (0.001)***	-0.019 (0.001)***	0.000 (0.001)
Recommend + no investm.				0.000 (0.001)	-0.025 (0.002)***	-0.004 (0.002)*
Recommend + investm.				-0.019 (0.002)***	-0.015 (0.004)***	-0.009 (0.004)**
Investm.+ no recommend.				-0.045 (0.007)***	-0.011 (0.004)***	-0.007 (0.004)
Previous Prosper loan						-0.042 (0.000)***
<i>Adjustment R²</i>	0.49	0.59	0.51	0.59	0.51	0.56
<i>N</i>	95,396	18,630	76,766	18,630	76,766	76,766

Table 8 – Lending rates, banking panics and signals

	All	Pre-SEC	Post-SEC	Pre-SEC	Pre-SEC	Post-SEC
...						
Currency to deposits ⁽¹⁾ : previous yr average	-0.058 (0.010)***	-0.066 (0.037)*	-0.029 (0.012)**	0.081 (0.033)**		-0.017 (0.010)*
Currency to deposits: % change	-0.041 (0.014)***	-0.013 (0.029)	-0.052 (0.015)***	-0.016 (0.022)		-0.097 (0.012)***
Bank run ^{(*) (2)}					-0.002 (0.001)**	
FICO score (hundreds)				-0.071 (0.001)***	-0.071 (0.001)***	-0.079 (0.000)***
Open credit lines (tens)				0.005 (0.001)***	0.005 (0.001)***	0.003 (0.001)***
Credit enquiries (tens)				0.009 (0.001)***	0.009 (0.001)***	0.030 (0.001)***
Current delinquencies ^(*)				0.028 (0.001)***	0.028 (0.001)***	0.009 (0.001)***
Monthly income (hundreds of thousands)				-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)***
Debt/Income				0.004 (0.000)***	0.004 (0.000)***	0.029 (0.002)***
Group dummy ^(*)				-0.005 (0.001)***	-0.005 (0.001)***	0.000 (0.001)
Recommend + no investm. ^(*)				0.000 (0.001)	0.000 (0.001)	-0.004 (0.002)*
Recommend + investm. ^(*)				-0.019 (0.002)***	-0.019 (0.002)***	-0.009 (0.004)**
Investm.+ no recommend. ^(*)				-0.045 (0.007)***	-0.045 (0.007)***	-0.006 (0.004)
Previous Prosper loan ^(*)				-0.002 (0.001)	-0.002 (0.001)	-0.042 (0.000)***
<i>Adjustment R²</i>	0.23	0.12	0.29	0.59	0.59	0.56

Concluding remarks

- Impressive growth of P2P platforms over recent years
 - Operating in most markets including high growth economies like China
- Potential risk for the profitability of the banking sector
- Could foster the build up of the capital market union
- Availability of signals reduces the risks from asymmetric information

Table 3 – Borrowers who are part of a group

	2006-2008		2009-2010		2011		2012		2013		2014	
	In group		In group		In group		In group		In group		In group	
	0	1	0	1	0	1	0	1	0	1	0	1
Loan status												
Completed	66%	58%	83%	87%	49%	56%	28%	33%	7%	11%	1%	1%
Current	0%	0%	0%	0%	29%	26%	54%	53%	90%	84%	99%	99%
Past due (1-120 days)	0%	0%	0%	0%	3%	2%	4%	4%	3%	3%	0%	0%
Charged off or defaulted	34%	42%	17%	13%	19%	16%	14%	10%	1%	1%	0%	0%
	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
Borrower APR	0.193	0.201	0.232	0.244	0.263	0.252	0.254	0.226	0.214	0.191	0.183	0.161
	<i>(0.081)</i>	<i>(0.071)</i>	<i>(0.104)</i>	<i>(0.102)</i>	<i>(0.086)</i>	<i>(0.089)</i>	<i>(0.818)</i>	<i>(0.080)</i>	<i>(0.065)</i>	<i>(0.075)</i>	<i>(0.059)</i>	<i>(0.064)</i>
Estimated return			0.105	0.092	0.116	0.111	0.110	0.105	0.089	0.083	0.073	0.068
			<i>(0.050)</i>	<i>(0.060)</i>	<i>(0.032)</i>	<i>(0.034)</i>	<i>(0.029)</i>	<i>(0.031)</i>	<i>(0.019)</i>	<i>(0.023)</i>	<i>(0.014)</i>	<i>(0.016)</i>
Prosper rating			4.010	3.429	3.550	3.598	3.676	4.179	4.251	4.799	4.722	5.209
Mean FICO score ⁽¹⁾	669	627	716	699	710	697	712	695	709	702	703	702
Time for funding (median)	10	11	12	13	10	9	8	7	6	7	5	6
# observations	17,252	11,666	6,953	746	10,676	552	19,066	487	33,499	412	11,666	67

Table 4 – Borrowers with recommendations from Prosper friends

	2007-2008 w/friends ^(*)		2009-2010 w/friends		2011 w/friends		2012 w/friends		2013 w/friends		2014 w/friends	
	0	1	0	1	0	1	0	1	0	1	0	1
Loan status												
Completed	63%	66%	83%	88%	49%	58%	28%	37%	7%	14%	0%	0%
Current	0%	0%	0%	0%	29%	29%	54%	52%	89%	83%	99%	100%
Past due (1-120 days)	0%	0%	0%	0%	3%	1%	5%	4%	3%	3%	1%	0%
Chargedoff or defaulted	37%	34%	17%	12%	19%	12%	13%	7%	1%	<1%	0%	0%
	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
Borrower APR	0.197	0.192	0.233	0.231	0.263	0.248	0.254	0.220	0.214	0.184	0.183	0.150
	<i>(0.077)</i>	<i>(0.078)</i>	<i>(0.104)</i>	<i>(0.104)</i>	<i>(0.086)</i>	<i>(0.088)</i>	<i>(0.082)</i>	<i>(0.076)</i>	<i>(0.065)</i>	<i>(0.075)</i>	<i>(0.059)</i>	<i>(0.068)</i>
Estimated return			0.105	0.081	0.116	0.111	0.110	0.105	0.089	0.080	0.073	0.065
			<i>(0.050)</i>	<i>(0.059)</i>	<i>(0.032)</i>	<i>(0.034)</i>	<i>(0.029)</i>	<i>(0.033)</i>	<i>(0.019)</i>	<i>(0.024)</i>	<i>(0.014)</i>	<i>(0.017)</i>
Prosper rating			3.974	3.614	3.549	3.690	3.680	4.295	4.253	4.948	4.723	5.522
Mean FICO score ⁽¹⁾	652	663	715	706	709	696	711	696	708	705	703	708
Friends who invest (%)	1	45	2	42	1	20	0	14	0	11	0	13
# observations	25,887	3,031	7,272	427	10,938	290	19,299	254	33,679	232	11,710	23

Table 5 – Borrowers with prior loans through Prosper

	2007-2008		2009-2010		2011		2012		2013		2014	
	Prior loans ^(*)		Prior loans		Prior loans		Prior loans		Prior loans		Prior loans	
	0	1	0	1	0	1	0	1	0	1	0	1
Loan status												
Completed	63%	69%	82%	86%	49%	50%	28%	30%	6%	10%	1%	1%
Current	0%	0%	0%	0%	27%	32%	54%	53%	91%	85%	99%	99%
Past due (1-120 days)	0%	0%	0%	0%	3%	3%	4%	5%	3%	3%	0%	0%
Chargedoff or defaulted	37%	31%	18%	14%	21%	15%	14%	12%	1%	2%	0%	0%
	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
Borrower APR	0.194	0.203	0.224	0.249	0.271	0.245	0.263	0.227	0.218	0.199	0.185	0.171
	<i>(0.078)</i>	<i>(0.086)</i>	<i>(0.103)</i>	<i>(0.103)</i>	<i>(0.086)</i>	<i>(0.085)</i>	<i>(0.082)</i>	<i>(0.075)</i>	<i>(0.063)</i>	<i>(0.071)</i>	<i>(0.059)</i>	<i>(0.058)</i>
Estimated return			0.107	0.097	0.117	0.111	0.111	0.107	0.089	0.086	0.073	0.070
			<i>(0.047)</i>	<i>(0.056)</i>	<i>(0.032)</i>	<i>(0.032)</i>	<i>(0.029)</i>	<i>(0.028)</i>	<i>(0.018)</i>	<i>(0.022)</i>	<i>(0.014)</i>	<i>(0.014)</i>
Prosper rating			4.255	3.424	3.458	3.731	3.502	4.178	4.163	4.658	4.697	4.973
Mean FICO score ⁽¹⁾	664	665	725	697	718	693	719	689	710	703	703	702
# observations	26,700	2,218	4,985	2,804	7,361	3,867	14,165	5,388	27,444	6,466	10,556	1,177