Asymmetries of information

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- Asymmetries of information : so what?
- Simple economic relation :
  - "seller-buyer" who create a surplus when trading. Very general :
    - cooperation
    - co-financing
    - ...
- When symmetric info : "market" is efficient, whatever the "market power"
- When asymmetric info
  - the surplus of "trade" depends on some "variable" which is private info of one part
  - Problem : how to share it?
  - The way it is managed can generate "market failure" : incentive to cheat, luck of confidence, luck of "effort"...

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Outline

- Chapter 0 : reminders of perfect info and introduction to asymmetries
    - a simple economic relation
    - market and market power
    - the "efficiency" theorem
    - The different types of asymmetries of information
        - private info/hidden action
        - examples in economics
        - examples in finance : probability of success of an investment, insider information in a stock market
- Chapter 1 : Lemons
    - The simple model and market shutdown
    - Incentive compatibility
    - Application 1 : in corporate finance : project financing
    - Conclusion

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- Chapter 2 : The theory of incentives : The principal/agent model of adverse selection
  - general framework with private value : the delegation model or the seller/buyer model
  - Applications :
    - non linear pricing
    - others...
- Chapter 3 : The theory of incentives : variations and exercises
  - Timing
  - Outside options
  - Common value : the case of insurance
  - Bid-ask spread in market finance
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- Chapter 4 : the continuous case
  - Application to pricing
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- Chapter 5 : Moral Hazard
  - The Moral hazard problem : the way the pie is shared has an influence on its size! (incentive)
  - An example in Corporate Finance
- Chapter 6 : the standard Moral hazard model
  - trade off insurance/incentive
  - Limited liability/Risk aversion
- Chapter 7 : Application to insurance
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Reminders

- buyers : willingness to pay (bid) v_i, $v_1 > v_2 > v_3 > v_4 ... > v_B$
- sellers floor prices (ask) c_j, $c_1 < c_2 < c_3 < ... c_S$.
- Gain from trade (i, j): $v_i - c_j$ if it is positive (surplus).
- How to trade?
  - Frst solution maximize the sum of surpluses.
    - Opimal trades are those involving buyers and sellers whose index (i and j) are lower than
$$k^* = sup[k, v_K \geq c_k]$$
  - market with "auctioneer" :
    - p such that the number of seller that agree is equal to the number of buyers that agree
$$\#\{i, v_i \geq p\} = \#\{j, c_j \leq p\}$$

Reminders

Main result : the two solutions give the same total surplus and the same trades! (but not the same distribution of surpluses)

Theorem

The competitive equilibrium maximizes the total surplus

Intuitions

- Take one seller with valuation c and one buyer with valuation v.
- In symmetric info the result is "efficient" whatever the bargaining process and the market powers
- Bargaining
  - One move (take or leave)
    - market power (MP) : the one that proposes (the other accepts or refuses). Equilibrium : $p = v$ (seller has the MP) $p = c$ (buyer has the MP)
  - Alternating proposals with discounting
    - The Equilibrium surplus sharing is : $(1-\alpha)(v-c) = \delta\alpha(v-c)$ that is $\alpha = \frac{1}{1+\delta}$: the seller proposes $p = c + \frac{1}{1+\delta}(v-c)$
- What happens when asymmetric information?

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- What happens when asymmetric information?

Intuition

- Then if MP and information is not in the same hands there is a problem
- For instance the seller has inperfect info on v : he cannot set $p = v$ (since he does not know v)
- What can he do?
- For instance he has some prior distribution probability on v : $F(z) = \Pr\{v \leq z\}$
- He can try to maximize the "expected profit" : $\max(p - c)(1 - F(p))$

The result will not be efficient

Chapter 1 : The lemons problem (Akerlof 1970)

- Market for used cars :
  - Two types of used cars H and L, ex ante proportions : λ_H,λ_L such that $\lambda_H + \lambda_L = 1$
  - Market structure : the seller proposes and the buyer accepts or refuses
- Values : bids : $v_H > v_L$, asks : $c_H > c_L$ with $v_H > c_H$ and $v_L > c_L$
- Complete symmetric info : everybody knows the v's and the c's : two markets.
  - The quilibrium is

$$p_i^* = v_i, i = H, L$$

All the sellers sell.

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- Asymmetric information : sellers know quality, buyers do'nt
  - What happens if $c_H > \lambda_H v_H + \lambda_L v_L$?
- If the buyer expects that the probability to face a H car is λ_H then he is ready to pay at most $v = \lambda_H v_H + \lambda_L v_L$.
  - But this is not enough to satisfy a H seller. This max price is lower than his min price! So that a H seller does not show. He does not want to sell.
  - So it was not rational to expect there is a positive probability to face a H type!
- However it is rational for the buyer to expect that he faces a L seller. Indeed if so the maximal price is v_L which is lower than $c_H$but larger than c_L : only L sellers are ready to sell at that price!

Definition

This is Adverse Selection!

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Chapter 1 Application to Corporate Finance

Project financing :

- An investment (amount I) (a project) needs to be integrally financed (no initial cash).
- The return is R with probability p and 0 with probability $(1-p)$.
- There are two types of borrowers : $p_H > p_L$ with ex-ante probabilities α and $(1-\alpha)$. One sets : $m = \alpha p_H + (1-\alpha) p_L$
- Contract : the lender lends I and leaves R_b to the borrower in case of success and 0 in case of failure

Fact

The good projects are creditworthy : $p_H R \geq I$

More over we assume perfect competition among lenders and a zero risk-free interest rate :

Fact

The expected profit of the lender is equal to zero

Perfect information benchmark : two different markets
Perfect competition among lenders implies that on each market the expected profit must be 0 :

$$p_i\left(R - R_b^i\right) = I$$

That implies that good projects are financed with

$$R_b^H = \frac{p_H R - I}{p_H} \geq 0$$

There are two cases :

1. The bad project is not creditworthy ($p_L R < I$), and then is not financed
2. The bad project is creditworthy and is financed with

$$0 \leq R_b^L = \frac{p_L R - I}{p_L} < R_b^H$$

Asymmetric information : one market
Recall we have :

$$p_L R < mR < p_H R$$

Perfect competition among lenders implies that on that market the expected profit must be 0 :

$$m(R - R_b) = I$$

There are three cases :

1. $p_L R < mR < I < p_H R$: complete adverse selection, no financing!
2. $p_L R < I \leq mR < p_H R$: both projects are financed. There is overinvestment since L is not credit worthy. That means there is crosssubsidy : good projects indirectly finance badones.
3. $I \leq p_L R \leq mR < p_H R$: both projects are financed.

In the two last cases : $R_b^L < R_b < R_B^H$: the loan is more expensive (the compensation R_b is lower) for good projects when information is asymmetric

Application :market timing : negative stock price reaction for a deepening investment

- The model :
  - A principal wants to delegate a task to an agent, for example produce q.
  - The gross surplus achieved by the principal is $v(q)$ wher v is a strictly increasing concave function with $v(0) = 0$
  - The cost for the agent is $c(q) = \theta q$ with $\theta \in \{\theta_L, \theta_H\}$ (two potential types with resp prob λ_L ,$\lambda_H = 1 - \lambda_L$)
  - Hence the total surplus is $\sum_i \lambda_i (v(q_i) - \theta_i q_i)$, this is maximized for q_i^* such that $v'(q_i^*) = \theta$
  - The "contract" stiplulates the quantity q to produce and the monetary transfer from principal to agent t

- The complete info benchmark
  - The principal observes θ : the optimal contract solves :

$$\max_{(t,q)} \{v(q) - t, t - \theta q \geq 0\}$$

    $t - \theta q \geq 0$ is called the "Participation Constraint of type θ" . Here the outside option is asummed to be 0.
  - At the optimum $t - \theta q = 0$ (obvious). This implies that the problem becomes :

$$\max_{q} \{v(q) - \theta q\}, \; t = \theta q$$

    That is :

$$v'(q_i^*) = \theta_i$$

$$t_i^* = \theta_i q_i^*$$

- Asymmetric information :
  - The principal does not observe the value of θ.
  - He proposes a menu of contract : $\{(t_L, q_L), (t_H, q_H)\}$, and let the agent choose.
  - Obviously, if the contract chosen by H is different of the one chosen by L, without loss of generality, we call (t_i, q_i) the one chosen by i.
- Consider first the menu formed by the two complete info contracts $\left\{(t_L^*, q_L^*), (t_H^*, q_H^*)\right\}$
  - One has : $t_H^* - \theta_L q_H^* = (\theta_H - \theta_L)\, q_H^* > 0 = t_L^* - \theta_L q_L^*$
  - And :$0 = t_H^* - \theta_H q_H^* > (\theta_L - \theta_H)\, q_L^* = t_L^* - \theta_H q_L^*$

- So that both types chose the H contract! The surplus of the agents are 0 for H and $(\theta_H - \theta_L)\, q_H^*$ for L
  - The surplus of the principal is $v(q_H^*) - \theta_H q_H^*$
- The principal can do better :

- By choosing the contract (t_H^*, q_H^*) the L type obtains a positive surplus equal to $(\theta_H - \theta_L)\, q_H^*$. This is an informational rent.
  - To induce the agent to chose $\left(t_L, q_L^*\right)$ instead (and then to produce more) he must be given a bonus on the top of the cost :

$$t_L = t_L^* + (\theta_H - \theta_L)\, q_H^*$$

  - By doing so, the principal induces L to choose $\left(t_L^* + (\theta_H - \theta_L)\, q_H^*, q_L^*\right)$.
  - Then the production is increased, with the same surpluses given to the agent (0 if H, $(\theta_H - \theta_L)\, q_H^*$ if L)
- The principal can do even better :

- The general program is :

$$\max_{\{(t_H,q_H),(t_L,q_L)\}} \{\lambda_L(v(q_L)-t_L)+\lambda_H(v(q_H)-t_H)\}$$

  - Under the constraints :

$$\begin{array}{cc} t_L-\theta_L q_L \geq t_H-\theta_L q_H & IC(L,H) \\ t_H-\theta_H q_H \geq t_L-\theta_H q_L & IC(H,L) \\ t_L-\theta_L q_L \geq 0 & PC(L) \\ t_H-\theta_H q_H \geq 0 & PC(H) \end{array}$$

- Lemmas
- Lemma 1 : at the optimum $t_H - \theta_H q_H = 0$: the tranfer is equal to the cost for bad type
- Lemma 2 : at the optimum : $t_L - \theta_L q_L = t_H - \theta_L q_H$: the IC(L,H) constraint is binding.
  - Lemma 1 and lemma 2 imply that $t_L = \theta_L q_L + (\theta_H - \theta_L) q_H$: there is an information rent (bonus)
- Lemma 3 : $q_H \leq q_L$
- Lemma 4 : Lemma1 and lemma 2 and lemma 3 imply that at optimum $t_H - \theta_H q_H > t_L - \theta_H q_L$ and $t_L - \theta_L q_L > 0$
- So that the program reduces to :

$$\max_{\{q_H,q_L\}}\left\{\lambda_L\left(v(q_L)-\theta_L q_L\right)+\lambda_H\left(v(q_H)-\theta_H q_H-\frac{\lambda_L}{\lambda_H}\left(\theta_H-\theta_L\right)q_H\right)\right\}$$

Uder the constraint :

$$q_H \leq q_L$$

The payments are given by :

$$t_H = \theta_H q_H$$

$$t_L = \theta_L q_L + \left(\theta_H - \theta_L\right) q_H$$

Solution :

$$v'(q_L) = \theta_L \Rightarrow q_L = q_L^*$$

$$v'(q_H) = \theta_H + \frac{\lambda_L}{\lambda_H}(\theta_H - \theta_L) \Rightarrow q_H < q_H^*$$

Remark (shut down policy) : q_H can be 0 if $\theta_H + \frac{\lambda_L}{\lambda_H}(\theta_H - \theta_L) \geq v'(0)$ i.e if : $\frac{\lambda_L}{\lambda_H} \geq \frac{v'(0)-\theta_H}{\theta_H-\theta_L}$

Timing : assume that the timing is the following

1 the principal proposes a menu

2 The agent accepts or refuses the menu

3 The agent learns the value of θ

4 The agent chooses the contract and the chosen contract is executed

Theorem

In the case of reverse timing, the principal can obtain the perfect info allocation, if the agent is risk neutral :

Indeed he proposes for instance :

$(t_H = v(q_H^*) - T, q_H^*), (t_L = v(q_L^*) - T, q_L^*)$

This menu verifies IC for all T !

Then the principal fixes T so as to bind the ex-ante participation constraint :

$$\lambda_H(t_H - \theta_H q_H^*) + \lambda_L(t_L - \theta_L q_L^*) \geq 0$$

Thats leads to :

$$T = \lambda_H(v(q_H^*) - \theta_H q_H^*) + \lambda_L(v(q_L^*) - \theta_L q_L^*)$$

which is the perfect info surplus!

- An entrepreneur has a project that needs I (investment) to start. He has an amount of initial cash equal to A.
  - So that $I - A$ must be borrowed.
- The project
  - can succeed : the return is R
  - of fail : the return is 0.
- The entrepreneur can
  - behave (make an effort) and then the project has a probability p_H to succed
  - Or he can misbehave (make no effort) and then the project has a probability to succed equal to p_L,
    - and the entrepreneur gets a private benefit B.

- A financing contract specifies the amount borrowed , here $I - A$, and the sharing of the return R_b for the borrower and R_ℓ for the lender.

Assumptions :

$p_H R - I > 0$ the net value is positve when effort

$p_L R - I + B < 0$ the net value is negative when no effort

- These hypothesis mean that the entrepreneur would behave if he financed the project on his own.

Assumption : there is competition among lenders (0 expected profit) :

$pR_\ell = I - A$

- Incentive constraint (the sharing contract induces that effort is better):

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

That is :

$$R_b \geq \frac{B}{\triangle p}$$

So that :

$$R_\ell \leq R - \frac{B}{\triangle p}$$

- This implies

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

- The project can be financed if

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

- That is

$$A\geq p_H\frac{B}{\triangle p}-(p_HR-I)=\overline{A}$$

- Interesting when $\overline{A}\geq 0$ that is $p_H\frac{B}{\triangle p}\geq(p_HR-I)$
  - In that case the project to be financed, needs an amount $\overline{A}$ of self financing

Theorem

When $A<\overline{A}=p_H\frac{B}{\triangle p}-(p_HR-I)$, there is credit rationing : one lends only to the rich.

- The continuous case :
- now the return is RI in case of succes, the private benefit is BI

Assumptions :

$$p_H R \geq 1$$

$$p_L R + B < 1$$

$$p_H R < 1 + p_H \frac{B}{\triangle p}$$

- The third one means that the net expected revenue is less than the expected information rent.

- The incentive constraint becomes :

$$p_H R_b \geq p_L R_\ell + BI$$

- That is

$$R_b \geq \frac{BI}{\triangle p}$$

- Then for the lender :

$$R_\ell \leq \left(R - \frac{B}{\triangle p} \right) I$$

- So that

$$p_H R_\ell - (I - A) \leq P_H \left(R - \frac{B}{\triangle p} \right) I - (I - A)$$

- In order to be financed (expected profit ≥ 0) : we must have :

$$\frac{I}{A} \leq \frac{1}{1 - P_H \left(R - \frac{B}{\triangle p} \right)}$$

- Let

$$\rho_0 = P_H \left(R - \frac{B}{\triangle p} \right)$$

And

$$\rho_1 = p_H R$$

- Then

$$I \leq \frac{1}{1 - \rho_0} A$$

Theorem

Debt/equity ratio : $\frac{I-A}{A} \leq \frac{\rho_0}{1-\rho_0}$

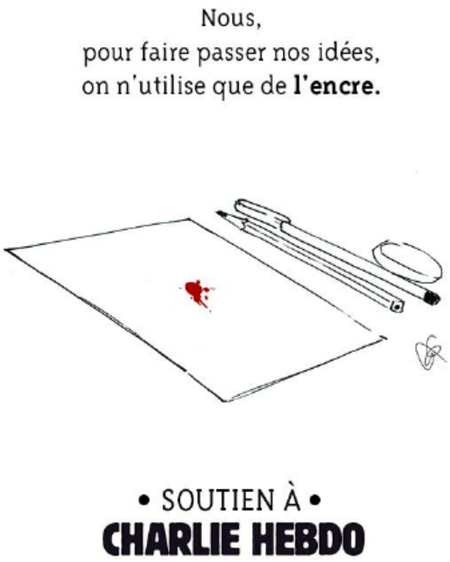
- It is optimal to borrow exactly $\frac{\rho_0}{1-\rho_0}A$
- The shadow value of equity
  - A gives rise to an investment equal to $\frac{1}{1-\rho_0}A$,
  - and then a total return equal to $\frac{\rho_1}{1-\rho_0}A$
  - The bank makes no profit so that $p_H R_\ell = I - A = \frac{\rho_0}{1-\rho_0}A$,
  - So that the return on equity is :

$$\frac{\rho_1 - \rho_0}{1 - \rho_0}$$

- This is larger than 1 !

Je suis Charlie

Je suis Charlie



Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - What we have not done yet.
  - Even more stuff.