MANAGERIAL ECONOMICS

Corrado Pasquali

6. AGENCY THEORY

Preliminary definitions

- An asymmetry of information in which there are hidden actions taken by one party in a transaction that are relevant for but not observed by the other party.
- When hidden actions on the part of one agent influence another agent's payoffs, we also say that we are facing moral hazard.
- Post contractual info asymmetry. "Hidden action".

An expression rooted in insurance markets

- The notion of moral hazard is usually associated with risk and insurance markets but reaches far beyond.
- The basic idea is that people tend to take more risks if they don't have to bear the costs of their behaviors.
- Likewise, once insured, home owners near water do not have full incentives to protect themselves from the adverse effects of floods.
- As a matter of fact, the insurance subsidizes risky behavior.

In five points

- Under moral hazard the uninformed party can sometimes design a contract to incentivize the party with private information.
- Economists refer to such relationships as a principal-agent relationship.
- The party with the hidden action is the agent.
- The uninformed party, who can design a contract before the agent chooses his action, is the principal. This contract determines the agent's payoff as a function of some indicators of his performance.
- The principal tries to structure the contract so as to provide appropriate incentives to the agent (for example, so as to incentivize the worker to work hard).

The model

- Also called: Agency Theory or Economic Theory of Incnetives
- It deals with incentives: reasons and motivations for having someone else do something she would not be doing otherwise
- It deals with the ways to attain efficiency and maximize the surplus from a social relation when individual aims do diverge.

The model

- The first actor is a Principal (henceforth P).
- The second actor is an agent (henceforth A)
- P owns an organization (say, a firm)
- P does not have time or competencies to personally carry out those tasks and jobs that create value for her firm
- P can however hire an agent A to work for her in producing value that she will appropriate and pay him a wage.
- At this point students are called to represent this situation in a perfectly competitive (labor) market.

The model

- After hiring A, however, P's and A' interests do actually diverge (note: this would not happen in a perfectly competitive market)
- P wants A to work as hard as he can and produce as much value as possible for the firm. P can either monitor A or motivate A (but both activities are either hard to carry out or costly)
- On the other hand, once A has been hired he has any reason to make his commitment and effort as small as possible
- As A's actions are partly hidden or not observable, moral hazard takes place: a form of post-contractal opportunistic behavior whose main consequence is a loss of efficiency

Cornerstones

The model is about nothing but motivation.

Motivation means incentives

Beating MH and restoring efficiency using appropriate contracts

Non observability and uncertainty will be our most fierce enemies

Building Blocks: Production Technology

1. Contribution. Have it denoted with y. It is A's contribution to value for P. E.g. harvest, increase in stocks prices. Contribution is assumed to be easy to observe, measure, and easy to be used in court
2. Effort. Have it denoted with e. This is "how hard A works", "how much effort he puts in his work". Effort is non observable, hardly measurable, not usable in court. We will assume that e can take on three values higher to lower: e_H, e_M, e_L.
3. Uncertainty. Have it denoted with ϵ. This is "the effects of uncertain events that have an influence on y but do not depend on A's effort". E.g. it rains, bad economic trend...

Building Blocks: Production Function

Our production function will thus be:

$$y = f(e, \epsilon)$$

Building Blocks: Production Technology

We will initially adopt a most simplified model of uncertainty.

1. Let $y_1 < \ldots < y_n$ be possible outcomes of A's work (ranked worst to best)
2. Let us assume that only one y_i will be realized
3. Let p_i^H, p_i^M, p_i^L the probabilities associated with y_i being realized when A works with e_H, e_M, e_L
4. It then follows that the expected result if A works with effort e_M will be: $E^M(y) = \Sigma_{i=1}^n p_i^M y_i$
5. Finally, we will assume that effort is productive, i.e. higher effort gets you higher expected contributions (but remember uncertainty: prob that contribution is miserable with highest effort is small but non null!)

Building Blocks: Contracts

That is: how to have A work (hard) for P.

1. Problem e can't be observed (this is what we call an *asymmetry of info*)
2. Thus: contracts can't be based on e
3. Solution: have contracts be based on y i.e. have y be a proxy for e
4. That is, we will have: $w = w(y)$.

Building Blocks: Contracts

We will consider a particular class of contracts: linear contracts.

1. These will set wage to be formed by a fixed (i.e. not depending on y) plus a variable part (i.e. depending on y).
2. Contracts will thus have the form: $w = a + by$
3. by is what we call an *incentive*

Building Blocks: P's Results

For the sake of simplicity, we will initially assume that both P and A are risk neutral (thus they are only interested in result's expected value and uncertainty has no cost for them). We will soon drop this assumption.

1. P she gets y but has to pay w. Thus her expected result is:

$$\pi(a, b) = E(y - w) = E(y) - E(w) = E(y) - a - b \cdot E(y)$$

2. Thus, assuming risk neutrality:

$$\pi(a, b) = e - a - b(e) = (1 - b)e - a$$

3. That is: P's result is given by the value created by A minus what P has to pay to incentivate him.

Building Blocks: A's Results

These will depend on the following consideration: if A accepts the contract he will receive a wage w but he will have to put effort in his work and thus bear some costs.

1. Let $c(e)$ be A's cost function. $c(\cdot)$ value corresponds to its monetary cost.
2. $c(e)$ is an increasing, convex function. $c'(e)$ will thus be increasing.
3. A's expected result will thus be given by the following utility function (assume a separable function for the sake of simplicity):

$$U_A(w, e) = U(w) - V(e)$$

4. As we assumed A to be risk neutral, we will have:

$$U_A(w, e) = a + b \cdot y - V(e)$$

Building Blocks: A's Results

1. If A does not accept the contract, he will receive his reservation utility $U_A(0) = U_0$.
2. That is: the result of his best alternative option or the utility he derives from leisure.

Temporal Sequence

1. P proposes to A a contract $w = a + b \cdot y$
2. A subscribes to the contract iff $U_A(w, e) \geq U_0$
3. If A subscribes to the contract, then he decides between e_H, e_M, e_L without having P be able to observe his choice.
4. P and A (and possibly a court) do execute the contract.
5. P gets $\pi(a, b) = y(e) - a - b(y)$ and A receives $U_A(w, e) = a + b \cdot y - V(e)$

Have a close look at Figures 1.1, 1.2, 1.3 on MSPC pp. 8, 9, 10 and the discussion therein.

Let us have everything formalized

P's problem:

$$max \sum_{i=1}^{n} p_i^H(y_i - w(y_i))$$

Let us have everything formalized

Participation constraint:

$$\sum_{i=1}^{n} p_i^H [U(w(x_i) - V(e_H)] \geq U_0$$

Let us have everything formalized

Incentive compatibility constraint:

$$\sum_{i=1}^{n} p_i^H [U(w(x_i) - V(e_H)] \geq \sum_{i=1}^{n} p_i^M [U(w(x_i) - V(e_M)]$$

$$\sum_{i=1}^{n} p_i^H [U(w(x_i) - V(e_H)] \geq \sum_{i=1}^{n} p_i^L [U(w(x_i) - V(e_L)]$$

A neat (tough) problem

It might well happen that the solution to this problem be too costly for P.

Total utility for P might not indeed be maximized by e^H but rather by e^M.

This happens when the difference between y and w (i.e. her profits) is not maximized by e^H but rather by e^M or even by e^L.

This is called *productivity constraint*. It requires that the increase in y obtained as a result of an increase in e be higher than the increase in b thet P has to pay in order to have a higher e.

Formal solution to this problem is real hard. We will deal with it only by some examples.

7. AGENCY THEORY SECOND PART

Introduction

- We will now try and examine the class of contractual implications of informational asymmetries.
- To that end, we will start from a somehow unrealistic assumption: let information be perfect and let A be a social maximizer of efficiency
- We will use the results from this totally unrealistic assumption as a benchmark for what follows.
- Not surprisingly, we will first examine what is called a "first best solution for the P/A model.

First best

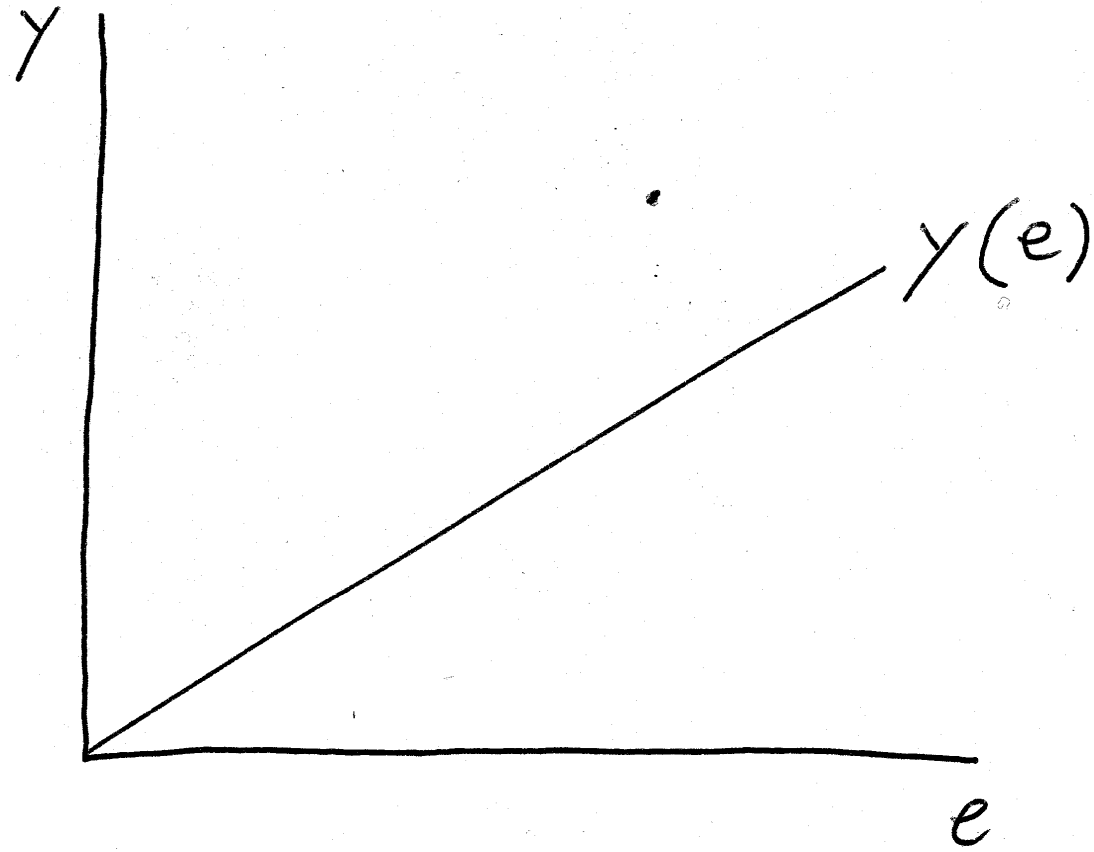
Building blocks and main assumptions

- Let there be a principal P and an agent A
- Let info be perfect
- Let effort e be perfectly observable from P
- A maximizes social surplus
- Once again: these assumptions are totally "heroic and utterly unrealistic. They are only made to sketch what the optimal solution for an agency relation looks like.

First best

Building blocks and main assumptions

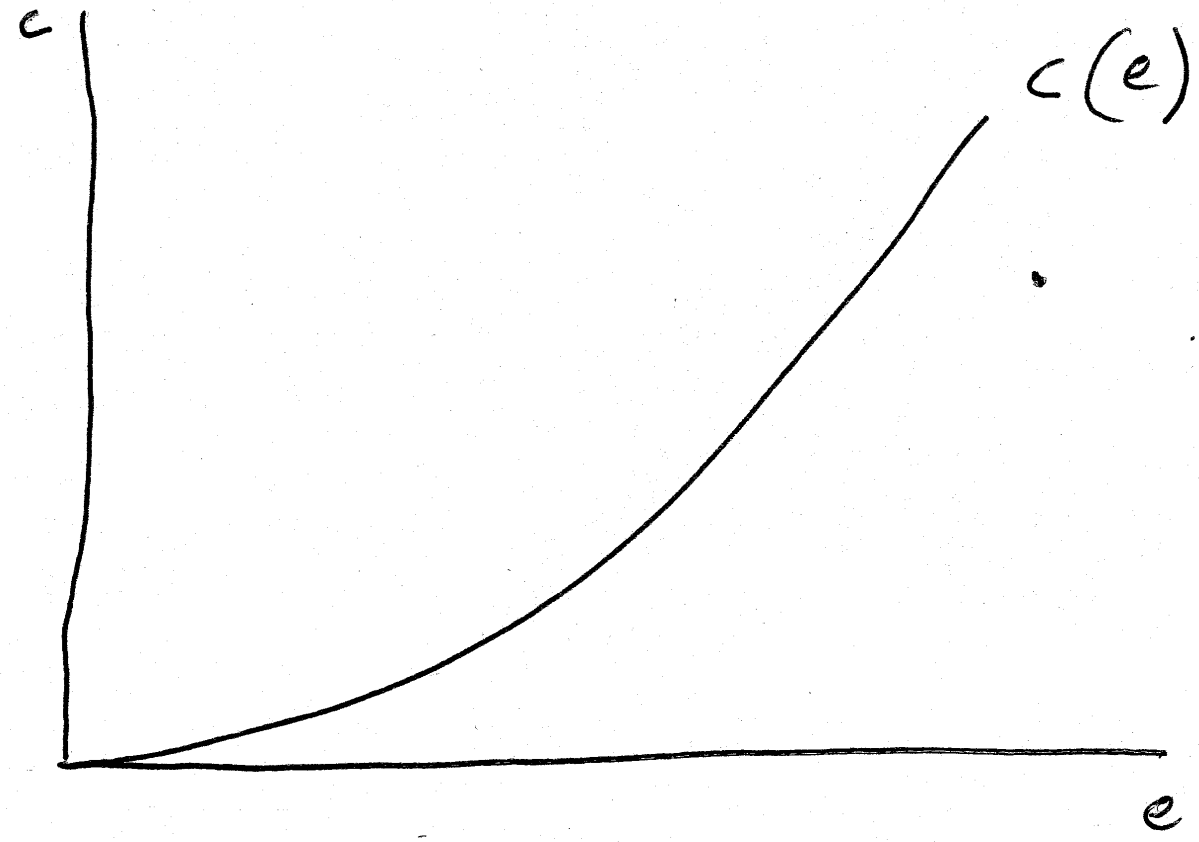
- A determines y thanks to his effort e.
- We thus have $y(e)$
- $y(e)$ is a linear increasing function
- $y(e)$ is thus constant.


Y
y(e)
e

First best

Building blocks and main assumptions

- e is a disutility for A
- let the monetary cost correspond to the cost function $c(e)$
- $c(e)$ is a convex, increasing function
- $c(e)$ is thus increasing.


c
c(e)
e

First best

Building blocks and main assumptions

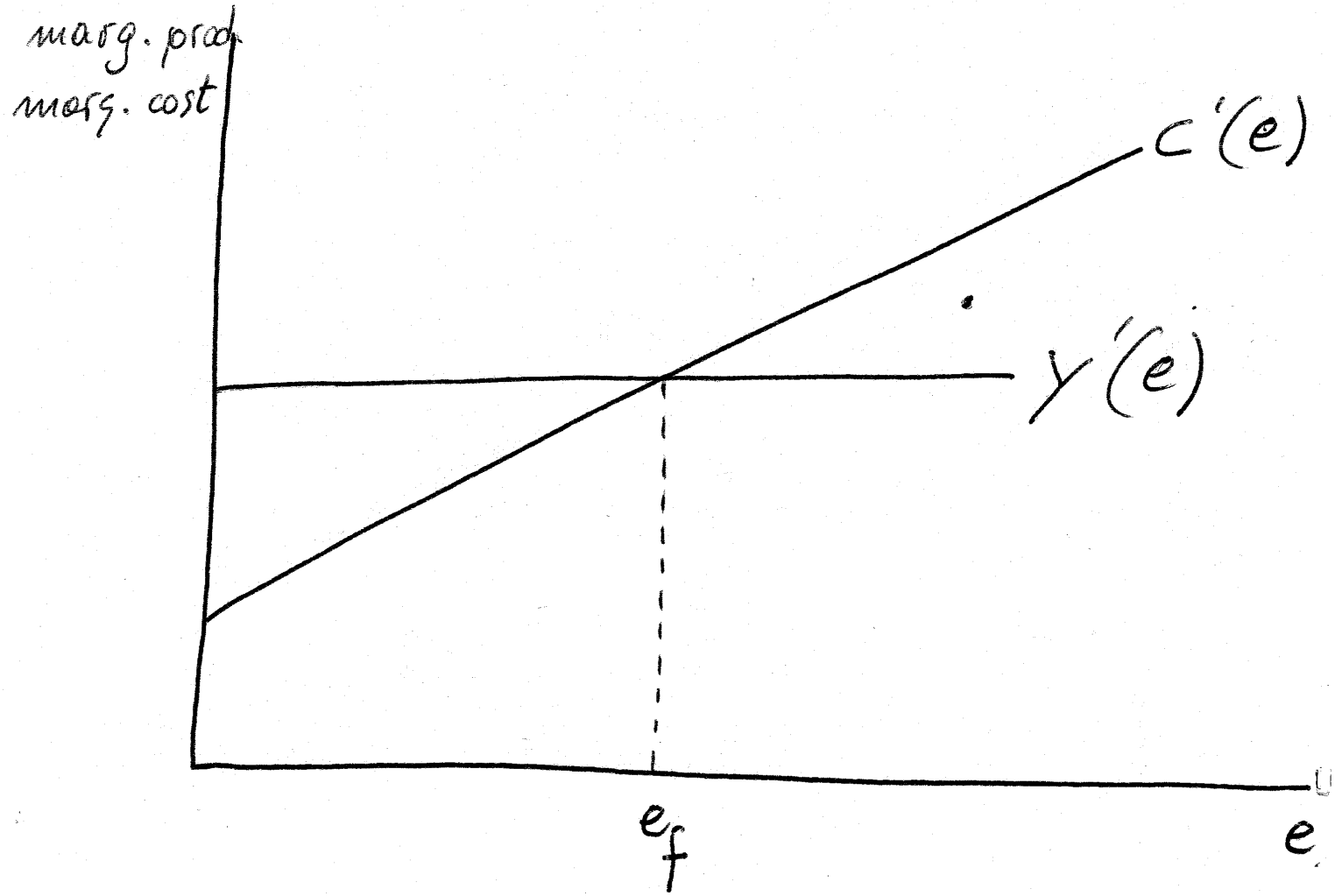
- The total surplus produced by the agency relation will be given by:

$$S = y(e) - c(e)$$

- Now, what is the optimal level of effort e_f?
- We have an easy answer: the optimal level of effort will be the one for which it holds true that:

$$y(e_f) = c(e_f)$$

- i.e. marginal product equals marginal cost


marg. prod.
marg. cost
c'(e)
y'(e)
e_f
e

First best

Building blocks and main assumptions

- Under this conditions, what will the contract that selects e_f look like?
- That is: what will the contract that maximizes social surplus look like?

First best

Optimal contract

- To get e_f, it will be enough that the contract forces P to compensate A with a positive wage if A chooses e_f and with $w = 0$ otherwise.
- The only other conditions to be met is that w be at least equal to As reservation wage (i.e. that the participation constraint be met)

Second best

Main assumptions

- Let us try to be more realistic and assume that e be not observable
- While $y(e)$ is observable and measurable

Second Best

Agents utility

- A has the following expected utility function

$$u = E[\sqrt{w} - e]$$

Second Best

Reserve utility

- Let As reserve utilitity be:

$$u_0 = 3$$

Second Best

Ps expected utility

- Ps expected utility is given by:

$$\Pi = E[y - w]$$

Second Best

Effort levels

- Effort e can take up two levels:

$$e_l = 0$$

$$e_h = 4$$

Second Best

Contribution levels

- Contribution can take up two levels:

$$y_A = 200$$

$$y_B = 0$$

Second best best

Expected results

With $e_L = 0$ we have: $p(y_b) = 0.8$ and $p(y_a) = 0.2$

With $e_H = 4$ we have: $p(y_b) = 0.3$ and $p(y_a) = 0.7$

Expected results will thus be:

$0.8(0) + 0.2(200) = 40$

$0.3(0) + 0.7(200) = 140$

Note well: we will keep using these values in what follows.

Second best

Let us now take two different paths corresponding to two different assumptions:

- e is observable
- e is not observable

Second best

Assume e is observable

- In a sense, we already know the solution: P pays a positive wage if e_H has been chosen and a null wage otherwise.
- So, there isn't anything interesting hhere: everything works as it did in the First Best scenario.
- As a simple exercise, let us try and determine a wage such that e_H will be exerted.

Second best

participation constraint

- First we check that the participation constraint be satisfied
- Reminder: the agent's utility function is: $u = E[\sqrt{w} - e]$
- Thus the participation constraint is satisfied for $w = 49$, that is:

$$\sqrt{49} - 4 \leq 3$$

Second best

Results

We will thus have:

- P pays $w = 49$
- A subscribes to the contract
- A chooses e_H
- A's expected utility will be equal to 3
- Note: A is not bearing any risk

Second best

Results

- As to P, we will have:

$$\Pi(e_H = 0.3(0 - 49) + 0.7(200 - 49) = 91$$

Second best

Results

What if we had e_L?

- A would choose $e_L = 0$ if $\sqrt{w} - 0 \leq 3$ i.e. $w = 9$
- This being the case, expected utility for P would be given by:
  $\Pi(e_L = 0.8(0 - 9) + 0.2(200 - 9) = 31$

Second best

summing up

- In the first case:
  i. $w = 49$
  ii. A chooses $e_H = 4$
  iii. A's expected utility is 3
  iv. P's expected utility is 91
- In the second case:
  i. $w = 9$
  ii. A chooses $e_L = 0$
  iii. A's expected utility is 3
  iv. P's expected utility is 31

A choice of e_H thus maximizes total surplus and, at the same time, no risk is however bore by A

Second best

Assume e is not observable

- As e is now assumed to be not observable, nececessity has it to incentivize A
- This in turn means that w must be bound to y
- As we will see, this implies a loss in efficiency

Second best

the contract

- A contract will set two wage levels: w_a and w_b
- This time wages will however be linked to y_A and $y - b$
- We thus ask: what are the conditions under which A chooses e_H rather than e_L?

Second best

participation constraint

- This will be given by:

$$u(e_H) = 0.3\sqrt{w_B} + 0.7\sqrt{w_A} - 4 \leq 3$$

Second best

Incentive compatibility constraint

- This will be given by:

$$0.3\sqrt{w_B} + 0.7\sqrt{w_A} - 4 \geq 0.8\sqrt{w_B} + 0.2\sqrt{w_A} - 0$$

Note: the left member is expected utility relative to low effort while the right member is expected utility relative to low effort.

Second best

Wage levels

- We now determine two wage levels w_A and w_B in such a way that profit is maximized while both participation and incentive compatibility constraint are are satisfied.
- Let these be w_A and w_B

Second best

Wage levels

- Skipping every calculations, by solving participation and incentive compatibility constraints we have:
- $\sqrt{w_a} = 9.4$ and $\sqrt{w_b} = 1.4$
- so: $w_a = 88.36$ and $w_b = 1.96$
- We thus conclude that for $y = 200$, A receives $w = 88.36$ and $w = 1.96$ with $y = 0$

Second best

Utility levels

- A's expected utility is thus $u(e_H) = 0.3\sqrt{1.96} + 0.7\sqrt{88.36} - 4 = 3$
- P's expected utility is thus

  $\Pi(e_H = 0.3(0 - 1.96) + 0.7(200 - 88.36) = 77.56$

Second best

Surplus reduction

Let us compare the results just obtained with the first best contract.

Under first best, we had:

- A's expected utility 3
- P's expected utility 91

Under conditions of asymmetric info we had:

- A's expected utility 3
- P's expected utility 77.56

We thus face a reduction in total surplus. What does it stem from?

Second best

Surplus' loss causes I

- This loss of social surplus is due to an inefficient risk allocation.
- In order to have A choosing e_H P had been forced to allocate a good degree of risk to A
- What rkind of rrisk are we talking about?

Second best

Surplus' loss causes II

- Even if A chooses e_H, in the 30% of cases he just get $w = 1.96$
- Total surplus drops as wage costs for P to the end of giving A the right incentives become higher (A's utility stays constant, though)
- So: for P (risk neutral) those extra costs are a reduction of profit while for A (risk averse) the higher wage level is merely sufficient to protect him from risk.

Incentives' intensity

As a matter of fact, b^* (the optimal level of incentives) will be higher:

1. the smaller is uncertainty in production. It is noteworthy that as uncertainty gets smaller accuracy in performance measurement increases and a strict correlation of wages to performance is way more convenient (this happens as risks on agent will be very small);

Incentives' intensity

As a matter of fact, b^* will be higher:

1. the smaller is the agent's risk aversion. If bearing risk is not costly for the agent strong incentives are a good idea because compensating the agent for risk becomes relatively cheaper;

Incentives' intensity

As a matter of fact, b^* will be higher:

1. the smaller is the marginal cost of effort. That is: incentives tend to be stronger the slower the disutility of effort grows as agent chooses a higher level of effort;

Incentives' intensity

As a matter of fact, b^* will be higher:

1. the larger is effort's marginal productivity. That is: it is optimal to give strong incentives whenever one gets large increases in output as effort increases.

12. THE ECONOMICS OF EMPLOYMENT RELATIONSHIPS

The economics of employment relationships

Consider the following points:

1. Long term employment is an ongoing relationship whose exact terms of trade are determined only as time passes
2. In place of a detailed agreement about how the relationship will evolve, the job comes with a process by which its evolution - i.e. its *what's next* - is determined;
3. Once the relationship has begun - and increasingly as time passes - the employee has assets at risk (can this be a hold-up?)
4. The last item works for an employer as well (human capital, training ...)

The economics of employment relationships

This is the reason why "supply equals demand" does not work in our case: it is simply not the adequate model.

What drives "supply equals demand" is the fact that every market participant has a nearly-as-good alternative: transact with another buyer or seller at virtually the same price for virtually the same good.

In that situation there is no possibility for hold-up (imagine the relation one has with his/her coffee shop)

The economics of employment relationships

Under another perspective: "supply equals demand" would be an adequate model if right from the outset contractual guarantees could be put put in place determining the *what next* over the entire duration of the employment relation.

At the very same time: "supply equals demand" would be an adequate model if no party would ever have assets at risk and had to face the perils of hold-up.

The economics of employment relationships

In a nutshell:

open-ended nature of the relationship

PLUS

parties have assets at risk once they enter the realtion

takes us away from a "supply equals demand" model.

The economics of employment relationships

WHAT IS THE RIGHT MODEL THEN?

A new class of models

A new class of model will now be our main subject.

We will now learn the Economics of Enduring Employment Relaionships.

Let's so proceed to illustrate the keystones of this new class of models.

First keystone: the “what next” issue

Enduring employment relationships evolve as time passes in ways that are not entirely specified at the outset (nor can they be fully anticipated or predicted).

At the outset, the parties involved know that they are entering into a “make it up as they go” relationship.

Second keystone: Assets at risk

As time passes, the parties develop (and increasingly so!) assets specific to the relationship.

Thus, walking away means a loss of those assets.

And because these are assets at risk each side can hold up the other.

Third keystone: Governance

Governance provisions do specify which party either by formal agreement or by custom have the right to decide on the "what next" issue.

CRUCIAL!!!

Exercise: gather some info on the relation between Toyota and its subcontractors. (. . . you'll be surprised. . .) Exercise: Tesla is barred from selling its cars in Michigan

Fourth keystone: Efficiency, ability, information

Better decisions means more value for the parties to split and better odds of surviving.

So decision rights should be assigned to the party with the best information and the best ability.

Fifth keystone: Credibility

Parties should be comfortable that they won't be held up or exploited by the decisions of others and they should be willing to invest in the relationship (which means putting even more of their assets at riks).
So, the credibility of the decision maker not to exploit its decision power is crucial

Sixth keystone: Reputation

The most important source of credibility is the decision making party's desire to keep and even enhance its reputation for not exploiting its decision making authority.

Two further remarks

First: incentive theory biases thinking in the direction of measurable performance and usually involves measures of short-run performance.
Second: the model of governance in incentive theory is that the employer says how the employee will be rewarded and the employee responds within a well understood and fixed set of rules. Things are way more complex than this especially as (new) events unfold. Focus should be on processes by which decisions are taken.

Enforcement and implicit contracts

One of the main features of agency contracts is their being "formal" or "explicit".

This means, among other things, that they can be enforced by a third party.

This is normally referred to as *external enforcement*

External enforcement is often impossible or way too costly, e.g. think about linear contracts.

Enforcement and implicit contracts

In some cases an *implicit contract* scheme is adopted whose realization is based on the very same actions and decisions taken by the parties and on their reputation.

An implicit contract is an agreement setting the behaviors and rules that each party should abide to.

Usually: promises, threats, expectations ...

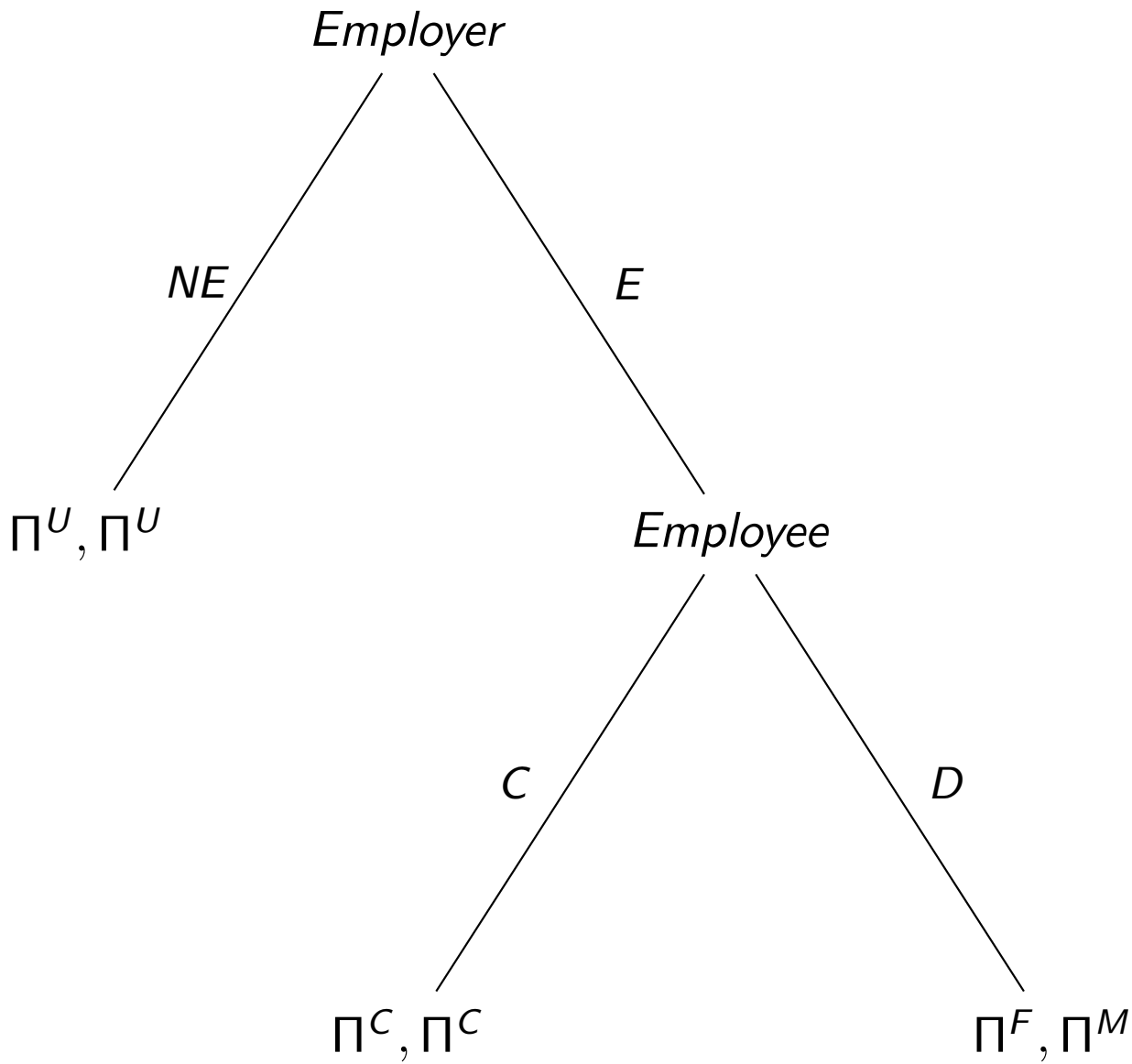
That's why they are also called *self enforcing contracts*: their execution is based on the parties' behavior (*endogenous enforcement*).

The Trust Game

Let us now examine how two parties execute an implicit contract establishing some form of cooperation between them without the intervention of an external authority.

This is called the *Trust Game*

The Trust Game



The Trust Game

Π_U reserve utility

Π_C payoff to cooperation

Π_M payoff to employer's opportunism. Note: $\Pi_M > \Pi_C$

Π_F payoff to employer after employee's opportunism

So: $\Pi_M > \Pi_C > \Pi_U > \Pi_F$

The Trust Game

One shot single play: by backward induction, employee would choose D once employer has chosen E as $\Pi_M > \Pi_C$

As a consequence never would employer choose E as $\Pi_U > \Pi_F$

Consequence: loss of mutual advantages to cooperation.

The Trust Game

Nothing changes for a finite or known number of repetitions.

Everything changes if at each play there is a non zero probability that the game will last for another play. (E.g. there is a non zero probability that one either gets fired or work for another time period).

The Trust Game

Key: if the game is indefinitely repeated, player know that their actual behavior can actually imply e.g. being fired or other credible threats...

...and they use this info at the time of their present choices

Consider this: the employer threats the employee with "I shall fire you if you don't cooperate", so I shall start by hiring you (E) and I shall keep playing E as long as you play C but I shall stop the game (i.e. "fire you") as soon as you play D.

The Trust Game

The employee then can:

1. play C and get Π_C
2. play D, get Π_M

Note: $\Pi_C < \Pi_M$ but employer would eventually be fired so he would receive Π_U afterwards and $\Pi_U < \Pi_C < \Pi_M$.

The Trust Game

So: for the contract to be executed and the gains from cooperation be attained one must be sure that short time gains obtained via opportunism (defection) be smaller than the actual value of the flow of future payments generated by cooperation.

Intermezzo for a quick reminder

Question: How do we calculate (discount) the actual value of a future payment?

Answer: we discount the payment via a discount factor $\delta = 1/(1+r)$ where r is the intertemporal discount rate.

E.g. if $r = 5\%$, the actual value of 1.000 in a year is: $\frac{1000}{1,05} = 952,38$.

So: the larger δ is (i.e. the smaller r is) the more indifferent you are between today and tomorrow

The Trust Game

If the employee cooperates (s)he obtains:

$$\Pi_C + \frac{\Pi_C}{(1+r)} + \frac{\Pi_C}{(1+r)^2} + \ldots + \frac{\Pi_C}{(1+r)^n}$$

and that is:

$$\Pi_C \left[1 + \frac{1}{1+r} + \frac{1}{(1+r)^2} + \ldots + \frac{1}{(1+r)^n} \right] = \Pi_C \, \frac{1+r}{r}$$

The Trust Game

If the employee chooses D, (s)he first obtains Π_M (and $\Pi_M > \Pi_C$) but after that and ever after (s)he will only get Π_U (and $\Pi_U < \Pi_C$).

That is:

$$\Pi_M + \frac{\Pi_U}{(1+r)} + \frac{\Pi_U}{(1+r)^2} + \cdots + \frac{\Pi_U}{(1+r)^n}$$

and that is:

$$\Pi_M + \frac{\Pi_U}{r}$$

The Trust Game

Employer will then play C and execute the contract iff:

$$\Pi_C \frac{1+r}{r} \geq \Pi_M + \frac{\Pi_U}{r}$$

. . . does this sound familiar?

The Trust Game

Conclusion: contractual enforcement is more likely as:

- the higher the gains from cooperation are (i.e. the larger Π_C is wrt Π_U)
- the smaller the benefits of opportunism (the smaller Π_M is wrt Π_C)
- the smaller r is and the smaller the probability that the relation be interrupted is. Note: low values for these two parameters implies a high benefits for future payments. Thus: if δ is close enough to 1, then cooperation is sustainable in the repeated game.

Deferred payments and seniority

Does anything change with the Gig Economy?

- Traditional jobs VS gigs
- Efficiencies? Better talents/job matching, autonomy in time management, efficiency in using (own) capital, potentially legall and tax efficiencies
- What as to motivation? i.e. motivating gig workers?

Joseph Stiglitz

Original paper: Shapiro, C., Stiglitz, J.E. (1984). "Equilibrium Unemployment as a Worker Discipline Device". In *The American Economic Review*, 74 (3): 433444.

Nobel motivation: "[. . .] for their analyses of markets with asymmetric information."

"Their" refers to Michael Spence and George Akerlof (Nobel price co-winners)

Main hypothesis

No firm will ever hire underbidders as a strong relation exists between wage level and effort level.

So: even if one assumes no workers' negotiation power nor firing costs, there could be hurdles to flexibility towards lower wages.

Note well: this is the kind of flexibility needed to "absorb" the unemployed and eventually reach full employment.

The model: worker's decision

A worker can either work or shirk:

$$e > 0$$

$$e = 0$$

The model: worker's utility

A worker's utility will be given by:

$$u = w - e$$

The model: being caught

Let us assume imperfect observability.

Let p the probability that the worker will be caught while shirking. So let:

$$p < 1$$

The model: contract

The firm pays $w*$ or fires the worker that has been cought shirking.

Once fired, the worker obtains his/her reservation utility $\underline{w}$

The model: contract

If the worker exerts positive effort, his/her utility is given by:

$$u_H = w^* - e$$

The model: contract

The opportunist worker (shirking) gets:

$$u_S = (1 - p)w^* + p\underline{w}$$

The model: determining the efficiency wage

The efficiency wage is set as to deter opportunistic behavior based on:

$$u_H \leq u_S$$

that is:

$$w^* - e \leq (1-p)w^* + p\underline{w}$$

from which we obtain:

$$w^* = \underline{w} + \frac{e}{p} \tag{1}$$

The model: results

i) the efficiency wage must be higher than the opportunity cost $\underline{w} + e$

ii) the efficiency wage is higher as p is small. So, it looks like higher wages and control are alternative tools to deter opportunism.

Bowles' argument on control

Given that wages and control are among the most effective incentives for effort, one should ask which of the two is more widely adopted by firms, which of the two is more efficient and under which conditions.
Samuel Bowles, has stressed that firms tend to prefer costly investments in control (thus increasing p) rather than paying higher wages (given a wage level sufficient to labor extraction).

Bowles' argument on control

Higher wages are not a waste of resources for society as they are a transfer from employers to employee.

Quite on the contrary, control related costs do actually consume real resources and, indeed, the capitalistic firm as an institution, has been described by many as an institution whose main *raison d'tre* is its increased possibility of control rather that superior technological efficiency.

If higher wages would be paid and, at the very same time, fewer resources were spent on control those resources could be freed and used for production.

Bowles' argument on control

In a sense, monitoring costs do not fit well with profit maximization and they would not be necessary at all if only levels of effort could be perfectly enforced by a contract.

Baker and Hubbard

Baker and Hubbard (1998) offer a most interesting example.
In the eighties, some US trucking companies equipped their trucks with computers with the aim of monitoring drivers behaviors and actions.
These computers allowed companies to have detailed information on a quite remarkable set of divers and trucks operations: mostly those in which a conflict of interests was more relevant for the company itself such as speed, idle time and the like.

Baker and Hubbard

The key point is that these computers did not provide any improvement say a more effective coordination between drivers and dispatchers in the service whatsoever.

Their main and probably sole function was rather to enlarge the domain of contractibility: the space of drivers behaviors first and foremost those behaviors that more heavily conflicted with companies interests that could be enforced by a contract thanks to making them observable and verifiable.

Facts and questions

No firm gives up control

Quite on the contrary: control expenses are increasing (much literature on this point)

Facts and questions

So, what is the social function of control?

Is control the only reason that firms do exist?

How does world in which control is perfect look like? (. . . wages should drop. . .)

Can you actually use control to get effort?

Are things changing with Industry 4.0? e.g. Cloud Computing, Smart Factories, Big Data Analytics, IoT, Advanced HMI. . .

Have a look at the following slide:

Amazon net revenue per group

Datification (S. Zuboff)

Recent times have seen an astonishing growth in the production of data. More data was created in 2014 and 2015 than in the **entire history of humankind beforehand**, and by 2020 there will be approximately 44 zettabytes, or 44 trillion gigabytes, of data (Marr, 2015).
Along with the growth of data has come new empirical methods for analyzing it (machine learning, text mining).

Data, Big Data, New Kinds of Data

One of the most important use of machine learning is the ability to use entirely new types of data.

Econometrics: uses data that are "regular": they can be represented in rectangular form with rows corresponding to individual observations and columns to variables. Moreover, variables are typically recorded as single, quantitative measurements.

However, many of the newly available digital data sources do not have this format: text, satellite images, and web search profiles contain vast amounts of economically relevant information but have non-standard data structures.

Machine learning can be used to extract the important information from these sources, and clean them for econometric analysis.