Corporate finance under asymmetric information

- Two big information problems
  - Moral hazard
  - Adverse selection
- Why do firms issue claims on the capital market?
  - financing investments
  - for risk-sharing reasons
  - cashing in and moving on
  - *trying to sell overvalued assets to investors*
- Asymmetric information between insiders and investors
  - The lemons problem: adverse selection
    - market breakdown
    - cross subsidization
  - Good borrowers may find it difficult to separate themselves from bad ones
  - Stock prices react negatively to equity offerings
    - An equity offering could indicate overvalued assets
    - Share issues are bad signals about profits
    - Conversely, share buybacks are good signals
  - The pecking-order hypothesis
    - internal finance $\succ$ debt $\succ$ hybrid capital $\succ$ equity
  - Distorted contracts may signal good borrowers' qualities.
    - Investing too little too late, etc.

- How to build a theory
  - Who are the insiders? And what are their objectives?
    - Managers? Current owners?
  - Which contracts are offered?
  - Who moves first – the informed or the uninformed?
    - Signalling vs screening.
- Who knows what?
  - Here: stick to insiders having private information
  - Some outside investors better informed than others?
  - Outsiders having information that insiders don't have?
  - Insiders' information affecting also third parties?
    - A firm may want to tell the capital market about high market demand, but does not want potential competitors to know.

A simple model: private information about prospects

- Borrower has no funds: $A = 0$. Investment costs I.
- Risk neutrality. Limited liability. Competitive capital market. No moral hazard: $B = 0$.
- Project returns R if successful, 0 otherwise.
- The borrower is one of two *types*: either *good* with success probability p, or *bad* with success probability q, where $p > q$, and $pR > I$.

- Two cases
  - Only the good type is creditworthy: $pR > I > qR$.
  - Both borrower types are creditworthy: $pR > qR > I$.
- The borrower knows her own type.
- Outside investors believe she is good with probability α and bad with probability $1 - \alpha$.
- Investors' *prior success probability*:

$$m = \alpha p + (1 - \alpha)q$$

- Contract: R_b – what borrower receives if success; 0 if failure.

- Benchmark: Symmetric information.
  - Good borrower receives R_b^G, holding investors at breakeven: $p(R - R_b^G) = I$
  - If bad borrower is creditworthy ($qR > I$), then she receives R_b^B such that $q(R - R_b^B) = I$.
  - Good borrowers get higher returns: $R_b^G > R_b^B$

- Asymmetric information:
  - Stick to the simple contract: R_b.
  - Investors cannot tell good borrowers from bad ones.
  - Breakeven: $m(R - R_b) \geq I$

- *No lending* if $mR < I$.
  - Happens if bad type is not creditworthy ($qR < I$) and expected overall profitability is low:

$$[\alpha p + (1 - \alpha)q]R < I \Leftrightarrow \alpha < \alpha^* = \frac{(I/R) - q}{p - q}$$

  - *Underinvestment* – good borrowers do not get financing, even though they have profitable projects.
- *Lending* if $mR \geq I$.
  - Happens either if both types are creditworthy, or if the bad type is not, but $\alpha \geq \alpha^*$.
  - Breakeven constraint binding: $R_b = R - \frac{I}{m}$
  - *Cross-subsidization* – investors lose money on bad borrowers and make money on good borrowers:

$$p(R - R_b) > I > q(R - R_b)$$

  - *Overinvestment* if bad type is not creditworthy, which happens if

$$\frac{(I/R) - \alpha p}{1 - \alpha} \leq q \leq I/R$$

- *A measure of adverse selection*

  Lending requires

  $mR \geq I \Leftrightarrow$

  $$\left[1-(1-\alpha)\frac{p-q}{p}\right]pR \geq I \quad \Leftrightarrow$$

  $[1-\chi]pR \geq I$,

  where: $\chi = (1-\alpha)\dfrac{p-q}{p}$

  - Good borrowers' pledgeable income pR is discounted by the presence of bad borrowers.
  - The problem of adverse selection is increasing in
    - the probability of the bad type, $1-\alpha$, and
    - the likelihood ratio $\dfrac{p-q}{p}$.
  - A counterpart to the agency cost in the moral-hazard case.

- With adverse selection, the good borrower does not receive the project's NPV = $pR - I$, conditioned on receiving financing – as in the moral-hazard case. Rather, she receives

$$pR_b = p(R - \frac{I}{m}) = (pR - I) - \frac{\chi}{1-\chi} I .$$

Private information about *assets in place*

- Suppose the firm has an ongoing project and only needs a *deepening investment* but has no cash available.

- As it stands – with the assets in place – the firm has either a good project with success probability p or a bad one with success probability q. The probability of the project being good, as seen from outside investors, is α. If the project is good (bad), then the firm is undervalued (overvalued).

- A deepening investment increases the success probability for both project types with τ, such that $\tau R > I$. But contracts cannot be based on this investment in isolation.

- Would the firm want to *issue new shares* in order to obtain funds for the deepening investment?

    - An entrepreneur with good assets in place is less willing to let new investors in than is one with bad assets in place.

- Pooling vs separating equilibrium

    - In a *pooling equilibrium*, the types behave identically and offer outside investors identical contracts.

    - In a *separating equilibrium*, the types behave differently and offer outside investors different contracts.

- Breakeven constraint in a pooling equilibrium

$$[\alpha(p + \tau) + (1 - \alpha)(q + \tau)]R_l = I \Leftrightarrow R_l = \frac{I}{m + \tau}$$

- Good firm's incentive constraint in a pooling equilibrium:
  - It must be better to carry out the deepening investment with the financing terms in the market than to keep the project as it is now.

$$(p + \tau)(R - R_l) \geq pR \iff \tau R \geq \frac{p+\tau}{m+\tau} I$$

$$\iff \tau R - I \geq \frac{\chi_\tau}{1-\chi_\tau} I,$$

where: $\chi_\tau = \frac{(1-\alpha)[(p+\tau)-(q+\tau)]}{p+\tau} = \frac{(1-\alpha)(p-q)}{p+\tau}$

  - *Type-dependent reservation utility*: The better project the firm has, the higher value it gets from simply staying out of the capital market.
  - The deepening investment must not only be profitable, but sufficiently so, since $\frac{\chi_\tau}{1-\chi_\tau} I$ is strictly positive.
  - The good type invests if
    - the deepening investment is very profitable, or
    - there is little adverse selection (χ_τ is low).
- In a pooling equilibrium, both types invest and carry out an equity offering. The total value of the firm after the investment, as seen from the outside, is $(m + \tau)R - I$.
  - No stock-market reaction to the equity offering, since it is uninformative.

- If $\tau R < \frac{p+\tau}{m+\tau} I$, then
  - the good type would not invest in a pooling equilibrium
  - no pooling equilibrium exists
  - the only equilibrium is a *separating* one, where the firm, if it is of good type, does not invest.
  - the outside investors, if observing an equity offering, understand that this must come from a bad type and require a higher stake: $R_b^B = \frac{I}{q+\tau}$
  - there is a negative stock price reaction to an equity offering:
    - before the announcement, the value of the firm to outside investors is

$$V_0 = \alpha[pR] + (1 - \alpha)[(q + \tau)R - I]$$

    - after the announcement, the value is

$$V_1 = (q + \tau)R - I$$

    - there is a fall in this value if

$$pR > (q + \tau)R - I$$

    - but we know already that

$$\begin{aligned} pR &> (p + \tau)(R - \frac{I}{m+\tau}) > (p + \tau)(R - \frac{I}{q+\tau}) \\ &> (q + \tau)(R - \frac{I}{q+\tau}) = (q + \tau)R - I \end{aligned}$$

  - The pooling equilibrium is more likely to exist in good times, when τ is high and/or I low: Stock-price reactions should on average be less negative in booms.

The pecking-order hypothesis: debt is preferable to new equity

- Myers and Majluf (1984)
- Again: in order to discuss debt vs equity in a simple model, it is necessary to introduce a salvage value: return if failure is R_F, if success $R_S = R_F + R$, where $0 < R_F < I$.
- No assets in place: $A = 0$; so private information is about prospects.
- Suppose $mR_S + (1 - m)R_F > I$; there will be lending even if investors cannot tell good type from bad.
- Contract: $\{R_b^S, R_b^F\}$ – what the borrower gets if success, failure.
- Breakeven constraint of outside investors:

$$m(R_S - R_b^S) + (1 - m)(R_F - R_b^F) = I$$

- Expected profit of a good borrower:

$$pR_b^S + (1 - p)R_b^F$$

- In the optimal contract, the good borrower wants to commit all the salvage value as safe debt to investors, because this decreases the adverse-selection problem.
  - A decrease in R_b^F makes the outside investors able to sustain an increase in R_b^S at a rate $\frac{m}{1-m}$, which will increase the good borrower's profit at a rate $\frac{p}{1-p} > \frac{m}{1-m}$.
  - The equilibrium contract: $\{R_b^S, R_b^F\} = \{R - \frac{I - R_F}{m}, 0\}$.

- Implementation of the contract.
  - First, a debt obligation $D = R_F$.
    - This is safe debt, since the firm will always have at least R^F to pay its debt.
  - Seondly, an equity issue, where shareholders get a fraction R_l/R of profits in excess of R_F, where

$$mR_l = I - D, \text{ or: } R_l = \frac{I-D}{m} = \frac{I-R_F}{m}.$$

- Adverse selection entails cross-subsidization from good to bad borrowers. Issuing debt minimizes this cross-subsidization and therefore minimizes the adverse-selection problem for a good borrower.

- More generally, the good borrower would want to issue *low-information-intensive claims* to mitigate the adverse selection problem.
  - The more sensitive the investors' claims are to the borrower's private information, the higher returns they demand from a good borrower to cover for the losses on a bad one.
  - Some modifications
    - Insurance needs for a risk-averse entrepreneur: who is most needy of service – the good type or the bad type?
    - Information-intensive claims are better for value measurement, improving incentives to create value and making it easier for the entrepreneur to exit in case of a liquidity shock.
    - If there is private information about the project *riskiness*, then the best solution may be some hybrid claim, such as convertible debt.
    - Investors with market power.

Dissipative signals

- Costly ways for the good borrower to separate from bad ones without having to abstain from investment altogether.
- Disclosure of verifiable information.
- *Certification*: buying the services of a certification agency, such as a rating agency, an auditor, etc.
  - Suppose $mR > I$, so that the good borrower gets funding, but is concerned by cross-subsidization.
  - Without certification, borrower gets R_b in case of success, where $m(R - R_b) = I$, so that $R_b = R - \frac{I}{m}$.
  - Certification costs c, needs to be covered out of the investment.
  - Bad borrower would never buy certification.
  - With certification, good borrower gets return R_b^G, where $p(R - R_b^G) = I + c$.
  - Good borrower buys certification if and only if

$$R_b^G > R_b \Leftrightarrow R - \frac{I+c}{p} > R - \frac{I}{m} \Leftrightarrow \frac{c}{I+c} < \chi$$

  - Certification pays off if its costs are small relative to the extent of the adverse-selection problem.
- *Collateral* as a costly signal of private information
  - A good-type borrower may use collateral in order to tell the outside investors about her type.
    - It is more expensive for a bad type to pledge collateral, since the probability of failure, and therefore loss of the collateral, is greater for the bad type than for the good type.

- Suppose that
  - without private information, even the bad-type would receive funding: $qR - I > 0$; and
  - a collateral of value C to the firm only returns βC to an outside investor, where $0 \leq \beta < 1$.
- Contract with collateral: $\{R_b, C\}$.
- The good-type borrower maximizes her expected profit subject to two constraints:
  - breakeven among investors, and
  - a *mimicking constraint* stating that it is better for a bad-type borrower not to offer this contract, even if this reveals her type, than to mimic the good type and suffer the risk of losing the collateral.
- Formally, the good-type borrower solves

  $$\max_{\{R_b, C\}} pR_b - (1-p)C$$

  subject to

  $$p(R - R_b) + (1 - p)\beta C \geq I$$

  $$qR_b - (1 - q)C \leq qR - I$$

- Both constraints are binding in equilibrium. The solution is found by solving the equation system where both constraints hold with equality:

  $$\{R_b^*, C^*\} = \{R - \frac{1-\beta\frac{1-p}{1-q}}{p-\beta q\frac{1-p}{1-q}}I, \frac{1}{1+(1-\beta)q\frac{1-p}{p-q}}I\}$$

- Here, $R_b^* > R - (I/p)$, the good borrower's return in case of success without private information. The equilibrium contract with private information makes use of both the bad-type borrower's greater concern for losing collateral and her smaller interest in return if success.

- Determinants of collateral: $C^* = \frac{1}{1+(1-\beta)q\frac{1-p}{p-q}}I$
  - Cheaper collateral implies that more collateral needs to be pledged: $\partial C^*/\partial\beta > 0$.
    - If the cost of collateral decreases, in the sense that βC (the outsiders' valuation of the collateral) gets closer to C (the borrower's valuation), then the good-type borrower needs to provide more collateral in order to scare off the bad type.
  - The stronger the asymmetry of information is, the more collateral is needed: $\partial C^*/\partial q < 0$.
    - Fixing the quality of the good type, p, outsiders get more concerned about the borrower's type when q is small.
- Testable implication: good firms pledge more collateral than bad firms.
  - The opposite implication of what the moral-hazard theory has.
  - Empirical studies exist supporting moral hazard as an information-based explanation for collateral.
- Other ways of signalling a firm's high quality to investors:
  - More *short-term debt* than called for without private information about the probability of reinvestment needs. This reduces the good (low-probability) firm's chances of continuation, but increases its return in the event of continuation and eventual success.
  - More *dividend* paid out than otherwise called for, in order to signal a firm's strength.