Chapter 4: Financial Constraints

Corporate Finance - MSc in Finance (BGSE)

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Why may firms be credit constrained?

- Moral hazard (hidden action) (chapter 2)
- Ex-ante info asymmetry (adverse selection) (chapter 5)
- Ex-post info asymmetry ("costly state verification" models)

Here we will...:

1. Review of the basic moral hazard model ("fixed investment")
2. Introduce the variable investment model
3. Identify the role of collateral
4. Study the macroeconomic implications

Review of the basic model

- Entrepreneur has a project that requires investment I but her assets are only worth $A < I$ (needs to borrow $I - A$)
- Project may be successful (probability p) and yield $R > 0$ or fail (probability $1 - p$) and yield 0
- Entrepreneur may exert effort ($p = p_H$) or shirk ($p = p_L$), with $\Delta p = p_H - p_L > 0$
- If she shirks she obtains private benefits $B > 0$
- Moreover,...
  - Entrepreneur has limited liability (no punishment for failure)
  - Investors are competitive (many, make zero profit)
  - Both entrepreneur and potential investors are risk neutral
  - There is no discounting

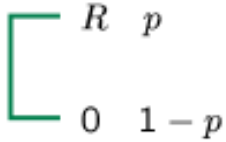
The timeline

Project costs I.
Entrepreneur has equity $A < I$; borrows $I - A$; is protected by LL.

Moral hazard

Verifiable outcome

	Pr (success)	Private benefit
Behaves	p_H	0
Misbehaves	p_L	B



Optimal contract

- *"Individual Rationality (participation) Constraint" (IR_I)*

$$p_H R_I \geq I - A$$

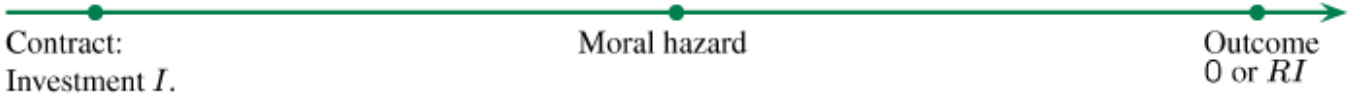
  - This assumes entrepreneur behaves (hence p_H instead of p_L)
- *"Incentive Compatibility Constraint" (IC_b)*

$$p_H R_b \geq p_L R_b + B$$

  - Entrepreneur needs to get at least $R_b^* = B/\Delta p$ to behave
- Lender can't get more than $R - R_b^*$ in "success"
  - Maximum expected pleadgeable income $p_H \left(R - \frac{B}{\Delta p} \right)$
- Maximum leverage

$$\frac{I - A}{I} \leq \frac{p_H \left(R - \frac{B}{\Delta p} \right)}{I}$$

The variable investment model



	Private benefit	Pr (success)
Behaves	0	p_H
Misbehaves	BI	p_L

- Notation: if effort exerted...
  - Income per unit of investment: $\rho_1 \equiv p_H R$ (return RI instead of R)
  - Pledgeable income per unit of investment: $\rho_0 \equiv p_H \left(R - \frac{B}{\Delta p}\right)$ (private benefit BI instead of B)
- Assumptions:
  - NPV$>$0 if effort and NPV$<$0 if not ($\rho_1 > 1 > p_L R + B$) (as before)
  - $(0 <)\rho_0 < 1$ (will ensure that investment is finite)

Optimal contract

- Borrower's objective: maximise payoff $p_H R_b - A$
  - s.t. (IC_b): $R_b \geq BI/\Delta p$
  - s.t. (IR_I): $p_H R_I \geq I - A$
- Substituting $RI = R_b + R_I$, and IR_I (which is binding. Why?)...
  - equivalent to maximise $p_H RI - I = (\rho_1 - 1)I$ $(= NPV)$
  - and therefore equivalent to maximise I (s.t. IC_b and IR_I)
  - and as a result IC_b is also binding
- Solving IC_b, IR_I and $RI = R_b + R_I$:

$$p_H \left(RI^* - \frac{BI^*}{\Delta p} \right) = I^* - A, \text{ hence } I^* = \frac{A}{1 - \rho_0}$$

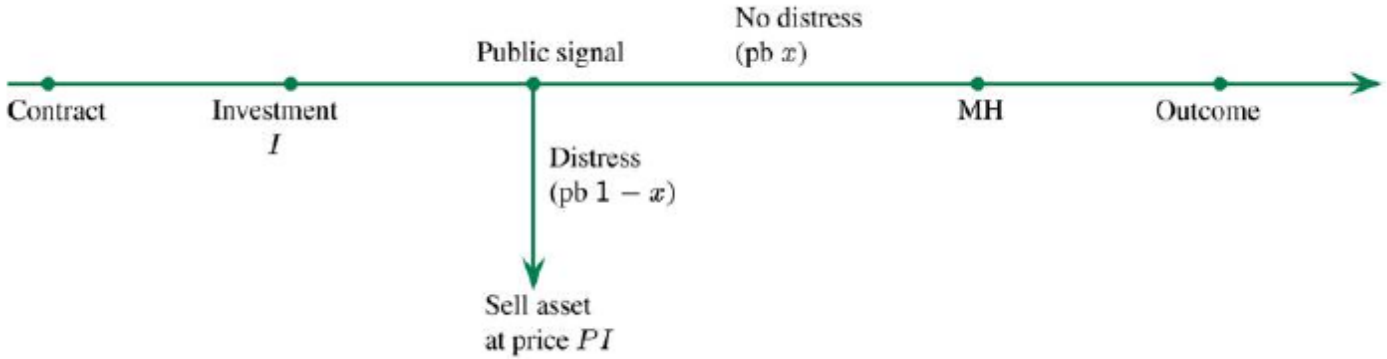
  - Defining k as $I = kA$ we have that $k = 1/(1 - \rho_0)$
  - $k > 1$ given that $0 < \rho_0 < 1$: multiplier effect!

Collateral constraints

- Pledging collateral
  - increases pledgeable income
  - might boost incentives
- Cost of collateralisation
  - transaction costs
  - suboptimal maintenance
  - lower value for lender
- Redeployability of assets boosts debt capacity
  - but, "relevant" value of collateral $\neq$ average value (low maintenance near distress and aggregate shocks)

The collateral value and investment model

Shleifer and Vishny (1992)



- Intermediate public signal about "productivity":
  - no-distress (0 or R) (prob x) or distress (0 for sure) (prob $1-x$)
  - lender can sell assets (useless if left in place) at price P per inv. unit
  - NPV>0: $x\rho_1 + (1-x)P > 1$; generalisation of previous model ($x = 1$)
- IR_I binding implies $x\rho_0 I + (1-x)PI = I - A$ or

$$I = \frac{A}{1-(1-x)P-x\rho_0}$$

and therefore I grows with P

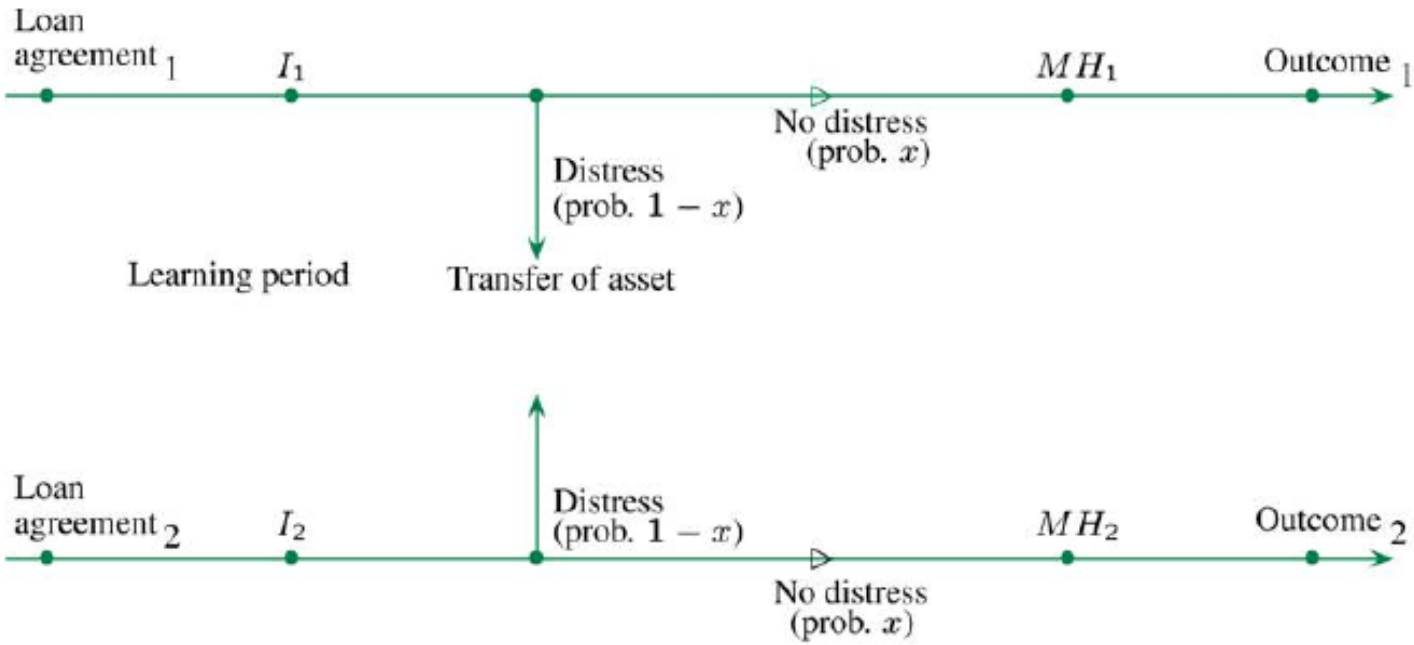
What does P depend on?

- P depends on existence of other firms able to purchase asset
- Assume 2 non-competing firms (only other could buy assets)
- Entrepreneur i: cash A_i , borrows $I_i - A_i$
- If j in distress and i not in distress, i can buy j's assets:
  - Assets $I_1 + I_2$
  - Potential private benefit $B(I_1 + I_2)$
  - Income in case of success $R(I_1 + I_2)$
- Assume as before

$$\rho_1 \equiv p_H R > 1 > p_L R + B \text{ and } \rho_0 \equiv p_H \left(R - \frac{B}{\Delta p} \right) < 1$$

Loan agreements

Lender i and entrepreneur i's loan agreement $\{I_i, R_{bi}\}$



Correlation of distress

		Conditional probability that firm j is: productive	in distress
when firm i is	productive (prob. x)	μ	$1-\mu$
	in distress (prob. $1-x$)	$1-\nu$	ν

- Correlation parameters: μ, υ
- If $\mu = \upsilon = 0$ perfectly negatively correlated
- If $\mu = \upsilon = 1$ perfectly positively correlated

Liquidation values

- Both firms in distress: no revenue for anyone.
- None in distress: standard model.
- What if firm 1 in distress but firm 2 is not?
  - If bought, borrower 2 must be paid more:

$$R'_{b2} = \frac{B}{\Delta p} I_2 + \frac{B}{\Delta p} I_1, \text{ hence extra rent } p_H \frac{B}{\Delta p} I_1 = (\rho_1 - \rho_0) I_1$$

and therefore firm 2 is willing to pay up to

$$P I_1 = p_H \left(R - \frac{B}{\Delta p} \right) I_1 = \rho_0 I_1 \text{ and therefore } P = \rho_0 < 1 \text{ (discount!)}$$

  - Assume lender 1 makes take-it-or-leave-it offer to firm 2 ($P = \rho_0$)

In expected terms...

- Entrepreneur 1's expected utility (=NPV)

$$x\rho_1 I_1 - I_1 + (1-x)(1-\nu)\rho_0 I_1 + x(1-\mu)(\rho_1 - \rho_0) I_2$$

- ... is again increasing in I_1 (IC_b binding). Lender 1's exp. profit:

$$xp_H(RI_1 - BI_1/\Delta p) + (1-x)(1-\nu)PI_1 - (I_1 - A_1) = 0$$

which can be rewritten, once we define k' as $I_i = k'A_i$, as

$$k' = \frac{1}{1 - \rho_0[x + (1-x)(1-\nu)]}$$

- Notice that multiplier (borrowing capacity)...
  - ... is greater than 1 since $\rho_0[x + (1-x)(1-\nu)] < 1$
  - ... is as before ($x = 1$) if $\nu = 0$ (even if assets sold at discount!)
  - ... decreases with correlation between shocks (ν)!

Economic crises

- "Balance sheet" channel (Fisher, 1933)
  - Redistribution of wealth from borrowers to creditors
    (non-indexed debt contracts and deflation)
  - Increased leverage and reduced investment
    (reduction of cash flows and fall in collateral values)
- "Lending" channel
  - Firms with weak balance sheets (small ones) depend on monitoring and certification of financial intermediaries
  - Hurt by financial intermediaries problems
    (collapse of 2000 IPO market harmed venture capitalists)
    (tight monetary policy, Bernanke, 1983)
    (bank panics, Friedman-Schwartz, 1963)

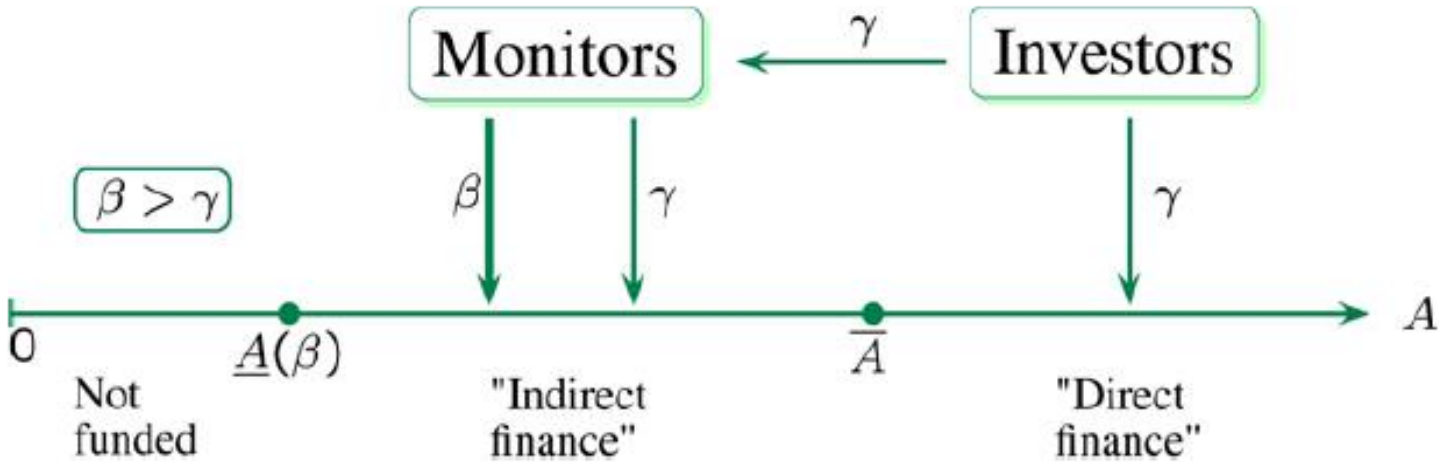
A model for the "lending" channel

- (i) Borrower ("firm")
  - return R if success & 0 if failure; **fixed** investment I; Assets $A \geq 0$
  - 3 possible actions (instead of 2):

Private benefit:	0	$<$	b	$<$	B
Prob(R)	p_H	$>$	p_L	$=$	p_L

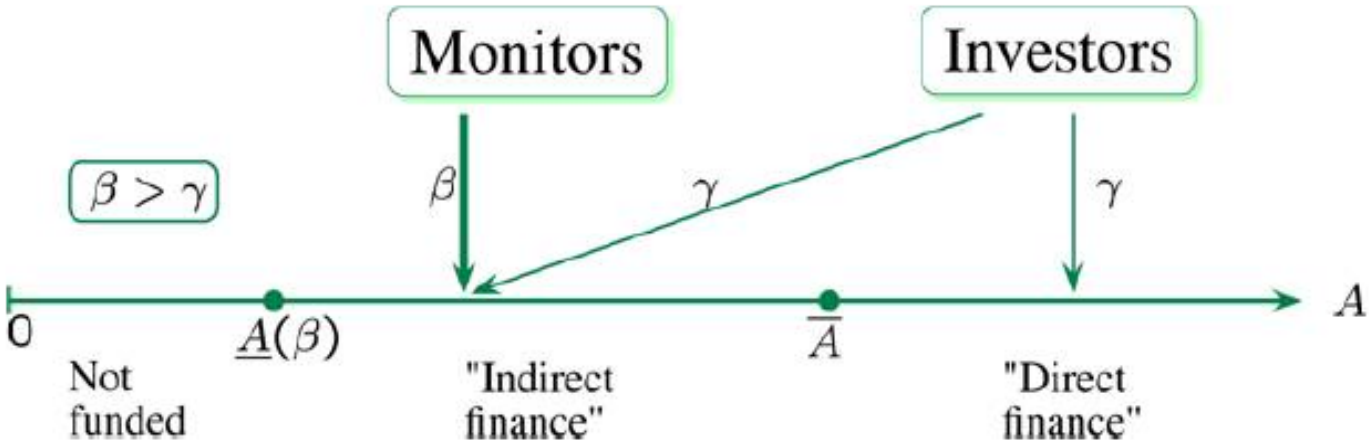
- (ii) Informed investors/monitors ("financial intermediaries", "banks")
  - can rule out high private benefit/bad project at a cost c (moral hazard)
  - demand excess return $\beta = 1 + i_m$
- (iii) Uninformed investors
  - demand excess return $\gamma = 1 + i_u < \beta$
- Further,
  - All agents are risk neutral
  - $p_H R - \gamma I > 0 > p_L R - \gamma I + B$ (only good viable if financed by (iii))

Equilibrium with intermediation



- Monitor...
  - collects funds from uninformed investors
  - offers them to borrowers bundled with own capital
- Examples: banks offering deposits and bank capital

Equilibrium with certification



- Monitor...
  - offers its own funds
  - also attracts funds of less uninformed investors
- Examples: venture capitalists or lead investment banks
- Intermediation and certification equivalent in our setting!!

Direct financing condition

- As before...
  - Split: $R = R_b$ (borrower) $+$ R_u (uninformed investors)
  - (IC_b): $(\Delta p)\, R_b \geq B$
- Now, (IR_I) needs $p_H R_I \geq \gamma(I - A)$

$$p_H\left(R - \frac{B}{\Delta p}\right) \geq \gamma(I - A)$$

which can be written as $A \geq \overline{A}$, where

$$\overline{A} = I - \frac{p_H}{\gamma}\left(R - \frac{B}{\Delta p}\right).$$

Indirect financing conditions

- Split: $R = R_b$ (borrower) $+ R_m$ (monitor) $+ R_u$ (uninformed) s.t....

$$\begin{array}{rrcl} (IC_b) & (\Delta p)\, R_b & \geq & b \text{ (effort) (with equality. Why?)} \\ (IC_m) & (\Delta p)\, R_m & \geq & c \text{ (monitoring) (with equality. Why?)} \end{array}$$

- Because $\beta > \gamma$, firms use as little informed capital as possible:

$$p_H R_m = \beta I_m \text{ and therefore } I_m^*(\beta) \equiv p_H c / (\beta \Delta p)$$

- Firm gets financed if

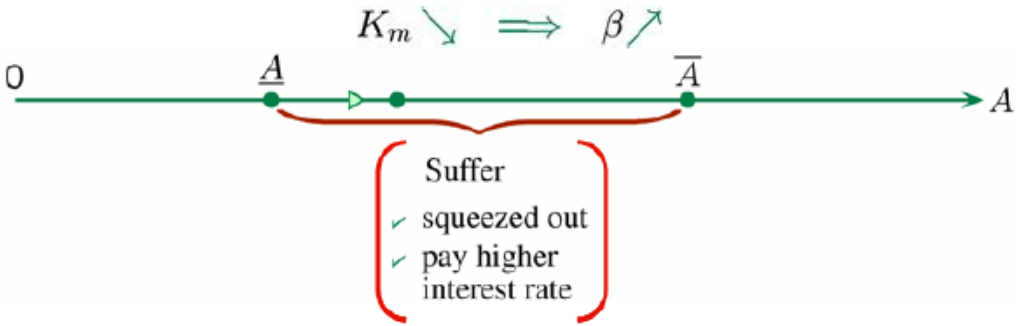
$$p_H \left(R - \frac{b+c}{\Delta p}\right) \geq \gamma (I - A - I_m^*(\beta)) \tag{1}$$

  i.e. if $A \geq \underline{A}(\beta)$ where $\underline{A}(\beta)$ satisfies (1) with equality

- Further $I_m^*(\beta)$ and $\underline{A}(\beta)$ are decreasing and increasing, resp. in β

Credit constraints at the macro level

- At the macro level...
  - Firms have different levels of capital A (cumulative dist. $G(A)$)
  - Informed capital assets: K_m (maximum supply capacity)
  - Equilibrium rate β^* satisfies $K_m = \left[G(\overline{A}) - G(\underline{A}(\beta))\right] I_m^*(\beta^*)$
  - Uninformed capital: infinite supply at γ (exogeneous)
- Recession through lending channel: $K_m \downarrow$, $\beta^* \uparrow$, $I_m^* \downarrow$, $\underline{A} \uparrow$



Small firms are prime victims of credit crunch

- Other channels:
  - Balance sheet (industrial recession) [firms]: $G(A) \uparrow$ for low A
  - Classical (saving shortage) [investors]: $\gamma \uparrow$, $\underline{A} \uparrow$, $\overline{A} \uparrow$