How Does a Firm Adapt in a Changing World? The Case of Prosper Marketplace

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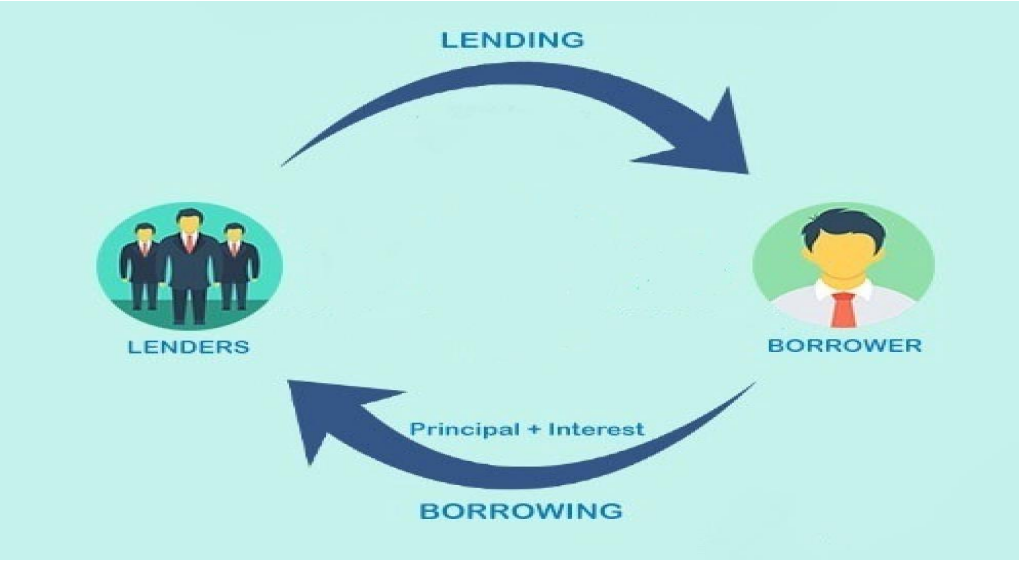
Research Questions

- How does a firm use historical data in a fast-changing world?
  - Not all past data are equally informative about the current environment.
  - Data prior to March this year is likely irrelevant now.
  - With high frequency data, tech firms can select more relevant data to use.
- We propose a Generalized Revealed Preference Approach.
  - Typically, Revealed Preference allows us to uncover structural parameters.
  - We argue that firm's choice is also a function of its data selection method.
    - By observing their choices, together with a structural model of its decision, we can back out their data selection method.
  - Useful for market intelligence – a firm may want to learn about how its rivals use the past data to set its market strategies.

Data and Institutional Details

- Two years data (01/01/2011 – 12/31/2012) from Prosper.com.
- Two-sided market for lenders and borrowers.
- Prosper assesses the risk of each borrower and assigns rating/interest rate to each loan.
- Prosper earns a fee when a loan is successfully funded.



Different Ways of Using Data (Unobserved – Revealed Preference)

Data

Funded Probability

Withdrawal Probability

Default Probability

Loss Given Default

Prosper assigns a rating to each loan application:

$$E_\epsilon \max_l \{(C_l + S) \cdot M_i \cdot (1 - W_{il}) \cdot F_{il} + \delta \cdot \overbrace{|E_l - D_{il} \cdot LR_{il}|}^{\text{Reputation}} + \epsilon_{il}\}$$

- E_l: Estimated loss rate at rating l reported by Prosper.
- D_{il}: Default probability of loan application i with rating l.
- LR_{il}: Loss rate given default of loan application i with rating l.

Table: Reported Estimated Loss, E_l

	AA	A	B	C	D	E	HR
Estimated Loss	1.42%	3.03%	5.56%	7.94%	10.83%	14.41%	17.08%

Prosper's Profit Fn.

Choose loan rating to maximize profits

Prosper Ratings (Observed Choice)

Summary of Results and Conclusion

- Among six data selection methods we consider, Ensemble-Recession Probability Method (E-RPM) explains Prosper's decisions (loan ratings) the best.
- Counterfactual experiment
  - We consider an alternative way to use the data – Ensemble-Hidden Markov Model (E-HMM).
  - We show that this method can increase Prosper's revenue from $4,871,951 to $5,464,959 in 2012.
- Main Contributions
  - Generalized Revealed Preference allows us to learn how a firm uses past data.
  - Demonstrate how to combine structural modeling with machine learning techniques to gain more insights about firm's adaptability.