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Quality externalities in credit markets: a case for taxing banks?

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November 14, 2011

Summary

Quality externalities in credit markets

- this is very much (exciting) work in progress
- contribute to understanding inefficiencies in banking activities
- study externalities from investments in quality of banks
  - bank quality: ability to evaluate projects of different quality
  - project quality: ability to generate profit (“productivity”)
  - externalities: on other banks through pool of credit applicants

Externalities: increasing bank quality

- **reduces applicant quality** – mechanical response
  - good projects extracted faster
  - negative externality on other banks (tax?)
  - excessive rents in OTC markets (Bolton/Santos/Scheinkman 2011)

- **raises applicant quality** – behavioral response*
  - improves information extraction from time on market
  - update beliefs about project quality using duration of application
  - better bank quality speeds up learning, exit ("paper submission")
  - faster exit of (on avg.) bad applicants raises avg. quality
  - positive externality on the other banks (subsidy?)

*our contribution

which dominates? – should we tax or subsidize bank activity?

Model *(1/4)*

- entrepreneurs (E), banks (B)
  - Es generate blueprints, look for financing – in frictional market
  - linear utility, continuous time, benchmark model: no discounting

- mass 1 of Es
  - get new project at cost F
  - project is good (g) with prob p, bad (b) ow.
  - E does not know type ($\Rightarrow$ a productive role for Bs)

- free entry for Bs
  - B invest in evaluation technology (signal on project quality)
  - B does not know history of E's project

Model *(2/4)*

- credit application
  - E applies for credit, but not "called" instantaneously
  - contagion on Bs desks (endog. prob of being evaluated)
  - when B looks at project: signal on quality with prob a – or not

- get signal, reveals truth – good project:
  - B, E negotiate contract, execute project
  - 1 unit of output, at capital cost k (instantaneous production)
  - $p < k$ (no production without Bs)

- no signal: no information revealed

- no signal AND negative signal: E NOT INFORMED
  - important: state of E is duration of search w/o receiving signal...

- ...a reasonable simplification
  - alternative: state is number of negative signals. complex.
  - continuous state variable makes life easy (as in Blanchard OLGs)

  bottom line: state is informative on how likely project is bad
  - the longer you are around, the less likely your project is good

- matching technology
  - benchmark: no real search (no search/time costs) – pure info friction
  - with b banks, B meets project at rate

$$h(b), \quad h' < 0$$

  - projects meet Bs at rate

$$m(b) = bh(b), \quad m' > 0$$

Model *(4/4)*

- define **maximum time that E looks for B (endog.)**: R
- Es pay F, start new project whenever
  - drop old project w/o having obtained credit (after R periods)
  - E obtains credit (instantaneous cookies)

Key statistics

- posterior prob of good project after t periods

$$Q(t) = \text{Prob}(\text{g}|\,t) = \frac{p\ e^{-m(b)at}}{\underbrace{1-p}_{\text{Prob(b)}\times\text{Prob}(t|\text{b})} + \underbrace{p}_{\text{Prob(g)}} \underbrace{e^{-m(b)at}}_{\text{Prob}(t\,|\text{g})}}$$

- avg. prob of good project in pool of applicants $\bar{p}$
  - equals avg. prob of good project at exit
  - # E's arriving at R b/c not called if good
  - all: them + # arrive at R because bad

Avg. prob of good project in applicant pool

$$\frac{\bar{p}}{1-\bar{p}} = \frac{p}{1-p}\, f(\underbrace{\alpha}_{(\text{-})}), \quad \alpha \equiv m\,(b) \times a \times R$$

- Raising a (better evaluation)
  - direct effect: **reduces avg. productivity**
  - but: infer faster that project is bad when evaluation is accurate!

$$\Rightarrow \quad R = R(\underbrace{a}_{(-)})$$

  - indirect effect: R falls, **raises avg. productivity**
  - equilibrium impact on b

Final ingredients

- determination of exit duration R
  - requires value of E
- terms of trade: payment or "wage" w
- close model: free entry into banking
  - requires value of B

Value after applying for t periods, exit at R

$$E(t,R) = [1 - Q(t)]\,[E(0,R) - F] + Q(t)\left[1 - \int_t^R m(b)\,ae^{-m(b)as}ds\right][E(0,R) - F] + Q(t)\left[\int_t^R m(b)\,ae^{-m(b)as}ds\right]\{w + [E(0,R) - F]\}$$

- Recall $Q(t)$: belief that project is good at "age" t
- $m(b)\,ae^{-m(b)as}$: inst. density that g is selected after exactly s periods
- at $t = 0$ we determine

$$m(b) \times a \times R = \ln \frac{p \times w}{p \times w - F}$$

Cool! Why?! ...

Avg. applicant quality determined by w (1/2)

$$\frac{\bar{p}}{1-\bar{p}} = \frac{p}{1-p} \frac{\frac{F}{pw}}{\ln \frac{pw}{pw-F}}$$

- depends exclusively on E's behavior
  - cost to start a project (F)
  - how much E may hope to get out of project (pw)

- irrelevant: rate at which agents meet
  - only b/c no discounting

- Blanchardish design to get block recursive structure/analytical results

Avg. applicant quality determined by w (2/2)

$$\frac{\bar{p}}{(1-\bar{p})} = \frac{p}{1-p} \frac{\frac{F}{pw}}{\ln \frac{pw}{pw-F}}$$

- $F = 0 \Rightarrow \bar{p} = p$
  - E start new project at every instant when not selected
- $F > 0 \Rightarrow \bar{p} < p$
  - not selected E (more likely to be bad) take time in exiting
- $pw \uparrow \Rightarrow \bar{p} \uparrow$
  - raises incentive to start new project given info that project is bad
  - not selected for some time: $pw \uparrow \Rightarrow R \downarrow \Rightarrow \bar{p} \uparrow$
- (no such block recursive solution with discounting)

Terms of trade: payment to E

- benchmark model

$$w = \beta(1-k)$$

- assumes Nash bargaining and exclusive contracts
  - E must realize project with B that has evaluated
  - removes "hold-up" from revealing information
- or strategic bargaining w/o exog. risk of breakdown (Rubinstein)
  - inside option matters for breaking point, it is zero
- Note: using Nash and no exclusivity, production breaks down
  - analogous to competitive market with fix costs (E gets all output)
  - b/c no search model (no search costs yet)

Value of Bs and free entry

- flow cost of technology a: $\psi(a)$, $\psi'(a) > 0$, $\psi''(a) < 0$
  - we specify

$$\psi(a) = \psi^2 + \frac{1}{4}a^2$$

- expected profit flow per unit time (incl. tax τ):

$$\Pi = (1-\tau)\, h(b)\, a\bar{p}\,(1-k-w) - \psi(a) \quad \rightarrow \max_a$$

- free entry given optimal technology $\hat{a}$

$$\Pi(\hat{a}) = 0 \quad \Leftrightarrow \quad h(b)\,\bar{p}\,(1-w-k)\,(1-\tau) = \psi$$

Recapturing and solving

4 equations (taken w as given) determine 4 variables $\bar{p}$, R, $\hat{a}$, b

- average productivity (extraction equation)
- E's rational "pricing" of projects (valuation)
- f.o.c. of Bs
- free entry into banking

obtain explicit solution!

Efficiency measure: GDP

- zero discounting: welfare infinite, use GDP
  - should be identical with risk neutrality

- GDP Y: steady state flow of output *per unit of time*

$$Y = \underbrace{m(b) \times a \times \bar{p} \times (1-k)}_{1.} - \underbrace{b\ \psi(a)}_{2.} - \underbrace{\frac{1-\bar{p}}{1-p}\frac{F}{R}}_{3.}$$

1. output generated by selected Es
2. cost of running Bs
3. cost of new projects. more complicated.

   Lemma 1 *The flow rate at which E either is selected or arrives at R, which in steady state equals the initial size of all cohorts, equals*

$$\frac{1-\bar{p}}{1-p}\frac{1}{R}$$

Model in action: efficiency showdown

- Let's say that the matching function is

$$m\,(b) = b^{\eta}$$

- remember, GDP
  - all endog. variables solved explicitly: get $Y = Y(\tau)$, $\left.\frac{\partial^2 Y}{\partial^2 \tau}\right|_{\tau^*} < 0$

Result 1

$$\tau^* = 1 - \eta = -\frac{\partial h(b)}{\partial b}\frac{b}{h(b)}$$

- CRS ($\eta = 1$): no tax
  - but appropriate to target externalities?

- $\eta < 1$: tax

Conclusions and outlook

- provide intuition for efficiency here
  - understand determinants of τ^*, can there be a subsidy?

- no discounting kills important effects
  - characterize model with discounting
  - internalize crowding externality using Hosios

- add losses, variable evaluation costs

- calibrate (?), quantitative relevance?

- anecdotal evidence

Appendix

“Wage” determination: no discounting

- Assuming Nash Bargaining with no discounting
  - outside option E (bargaining power $\widehat{\beta}$): knows project is good
    - knows will be called eventually, does not discount
    - outside option: will get certain payment $\widehat{w}$ in future
  - outside option B: zero, b/c instantaneous production
    - get nothing, look for another project at zero value
  - split total surpluss $S = 1 - k - \widehat{w}$:

$$(w - \widehat{w}) = \widehat{\beta}\,(1 - k - \widehat{w})$$

- any rational expectation equ. $w = \widehat{w} \Rightarrow w = 1 - k$
- BUT: there would be no production if Bs get no output
- Thus, our assumption.

“Wage” determination: with discounting

- discounting introduces real search

- E’s outside option – gives mileage: independent of R

$$D\left(m\left(b\right)a,\delta\right)\times\widehat{w},\qquad D\left(m\left(b\right)a,\delta\right)\in\left(0,1\right)$$

  - incr. meeting rate, less discounting: raises outside option to limit $\widehat{w}$
  - rational expectations w is

$$w=\frac{\beta}{1+\beta D\left(m\left(b\right)a,\delta\right)}\left(1-k\right)$$

- no “block recursive” solution because the wage depends on the other endogenous variables

- complexity motivates our simple sharing rule in the benchmark model

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