14.771: Credit Lecture 1

Ben Olken

Outline

- This set of lectures:
  - Theory of credit constraints:
    - Moral hazard
    - Adverse selection
    - Monitoring
  - Credit constraints and the return to capital for individuals and microenterprises
  - Micro-finance as intermediaries and the impacts of microfinance

- Next semester in 14.772:
  - Banks as intermediaries
  - Demand for credit and impact on firms

The neo-classical model of the capital market

- Everyone faces the same interest rate, adjusted for risk.
  - i.e. if there is a $d\%$ risk of default then $(1-d)\,r$ (where r is the gross interest rate) is a constant.
- The interest rate paid to depositors is equal to $(1-d)\,r$ less some small charge for the cost of operating a bank.
- The expected marginal product of capital should be equated to $(1-d)r$.

Stylized facts

1. Sizeable gap between lending rates and deposit rates within the same sub-economy
2. Extreme variability in the interest rate within the same sub-economy:
3. Low levels of default
4. There seems to be ex ante competition in the markets
5. Rich people borrow more and pay lower rates of interest; more generally it appears that those who borrow more pay lower interest rates:

Credit constraints: Moral Hazard in Investment Choice

- Suppose that there are a menu of possible investments denoted by their probability of success p.
  - Investment p yields $R(p)$ with probability p and 0 with probability $1-p$.
  - Total expected return $E(p) = pR(p)$.
  - Assume $R'(p) < 0$ (otherwise projects are strictly dominated).
  - Assume $E'' < 0$.
  - Denote p^* the level of p that maximizes E. p^* is socially efficient.
- Capital
  - These investments have returns to scale denoted by $F(k)$
  - So if you invest k in project p you get expected return $F(k)E(p)$
- Credit:
  - Suppose the investor has wealth w. If she wants to invest k she must borrow $k-w$.
  - Gross interest rate is r.
  - Limited liability. If you can't pay, they take your collateral w, but no more. So you get 0 if your project doesn't return. Important?

Project choice

- Suppose k is contractible but project choice p is not. Borrower solves

$$\max_{p} p\left[F\left(k\right)R\left(p\right)-r\left(k-w\right)\right]+\left(1-p\right)0$$

- FOC:

$$F\left(k\right)E'\left(\widehat{p}\right)=r\left(k-w\right)$$

- Recall that $E'\left(p^{*}\right)=0$.
- Since $E'\left(\widehat{p}\right)>0$, $\widehat{p}<p$, i.e., borrower takes too much risk. Why?
  - Intuition: Limited liability means that you care more about the return in the good state than the probability of ending up in the bad state. If you had to pay $r\left(k-w\right)$ in both states, this effect would disappear.

Credit

- Comparative statics:
  - Note that

$$\begin{aligned} F(k) E'(\widehat{p}) &= r(k-w) \\ E'(\widehat{p}) &= \frac{k}{F(k)} r\left(1-\frac{w}{k}\right) \end{aligned}$$

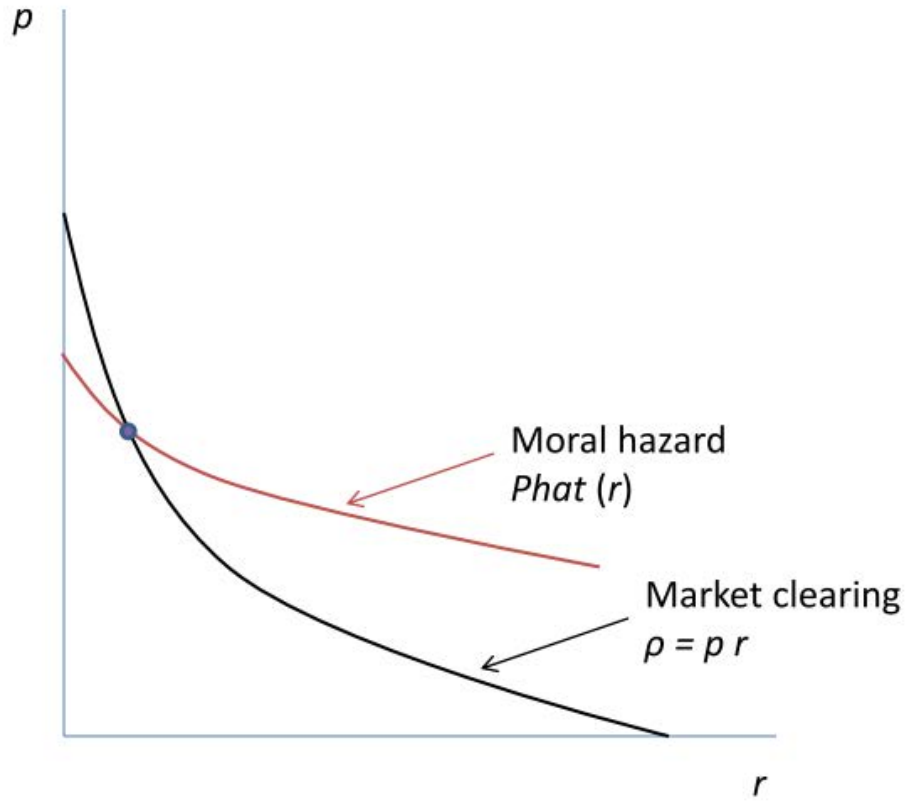
  - How does $\widehat{p}$ depend on r? Decreasing.
  - How does $\widehat{p}$ depend on $\frac{F(k)}{k}$ (returns)?Increasing.
  - How does $\widehat{p}$ depend on $\frac{k}{w}$ (leverage)?Decreasing.
  - Note that a positive correlation between default probability $1-p$ and interest rate r is a classic prediction of moral hazard.

Market clearing

- Market clearing:
  - Suppose exogenous supply of funds at market rate ρ. Zero profit for lenders implies $\rho = pr$.
  - Equilibrium depends on shape of $\widehat{p}(r)$ function

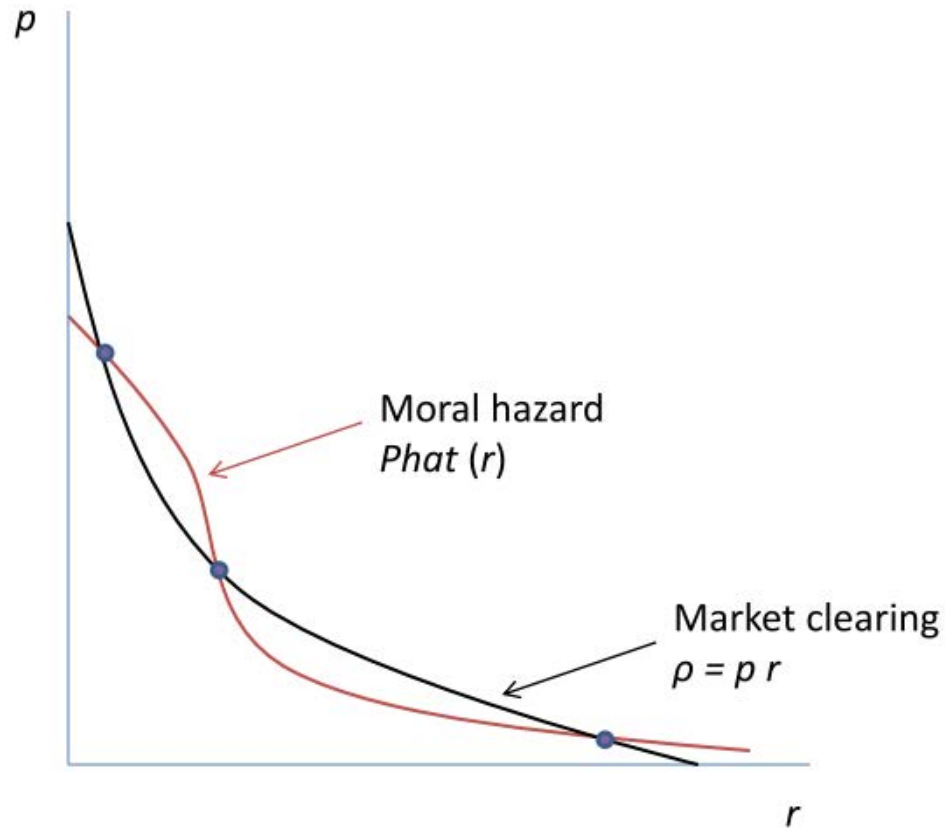
Market clearing

Single equilibrium



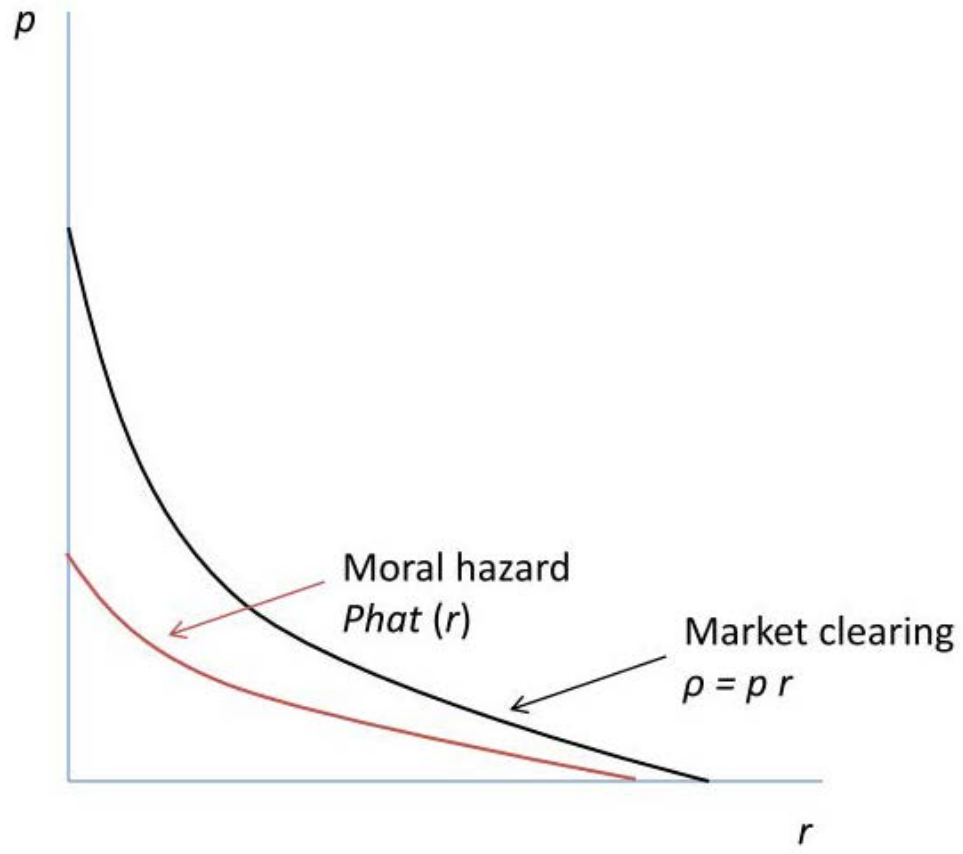
Market clearing

Multiple equilibria



Market clearing

No lending equilibrium



Investment decision

- What about capital?
  - We derived $\hat{p}\left(\frac{F(k)}{k}, \frac{k}{w}, r(k)\right)$.
  - Now solve

$$\max_k F(k) E\left(\hat{p}\left(\frac{F(k)}{k}, \frac{k}{w}, r(k)\right)\right) - \rho(k - w)$$

  - Note you always repay ρ in equilibrium. Why?
  - Why are you only maximizing over k, not k and p jointly?

- FOC:

$$F'(k) E(\hat{p}) + F(k) E'(\hat{p}) \frac{\partial \hat{p}}{\partial k} = \rho$$

Investment decision

- We had

$$F'(k)\,E(\hat{p}) + F(k)\,E'(\hat{p})\,\frac{\partial \hat{p}}{\partial k} = \rho$$

- Whereas first best is

$$F'(k)\,E(p^*) = \rho$$

- Comparative statics:
  - Assuming $F''(k) < 0$, then $k < k^*$ (i.e., underinvestment). Why? Because interest rate is higher given moral hazard, and there will be more of this with more capital (i.e. $\frac{\partial p}{\partial k} < 0$ holding interest rate fixed; this will be even more true given that interest rate adjusts since $\frac{\partial p}{\partial r} < 0$. So you'd prefer to be able to commit to a level p.
  - $\frac{\partial k}{\partial w} > 0$. Why?Also interest rate channel.
- Would you say there are "credit constraints" in this model?

Adverse selection

- Alternative story is adverse selection.
- Setup:
  - Now suppose that p is a fixed characteristic of an individual: some people have high p, some have low p.
  - Suppose the bank offers an interest rate of r.
  - Who takes the loan? People will accept if

$$p\left[F\left(k\right)R\left(p\right)-r\left(k-w\right)\right]>0$$

    i.e., if

$$R\left(p\right)>\frac{r\left(k-w\right)}{F\left(k\right)}$$

  - Since $R'\left(p\right)<0$, the higher the interest rate charged, the lower the p that will be selected.
  - Define $\widetilde{p}\left(r\right)$ as highest value of p you get given r.
  - $\frac{d\widetilde{p}}{dr}<0$, so also a negative correlation between interest rates and repayment rates.

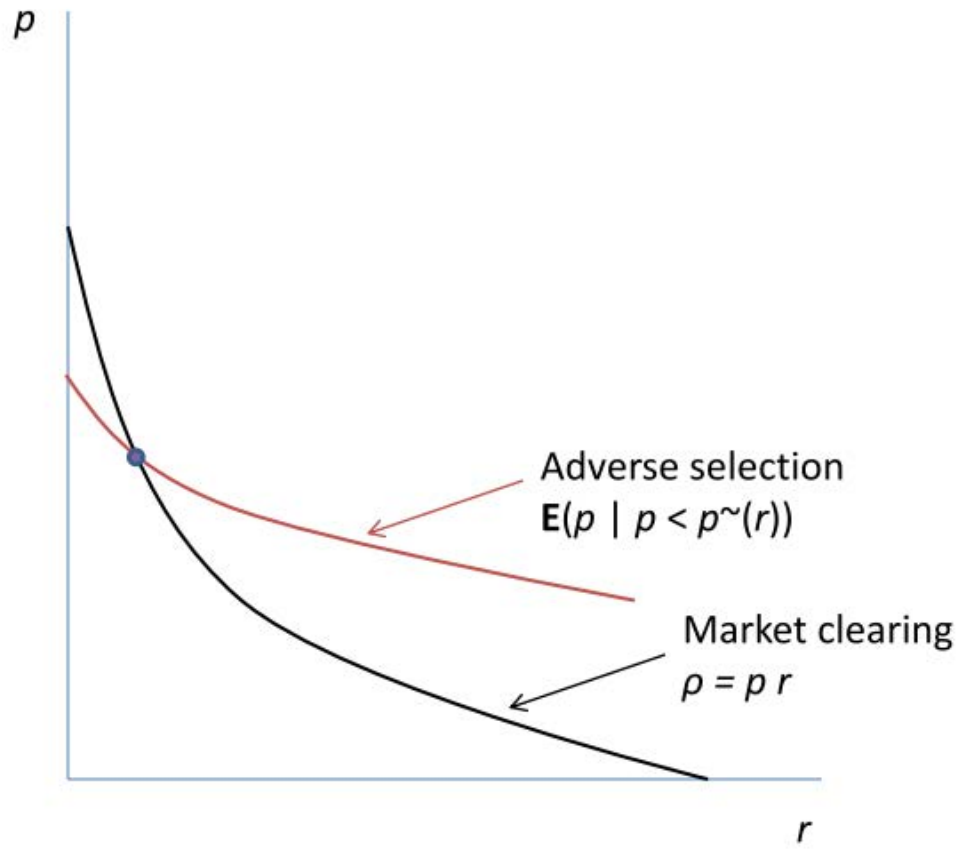
Adverse selection equilibrium

- Market equilibrium: break-even implies that

$$\mathrm{E}\left(p \mid p < \widetilde{p}\right) = \frac{\rho}{r}$$

  - Also higher interest rates than equilibrium, but reasoning is different
  - Suggests banks will want to screen customers ex-ante

Adverse selection equilibrium



Monitoring

- Both models above (moral hazard, adverse selection) generate high interest rates.
- But they also predict high non-repayment in equilibrium.
- Stylized fact: interest rates are high but equilibrium repayment rates are also often high.
- How to reconcile: monitoring costs

Monitoring model: Basic setup

- Model of repayment decisions:
  - Abstract from project choice p and projects failing. All projects now succeed with probability 1.
  - As before, suppose k dollars invested yields a gross return $F(k)$ and that the gross interest rate is r. A borrower who has a wealth of w and invests k will need to borrow $k - w$. She is supposed to repay $(k - w)r$.
  - Now the borrower can simply choose not to repay by paying cost η that is proportional to amount invested.
  - Lenders will only provide finance up to the point where the borrower has the incentive to repay. This requires

    $$F(k) - r(k - w) \geq F(k) - \eta k$$

    which gives us:

    $$\frac{k}{w} = \frac{r}{r - \eta} \equiv \lambda(r, \eta).$$

- This model predicts that firms are credit rationed, with amount borrowing increasing in w and decreasing in r.

Monitoring model: Adding Monitoring

- Monitoring technology:
  - Idea: the lender needs to spend resources in order to make the borrower want to repay. In other words, $\eta = 0$ unless the lender spends some resources.
  - What is the nature of the cost of monitoring? Aleem (1989) gives some clues
  - Most lenders say that they go through the same steps vis a vis every new borrower, seemingly independently of the amount of the loan.
  - A significant part of monitoring cost is probably a fixed cost.
  - The costs are substantial. Aleem calculates them to be 50 cents per dollar lent on average, easily explaining the gap between the 32.5% cost of capital and the 78.5% average interest rate in this data
  - The fact that lenders do not earn excess profits on average suggests that the industry is competitive. However in a world with monitoring there are probably ex post rents on repeat borrowers.

Adding Monitoring to the Model

- Let monitoring involve a fixed cost, ϕ, but no variable cost. Under the assumption of competition, the lender just breaks even:

$$r(k-w) = \rho(k-w) + \phi$$

- For any credit constrained borrower,

$$\frac{k}{w} = \frac{r}{r-\eta}$$

which implies that

$$\begin{aligned} r &= \rho + \frac{\phi}{\eta w}(r-\eta) \\ r &= \frac{\rho - \frac{\phi}{w}}{1 - \frac{\phi}{\eta w}} \end{aligned}$$

- For $\phi > \eta w$, this has no solution with $r > \rho$. These people will not be able to borrow.
- For $\phi < \eta w$, this has a solution: r goes down when w goes up (why?), η goes up.

Adding Monitoring to the Model

- Recall

$$r = \frac{\rho - \frac{\phi}{w}}{1 - \frac{\phi}{\eta w}}$$

- Multiplier property

$$\frac{dr}{d\rho} = \frac{1}{1 - \frac{\phi}{\eta w}}$$

$$\frac{dr}{d\phi} = \frac{\frac{1}{\eta w}(r - \eta)}{1 - \frac{\phi}{\eta w}}$$

- May explain why the interest varies so much.

Implications of the model

- Can explain a large wedge between the cost of capital and the interest rate and by implication a very high monitoring cost.
- The interest rate can be very sensitive to the cost of capital and the monitoring cost, if $1 - \phi$ is small
- The interest rate will be especially sensitive where the interest rate is high relative to the cost of capital
- Subsidizing the cost of capital can lead to welfare gains because r will go down and this will allow firms to borrow more.
- Reducing monitoring costs can lead to large social gains. Monitoring is costly in itself and generates costly deviations from efficient production.
- Borrowing from a neighbor, friend or relative may be efficient because he can monitor you easily and because she can punish you for default in more effective ways.

Testing for moral hazard vs. adverse selection

Karlan and Zinman (2010) : "Observing Unobservables: Identifying Information Asymmetries with a Consumer Credit Field Experiment"

- Idea:
  - Two types of asymmetric information problems in credit: moral hazard and adverse selection
    - Adverse selection: some people are riskier than others
    - Moral hazard: people can choose how much effort to exert to get the high outcome
  - Both look similar in cross sectional data.What do they predict? Positive correlation between interest rates and default probability.
  - Why?
  - Adverse selection:
  - Moral hazard:

Empirical design

- Design idea:
  - Adverse selection is driven by selection on ex-ante interest rate
  - Moral hazard is driven by selection on ex-post interest rate
  - In the world these are the same, but in an experiment you can vary them by surprising people with an interest rate discount after they agree to take the loan.

Design

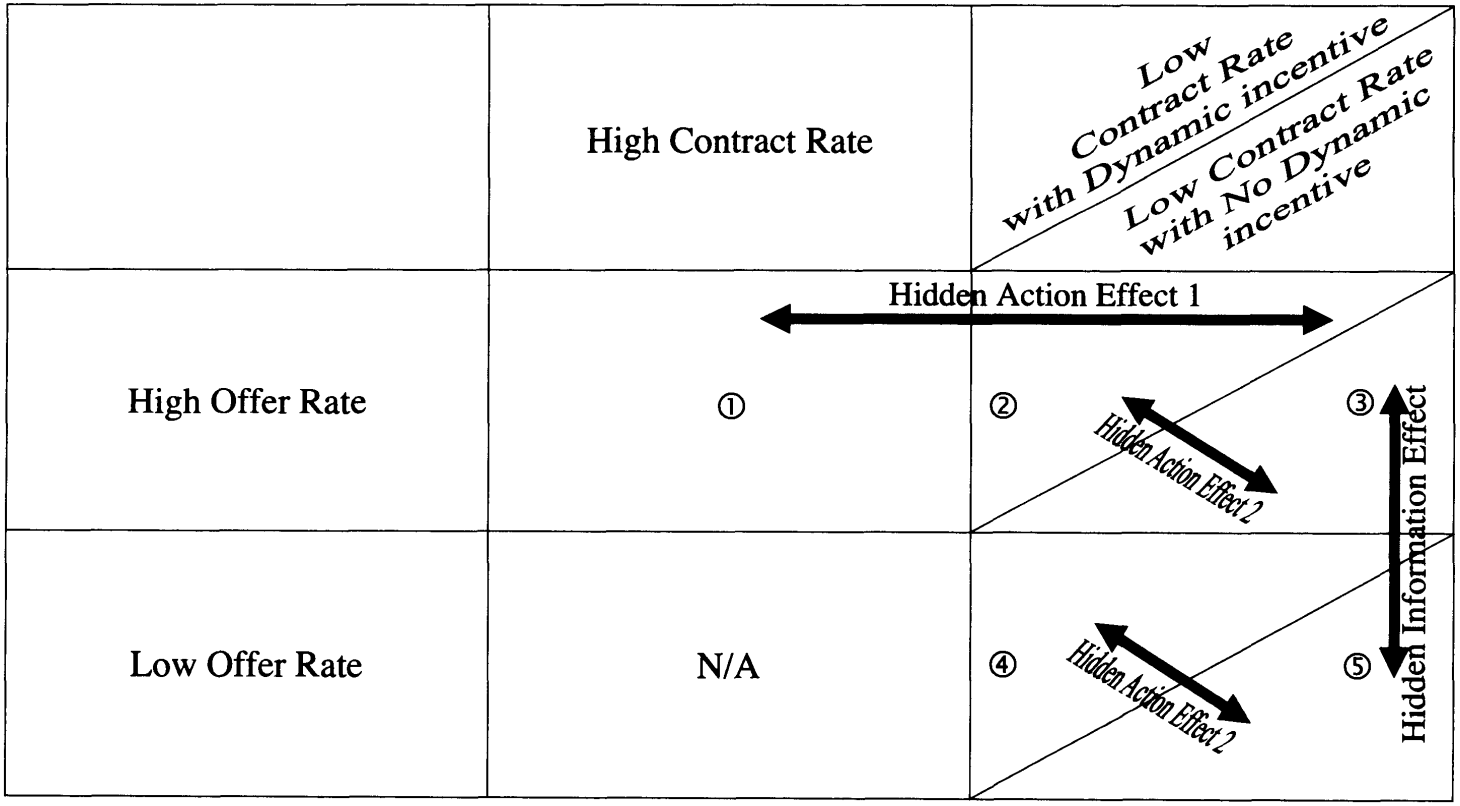


FIGURE 1.—Some basic intuition for our identification strategy.

© The Econometric Society. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/

Empirical design

- Design idea:
  - Adverse selection is driven by selection on ex-ante interest rate
  - Moral hazard is driven by selection on ex-post interest rate
  - In the world these are the same, but in an experiment you can vary them by surprising people with an interest rate discount after they agree to take the loan.
- Design:
  1. *High initial offer rate, high final offer rate.*
  2. *High initial offer rate, low final offer rate.*
  3. *Low initial offer rate, low final offer rate.*
  - Comparing 2 vs. 3 yields estimate of adverse selection
  - Comparing 1 vs. 2 yields estimate of moral hazard
  - Also test for moral hazard with "dynamic incentive" (if you ever default you get high rate in future)
- Setting:
  - Payday loans in South Africa. Good setting?

Results

TABLE I

EMPIRICAL TESTS OF HIDDEN INFORMATION AND HIDDEN ACTION: FULL SAMPLE

	OLS							
Dependent Variable:	*Monthly Average Proportion Past Due*		*Proportion of Months in Arrears*		*Account in Collection Status*		*Standardized Index of Three Default Measures*	
Mean of Dependent Variable:	0.09	0.09	0.22	0.22	0.12	0.12	0	0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Contract rate (Hidden Action Effect 1)	0.005	0.002	0.006*	0.002	0.001	−0.001	0.014	0.004
	(0.003)	(0.004)	(0.003)	(0.004)	(0.005)	(0.005)	(0.011)	(0.013)
Dynamic repayment incentive dummy (Hidden Action Effect 2)	−0.019*	−0.000	−0.028**	0.004	−0.025**	−0.004	−0.080**	−0.000
	(0.010)	(0.017)	(0.011)	(0.021)	(0.012)	(0.020)	(0.032)	(0.057)
Dynamic repayment incentive size		−0.005		−0.009**		−0.006		−0.023*
		(0.004)		(0.004)		(0.005)		(0.013)
Offer rate (Hidden Information Effect)	0.005	0.004	0.002	0.002	0.007	0.007	0.015	0.015
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.011)	(0.012)
Observations	4348	4348	4348	4348	4348	4348	4348	4348
Adjusted R-squared	0.08	0.08	0.14	0.15	0.06	0.06	0.10	0.11
Probability(both dynamic incentive variables = 0)		0.06		0.00		0.06		0.01
Probability(all 3 or 4 interest rate variables = 0)	0.0004	0.0005	0.0003	0.0012	0.0006	0.0016	0.0000	0.0001

- Also find gender differences (adverse selection for women, moral hazard for men)

References

- Aleem, Irfan (1990). "Imperfect Information, Screening and the Costs of Informal Lending: A Study of a Rural Credit Market in Pakistan." World Bank Economic Review, 4(3): 329-349.

- Karlan, Dean and Jonathan Zinman (2009). “Observing Unobservables: Identifying Information Asymmetries with a Consumer Credit Field Experiment.” Econometrica, 77(6): 1993-2008.

MIT OpenCourseWare
https://ocw.mit.edu/

14.771: Development Economics

Fall 2021

For information about citing these materials or our Terms of Use, visit: https://ocw.mit.edu/terms.