Fintech and Bank competition: The impact of lending technology on market segmentation

Konstantinos Serfes (Drexel)
Kejia Wu (Philly Fed & Drexel)
Panagiotis Avramidis (Alba, ACG)

CRETE–July 11-15th 2022

Introduction

FinTech lending (Berg, Fuster, Puri (NBER, 2021))

- Use of technology to provide lending products.
- The use of technology has two main flavors:
  1. To improve the customer-lender interaction (for example, with a fully online application process), giving rise to a better user experience, **faster processing times** and lower operational costs.
  2. Technology can be used to **improve screening or monitoring**, for example, by using alternative data sources or machine learning methods.

- Fintech lending has experienced a tremendous growth in the last decade
  - Business lending grew a 43.1% per annum in 2016-2020
- Nevertheless, fintech lenders compete with traditional lenders (banks) for borrowers

- Fintech lenders:
  - More focus on short-term lending
  - Usually, no collateral requirements

- Traditional lenders (banks):
  - Usually demand a collateral
  - Longer-term loans
  - Longer processing time
  - Use more traditional data and methods to screen borrowers

This paper

- Competition in the credit market between a traditional lender and a fintech
- Borrowers with different financing needs: short-term vs. long-term
- Fintech has a superior screening ability, but the gap decreases for long-term predictions
- Competition: First-price sealed-bid common value auction with differentially informed bidders
- Main focus: How technology affects the “landscape” of competition between traditional lenders and fintechs

Main theoretical findings

- Segmentation:
  - Fintech: More likely to offer short-term unsecured loans
  - Bank: More likely to offer long-term, secured (by some asset) loans
- Interest rates:
  - Short-term: Fintech offers higher (FOSD) interest rates than the traditional lender
  - Long-term: Traditional lender offers rates with a higher “spread” than the fintech rates
- Screening ability and collateral requirements are substitutes
- Market segmentation: As the screening ability gap between the two lenders increases, segmentation decreases in the long-term segment, while in the short-term it can increase or decrease (depending on the level of collateral)
- Federal Reserve’s Small Business Credit Survey (2019): These findings explain some of the empirical observations from the survey

Literature review

- Closest paper is: He, Huang and Zhou (NBER, 2020):
  - Competition between a fintech and a traditional lender
  - Effect of credit information sharing between the lenders
  - **No collateral requirements**
  - **No loans of different maturities**
- Thakor (JFI, 2020), Berg, Fuster and Puri (NBER, 2021): Fintech survey papers
- Manove, Padilla and Pagano (Rand, 2001), Inderst and Mueller (JFE, 2007), Stroebel (JF, 2016): Collateral determination
- Donaldson, Piacentino, and Thakor (JF, 2021): Bank and non-bank finance

Borrowers

- Continuum of risk neutral entrepreneurs (borrowers) of measure one
- Each entrepreneur can have either a short-term (S) or a long-term project (L), and needs one unit of capital
- Each S (L) entrepreneur has an investment project that generates a return that is either $\bar{r}^S$ ($\bar{r}^L$) or 0, in case of a default
- A fraction μ_i has good projects (G) and a fraction $1 - \mu_i$ has bad (B) projects for $i \in \{S, L\}$
- The probabilities of no default are given by $1 \geq p_G > p_B \geq 0$ and they are the same for S and L borrowers.

Lenders, screening ability and collateral

- Two risk neutral lenders: a fintech (F) and a traditional lender (T)

- Let $\mathcal{S}_j^i \in \{g, b\}$ denote lender j's, $j \in \{F, T\}$, signal about borrower of type $i \in \{S, L\}$, which can be either good (g) or bad (b)

- The signal conditional probabilities are given by

$$q_j^{i,g} = (\mathcal{S}_j^i = g|G) \geq \frac{1}{2} \text{ and } q_j^{i,b} = (\mathcal{S}_j^i = b|B) \geq \frac{1}{2},$$

- where $q_j^{i,g}$ and $q_j^{i,b}$ capture the accuracy of lender j's signals for borrower of type i

- We set $q_F^{S,g} = q_T^{S,g} = 1$ and $q_F^{L,g} = q_T^{L,g} = 1$

- Furthermore, we let

$$q_F^{S,b} \equiv q_F^S, q_T^{S,b} \equiv q_T^S, q_F^{L,b} \equiv q_F^L \text{ and } q_T^{L,b} \equiv q_T^L.$$

- Let $\Delta q^i \equiv q^i_F - q^i_T$ denote the difference in the signal accuracy between the two lenders.
- We make the following assumption regarding the screening ability of lenders as a function of the lending horizon.

$$\Delta q^S > \Delta q^L \geq 0 \text{ and } q^S_j \geq q^L_j$$

Collateral

- In addition to the interest rate, lender j can ask borrowers to post a collateral $c_j < 1$.
- The collateral is used to mitigate the losses in case of default.
- That is, if borrower defaults the lender liquidates the collateral.

Timing

- Lenders receive their private signals, update their beliefs about the borrower's type and simultaneously make their interest rate offers to the S borrowers, r_j^S, and to the L borrowers, r_j^L
- Lender j also asks borrowers to post a collateral c_j
- Competition is on a borrower-by-borrower basis. Borrowers then choose the offer with the higher expected payoff
- For simplicity we assume the lenders have the same cost of funds, which we normalize to one

Borrower signals

- Probability both lenders observe good signals

$$p^i_{gg} \equiv (\mathcal{S}^i_F = g, \mathcal{S}^i_T = g) = \mu_i + (1 - \mu_i)(1 - q^i_T)(1 - q^i_F)$$

- Let

$$\nu^i_{gg} = \frac{\mu_i}{p^i_{gg}}$$

be the probability of repayment of an i borrower, conditional on two good signals

- F lender observes a good signal, while a T lender observes a bad signal

$$p^i_{gb} \equiv (\mathcal{S}^i_F = g, \mathcal{S}^i_T = b) = (1 - \mu_i)q^i_T(1 - q^i_F)$$

- F lender observes a bad signal, while a T lender observes a good signal

$$p^i_{bg} \equiv (\mathcal{S}^i_F = b, \mathcal{S}^i_T = g) = (1 - \mu_i)(1 - q^i_T)q^i_F$$

Borrower choices

- Suppose a borrower of type i has received two interest rate offers, r_F^i and r_T^i from the fintech and the traditional lender, respectively
- Then, the borrower knows that both lenders have received good signals
- The borrower will borrow from lender F if and only if

$$r_F^i < r_T^i + z_{gg}^i c,$$

where $z_{gg}^i \equiv \frac{1-\nu^i}{\nu^i} = \frac{(1-q_T^i)(1-q_F^i)}{\tau^i}$, is the likelihood ratio of no repayment over repayment, conditional on two good signals

Mixed strategy equilibrium

- Competition in the credit market has a flavor of a first-price sealed-bid common value auction with differentially informed bidders
- Winning an entrepreneur entails a winner's curse
- Due to the winner's curse, an equilibrium in pure strategies does not exist

- We will construct the mixed strategy equilibrium
- Let m_j^i be the probability that lender j makes an offer to an i borrower upon drawing a good signal
- Let $Z_F^i(r) \equiv (r_F^i - z_{gg}^i c \leq r)$ be the probability distribution of lender F's interest rate offers, conditional on making an offer to an i borrower
- Similarly, let $Z_T^i(r) \equiv (r_T^i + z_{gg}^i c \leq r)$ be the probability distribution of lender T's interest rate offers, conditional on making an offer to an i borrower

Indifference conditions

$$p^i_{gg}\left(1 - m^i_T + m^i_T(1 - Z^i_T(r))\right)\left((1+r)\nu^i_{gg} - 1\right) - \underbrace{p^i_{gb}}_{\text{winner's curse}} = \pi^i_F$$

$$p^i_{gg}\left(1 - m^i_F + m^i_F(1 - Z^i_F(r)\right)\left((1+r)\nu^i_{gg} - 1\right) - \underbrace{p^i_{bg}(1-c)}_{\text{winner's curse}} = \pi^i_T$$

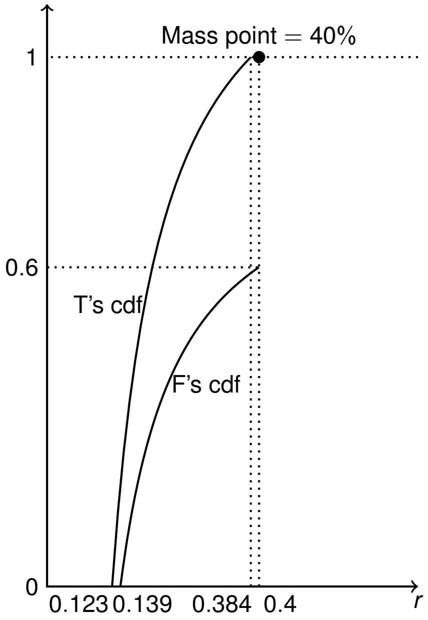
- We make the following assumptions that determine the magnitude of the winner's curse.
- $$p^S_{bg}(1-c) \geq p^S_{gb} \Leftrightarrow c \leq \frac{\Delta q^S}{q^S_F(1-q^S_T)}$$
- $$p^L_{bg}(1-c) \leq p^L_{gb} \Leftrightarrow c \geq \frac{\Delta q^L}{q^L_F(1-q^L_T)}$$
- F lender dominates the S segment; T lender dominates the L segment

Lemma

- S segment: The F lender makes a strictly positive profit $\pi_F^S > 0$, while T lender makes a zero profit $\pi_T^S = 0$
- L segment: The T lender makes a strictly positive profit $\pi_T^L > 0$, while F lender makes a zero profit $\pi_F^L = 0$

Equilibrium for S borrowers

- The F lender always makes an offer upon drawing a good signal and its interest rate distribution has a mass point at the upper bound of the support
- The T lender makes an offer with a probability
- The F lender's rate distribution FOSD the distribution of T
- The support of T lender's distribution is shifted to the left by the amount of the collateral times the likelihood ratio of no repayment over repayment


Mass point = 40%
1
0.6
0
T's cdf
F's cdf
0.123
0.139
0.384
0.4
r

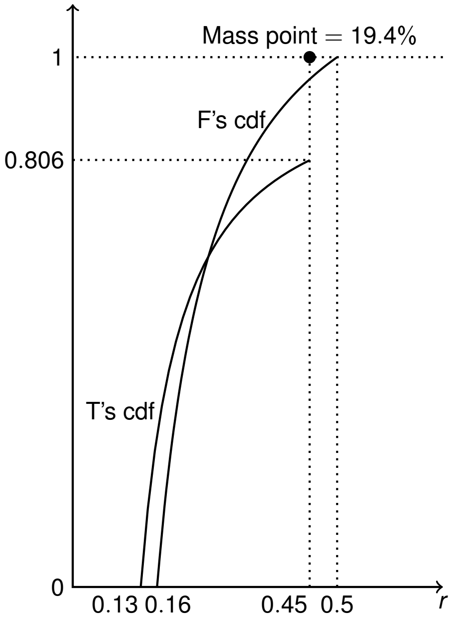
- T lender, given its high winner's curse, does not always make an offer
- F is a monopoly lender with some probability
- This allows the F lender to raise its interest rates

Effect of screening capacity on market segmentation and credit supply in the short-term segment

- Level of collateral determines the effect of better screening ability on supply of credit
- Suppose the screening capacity of lender F increases
- If the collateral is low, the T lender lowers the probability with which it makes loan offers
- If the collateral is high, the T lender increases the probability with which it makes loan offers

Equilibrium for L borrowers

- The T lender always makes an offer upon drawing a good signal and its interest rate distribution has a mass point at the upper bound of the support
- The F lender makes an offer with a probability
- The T lender's rate distribution "spread" is higher than that of the distribution of F
- The lower winner's curse for the T lender allows it to offer high interest rates more frequently


Mass point = 19.4%
1
0.806
0
F's cdf
T's cdf
0.13 0.16
0.45 0.5
r

Effect of screening capacity on market segmentation and credit supply in the long-term segment

- Suppose the screening capacity of lender F increases
- Then, F lender increases the probability with which it makes an offer
- Market segmentation decreases

Collateral competition

- Add a stage in the game where lenders choose c_j
- Cost: $\frac{c_j^2}{2\gamma_j}$
- Equilibrium collaterals

$$c_F^* = \theta(1-\mu_S)\gamma_F q_T^S(1-q_F^S) \text{ and } c_T^* = (1-\theta)(1-\mu_L)\gamma_T q_F^L(1-q_T^L)$$

- The collateral requirement of lender j depends on:
  1. the cost of lender j of underwriting the collateral, as captured by the parameter γ_j and
  2. the likelihood of lender j's winner's curse, $(1-\mu_i)q_{-j}^i(1-q_j^i)$, in the segment in which it earns its rents

- Own screening ability and collateral requirements are substitutes
- Rival screening ability and collateral requirements are complements
- F lender's superior screening ability affords a lower collateral requirement than the T lender, $c_T^* > c_F^*$

Conclusion

- Fintech: Short-term, unsecured loans; higher interest rates and higher likelihood of loan offers relative to traditional lenders, in the short-term segment
- Bank: Long-term, asset-backed loans; more dispersed rates and higher likelihood of loan offers relative to fintech lenders, in the long-term segment
- Collateral mitigates the winner's curse, but is also a function of the winner's curse
- Fintech chooses lower collateral than the traditional lender due to its superior screening ability
- As screening ability gap between the two lenders increases, segmentation in the short-term segment can increase or decrease depending on the level of collateral, but in the long-term segment it will decrease

Thank you!

Q&A