

Lecture 10 Game Plan

- Hidden actions, moral hazard, and incentives
- Hidden traits, adverse selection, and signaling/screening

Hidden Information

"A little knowledge is a dangerous thing.

So is a lot."

- Albert Einstein

Strategic Manipulation of Hidden Information

- Hidden Actions: Incentives
 - Associates others' unobservable actions with observable outcomes
- Hidden Traits: Signaling & Screening
 - Associates others' unobservable traits with their observable actions

Incentives

- High hurdle and a lot of money
- Low hurdle and a little money

Hidden Effort

- You are contracting a project to an outside firm. The project has an uncertain outcome
 - Probability of success depends on firm's effort
 - prob. of success = 0.6 if effort is routine
 - prob. of success = 0.8 if effort is high
 - Firm has cost of effort
 - cost of routine effort = \$100,000
 - cost of high effort = \$150,000
 - Project outcome = \$600,000 if successful

Compensation Schemes

- I. Fixed Payment Scheme
- II. Observable Effort
- III. Bonus Scheme
- IV. Franchise Scheme

Incentive Scheme 1: Fixed Payment Scheme

- If firm puts in routine effort:
 - Profit = Payment - \$100,000
- If firm puts in high effort:
 - Profit = Payment - \$150,000
- Firm puts in low effort!
→ *“moral hazard”*
- Optimal Payment: lowest possible.
 - Payment = \$100,000
- Expected Profit
= $(.6)600,000 - \$100 = \$260K$

Incentive Scheme 2

Observable Effort

- Firm puts in the effort level promised, given its pay
- Pay \$100,000 for routine effort:
 - $E[\text{Profit}] = (.6)600,000 - 100,000$
 $= \$260,000$
- Pay additional \$50K for high effort:
 - $E[\text{Profit}] = (.8)600,000 - 150,000$
 $= \$330,000$
 - want to induce high effort
- Expected Profit = \$330K

Problems

- Fixed payment scheme offers no incentives for high effort
 - High effort is more profitable
- Effort-based scheme cannot be implemented
 - Cannot monitor firm effort

Incentive Scheme 3

Wage and Bonus

- Suppose effort can not be observed
- Compensation contract must rely on something that can be directly observed and verified.
 - Project's success or failure
 - Related *probabilistically* to effort
 - Imperfect information

Salary + Bonus Schemes

A successful scheme must

1. Be “Incentive Compatible”

- Firm must *prefer* to put in high effort

2. Induce Participation

- Firm must *prefer* to take the job

On-Line Game #7

Incentive Pay

Incentives

- Cost of routine effort: \$100K
- Cost of high effort: \$150K
- Added cost of high effort: \$50K

- Benefit of routine effort: .6b
- Benefit of high effort: .8b
- Added benefit of high effort: .2b

Incentive Compatibility

- Firm will put in high effort if

$$\begin{aligned} & s + (0.8)b - 150,000 \\ & \geq s + (0.6)b - 100,000 \end{aligned}$$

- $(0.2)b \geq 50,000$

marginal benefit > marginal cost

- $b \geq \$250,000$

Participation

- Expected salary must be large enough to make work worthwhile
- If induce high effort: $b > \$250K$
expected salary = $s + .8b$
but even if $s=0$:
 $.8b = \$200K > \$150K$
- No base salary needed!

Profitability Summary

- Greatest Profit from inducing high effort:
\$280K (unless $s < 0$)
- Greatest Profit from inducing low effort:
\$260K
 - Using the “no brainer” solution
 - Salary = \$100K, no bonus
- Do we want to induce high effort?
- Carefully.
- Don't give away the farm to do it.

Optimal Salary and Bonus

- Incentive Compatibility:
 - Firm will put in high effort if $b \geq \$250,000$
- Participation:
 - Firm will accept contract if $s + (0.8)b \geq 150,000$
- Solution
 - Minimum bonus: $b = \$250,000$
 - Minimum base salary: $s = 150,000 - (0.8)250,000 = -\$50,000$

Negative Salaries?

- Ante in gambling
- Law firms / partnerships
- Work bonds / construction
- Startup funds

Interpretation

- \$50,000 is the amount of capital the firm must put up for the project
- \$50,000 is the fine the firm must pay if the project fails.
- Expected profit:
$$\begin{aligned} & (.8)600,000 - (.8)b - s \\ & = (.8)600,000 - (.8)250,000 + 50,000 \\ & = \$330,000 \end{aligned}$$
- Same as with observable effort!!!

Incentive Scheme 4

Franchising

- Charge the firm f regardless of profits
 - Contractee takes all the risks and becomes the “residual owner” or franchisee
- Charge franchise fee equal to highest expected profit
 - Routine effort: $.6(600K) - 100K = 260K$
 - High effort: $.8(600K) - 150K = 330K$
- Expected Profit: \$330K

Summary of Incentive Schemes

■ Observable Effort

- Expected Profit: 330K
- Expected Salary: 150K

■ Salary and Bonus

- Expected Profit: 330K
- Expected Salary: 150K

■ Franchising

- Expected Profit: 330K
- Expected Salary: 150K

Upside of Assigning Risk

- Assign risk to the *agent*, the party that has control of the hidden action
- This leads to
 - more efficient outcome
 - more profit for the principal

Downside of Assigning Risk

- Employees (unlike firms) are rarely willing to bare high risks
- Salary and Bonus
 - 0.8 chance: 200K
 - 0.2 chance: -50K
- Franchising
 - 0.8 chance: 270K
 - 0.2 chance: -330K

Summary So Far

- Suppose you know agent's payoffs but *can't observe its actions*.
- You can still induce agent to take action you want by making it bear more risk
 - Franchising
 - Salary and bonus
- Such schemes can give as much profit as if you could observe actions perfectly!

Venture Capital

- A venture's success depends on whether a new technology will work
 - 50% chance it works
 - venture worth \$20M if it works
 - venture worth \$0 if it doesn't work
- Entrepreneur knows whether the technology works or not

Venture Capital

- Entrepreneur approaches you: “I am somewhat risk averse and hence prefer to take a smaller than 100% stake”
- How much are you willing to pay if she offers you
 - 50% stake?
 - 90% stake?

Problem of Adverse Selection

- Expected value of venture given that she wants to sell 50%
 - $(50\% * 20 + 50\% * 0) = \$10M$
- Expected value of venture given that she wants to sell 90%
 - $100\% * 0 = \$0M$
- Because of this “adverse selection”, you are willing to pay *less* for a larger stake!!

Problem of Average Selection

- Only “bad” entrepreneur is willing to sell 90% of venture
 - adverse selection if you buy 90%
- But both “good” and “bad” are willing to sell 50% of venture
 - average selection if you buy 50%
- Still not ideal: you only want to invest when technology works!

Signaling & Screening

Screen = "Jump over this while I watch"

Signal = "Watch while I jump over this"

- High hurdle and a lot of money
- Low hurdle and a little money

How to Screen

- Want to know an *unobservable* trait
- Identify a “hurdle” such that:
 - those who jump the hurdle get some benefit but at some cost
 - “good” types find the benefit exceeds the cost
 - “bad” types find the cost exceeds the benefit
- This way we get **self-selection**: only “good” types will jump the hurdle

Auto Insurance

- Hidden Trait = high or low risk?
 - Half of the population are high risk, half are low risk
 - High risk drivers:
 - 90% chance of accident
 - Low risk drivers:
 - 10% chance of accident
 - Accidents cost \$10,000

Example: Auto Insurance

- The insurance company can not tell who is high or low risk
- Expected cost of accidents:
 - $(\frac{1}{2} \cdot .9 + \frac{1}{2} \cdot .1)10,000 = \$5,000$
- Offer \$6,000 premium contract to make \$1,000 profit per customer
- What happens?

Self-Selection

- High risk drivers:
 - Don't buy insurance: $(.9)(-10,000) = -9K$
 - Buy insurance: $= -6K$
 - High risk drivers buy insurance
- Low-risk drivers:
 - Don't buy insurance: $(.1)(-10,000) = -1K$
 - Buy insurance: $= -6K$
 - Low risk drivers do not buy insurance
- Only high risk drivers buy insurance

Adverse Selection

- Expected cost of accidents in population
 - $(\frac{1}{2} \cdot .9 + \frac{1}{2} \cdot .1) 10,000 = \$5,000$
- Expected cost of accidents among insured
 - $.9 (10,000) = \$9,000$
 - Insurance company loss: \$3,000
- Cannot ignore this “adverse selection”
- If only going to have high risk drivers, might as well charge more (\$9,000)

Screening

- Offer two contracts, so that the customers self-select
- Compare contracts aimed at high- and low-risk drivers.
 - Which will have the higher premium?
 - Which will have the higher deductible?

“New Issues Puzzle”

- Firms conducting seasoned equity offerings (SEOs) afterwards perform worse on average than other firms
- Loughran and Ritter (J Finance 1995) argue you lose 30% over five years investing in a SEO
- 1970-1990 data. Comparison is relative to performance of “matched firm”, i.e. one having similar characteristics that did not have any SEO in the following 5 years

SEO Underperformance

For this table, please see Table II from:

Loughran, Tim, and Jay Ritter. "The New Issues Puzzle" *Journal of Finance* 50, no. 1 (1995): 23-51.

Is the market failing?

- Why doesn't the market assimilate this information immediately?
- One possible explanation: *positive selection*
 - "Matched firms" are chosen retrospectively to be firms that will not have any SEO in next five years
 - Even if the market had *already* priced in the negative info, it might not have assimilated the (future) positive info about the matched firm!

Signaling

- The seasoned offering is a signal about the status of the companies current projects as well as future ones.

Seek outside equity



Fund projects internally



LOW

HIGH

Profitability of current/future projects

... & Adverse Selection

- If the current projects are not profitable, the cost (in dilution) to the owner-manager of issuing new share is lower.
- Therefore, seasoned offering is likely associated with
 - bad news about the firm's present condition
 - low threshold for profitability of new project.

Dividends

“It would be uneconomic as well as pointless [for firms to pay dividends and raise capital simultaneously]”

- Merton Miller and Kevin Rock, 1982

Dividends

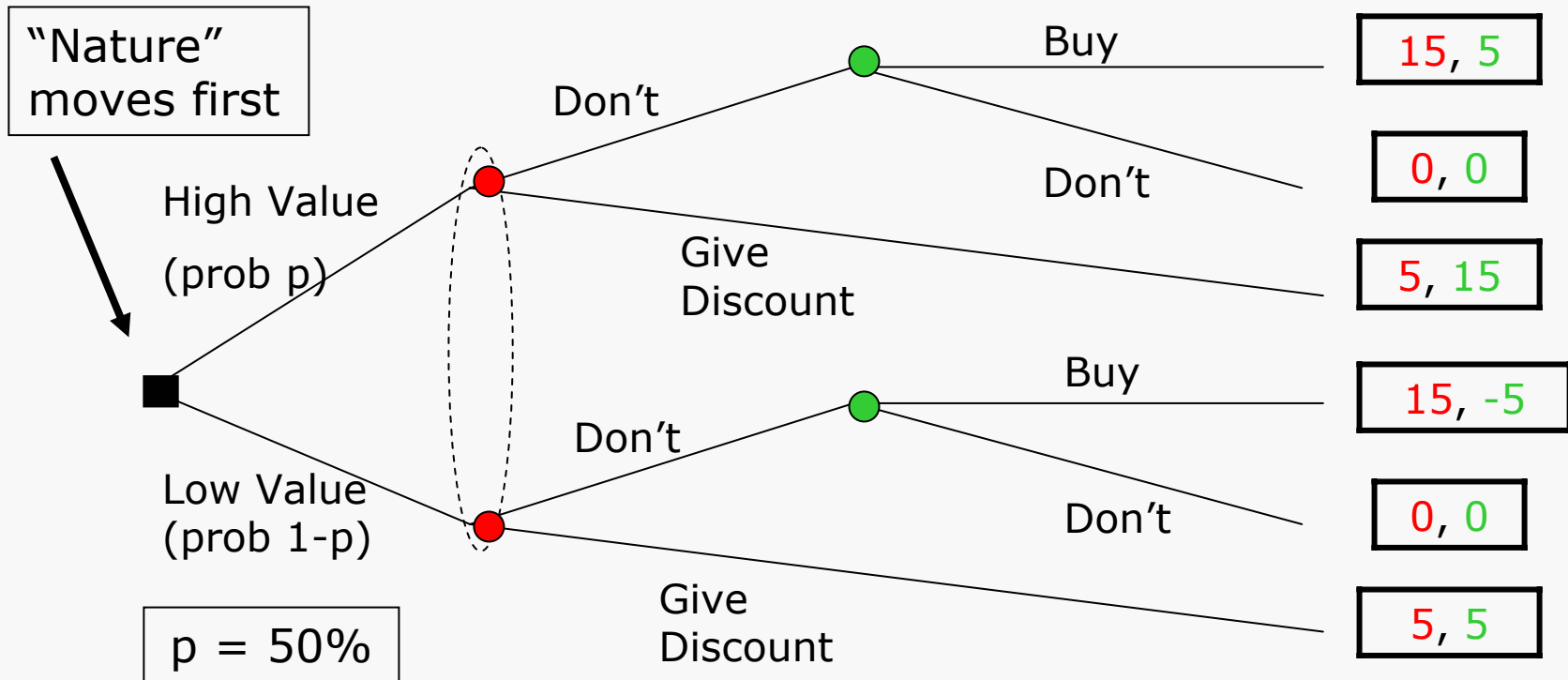
- Why might it be make sense for a firm to issue a dividend *and* for investors to view this positively?



Bargaining with a Customer

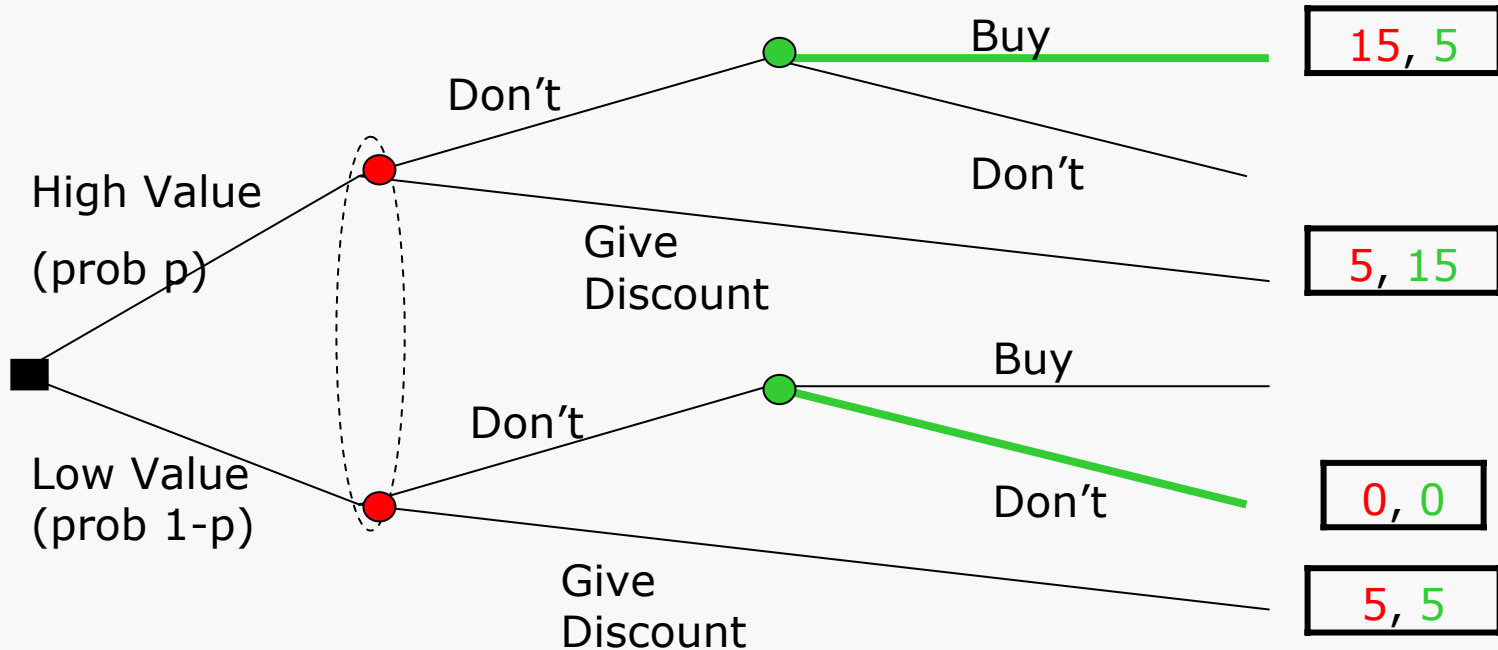
- Customer either willing to pay \$20 or \$10, *equally likely*
- Your price is \$15 (zero costs), but customer asks for a deeply discounted price of \$5
- You don't know whether the customer has value \$20 or \$10

Bargaining with Customer



Information set represents that seller can't distinguish whether buyer has high or low value

Solving for “Sequential Eqm”



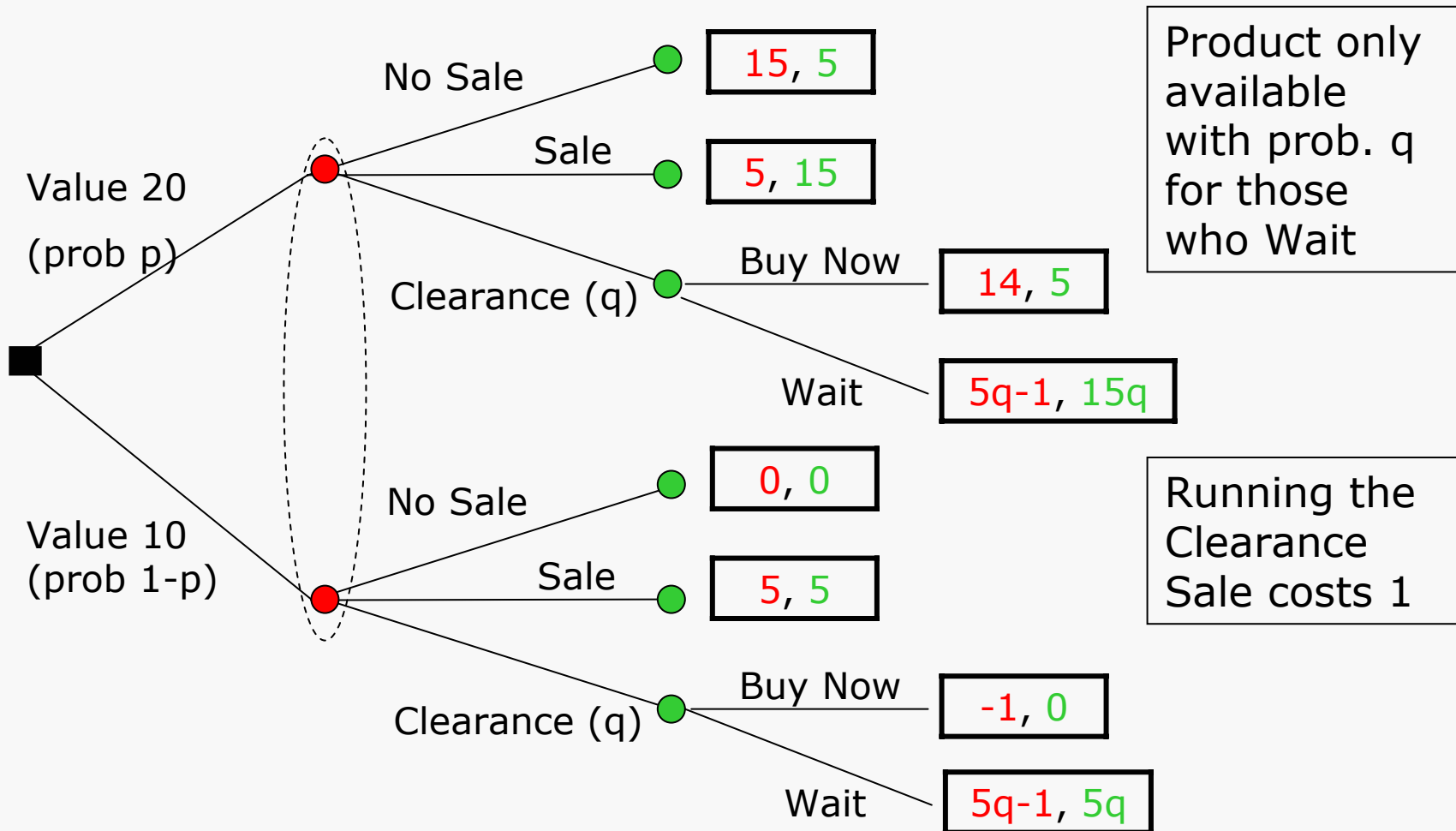
Seller's equilibrium choice depends on its **belief** about likelihood of High Value vs. Low Value

- *By Don't Discount, seller is "risking 5 to gain 10"*
- ***Don't Discount if $p > 1/3$***

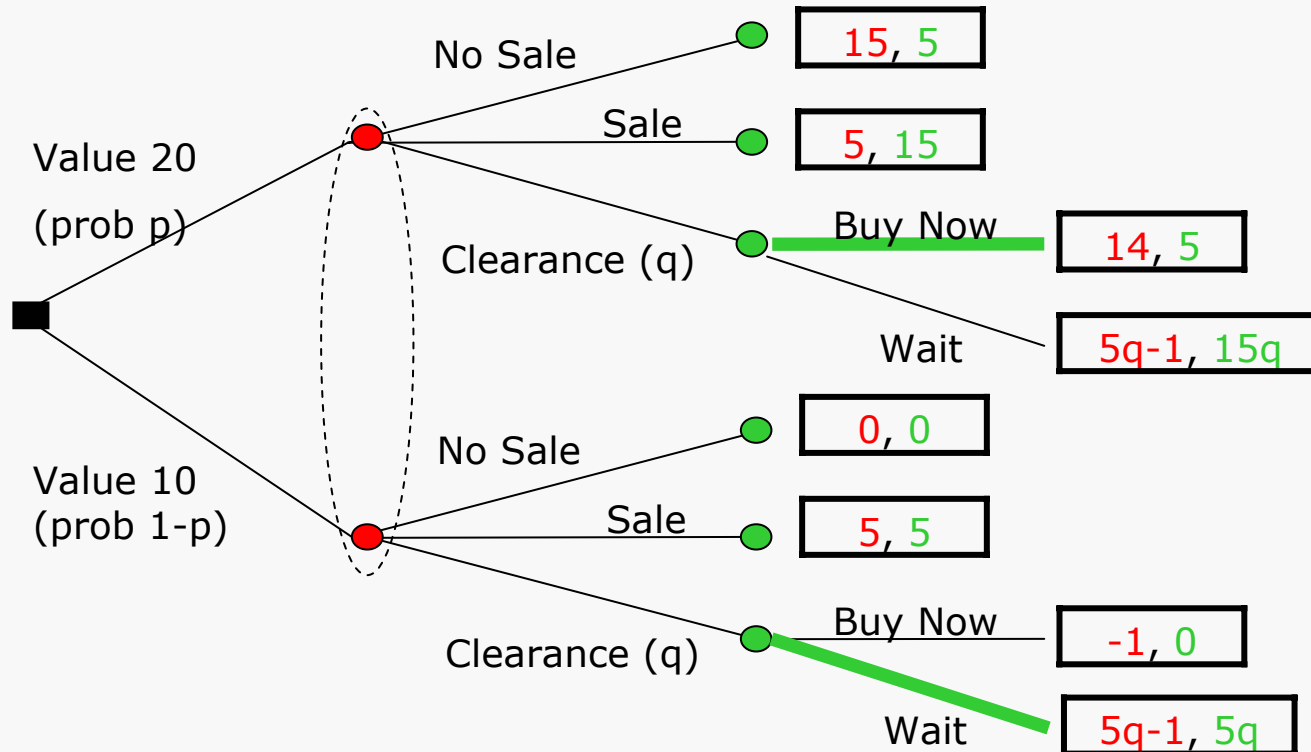
Other Approaches?

- If a customer “pleads poverty” for a discount, you have other options than simply to grant/refuse request
- What else might you do?

Clearance Sale



Clearance Sale as Screen



Clearance is an *effective screen* if $q < 1/3$

Clearance Sale?

Clearance Sale
or Sale?

Clearance Sale
or No Sale?



- $p > 1/3$: No Sale better than Sale
- $p < 1/3$: Sale better than No Sale

When (not) to have Clearance Sale ($p < 1/3$)

Clearance Sale
or Sale?

Clearance Sale
or No Sale?



- Clearance Sale vs. Sale
 - Clearance gives +9 more on High
 - Clearance loses $1 + 5(1-q)$ on Low
- *Only have Clearance when chance of High is sufficiently large*

When (not) to have Clearance Sale ($p > 1/3$)

Clearance Sale
or Sale?

Clearance Sale
or No Sale?



- Clearance Sale vs. No Sale
 - Clearance gives $-1 + 5q$ more on Low
 - Clearance loses 1 on High
- *Only have Clearance when chance of High is sufficiently low*

When to have Clearance Sale ($p = 1/3$)

Clearance Sale
or Sale?

Clearance Sale
or No Sale?



- If Clearance is *ever* your best strategy, it must be *when you are indifferent* between Sale and No Sale ($p = 1/3$)
 - “*when you can’t decide whether to offer a High- or Low-Quality product, offer both!!*”

Versioning

- Suppose that high-quality/high-cost item will be equally profitable as low-quality/low-cost item
- In this case, you can always do better offering a *menu* of both items that acts as a consumer screen

Versioning: Example

Customer willingness -to-pay	GOOD PRODUCT	BAD PRODUCT
HIGH CUSTOMER	\$35	\$20
LOW CUSTOMER	\$20	\$15

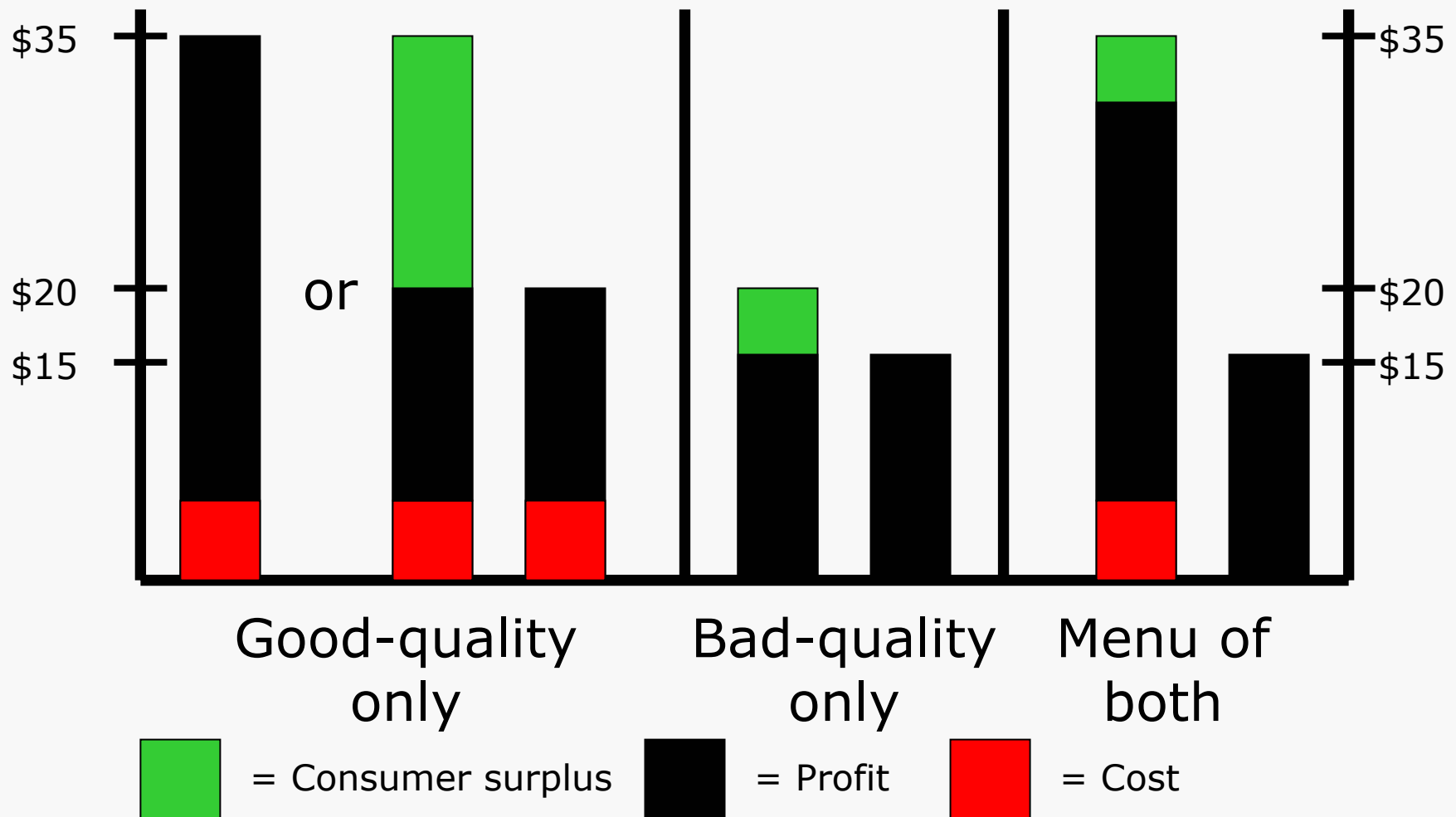
Good product costs \$5, bad product \$0

Versioning: Example

	GOOD PRODUCT	BAD PRODUCT
HIGH CUSTOMER	\$35	\$20
LOW CUSTOMER	\$20	\$15

- Sell only Good $\rightarrow 2 * (\$20 - \$5)$ or $(\$35 - \$5)$
- Sell only Bad $\rightarrow 2 * (\$15 - \$0)$
- Sell both $\rightarrow (\$15 - \$0) + (\$30 - \$5)$

Good-quality vs. Bad-quality



Summary

- Strategic issues arise when different players have different information
- Moral hazard given hidden action
 - role for incentives / tying one's hands
- Adverse selection given hidden trait
 - role for screening / signaling
- *Next time*: using hidden traits about yourself to make a credible commitment