

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
 - liquidity: 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

$$mR \geq I \Leftrightarrow$$

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

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

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

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

- 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 $\frac{p - q}{p}$.
 - 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

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

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.

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

$$\Leftrightarrow \tau R \geq \frac{p + \tau}{m + \tau} I \Leftrightarrow \tau R - I \geq \frac{\chi_\tau}{1 - \chi_\tau} I,$$

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

- *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

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

- 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.
 - Secondly, an equity issue, where shareholders get a fraction R_I/R of profits in excess of R_F , where

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

- 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:

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

- 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.