Strategic Uses of Information I

Topics (across two lectures):

1. **Cheap Talk Equilibria**
   - **credibly communicating information**
2. **Screening/Sorting**
   - **elicit another's information**
3. **Signalling Unobservable Information**
   - **convey one's own information**
4. **Education as a Signal**
   - **when a credible signal?**
5. **The Market for "Lemons"**
   - **when the bad drives out the good**

The Economics of Information

has been useful not just in Finance, but also at winning Nobel prizes, in 1994, 1996, 2001, 2005, and 2007.

Who knows what when?

- **Can be structured into a game tree using Information Sets.**

Has helped in understanding: (1) the nature of incentive contracts, (2) the organization of firms, (3) markets for labour and for durable goods, (4) government regulation, and (5) credit defaults, etc.

Includes means to use private information about oneself and to elicit others' private information, as well as manipulating what others think they know about you.

Basic Ideas About Asymmetric Information

A player might know more about: (1) her possible actions, (2) her preferences & her payoffs, (3) her innate characteristics, or (4) her outcomes, etc than do others.

She is *better informed* (BI), compared to *less informed* (LI) players.

She can try to manipulate others' knowledge of her — their beliefs about her — to affect the game's outcome.

So the *Tactics of manipulation of information* become part of the game.

Screening, Signalling. etc

A Better Informed BI player can:

1. **Conceal or mislead about what she knows.**
2. **Reveal selected information truthfully.**
   Signal **unobserved information credibly.**

A Less Informed LI player can:

1. **Elicit information, or filter truth from lies.**
   Screen **or Sort.**
2. **Choose to remain ignorant ("credible deniability").**

Why not just ask? or tell?

Well, actions speak louder than words, because talk is cheap (because supply exceeds demand).

∴ Watch what he does, not what he says.

Knowing this, the BI will try to manipulate beliefs.

Signal jamming: **confuse the other player about one's own information, often by using a mixed strategy.**

An incentive scheme: **a strategy that, through rewards or penalties based on observable outcomes, influences another player's unobservable actions. (See Lectures 19, 20 on Contracts.)**

e.g. tie a bonus to sales figures to induce more effective selling, not easily monitored.

Bargaining and Information

(See McM Ch.6)

Uncertainty, not perfect knowledge, is the norm: valuations, alternative opportunities, costs of delay, commitment possibilities.

Negotiators go to great lengths to learn their opponents' aims and to conceal their own. (Robert Maxwell bugged his guests' cabins in his yacht.)

Information and misinformation are released during negotiations.

Tricks: (1) exaggerated impatience, (2) feigned anger, (3) excessive friendliness, (4) personal abuse — used to obtain opponents' true aims; or (5) countered with feigned ignorance, excessive demands.

Questions about information

The full complexities of information transmission and concealment in negotiation are rich:

- **Why do some tactics work?**
- **What are the limits of what negotiators can achieve?**
- **Uneven distribution of information may result in no agreement. How to mitigate an informational disadvantage. Screening.**
- **Credible strategies for communicating information. Signals.**

1. Cheap Talk: or Direct Communication

Works well when the players' interests are well aligned, such as in The Assurance Game. (Lecture 2, p. 24)

> **Both H & S want to meet and prefer the Local, so one saying "Let's meet at the Local" will work.**
>
> **Stage 1: H: Saying where to meet;**
> **Stage 2: Both go to Local if "Local" said, both to Starbucks if "Starbucks" said.**

Doesn't work at all if players' interests are diametrically opposed, as in a Zero-Sum game, such as Tennis. (Lecture 2, p. 31)

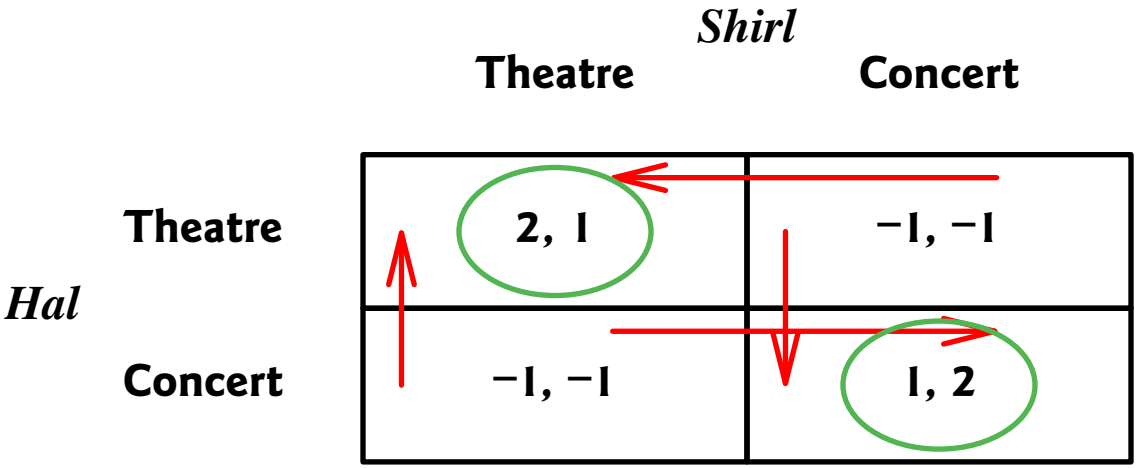
> **If Venus says "DL" and Serena belives this, Venus will CC; and vice versa. But Serena will not believe that Venus's lying either. ∴ Serena will disregard anything Venus says: only a *babbling equilibrium.***

What if there is some commonality of interest?

Will a message lead to a clear N.E.: will there be a cheap-talk equilibrium at one of the two N.E.? Or will the message be ignored, with a babbling equilibrium at either N.E.?

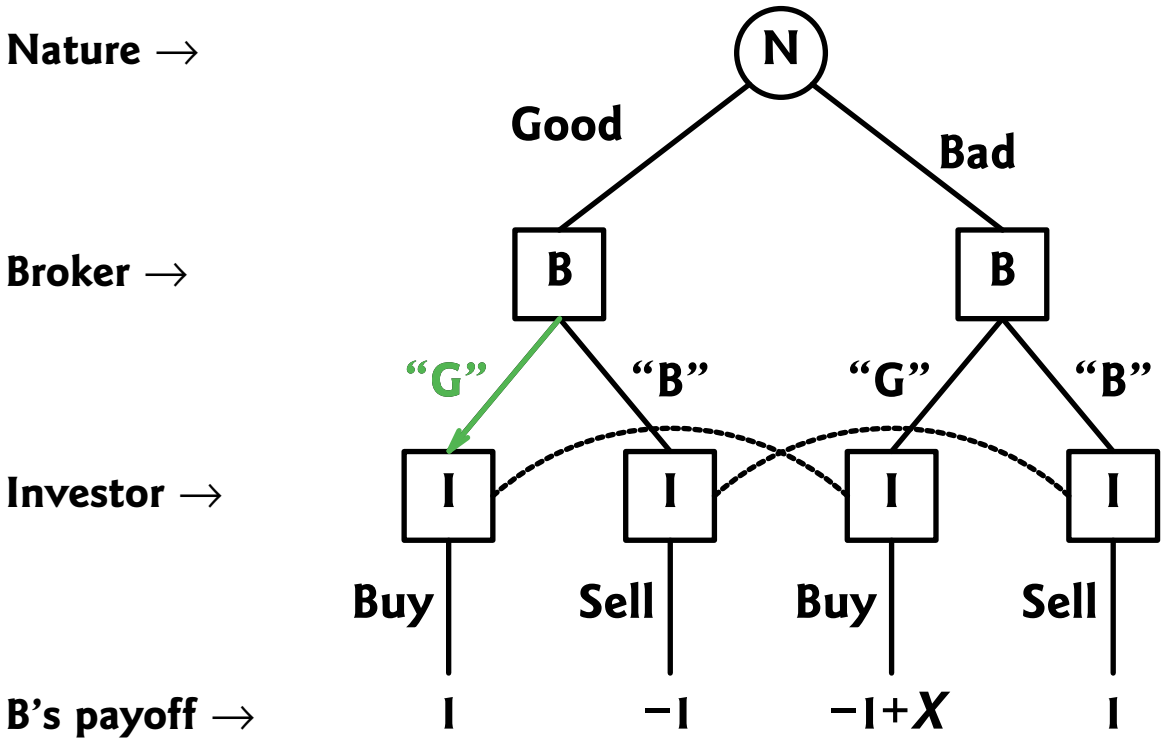
In the Battle of the Sexes (L. 2, p. 27), *Yes!* get a *cheap-talk equilibrium:*

Hal says "Theatre", and then Shirl meets him there — a R.E. (Rollback Eqn.), and only one of the two N.E.s is chosen.



The Broker's Game

The Investor relies on the Broker to know whether a stock is Good or Bad: (a Harsanyi tree)



The Broker knows: ∴ no Information Set.
The Investor is ignorant: ∴ 2 Information Sets: "G" and "B".

What is the Broker's incentive to tell the truth?

X is a secret commission the Broker gets from inducing the Investor to buy a Bad stock.

Investor believes the Broker, $\rightarrow$ Broker's payoffs:

$$\begin{aligned} &\text{G \& ``G'' \& Buy} \rightarrow 1 \\ &\text{G \& ``B'' \& Sell} \rightarrow -1 \\ &\text{B \& ``G'' \& Buy} \rightarrow -1 + X \\ &\text{B \& ``B'' \& Sell} \rightarrow 1 \end{aligned}$$

If the stock is Good, the Broker has no incentive to lie.

If the stock is Bad:

- **if $X < 2$, there will be a Cheap-Talk equilibrium, with no incentive to lie. Why?**
- **if $X > 2$, the Broker has an incentive to lie "G" $\rightarrow$ Buy when the stock is Bad.**

Then over time the Investor will distrust the Broker's advice, and ignore it $\rightarrow$ *babbling equilibrium*. Ways to overcome?

Informational Handicap in Negotiation

Sally the seller and Burt the buyer are negotiating over a used car.

Suppose Sally doesn't know Burt's valuation of the car,

- **Sally has many cars for sale, all of which cost her $1000.**
- **Sally knows that there are two kinds of buyer, say:**
  - **one (L) values this type of car at $1040,**
  - **the other (H) values it at $1100.**
- **Equal numbers of both types of buyer; no distinguishing marks.**
- **Private information.**

Knowledge is a source of bargaining power.

Sally makes a take-it-or-leave-it offer.

- **If Sally knew how much Tom, Dick, or Harry would pay, then she could extract all the gains from trade.**
- **If Sally isn't sure of any buyer's willingness to pay, she can't.**
- **She risks:**
  - **asking too high a price and losing a sale (with L low valuers) or**
  - **asking too low a price and forgoing some profits (with H high valuers).**

  The best price balances these risks.

The best price

Q: What price?

A: The same price (why?).

- **Either \$1040:**
  (and making \$1040 − 1000 = \$40 from every customer: all are buyers);
- **Or \$1100:**
  (and making \$1100 − 1000 = \$100 from every sale but losing half the customers, on average a return of \$50 per potential buyer).
- **Sally should ask \$1100 to maximise her expected profit, at the cost of forgone sales.**

Inefficiency from private information

Even the low-valuation customers L could yield a $40-per-sale gain, but in ignorance Sally excludes them with a high price:

Private information results in some of the potential gains from trade not being realised: inefficient.

As in the PD, bargaining with private information can result in *inefficiencies* (non-Pareto-optimal outcome: the low-value buyers L would like to buy up to $1040 and Sally would like to sell above $1000, but no sales in this region):

Each bargainer's attempt to grab a larger share of the gains from trade when he or she doesn't know the other's limit results in inefficiencies, and ignorance
$\rightarrow$ a significant probability of negotiation breakdown.

Are inefficiencies inevitable?

Inefficiencies need not occur, gains from trade need not be lost:

For instance: What if the buyers' valuations were closer (say, $1060 and $1100)?

Then there would always be a sale, at $1060:

- **since Sally'd make $1060 − 1000= $60 per potential buyer if she asked for $1060 in this case, and**
- **all would buy, some of the buyers (H) making a windfall profit of $1100 − 1060 = $40 per purchase, however.**

Two lessons

Two lessons from these simple models of exchange with differential information:

1. **Private information can lead to inefficient outcomes, with no trading, although potential gains from trade exist;**
2. **in other cases, *private information can be a source of bargaining power*, with extra gains accruing to the holders of information.**

Sally's in a powerful bargaining position by virtue of her ability (we have assumed) of being able to make commitments;

The buyers, however, have some countervailing power from Sally's lack of knowledge, which precludes her from extracting all the gains from trade.

2. Screening: Overcoming an Informational Disadvantage

- **Can Sally mitigate her informational disadvantage when she's asking \$1060, but losing \$40 per sale to the high valuers H?**
- **Can Sally structure the negotiations to induce the sellers to reveal their private valuations?**
- **Can Sally *screen* the potential buyers?**

NB: ***Lower costs of delay are a source of bargaining power.***

Who's less impatient?

- **Suppose buyers incur costs if agreement is delayed:**

  suppose that settlement can be reached when buyers enter Sally's yard or a week later,

  but also suppose that buyers value costs and benefits a week hence at only 80% of their current value; (a 20% per week discount rate)
- **Sally, however, faces no costs of delay. (She's relatively less impatient.)**
- **Sally chooses, announces, and commits herself to, not simply a single price, but a *price schedule* or *menu*:**
  a spot price now and a lower price next week.
- **What's her best schedule or menu? Remember, both parties know it beforehand.**

A game tree

Consider an extensive-form Harsanyi tree:

Sally:

1. **asks a high price in the first period and**
2. **announces that she will drop her price in the second period if the car hasn't sold then.**

Assume that Burt is one of two types with equal probability:

(H): Burt values the car at $1100 (H), or

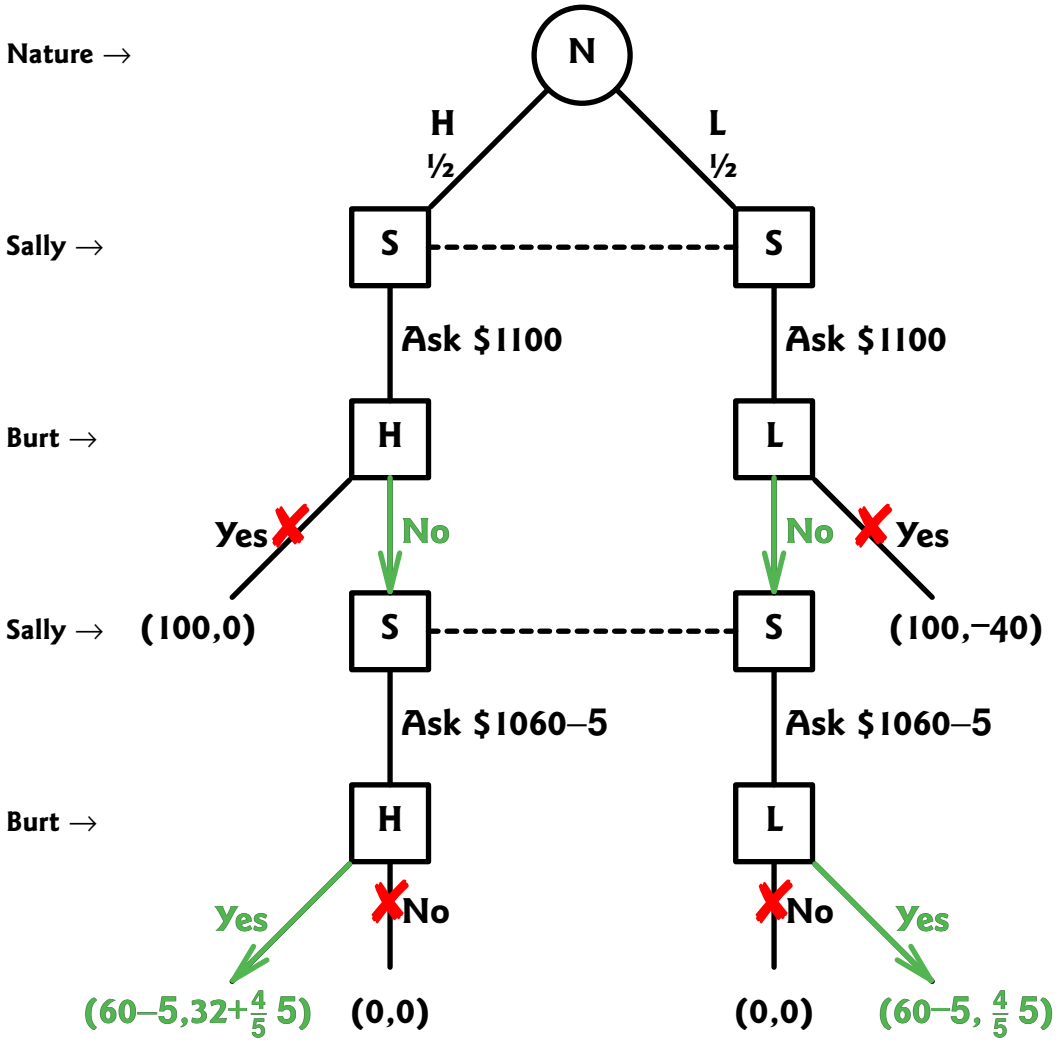
(L): Burt values the car at $1060 (L).

Sally knows the two types' values, but she doesn't know which type Burt is, (private information) as indicated by the dashed lines (the Information Set) between the two pairs of possible decision nodes of Sally's.

This game tree represents the Harsanyi transformation. The late John Harsanyi, who studied at Sydney University and taught at A.N.U., shared (with Nash and Selten) the 1994 Nobel.

Bargaining Tree with Pooling of Types:

H Burt: \$1100
L Burt: \$1060



5 is a small amount, chosen so that \$1060−5 < Low B valuation.

Look forward and reason back

What will the players do? *Look forward and reason back.* (Start at the bottom of the tree.)

- ***First,* if Burt is an H type and finds himself in the second period with an offer of \$1060–5 for the car, then he will buy and make himself a windfall profit of**

$$\$32+\tfrac{4}{5}\,5 = 80\% \text{ of } \$40+5 = 80\% \text{ of } (\$1100 - (\$1060-5))$$

  (Remember that Burt's benefits shrink by 20% by the second period.) Otherwise, no deal, and neither gets anything.
- **Will Burt get this opportunity?**
- **If Sally can't sell the car for \$1100 in the first week, then she'll offer it at the lower price a week later.**
- **Will Burt buy at \$1100 in the first week?**
- **No: since Burt is an H type, that's his valuation of the car, meaning he gains none of the gains to trade at the high price, and he knows that Sally will offer it a lower price later.**

and if Burt is a low valuer L?

- ***Second,*** **if Burt is an L type and finds himself in the second period with an offer of \$1060–5 for the car, then he will buy and make himself a (small) windfall profit of**

$$\tfrac{4}{5}\,5, \qquad \text{(80\% of 5 = \$1060 − (\$1060–5)).}$$

The alternative is no deal and nothing for either of them.

- **Since Burt values the car for less than \$1100 (he's an L), then he won't buy at the higher price in the first period.**

There is *pooling of types* of buyers.

So Sally's schedule of (\$1100, \$1060–5) doesn't screen or sort the buyers.

Can Sally screen the buyers into the two groups?

Is there a schedule that does *screen* or sort the buyers into the two types?

(That is, is there a schedule that results in *separating of types* of buyers?)

Can Sally improve her expected return as well?

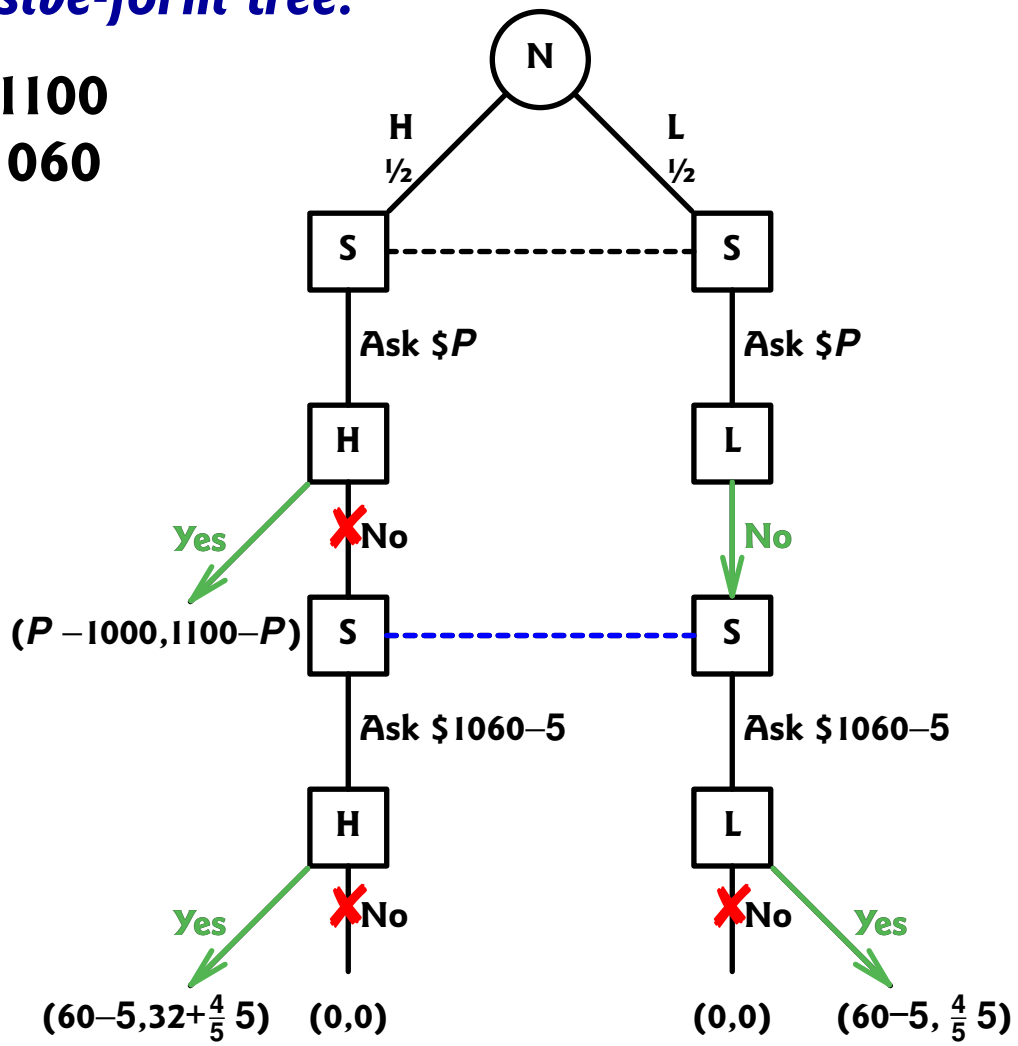
If there is such a schedule, then an unsold car in the second period will be offered at \$1060–5 :

even if Burt is a low valuer L (as he must be for the car not to have sold in the first period), he will buy at this price.

Call the first-period price P.

The extensive-form tree:

H Burt: \$1100
L Burt: \$1060



Bargaining Tree with Separating of Types:
Payoffs (Sally, Burt)

Rollback

- If Burt is H and buys at $\$P$ in the first period, then his return is $\$1100-P$,
- whereas if he doesn't buy in the first period, then he will buy at $\$1060-5$ in the second, with a return of $\$32+\frac{4}{5}5 = \$36$.
- So long as P is low enough to induce H Burt to buy in the first period, then Sally can screen Burt for his type, and make a higher return than the average of \$60 per customer of the previous section.
- If $\$1100-P$ is greater than $\$32+\frac{4}{5}5 = \$36$, then Burt (H) will buy in period one; that is, if P is no greater than $\$1068-\frac{4}{5}5 = \$1064$.
- In the limit (as $5 \to 0$), $P = \$1068$, and Burt (H) will be indifferent between buying sooner or later.

Screening works.

Because of Burt's higher cost of waiting, Sally can screen or sort Burt's type:

If she prices with the schedule:
(Week 1 = $1068, Week 2 = $1060),
then Burt (H) will buy in the first period, while Burt (L) will wait for the second period to buy.

Note that the higher Burt values the car, the greater the loss he suffers by waiting: high-valuation buyers H are more impatient to settle than are low-valuation buyers L, which enables sellers to screen them.

Sally's average return with screening is ½ × $68 + ½ × $60 = $64, which is $4 per customer higher than the $60 average with the non-screening strategy above.

Haggling

This model might motivate *haggling*: Sally as the seller quotes a high price and then lowers it.

High-valuation buyers are relatively more impatient to settle, and so may be prepared to pay a higher price, sooner, than may low-valuation buyers, who credibly prove their low valuations by holding out for lower prices.

Haggling can be seen in this light as revealing information about the other's limit.

But haggling doesn't always work.

A lower valuation

If Burt's low valuation L were $1040, instead of $1060 as above, then Sally could still screen with a schedule of

(W1: $1046, W2: $1040),

but her average return would be $43, less than $50, the average return of charging $1100 and only selling to high-valuation buyers H.

In this case, Sally is better off demanding the (high) fixed price and not trying to screen the buyers, since their valuations are too widely spread for screening to be profitable.

This is inefficient: some gains from trade are left unappropriated, and no sales are made to low-valuation customers, even though they will pay more than Sally's valuation of the cars.

Other screening devices.

Joe Stiglitz, my old Stanford supervisor, shared (with Ackerlof and Spence) the Nobel for this work in 2001.

- **A range of deductibles when you buy insurance: you're a better judge of your risk than is the insurance company.**
- **Whether to buy a service warantee for a longer period than the standard (for cars, for computers).**
- **Others?**

All reveal private information, and enable a more efficient trade to take place — both buyers and sellers are happier than if no trade took place.

Inefficiencies

Even when screening works, there are some dead-weight losses, caused by *asymmetric information*: with screening (and high-valuation buyers paying more), low-valuation buyers must wait, at some loss, so not all gains to trade realised, with some inefficiency.

Haggling survives for large consumer items, such as cars.
B2B: Between suppliers and processors or between manufacturers and distributors prices usually determined by negotiation.
Haggling is attractive to seller when the gains from discriminating among customers may be large, when prices are high.

But what are the cost to haggling for the seller?

Delay is only one device for screening to reduce an informational handicap: other methods too may result in opponents' revealing their valuations:

- **Sales methods.**
- **Employment contracts.**

Information and Bargaining Breakdown

Lessons:

- **the bargaining process depends on the bargainers' Information Sets: *what they know* (and know they know) and vice versa**
- ***private knowledge* can be a source of bargaining power**
- **asymmetric information can result in *inefficiencies* (DD in the PD): no trade, or delay**
- ***screening* by delay may be an effective strategy in the face of an opponent's informational advantage and impatience**
- **if *delay* — a temporary breakdown — is costly for any bargainer, then there are dead-weight losses (inefficiencies).**

Rational breakdowns

When information is private, *breakdown can be rational.* Pushing too hard, with breakdown, can be a sensible bargaining technique when you don't know your opponent's limit.

Rational for Sally to claim a "rock-bottom selling price" (RBSP), below which she could still profitably go; to mislead about her limit price.

- **The cost of this: if Burt's resistance point (unknown to Sally) is lower than Sally's RBSP, then no agreement at a dead-weight loss, an inefficiency. (But see "Settlement Escrow" in Lecture 17.)**
- **The benefit: if Burt's resistance point is higher than Sally's RBSP and agreement occurs, then Sally has gained more than otherwise.**

Similarly for Burt and other buyers.

Failures

Apparent inefficiencies and irrationalities may be caused by both parties trying to squeeze as much advantage as possible from the secrecy of their own limits, under the handicap of ignorance about their opponent's limit.

Spectacular efficiency losses: e.g. the common-pool problem, a PD. Solution: single extractor or "unitization", would result in between two and five times more oil being extracted.

Why so seldom?

Private estimates of values of the leases. In unitization, each firm assigned a revenue share based on its lease's value, so has an incentive to exaggerate the value. Sufficient to cause breakdown.

Lessons:

- **bargainers should try to learn their rivals' valuations of the item under negotiation**
- **bargainers will conceal their own valuations, to try to bluff their rivals into overestimating the minimum (or underestimating the maximum) they'd settle for, even if breakdown**
- **long-term consequences to reputation of deception?**

Ethics

Strategic uses of information.

Bluffing involves deception ("strategic misrepresentation").

Nice distinction between deception and lying.

Is honesty the best policy?

Is playing one's card close to one's chest innocuous?

How valuable is a reputation for honesty?

"Would you buy a used car from this man?"