Bank of One: Empirical Analysis of Peer-to-Peer Financial Marketplaces

Sanjeev Kumar
University of Michigan

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Bank of One: Empirical Analysis of Peer-to-Peer Financial Marketplaces

Sanjeev Kumar
Ross School of Business, University of Michigan, Ann Arbor
sankum@umich.edu

Abstract

Peer to peer financial marketplaces provide a platform for individual lenders and borrowers to interact and transact. These marketplaces disintermediate the traditional financial services business models. In this exploratory paper we study the operation and effectiveness of one such marketplace: Prosper.com. We analyze six months of lender, borrower and loan repayment data to answer preliminary research questions about lender behavior, market effectiveness and antecedents of loan default. We show that lenders mostly behave rationally and charge appropriate risk premiums for antecedents of loan default. We also show that there are mismatches between risk premiums charged and relative importance of factors that drive loan default. We then explore the dynamic process of lenders adjusting their lending strategies to reduce these mismatches. We analyze the effectiveness of the group reputation used in the marketplace and show that it is not effective in promoting good borrower behavior. Our analysis provides a base for future research in this exciting and evolving context. Our results provide directions for practice applications as well as future research in design of financial marketplaces, investing and risk mitigation strategies and improving the effectiveness of peer-to-peer financial marketplaces.

Keywords: Peer-to-peer, financial marketplace, e-commerce, prosper.com,

Introduction

Internet and the digital economy have transformed the financial services industry. The first era of Internet-led transformation was led by lower transaction cost that allowed transaction volumes to increase and provided banks and other financial services firms like Charles Schwab with cheaper channels to reach customers. However, the impact of Internet on financial services industry is taking a larger shape than just lowering of transaction cost. Clemons, Hitt et al (2002) argue that the three main impact of Internet and e-commerce on financial services industry are disintermediation, differential pricing and transparency. Malone, Yates, and Benjamin (1987) argue that increasing use of IT will lead to an overall shift toward the use of electronic markets rather than hierarchies to coordinate economic activity. As the cost of communication and searching other participants of the electronic markets reduce, it becomes feasible for individuals to transact on the market rather than going to a firm. The “old” Internet was all about reducing communication and transaction cost which led to formation of large B2B and B2C electronic marketplaces. However, the “new” Internet or Web2.0 allows individuals to collaborate and harnesses the collective intelligence and decision making power of a large group of individuals (Oreillynet.com 2007). This reduces the searching cost associated with finding other members of C2C electronic markets and makes C2C markets more viable. Peer to peer financial marketplaces are a result of this growing trend towards Web2.0 enabled C2C electronic markets.
In traditional business model of a bank, the bank acts as the aggregator and manager of deposits and loans. Banks take deposits from individuals at a lower interest rate and lend the money to others at a higher interest rate. The difference between the two interest rates, called the spread, is the main source of bank’s income. For example – a recent sample of prevailing interest rates indicate that while prime lending rate for banks is 8.25% (Bankrate.com 2007b), the deposit rate for a 1 year deposit is only 4.8% (Bankrate.com 2007a), giving the bank a spread of 3.25% even for the prime borrowers. Peer to peer financial marketplaces allow lenders (individuals who deposit) and borrowers to interact, transact and take a share of the spread. Recent loans to quality borrowers at a peer to peer financial marketplace carried an average interest rate of only 7.79% (Prosper.com 2007a), which is lower than the prime rate, indicating that the marketplaces are allowing the borrowers to get a share of the spread which would otherwise have gone to the bank.

Peer to peer financial marketplaces have alternately been called “the eBay for loans” (Hof 2006; Pearlstine 2006). Borrowers list their requirements and the maximum interest rate they would be willing to pay and lenders then bid on the loan listings. If there is sufficient interest in the listing then the loan interest rate is bidded down and the loan is finalized at the market clearing interest rate. The marketplace works as the platform provider and takes a commission from the borrowers and the lenders. The essential concept of peer to peer financial marketplaces has also been extended towards charitable lending or “social lending”. For example: Kiva.org provides a platform for individuals to lend interest free to entrepreneurs in developing countries (Kiva.com 2007). Although profit oriented marketplaces like Prosper.com, where lender’s have an opportunity to get attractive returns, have also been sometimes clubbed together with marketplaces solely devoted to social lending (Vanderkam 2006), in this paper we have assumed that lenders are working for profit motive and are trying to maximize their returns for the given risk profile of their investment. Informal discussions with lenders at Prosper.com support the assumption.

The first peer to peer financial marketplace in the US, Prosper.com, was established on Feb 13, 2006. Since then the platform has witnessed rapid growth and now has more than 8000 loans with total loan origination of over $41 million. Prosper.com boasts of more than 180,000 registered users and currently clocks more than $6 millions in new loans every month (Prosper.com 2007b).

Peer to peer financial marketplaces are in their early stages of evolution and corresponding lender and borrower behaviors in the marketplace are still evolving. This presents a unique opportunity for Information Systems researchers to study novel organizational forms and business models, design of such platforms and their effect on borrower and lender behaviors; and finally, transformative impact of such technology led disintermediation on wider financial services industry. In this paper we present an exploratory analysis of one peer to peer financial marketplace, Propser.com, to provide the foundation for future research on this phenomenon. We analyze six months of lender, borrower and loan repayment data collected from Prosper.com to analyze the following preliminary research questions:

- Do lenders follow rational lending practices while lending on the marketplace? That is, what factors affect their lending strategy and whether they are in line with rational expectations?
- Do lenders follow efficient lending practices while lending on the marketplace? That is, what are the antecedents of loan default and whether lenders charge appropriate risk premiums for factors that drive loan defaults?
- What is the impact of group reputation systems on borrower and lender behavior? (more information on group reputation system used by peer to peer financial marketplaces are provides in later sections)
- Is the marketplace evolving to achieve higher lending efficiency? That is, are lenders adjusting their lending strategies and charging appropriate risk premiums as more information becomes available on antecedents of loan defaults and the relative importance of these factors that drive loan defaults?

The above research questions address the fundamental questions about the evolution and the effectiveness of peer to peer financial marketplaces in a rigorous empirical setting. They establish the baseline demonstrating rational basis for their operations and uncover unique facets of these marketplaces. More importantly, they form the basis for future research with more complex relationships and richer constructs in a novel context in early stages of its evolution. This research is also relevant for practice as it provides directions for optimal design of such marketplaces and the associated group reputation systems and uncovers antecedents of borrower and lender behavior in these marketplaces that can be used for assessing future scalability and efficiency of the market, devising investment strategies and risk mitigation approaches etc.
The rest of the paper is organized as follows: the next section provides details of how peer to peer financial marketplaces work with specific example of Prosper.com. Then we discuss prior literature relevant to the study followed by development of exploratory hypotheses and propositions. We then present the data used for the analysis and describe the preliminary results. Finally we discuss the results, their implications and the limitations of the study.

How Peer-to-Peer Financial Marketplaces Work?

We will use Prosper.com as the typical (and currently the only available example in the US) example of a peer to peer financial marketplace. The service is essentially positioned as an eBay style loan marketplace. Prosper matches people who need small loans, but can't get them from traditional banks (or get them from traditional banks at higher interest rates than those available at the marketplace), with willing lenders. It is the first such peer to peer financial marketplace in US; although Zopa.com provides a similar service in Britain. BusinessWeek (Hof 2006) explains Prosper.com’s working as follows: People who want a loan of up to $25,000, put it up for bid at a maximum interest rate they're willing to pay. Although they can remain anonymous to everyone but Prosper and regulatory authorities, they must submit to having their credit record checked and their credit grades displayed on their listing. They also must provide details of their annual income for calculating their debt to income ratio. Lenders bid in increments starting at $50, usually just for a portion of the loan. Prosper provides borrowers and lenders information on standard interest rates and default rates associated with the various credit rating levels, so they can make judgments about reasonable payments and risk levels. When the listing ends, the bids with the lowest rates are combined to produce a single loan that's repaid over three years. Prosper draws payments from the borrower's bank account and sends them monthly to the various lenders' accounts. Prosper charges borrowers a fee equal to 1% of the funded loans, as well as a 0.5% annual loan-servicing fee to lenders.

If a borrower fails to pay, Prosper refers the loan to collection agencies chosen by lenders. Prosper has also implemented a group membership system that attempts to introduce collective reputation for borrowers. People can form groups of borrowers whose collective repayment record is made public. It is expected that people will be less likely to default if they know their delinquency will hurt a group of people they know, and that the group leaders will be inclined to make sure members don't miss payments. Group leaders get cash incentives when a loan is repaid in time. Group leaders can choose to keep or share rewards with the borrowers. If a borrower defaults then it is reported to the credit agencies.

Expected Lender Behavior

We expect lenders to be rational profit maximizers. Specifically, we expect that after controlling for interest rate and loan amounts lenders will bid more for listings that have characteristics indicative of higher credit quality and lower risk of default. We can formalize this argument in the form of the following proposition:

**Proposition 1**: Lenders will bid more for loan listings with higher credit quality for the same level of risk.

We can further specify this proposition in the form of testable hypotheses as follows. The very first indication of credit risk of a borrower is the credit grade assigned to the borrower based on the information in borrower’s credit file. Hence, lenders are expected to bid more for loan listings with higher credit grade. Then, the borrower’s debt to income ratio represents the borrower’s ability to pay back the loan. Hence lenders are expected to bid more for loan listings that have lower debt to income ratio. Finally, owing a home and having a verified bank account points towards financial stability and good financial management on the part of the borrower. Hence, lenders are expected to bid more for loan listings with verified bank accounts and loan listings from borrowers that are also homeowners. Hence, we can posit the following:

**Hypothesis 1A**: Lenders will bid more for loan listings with higher credit grade

**Hypothesis 1B**: Lenders will bid more for loan listings with lower debt to income ratio

**Hypothesis 1C**: Lenders will bid more for loan listings with verified bank accounts

**Hypothesis 1D**: Lenders will bid more for loan listings from borrowers that are also homeowners

Trust is a major determinant of people’s behavior in online marketplaces (Hoffman, Novak et al. 1999). The amount of trust lender’s place on the borrowers is affected by the amount of information that borrower’s provide about themselves.
Borrowers provide optional information about themselves and their plan for paying back the loan in the description field. Such information can include income, expense, budget, purpose of taking the loan, explanation of negative items on the credit report etc. Lenders are expected to place more trust on borrowers that provide more information. Hence, we can posit:

**Hypothesis 2**: Lenders will bid more for loan listings with more information in the listing description.

Reputations systems are used to encourage trust formation in online transactions (Resnick, Kuwabara et al. 2000). Peer to peer financial marketplaces use a group reputation system. Borrower’s position in the reputation system is another source of information and trust for the lender. First, borrowers that are part of a group and have gone through the group membership process and are accountable to the group leader are expected to be more careful about repaying their loan in time. Further, borrowers that have received endorsements from group leaders are also expected to be better credit risk as the group leader has recommended them after personal interaction with them and have found them worthy of confidence. Hence, we can posit the following two hypotheses about the impact of the reputation system on lender’s bidding behavior:

**Hypothesis 3A**: Lenders will bid more for loan listings from borrowers that are member of a group

**Hypothesis 3B**: Lenders will bid more for loan listings that have been endorsed by the group leader.

The hypotheses above expect the lenders to behave in a rational way and bid more for loan listings that are perceived to be lower credit risk for the given credit quality. However, financial marketplaces are dynamic environment where lenders can observe the success (i.e. repayment of the loan principal with designated interest) or failure (i.e. loan default) of their loans and adjust their lending strategies for future loans to minimize the level of default for a given interest rate. For example, if lenders observe that loans from borrowers that are homeowners have a higher rate of default then they will charge a higher interest rate (i.e. risk premium) for such loans in future. Similarly, if lenders observe that borrowers that belong to a group or have group leader’s endorsement have lower rate of default then they would willing to charge a lower interest rate for such loans. Thus, we expect that in the dynamic lending environment of peer to peer financial marketplaces, where lenders have an opportunity to learn and adjust their expected risk premiums, lenders will charge higher risk premiums for loan listings that are associated with factors that drive loan default. Hence we propose the following:

**Proposition 2**: Lenders will charge higher risk premiums for factors that drive loan default rates.

We are not formalizing the proposition above as hypotheses in this paper as we can not rigorously test the above proposition with the current dataset available. However, we will explore whether the above proposition holds in a descriptive way through empirical analysis. Further, if there is any mismatch between the relative importance of a factor as an antecedent of loan default and the corresponding risk premium charged for that factor, we can expect that lenders will learn and adjust their bidding strategy such that the mismatches will be reduced with time. The current paper presents the view of the marketplace in one point in time and does not include time series analysis. Hence we are not hypothesizing the dynamic adjustment of risk premiums in this paper. The time series analysis is under progress and we expect to present its results in the conference.

The proposition above represent the market’s ability to appropriately match antecedents of default risk with corresponding risk premiums, which can be taken as a measure of market effectiveness. If peer to peer financial marketplaces can satisfy the above hypotheses with a lower cost of operation than the traditional business model of financial services, then we can expect these marketplaces to be competitive in the long run.

**Data**

Data for this study was collected from Prosper.com over six months. First stage of data collection was done using automated spider programs. These spider programs systematically access individual web pages, download the HTML code of the pages and then process the HTML code to extract relevant information into a local database. Previous research has pointed out several pitfalls, such as inconsistent data and missing data, of using spiders for extracting information (Crowston and Howison 2004). We employed safeguards in the spider code to maintain data integrity. We also manually verified parts of the spider output to make sure that the output was correctly parsed. Data collected using Spiders was then combined with proprietary data released by Prosper.com about financially sensitive information like loan defaults which are not available through public webpages.
For six months of Prosper.com’s operations between July to December 2007, we collected listings, bidding and loan repayment information. Following are the main data items collected:

- **Listing Data**: Information about loan listings posted by borrowers on Prosper.com
  - **Amount Requested**: Amount of loan requested by the borrower
  - **Date of Listing**: We used the date of listing information to create dummy variables to control for time.
  - **Borrower’s Credit Grade**: Prosper.com uses a letter grade credit rating system which has the following grades from higher to lower credit: AA, A, B, C, D, E, HR, NC. HR refers to “High Risk” and NC refers to “No Credit Information Available”. We have coded the credit grades to numerical scores from 1 (good credit) to 7. NC credit grades were excluded from the analysis.
  - **Borrower’s Debt to Income Ratio**: Ratio of borrower’s total debt (including the proposed Prosper.com debt) and total income from all sources.
  - **Listing Title and Description**: Borrower’s can include a title and a description in their loan listings to better convey the merits of their listing to the lenders. The description field is used to create a “Description Length” variable to indicate the amount of information contained in the description field.
  - **Group Membership**: Whether the borrower is a member of a group.
  - **Group Leader Endorsement**: Endorsement by the group leader including document and identity verification.
  - **Group Leader Reward Rate**: Percentage commission received by the group leader if the loan is successful.
  - **Account Verification**: Binary variable indicating whether the borrower has a verified bank account
  - **Homeowner Verification**: Binary variable indicating whether the borrower is a homeowner

- **Lender Data**: Information about bids made by lenders and the resulting final status of the loan
  - **Amount Funded**: Amount for which bids were received from lenders for a listing
  - **No of Bids**: Total number of bids received from lenders for the listing
  - **Final Loan Interest Rate**: Final interest rate applicable for the loan. This rate will be lower if lender interest is high and larger number of bids are received for the listing
  - **Listing Status**: Final status of the listing – funded, expired or withdrawn. We have encoded this as a binary variable where 1 means that the listing is successful (status is funded) and 0 means that the listing is unsuccessful (status is either withdrawn or expired).

- **Loan Repayment Data**: Information about the loan repayment history
  - **Loan Status**: Current status of loan repayment. This can be current or in various stages of late payment/default. We have coded it as a binary variable where 1 means that the loan has defaulted or gone bad (status other than current) and 0 means that the loan is being repaid in time and is in good standing (status current).

The dataset consists of more than 25,000 loan listings and close to 4,000 loans. This provides a large and rich dataset to test the hypotheses presented before.

**Methodology and Results**

For testing hypotheses 1 through 3, we have taken the number of bids received by a listing as the dependent variable. We have controlled for factors that may affect lender behavior such as listing duration, title length, month of listing as well as basic risk reward factors like interest rate and amount requested. As the dependent variable is a continuous one, an Ordinary Least Square analysis is sufficient. We checked for usual violations of OLS assumptions and found the model to be satisfactory. Results of the OLS model are summarized in the table below:
Hypothesis Description Supported
1A Higher Credit Grade → Higher No of Bids Yes
1B Lower Debt to Income Ratio → Higher No of Bids No
1C Verified Bank Accounts → Higher No of Bids Yes
1D Homeowner → Higher No of Bids No
2 Listing Description Length → Higher No of Bids Yes
3A Group Membership → Higher No of Bids No
3B Group Leader Endorsement → Higher No of Bids Yes

Figure 1: Summary of Hypotheses Testing

While we see that only some of our expectations about rational behavior by lenders in the peer to peer financial marketplace are empirically supported, this may be due to the fact that the marketplace is dynamic and lenders adjust their lending strategies to reflect appropriate risk premiums for the “actual” antecedents of loan defaults in the marketplace (Proposition 2). While we can not rigorously test proposition 2 with the current dataset, we can descriptively explore the argument using two empirical models. The first model uses the actual defaults data to discover the antecedents of loan default. The second model takes the actual interest rates charged by lenders as dependent variable and various potential antecedents of loan default as explanatory variables. Thus, this model represents the “actual risk premiums” charged by lenders for various antecedents of loan default. A comparison of the two models can provide us with descriptive evidence for or against proposition 2.

Figure 2 below summarized the results of the empirical models used to explore the impact of various potential antecedents of loan default on the probability of loan default and on the interest rates charged for the loans. Comparison of the direction and significance of the two effects provides information about whether lenders are charging appropriate risk premiums. For example: the first row indicates that higher loan amount leads to higher probability of loan default and also higher interest rates charged and both of these effects are statistically significant. This shows that lenders recognize the risks of a loan with higher loan amount and appropriately charge higher risk premiums.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Probability of Loan Default</th>
<th>Interest Rate Charged</th>
<th>Risk Premiums</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loan Amount</td>
<td>Higher</td>
<td>Higher</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Debt to Income Ratio</td>
<td>Not Significant</td>
<td>Higher</td>
<td>Not Appropriate</td>
</tr>
<tr>
<td>Description Length</td>
<td>Not Significant</td>
<td>Not Significant</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Credit Grade</td>
<td>Lower</td>
<td>Lower</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Whether Account Verified</td>
<td>Lower</td>
<td>Not Significant</td>
<td>Not Appropriate</td>
</tr>
<tr>
<td>Whether Homeowner</td>
<td>Not Significant</td>
<td>Lower</td>
<td>Not Appropriate</td>
</tr>
<tr>
<td>Group Membership</td>
<td>Higher</td>
<td>Higher</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Group Leader Endorsement</td>
<td>Not Significant</td>
<td>Lower</td>
<td>Not Appropriate</td>
</tr>
</tbody>
</table>

Figure 2: Antecedents of Loan Default and Corresponding Risk Premiums
The results presented above in Figure 2 show that lenders charge a positive risk premium for amount of loan, debt to income ratio and group membership. Lenders charge lower interest rates (negative risk premium) for higher credit grade, for being a homeowner and for being endorsed by the group leader. Lenders do not consider having a verified account and the length of description as having a significant impact over the risk of default as these factors have no significant impact on interest rates charged.

We can immediately see that risk premiums being charged are in the same direction as expected for amount funded and credit grade. However, lenders give interest risk discounts for being a homeowner and for having group leader endorsements even though they have no significant impact on the probability of loan defaults. Further, lenders charge significant risk premiums for higher debt to income ratio while it also does not have a significant impact on loan default. Interestingly, we find that lenders have recognized (in contrast to our rational expectation hypotheses 3A) that group membership actually leads to higher defaults are hence charging a positive risk premium for that. We can conclude that there is mixed descriptive empirical evidence for proposition 2. We expect to develop the proposition into testable hypotheses, rigorously test the hypotheses and present the results in the conference.

We see that lenders have adjusted their bidding behavior to take care of some antecedents of loan defaults but some others are not being given appropriate risk premiums. As the marketplace is a dynamic process, lender’s adjustment of their strategy is a dynamic evolving process and we can expect that with time lenders will narrow these mismatches.

Discussion and Conclusion

We have presented the first empirical analysis of the operations of peer to peer financial marketplace in this paper. We have explored two simple but very important arguments: first, are market participants behaving rationally in the marketplace and second, is the market successful in effectively matching antecedents of loan defaults with appropriate risk premiums. We find that lenders are indeed behaving rationally for the most part and bidding more for listings that are expected to be lower risk. We also observe that lenders are not behaving rationally for some elements (example: group membership) and find that the answer lies in the expected risk premiums based on actual default experience. As group membership is associated with higher defaults hence lenders attach a higher risk premium to it and bid less. Thus, we find evidence that peer to peer financial marketplaces are operating as expected from a rational profit motive. However, the study also demonstrates that there are definitive weaknesses in the effectiveness of the marketplace to match antecedents of loan default with appropriate risk premiums. We expect that a time series analysis of dynamic adjustment of lender’s risk premiums with throw more light on whether the market is successful in learning over time and reducing the mismatch.

We see that lenders have adjusted their bidding behavior to take care of some antecedents of loan defaults but some others are not being given appropriate risk premiums. As the marketplace is a dynamic process, lender’s adjustment of their strategy is a dynamic evolving process and we can expect that with time lenders will narrow these mismatches.

The results of this paper are also relevant for practice. From a design of the marketplace platform point of view, we show the elements which are significant in lender’s decision making and borrower’s default rates. These factors are an essential part of the platform and should continue to be included. Other factors which are not significant do not add to the effectiveness of the platform and can be discontinued or modified. Further, the effectiveness mismatches discovered in analysis of proposition 2 can point towards future revision of the marketplace platform for improving effectiveness. These mismatches can also provide directions for devising investment strategies which exploit the mismatches to generate higher returns than the market average.

Our results also point towards the inadequacy of the current group reputation system being used. Essentially a group reputation system should encourage good behavior by borrowers which will in turn be rewarded by lenders (Resnick, Kuwabara et al. 2000). We note that group membership actually leads to lower bidding and higher interest rates as it increases the risk of defaults. Further, we observed that even though group leader endorsements provide lenders with enhanced trust and they ask for lower interest rates for such loans, the endorsements in fact have no significant impact on the default risk. Thus, we can conclude that the current group reputation system is not effective currently and needs to be modified.

The current research has many limitations. First of all, as this is a preliminary and exploratory analysis, the research does not have a strong theoretical background. We expect that as we progress towards studying specific elements of the marketplace, we would be able to leverage specific theoretical groundings to do a more robust and theoretically grounded
analysis. The data used is also limited as we are unable to conduct an extensive time series analysis of lender behavior with the current data. Many variables used in this study are also simpler and can be made richer. For example – we have only considered the “quantity: of information provided in description length and not the quality or content of the description. We have collected more extensive dataset of Prosper.com and are in process of rectifying these limitations.

Peer to peer financial marketplaces are an exciting new development in the continuing transformation brought about by the digital technologies. These marketplaces are rapidly growing and provide Information System researchers a unique opportunity to study the evolution and effectiveness of such marketplaces. As the first study to rigorously analyze this phenomenon, we believe that this research makes important contributions to both research and practice. We hope that future research with further extend its contributions and rectify the limitations.

References