The impact of machine learning and big data on credit markets

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Credit markets: a few stats (i)

- SMEs: 90% of businesses and more than 50% of employment worldwide
- UK:
  - 30% SMEs report difficulties in obtaining required finances
  - 22% use bank overdrafts as a source of finance
  - 8% use bank loans (£57 billion in 2017 and constituted nearly 68% of all gross new funding)
- U.S.
  - in 2015 63% of companies with revenue < $1mln and 58% of startups reported not being able to obtain required finances
  - In 2018 32.7% of SMEs' loan applications were rejected; 55.2% applied

Source: https://www.merchantsavvy.co.uk/uk-sme-data-stats-charts/; https://www.bva-bdrc.com/products/sme-finance-monitor/; https://www.ukfinance.org.uk/system/files/UK-Finance-SME-Finance-in-UK-AW-web.pdf; https://www.pymnts.com/news/b2b-payments/2016/smes-severely-dissatisfied-with-elending-experience-fed/

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Credit markets: a few stats (ii)

Consumer lending

- ## UK

  - The outstanding value of all residential mortgages loans was £1,513.3 billion in Q2 2020
  - Consumer lending (excl student loans) was £25.8 billion in Feb 2020
  - Household debt to GDP ratio was 84.5% in Feb 2020

- ## U.S.

- Home mortgage debt of households and non-for profit organisations was $10.68trn in Q1 2020
- Existing personal loan debt (secured and unsecured) was $305 billion in Dec 2019
- Household debt to GDP ratio was 77.24% in Q1 2020

Source: https://www.fca.org.uk/data/mortgage-lending-statistics; https://www.statista.com/statistics/311415/uk-lending-total-gross-consumer-lending-in-the-united-kingdom/; Federal Reserve

Literature

- Banks have a long record of discrimination against various types of investors (e.g. Cavalluzzo et al. 2002, Beck and Brown 2015, Agarwal et al. 2017, Karolyi 2018)

- Relationship/'soft' information matters (e.g. Petersen et al. 2002;Voordeker and Steijvers, 2006; Ono and Uedugi, 2009; Puri et al. 2017; Uhida et al. 2011; Canales and Nada, 2012; Bartoli et al. 2013)

- Fintech
  - Allows for better identification of project risk (e.g. Behr and Sonnekalb 2012; Iyer et al. 2015; Dorfleitner et al. 2016; Berg et al. 2019; Frost et al. 2019; Fuster et al. 2019; Gambacorta et al. 2019)
  - Not necessarily beneficial: (e.g. Behr and Sonnekalb 2012, Milone 2019; Parlour et al. 2020)

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Model (i)

- Three types of borrowers:
  - S – safe
  - A – low risk
  - B – high risk

  - return on A ≥ return on B
  - probability of A default ≤ probability of B default
  - At least one of the above is strict

- Demand for loans by borrower types depends on repayment rates

- Two types of banks, which we call traditional and innovative:
  - Traditional banks can separate between safe and risky borrowers but cannot separate between type A and type B borrowers
  - Innovative banks can separate between safe and risky borrowers but all innovative banks also receive the same (imperfect) signal (θ_A, θ_B) about the type of risky borrowers.

Model (ii)

- There is a fixed amount of deposits in the system, offered at s.

- Shareholder capital is expensive.

- Regulator sets a minimum capital ratio.

- If in a state of the world a bank cannot repay depositors the agreed repayment rate, the depositors are paid from deposit insurance.

Background

No innovative banks

- Given that all banks are the traditional banks, A and B type borrowers pay the same repayment rate.

- The expected repayments rates from Safe borrowers and Risky borrowers are the same.

Introducing innovative banks can change the nature of competition and change the composition of risky projects in the rest of the market.

Emerging Stage:

(Proportion of the innovative banks (μ) small relative to the proportion of A type borrowers)

To simplify this presentation, we assume that if μ is zero or close to zero the traditional banks will be able to repay depositors whenever type A projects succeed.

- During the emerging stage the composition effect dominates

- Repayment rates are driven by competition among the traditional banks

- The share of B type borrowers in the portfolios of the traditional banks is higher the greater the proportion of innovative banks. Hence, as μ increases
  - Repayment rates for risky projects increase
  - The traditional banks and the innovative banks charge the same repayment rates for the risky projects
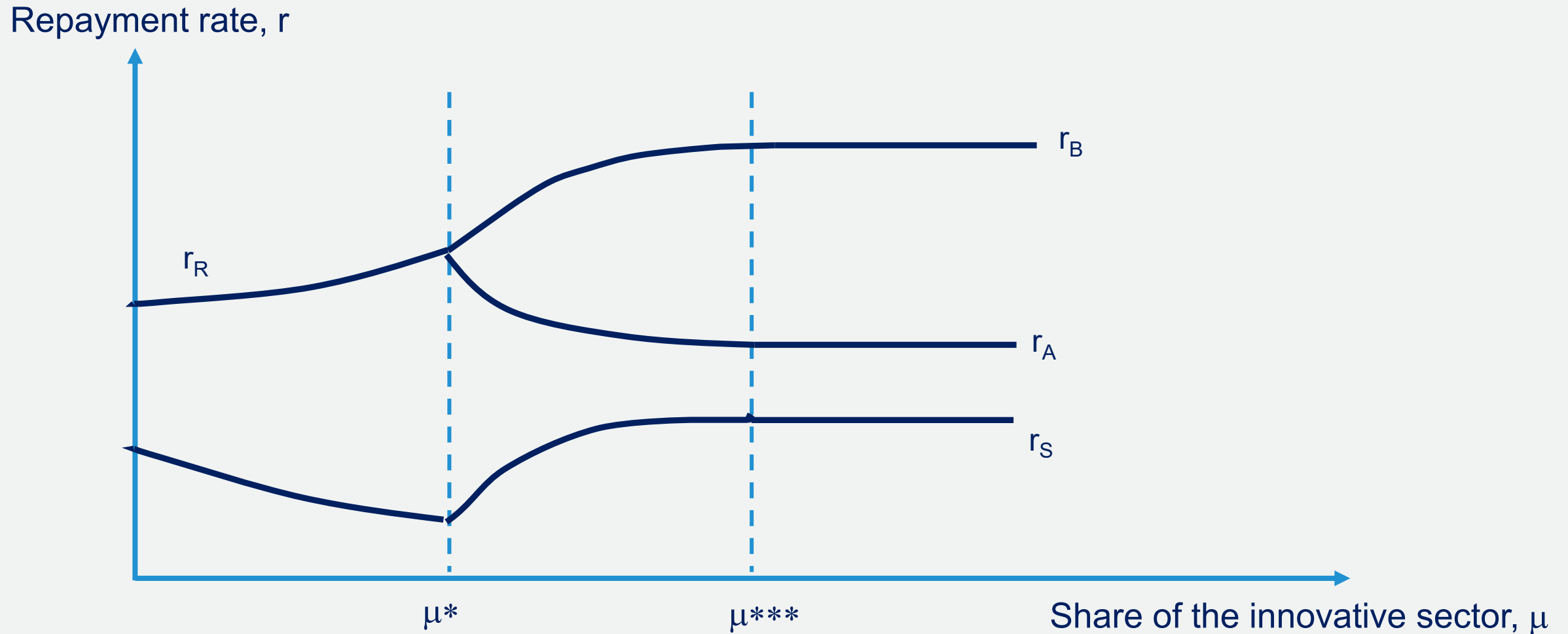 - Repayment rates for S borrowers decline (there is a flight to safety)

Intermediate Segregated Stage:
The innovative banks competition begins to bite

- There is a min μ such that innovative banks absorb all A type borrowers

- If the proportion of the innovative banks is greater than this, then innovative banks begin to compete for A type borrowers:

  - As μ increases:
    - Repayment rates for A type borrowers decline (to attract more of them into the market)
    - Risky borrowers from the traditional banks are all B type and their repayment rates increase
    - Safe borrowers all borrow from the traditional banks and their repayment rates increase

Mature Stage:

- Repayment rates for all types of borrowers are constant

- All borrowers have the repayments rates that they would have with full information (this assumes there are 'costs to innovation')

The three stages

Intermediate non-Segregated Stage:

For completeness, there is another possible stage before segregation which we call the intermediate non-segregated stage. If this stage exists:

- Repayment rates for the borrowers with risky projects stop increasing and then fall

- Repayment rates for the borrowers with safe projects stop declining and then rise

- Hence, the figure in the paper looks a little more messy
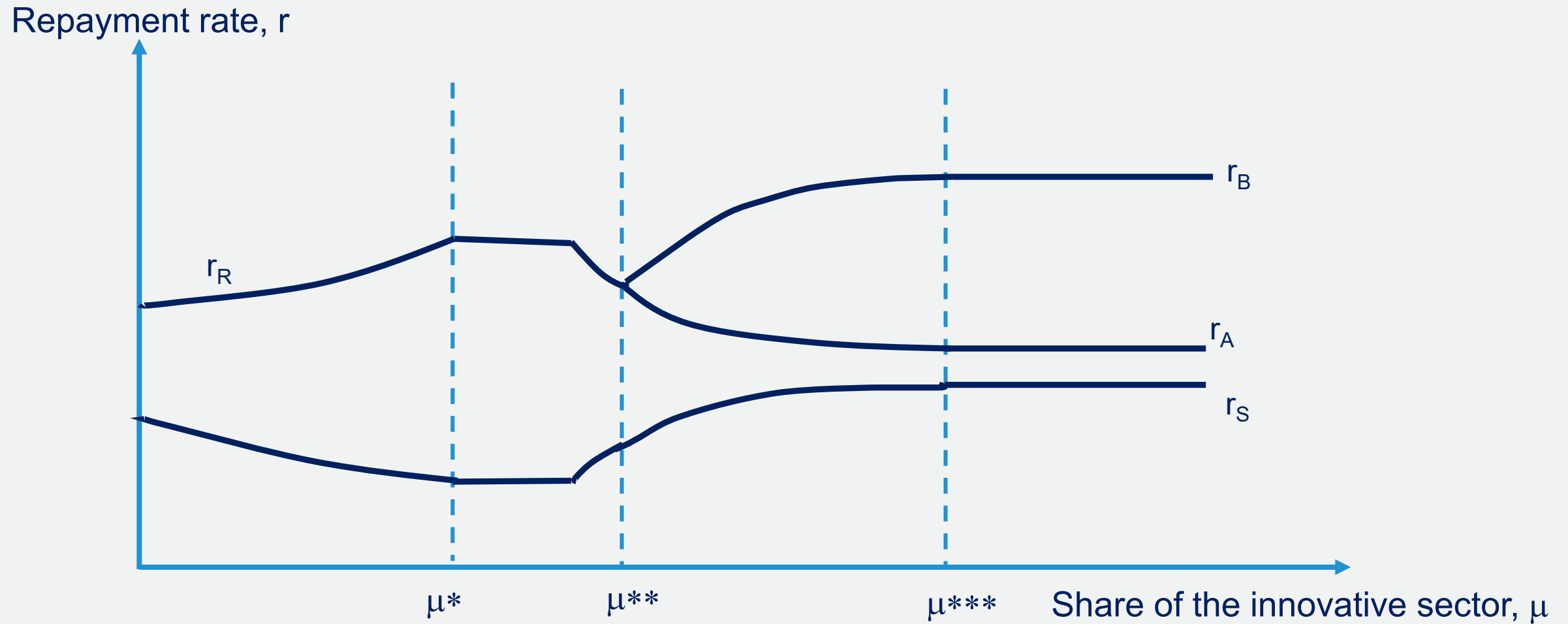
Stability and concentrated business models

- The innovative banks impact relative repayment rates and the composition of projects between bank types.

- The relative repayment rate effect initially 'penalises' risky projects:

  - Repayment rates are based on 'false' mix of good and bad projects.

  - This increases the proportion of safe borrowers in the market.

- The composition effect works in the opposite direction

  - If the traditional banks are sound in all states of the world when $\mu = 0$, then at some μ the composition effect will lead the traditional banks to adopt concentrated business models.

  - Specifically, a non-concentrated traditional business model can be sound but dominated by concentrated traditional business models (assuming there is deposit insurance).

Cost and big data (i)

- Story so far assumes that there are no costs of being an innovative bank and μ is fixed at specific levels. What if we drop these assumptions?

- If costs of being an innovative bank are very small, then little changes – what if this is not the case? Suppose the innovative banks have different costs:

- Example 1

- If some have very low costs but costs differ significantly across innovative banks, then there will be a ceiling on μ.

- The ceiling can be in any of the first three stages.

- Example 2

- Suppose costs exist, are not very small but are not too dissimilar across the innovative banks.

- A small μ may not be sustainable but higher μ could be (network externality with multiple equilibria).

Cost and big data (ii)

- Example 3

- Assume the cost is not in technology but in accessing big data.

- Big data are often concentrated in large firms, suggesting monopolistic access prices.

- The access price will be set to constrain the market.

- If the innovative banking sector is growing, then the access price would rise as the market grows.

- If there is a network issue, then the access price may initially be negative.

Welfare

- Emerging stage: higher μ lowers welfare – wrong mix of risky projects and too many safe projects.

- Segregation stage: higher μ implies project mix improves but banks are taking advantage of deposit insurance (moral hazard).

- Which is preferable depends on losses due to moral hazard relative to misallocation

Summary

- Main idea: innovative banks, by better identifying the less risky borrowers, can generate competition but bring a negative externality.

- If innovative banks are a small proportion of the market, the negative externality impact dominates.

- If innovative banks are a big proportion of the market, the competition effect dominates, and the negative externality unravels.

- Costs will determine where the equilibrium lands and there could be network effects

- Innovative banks encourage concentrated business models even amongst traditional banks

- Welfare effects are uncertain