7 – Information: Contracts, Norms & Power

Extended slides

this is an extended version (much more crowded with text and with additional explanations) of the slides I will project in class. You can use them as lecture notes.

7 – Information

Takeaways

- Many contracts are incomplete.
  - cannot specify all relevant aspects of the transaction.
  - (some aspects might be unobservable, unpredictable, or not demonstrable).
- Under incomplete contracts, markets can produce inefficient outcomes (*market failures*).
- With incomplete contracts, social institutions & power play a role in regulating exchange
  - they can allow mutually beneficial transactions that would not happen otherwise.

7 - Information

The Plan

1. Incomplete contracts
2. Principal-agent relations
3. Hidden attributes & adverse selection.
4. Hidden actions & moral hazard.
5. Power in economic relations.

1 – Incomplete contracts

"Not everything in the contract is contractual. . . the contract is not sufficient in itself but is possible only thanks to a regulation of the contact, which is social in origin."

Emily Durkheim

1 – Incomplete contracts

- Many important economic exchanges are regulated by *incomplete contracts*.
- Not all the relevant aspects of the exchange can be written down in a enforceable contract.
- This may be because some actions or attributes are difficult to observe, or because they can be observed but cannot be proved in courts.
- Incomplete contracts generate *conflicts of interest*
  - > the aspect that can't be fully specified by the contract affects the distribution of gains among participants.

Examples

- Job contract
  - can't specify amount of effort that the employee has to exert (difficult to observe, measure and prove in court).
- Car insurance
  - can't specify exactly 'how safely' the driver will have to drive.
- Used car purchase
  - not easy to assess its real conditions; if it gets broken after, difficult to prove that it was defective from the start.
- Owners of big corporations hiring managers
  - difficult to control that managers are really doing everything they can to increase the long-term value of the company (rather than just boosting their own power, pay & lifestyle).

Why are contracts incomplete?

1. Verifiability: an aspect on which verifiable information (usable in court) isn't available cannot be fully regulated by the contract.

2. Time: Contract specifies what a party must do over the duration of the contract. But it's often impossible to specify what a party must do in every possible future situation
   - *Ex: job contract can't specify every task that the employee is required to do under every situation that might possibly arise*

3. Measurability: Some aspects are important for the exchange but not measurable
   - *how you measure 'how nice' a cashier is with clients?*

Why are contracts incomplete?

4. Authority: For some transactions, no judicial apparatus is there to enforce contracts
   - Ex: international agreements between States

5. Motivation: Sometimes even if a complete contract would be possible, agents prefer not to regulate some aspects, for motivational reasons.
   - *how would you feel if an employer offered you a work contract specifying how many times you can go to bathroom and for how many minutes? Would you work hard for this employer?*

2- Principal-agent relations

- Markets with incomplete contracts are typically characterized by *principal-agent relations*.
- Principal benefits from some action/attribute of the agent.
  - Ex.: employer, who profits from work effort of employee;
- Agent obtains a benefit from the principal, in exchange for undertaking a costly and hard to observe (or measure) action
  - Ex.: worker, borrower, insurance buyer, used-car seller…
- Conflict of interest between principal and agent, about something that cannot be subject to enforceable contract.

Principal-agent relations

- Information asymmetry favors the *agent*: he/she knows something that the principal does not.
- But strategic asymmetry gives more power to the principal: he/she has TIOLI or price-setting power.
- The principal uses power to address the problem arising from asymmetric information.

Two types of principal-agent problems

- Hidden actions: something an agent does is relevant for the principal, but the principal cannot observe it or demonstrate it in court.
  - Ex.: Work effort; managerial effort; risky behavior of insured people…
  - → Moral hazard.
- Hidden attributes: a characteristic of the agent (or object she sells) is relevant for the principal, but the principal cannot observe or demonstrate it in court.
  - Ex.: Health status of health insurance buyer, used car conditions, …
  - → Adverse selection.

3 – Hidden Attributes & adverse selection

- Example: "The market for lemons" (Akerlof, 1970)
- A model of the market for used cars
  - Principals are prospective buyers
  - Agents are car sellers
  - Only agents know the *hidden attribute* (real car value)

- This example will show that, without some solution to the information-asymmetry issue, markets with contractual incompleteness would cease to exist.

The market for lemons

- 10 used cars in the market everyday
- True value ranges from $0 to $9,000 in increments of $1,000.
- A seller will accept an offer higher than ½ the car's true value
  - i.e. seller of the car worth $9,000 will sell for no less than $4,501.
- Buyers can't observe true value of today's cars.
- But they can see the average value of the cars sold yesterday, and use this to form an *expectation* about today's cars.
  - if the average value of the cars sold yesterday was *n*, you expect a car on sale today to be worth *n* on average.
- Assume in day 1 all cars were sold.
- What will happen in day 2? And 3, 4, 5, 6…?

The market for lemons

Day 1:

- all cars are sold at their true value (by assumption)

Day 2:

- All cars were sold yesterday, so their average true value was $4,500.
- Now buyers expect cars on the market to be worth $4,500 on average, and won't to pay more than that.
- OK for sellers with car worth $8,000 (they would be willing to accept anything above $4,000) or less.
- Not OK for the guy with the car worth $9,000: he will prefer not to sell, since he cannot get at least $4,501.
- So all cars are sold, except the most valuable.

Day 3:

- What is the average true value of cars sold yesterday?
  - All cars except the one worth 9,000$ were sold. So the average true value was 4,000.
- Now buyers are not willing to pay more than 4,000$ for a car.
- So the guy with the car worth 8,000 will not sell, because he cannot accept a price lower than 4,001.

Day 4:

- The average true value of cars sold yesterday decreased to 3,500. So also the guy with a car worth 7,000 will not sell.

….

- Everyday the most valuable cars are driven out of the market. As a result *quality will relentlessly decrease*, until only the worthless car remains on the market (0$ value), and no one will want to buy used cars anymore.

Takeaways of the 'Market for lemons'

- When contracts are incomplete (for example because some important aspect is difficult to observe), *markets can fail*.
- A market that would have created mutual benefits (like the used car market of the example) will disappear: *missing market.*
- There are many missing markets in the economy
  - For example many people are denied credit although they would make good use of it and repay, because the lender cannot be sure that they are really trustworthy.

Adverse Selection

- Hidden attributes → adverse selection.
- Adverse selection: market attracts only those types that the principals would like to avoid
  - the sellers of 'lemons' in our used-car-market model
- Big example: health insurance market
  - not perfectly observing the health of insurance buyers, health insurance companies charge high prices, but at those prices only the already sick buy insurance.
  - Example: ACA forces insurers to cover pre-existing conditions but also requires everybody to buy health insurance: otherwise only the sick would buy insurance and prices would skyrocket.
  - See 'Application: Health Insurance' in the textbook.

Institutional solutions to adverse selection

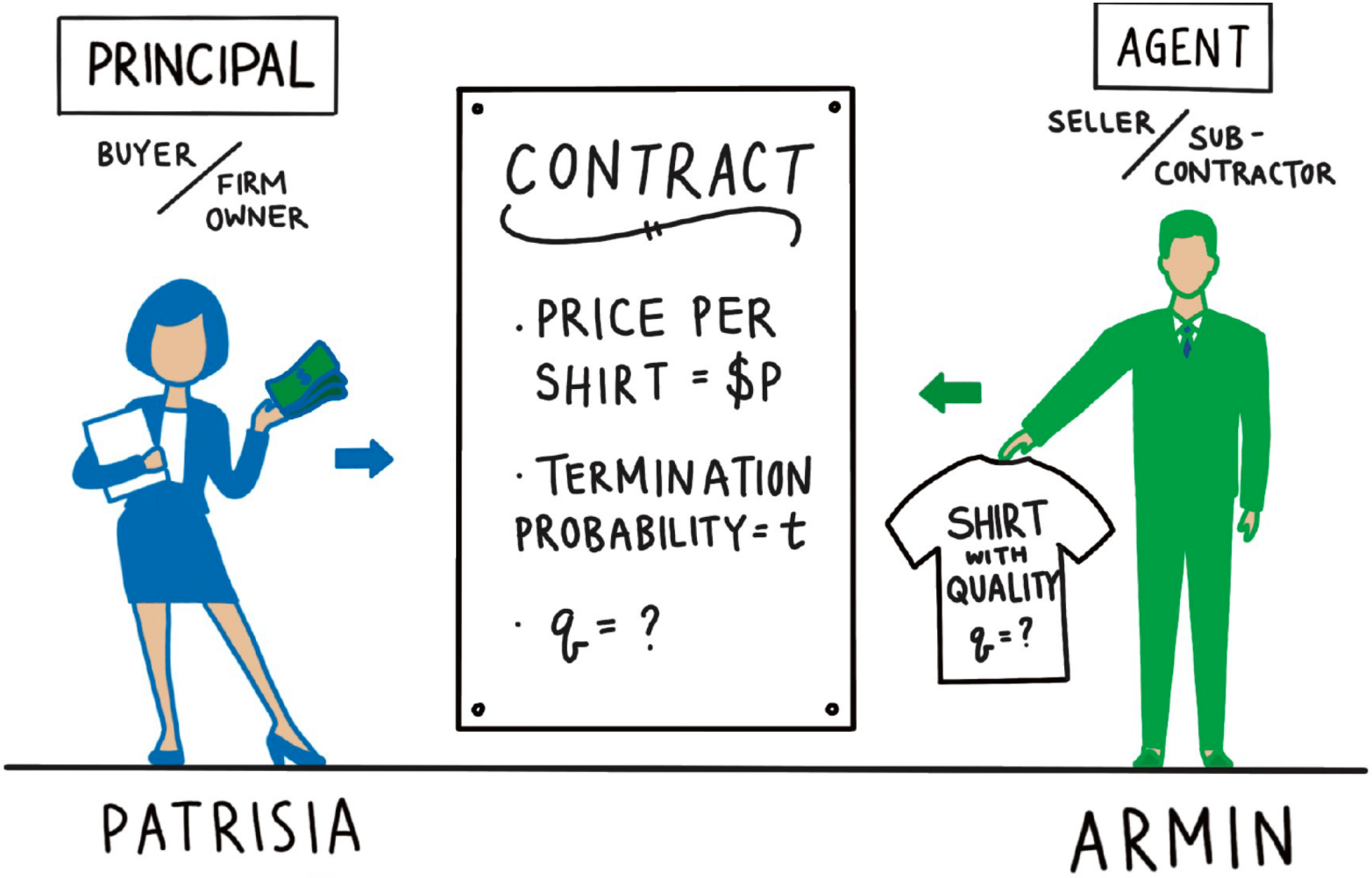
- Quality certification: expert 3rd party assesses the hidden attribute (to the extent that it is possible).
  - For example, when you buy an existing home, an independent professional will inspect it in detail to assess its conditions.
- Warranties: seller commits to repair or replace the product if it gets broken within a certain period of time.
  - (only a partial solution, because it is often difficult to distinguish damages made by improper use from damages due to defects.)
- More generally, principals try to reduce adverse selection through screening (attempts to assess the 'type' of the agent)
  - Health insurers request medical record of applicants
  - Banks investigate the credit history of would-be borrowers

4 - Hidden Actions & Moral Hazard

- hidden action → moral hazard
  - once your car is fully insured against theft & damages, you may stop worrying about parking it in safe places;
  - after you get hired by a firm to do a job, you may do it carelessly, because you'll be paid anyway.

- typical strategy used by principals to deal with hidden actions: <u>contingent renewal</u>
  - Principal introduces incentives for the agent to act according to the principal's interest.
  - The strategy involves repeated interaction: the contract will be renewed each period.
  - The renewal is contingent on the principal observing the agent doing what the principal wants.

The Benetton Model



The Benetton Model

- Each period, principal *P* buys a good from agent *A* for price *p*.
- *P* wants the good to be of high quality level *q*.
- *P* observes *q* only after buying (and paying for) the good.
- For *A*, providing higher *q* is costly (*disutility of effort*)
- In one-shot interaction, *A* would do *q=0* (gets paid anyway)
- To induce A to produce a decent *q*, P does the following:
  1. establishes durable commercial relation with *A,* which provides benefits to *A* (relative to A's fallback position).
  2. announces that the probability of terminating the contract will depend on quality level *q* of last good delivered.

Players' preferences

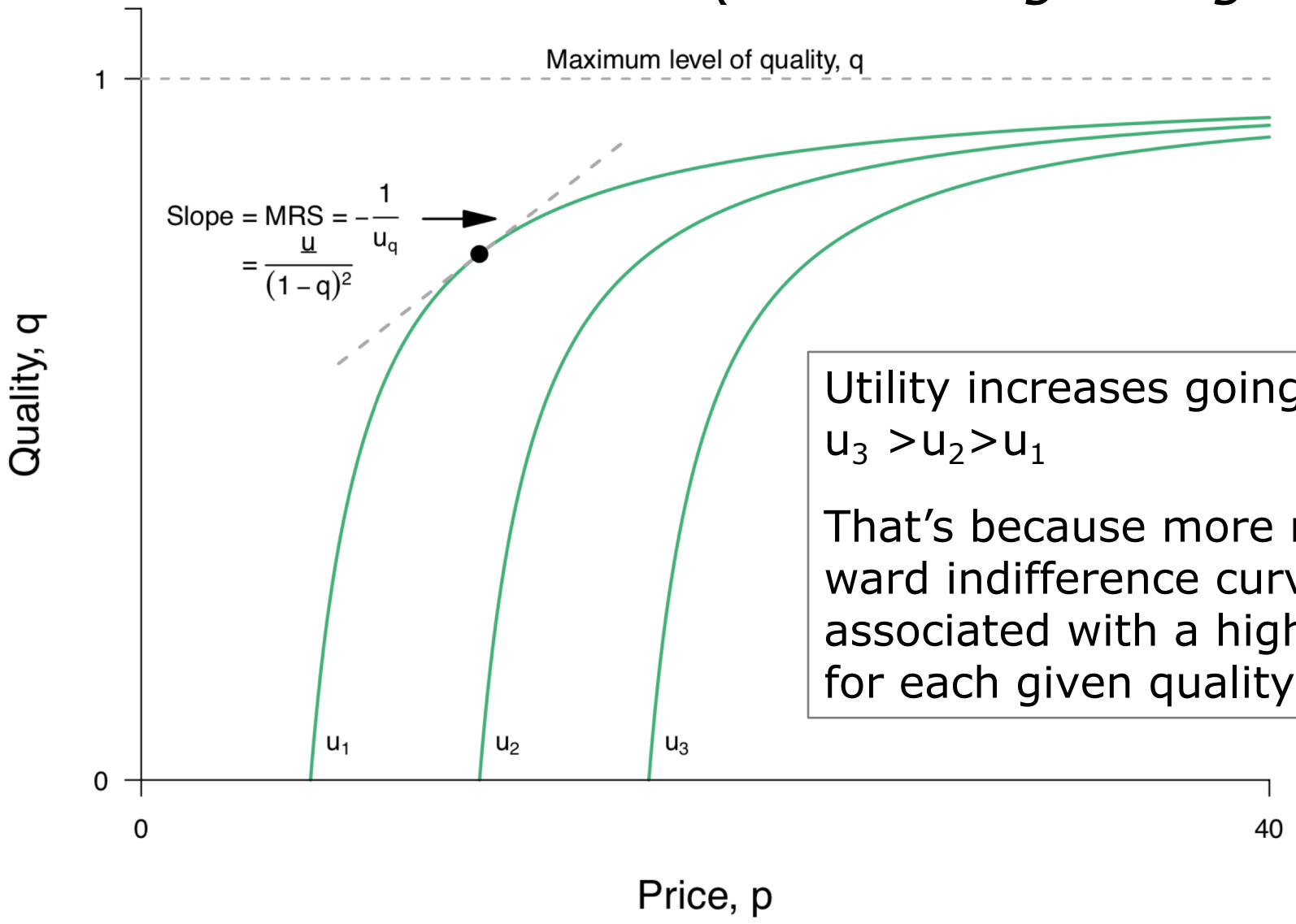
- *Principal* wants to maximize *q/p (quality per $)*
  - Higher q/p → higher profits for Principal
- *Agent*'s utility in a single period:

$$u(p,q) = p - \frac{\underline{u}}{(1-q)}$$

  - Price received *p* gives positive and constant marginal utility;
  - Providing quality *q* gives negative and decreasing utility ('increasing marginal disutility').

Agent's indifference curves over *q* and *p*

(considering a single period)

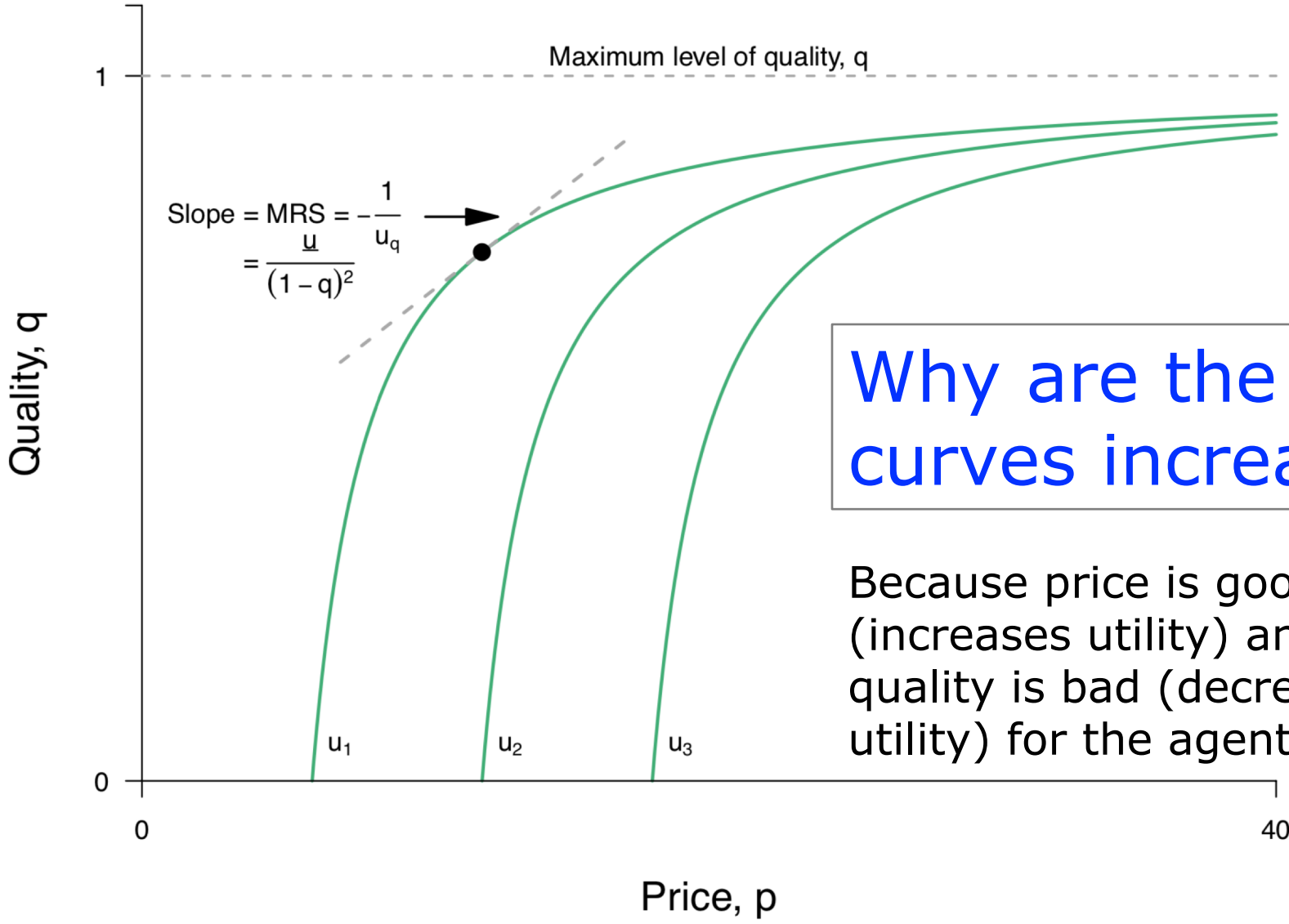


Utility increases going right: $u_3 > u_2 > u_1$

That's because more right-ward indifference curves are associated with a higher price for each given quality level.

Agent's indifference curves over q and p

(considering a single period)



Why are the curves increasing?

Because price is good (increases utility) and quality is bad (decreases utility) for the agent!

Termination schedule

Principal will terminate the relation with probability

$$t = 1 - q$$

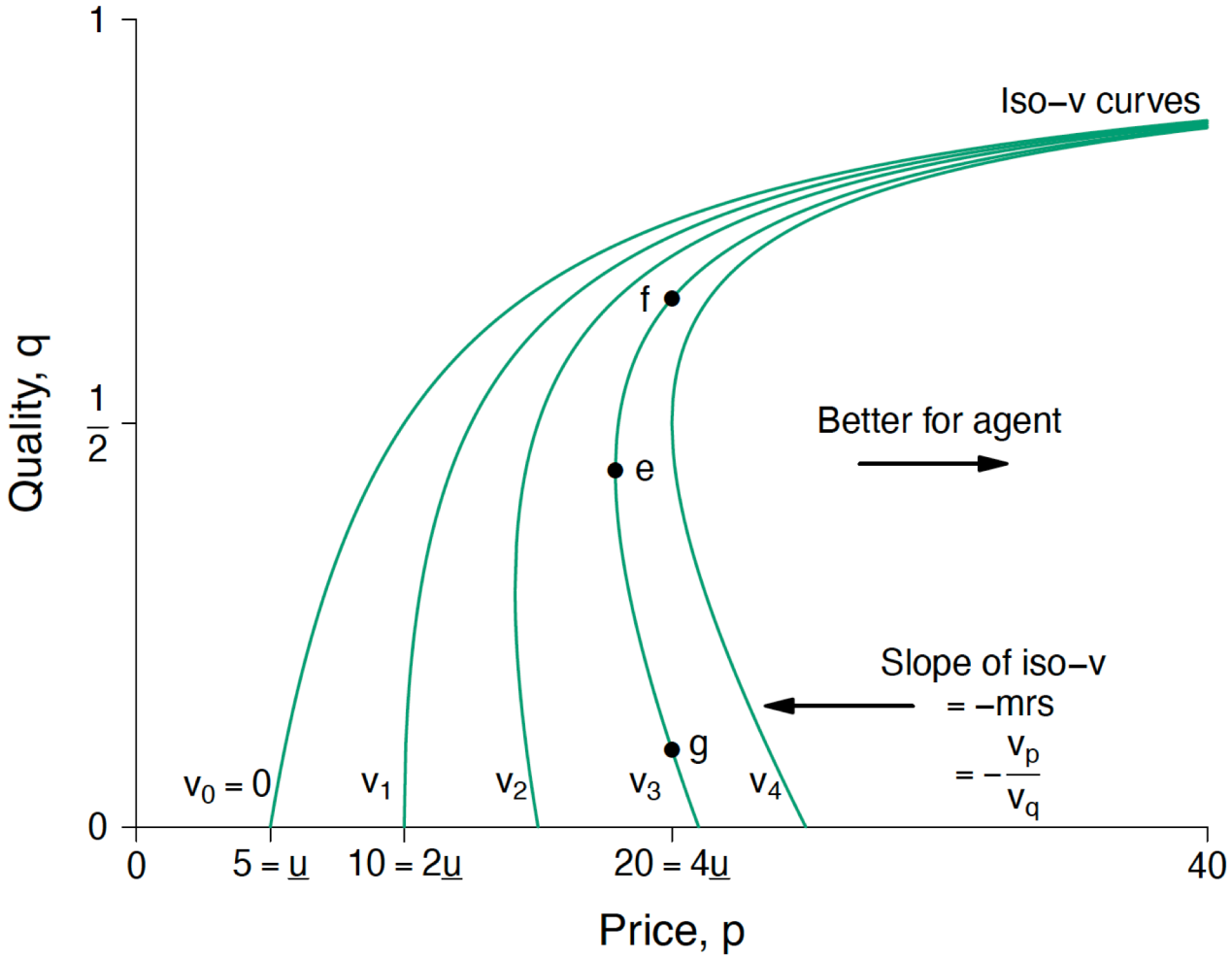
- lower quality → higher probability of termination
- Max quality (q=1) → t=0
  (contract renovated for sure)
- Min quality (q=0) → t=1
  (contract terminated for sure)
- Intermediate quality (q=0.5) → t=0.5
  (50% change of keeping the contract)

- Agent cares not only about utility this period, but also about *future* periods.
- *Value*: the total utility that Agent gets from the relation with Principal, including future exchanges
  (we call it value to distinguish it from u, utility in a single period)
- Value = utility per period x duration of the contract

$$v(p,q) = u(p,q) * T(q) = \left(p - \frac{\underline{u}}{(1-q)}\right)\frac{1}{(1-q)}$$

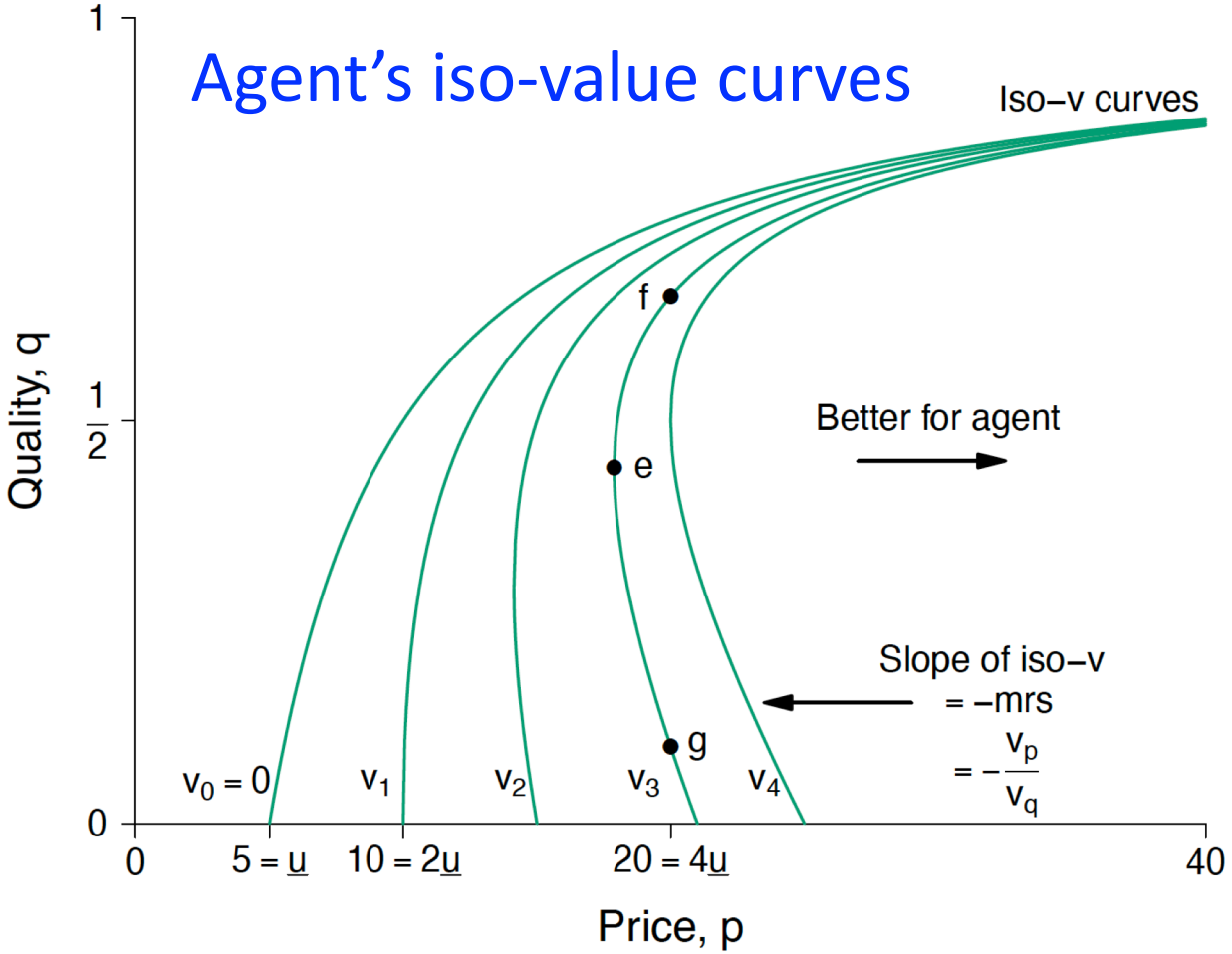
- Given the termination function, the exchange is expected to last for: T(q) = 1/t(q) = 1/(1-q)
  - [we will not demonstrate the derivation of T(q) mathematically: just believe me– or look into your math book]

Agent's iso-value curves



- Value increases going towards the right.
- in this graph, for the agent $v_4>v_3>v_2>v_1>v_0$
- If you move from a given iso-value curve to another to the right of it, you increase price for any given quality level.
- The agent prefers more right-ward iso-value curves.

The slope of the iso-value curves is due to contingent renewal contract & termination function: now q is not always bad for the agent



– Higher q now increases the expected duration of the contract.

– Increasing q means receiving p for longer (higher T).

– so *q* is now a *good* up to a certain point: until it becomes too costly (increasing disutility of q).

– For low levels of *q* and high enough *p*, both *p* & *q* are good
-> negative slope

– For high levels of *q* and/or low *p*, *p* is a good but *q* is a bad
-> positive slope

The Agent's Best Response Function

- Given the price offered by the Principal, the Agent will set the quality level in such a way as to maximize the value he gets from the relation.
- So he sets the value of *q* that maximizes $v(p,q) = \left(p - \frac{\underline{u}}{(1-q)}\right)\frac{1}{(1-q)}$
- Value-maximizing level of q for the agent:

$$q = 1 - \frac{2\underline{u}}{p}$$

  - It is the Agents's BRF: gives the quality level the Agent will choose to provide, as a function of the price offered by Principal.
  - Higher price induces the Agent to provide higher quality.

Derivation of the agent's BRF

(you can also see M-Notes 10.3 and 10.4 in your textbook)

- Agent wants to pick the q level that maximizes value. Value is given by

$$v(p,q) = u(p,q)\frac{1}{t(q)} = \left(p - \frac{\underline{u}}{(1-q)}\right)\frac{1}{(1-q)}$$

- Take the derivative of *v(p,q)* with respect to q

$$v_q = \frac{u_q \cdot t(q) - u(p,q) \cdot t_q}{(t(q))^2}$$

- To maximize *v* with respect to *q*, we need to set v_q equal to zero

$$\frac{u_q \cdot t(q) - u(p,q) \cdot t_q}{(t(q))^2} = 0 \quad \rightarrow \quad u_q = t_q \frac{u(p,q)}{t(q)}$$

- Now we need to figure out the values of u_q, t_q, $u(p,q)$ and $t(q)$ from the utility and termination function…

Derivation of the agent's BRF (2/2)

- $u_q = t_q \frac{u(p,q)}{t(q)}$
  - from the utility function, $u(p,q) = p - \frac{\underline{u}}{(1-q)}$
  - … and $u_q = -\frac{\underline{u}}{(1-q)^2}$
  - from termination function, $t(q) = 1 - q$
  - … and $t_q = -1$
- Plugging these into the equation, we get:

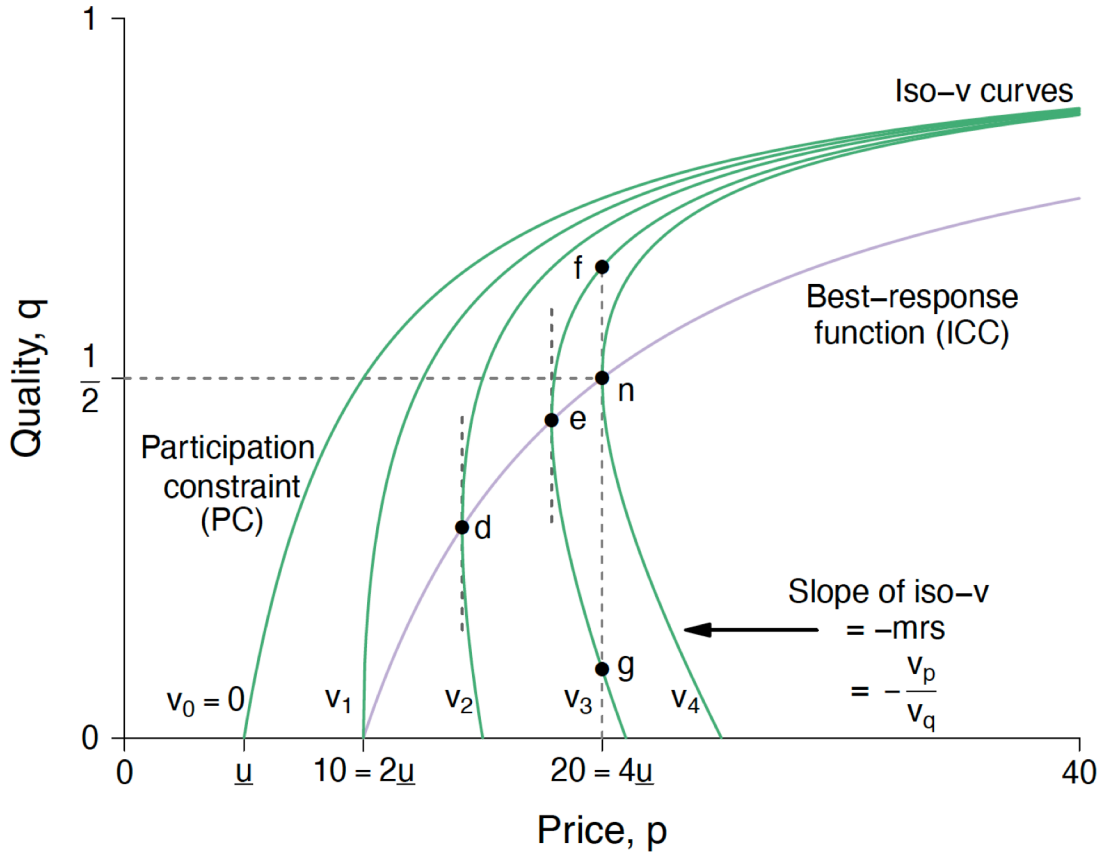
$$-\frac{\underline{u}}{(1-q)^2} = -\left(p - \frac{\underline{u}}{(1-q)}\right)\left(\frac{1}{1-q}\right)$$

- Solving for q (details in M-Note 10.4) we obtain

$$q = 1 - \frac{2\underline{u}}{p}$$

this is the BRF: gives the optimal q that the agent will choose, given the price set by the principal.

Agent's iso-value curves and BRF



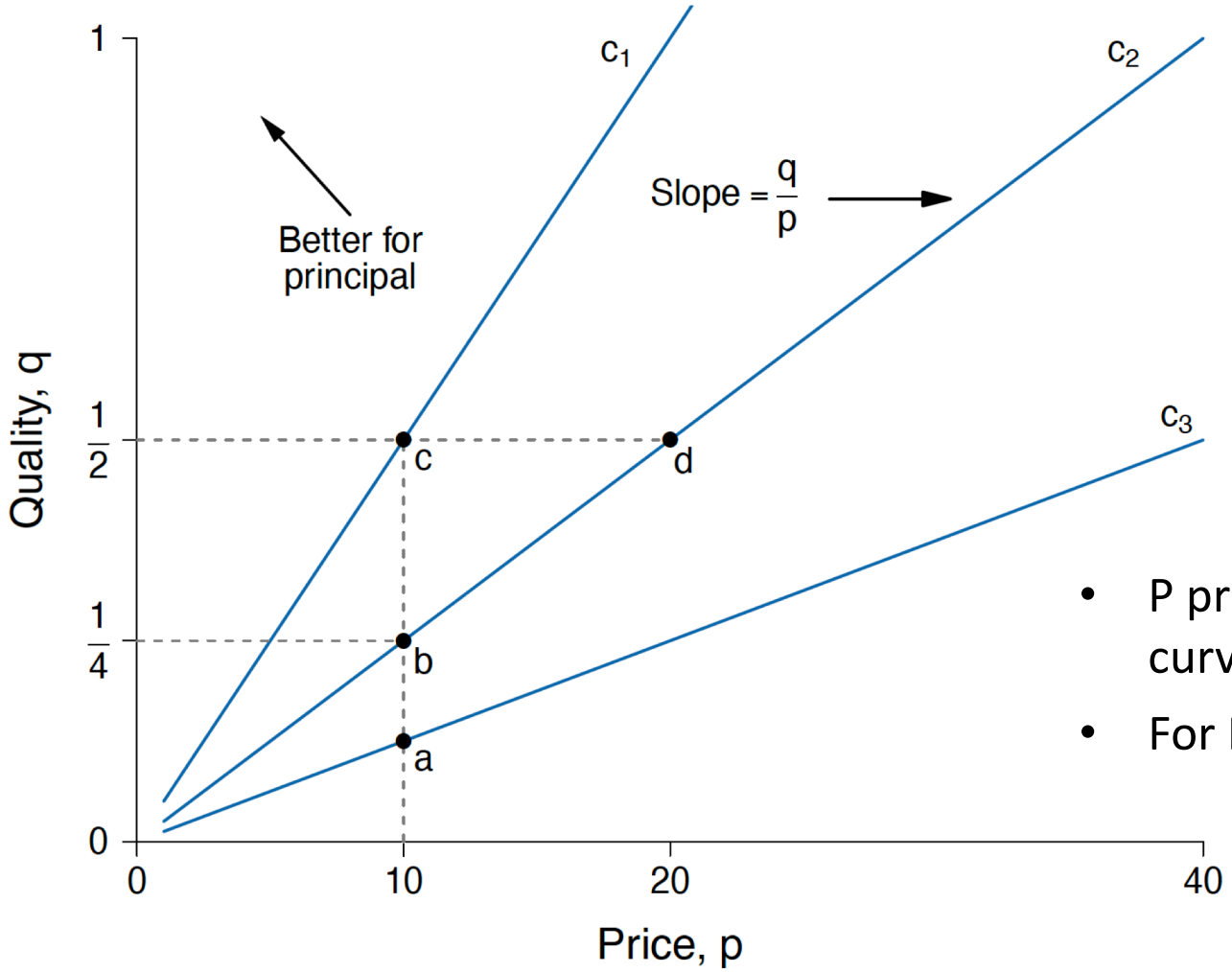
- Agent wants to be on the most right-ward possible iso-value curve he can reach.
- But he can only pick points on the vertical line that represents the price offered by the Principal.
- Agent achieves maximum possible value by picking a point of tangency between iso-value curve and price.
- BRF connects all such points of tangency.
- BRF says that the quality level chosen by Agent is a increasing function of the price offered by Principal.
- The Agent's BRF will be the incentive compatibility constraint (ICC) for the principal.

Nash Equilibrium of the Benetton model

- What price will the Principal set?
- In setting the price, the Principal wants to maximize $\frac{q}{p}$
  - she has to take into account that the quality provided by the agent will depend on the price offered, according to the agent's BRF.
  - *incentive compatibility constraint*: principal must choose a point on the agent's BRF.
  - we call p^N the specific price that, given the BRF, maximizes q/p for the principal.
- The agent will then best-respond according to his BRF, choosing the quality level q^N that maximizes value given the price offered.
- The resulting quality level q^N determines the probability of termination t^N, and so the expected duration of the contract T^N.
- p^N, q^N and t^N represent the Nash Equilibrium of this model.

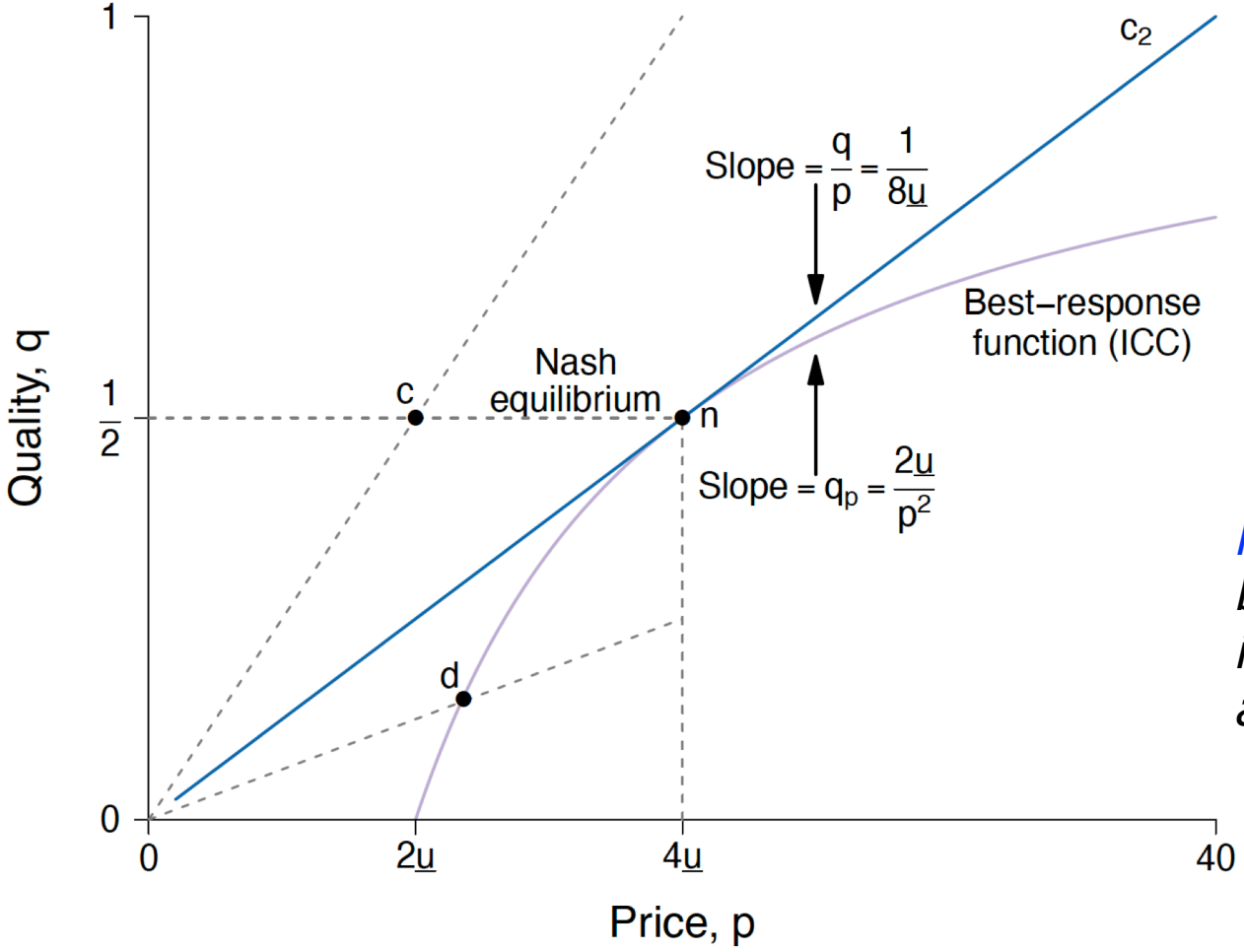
  > Agent & Principal are best-responding to each other's actions.

Principal's iso-profit curves



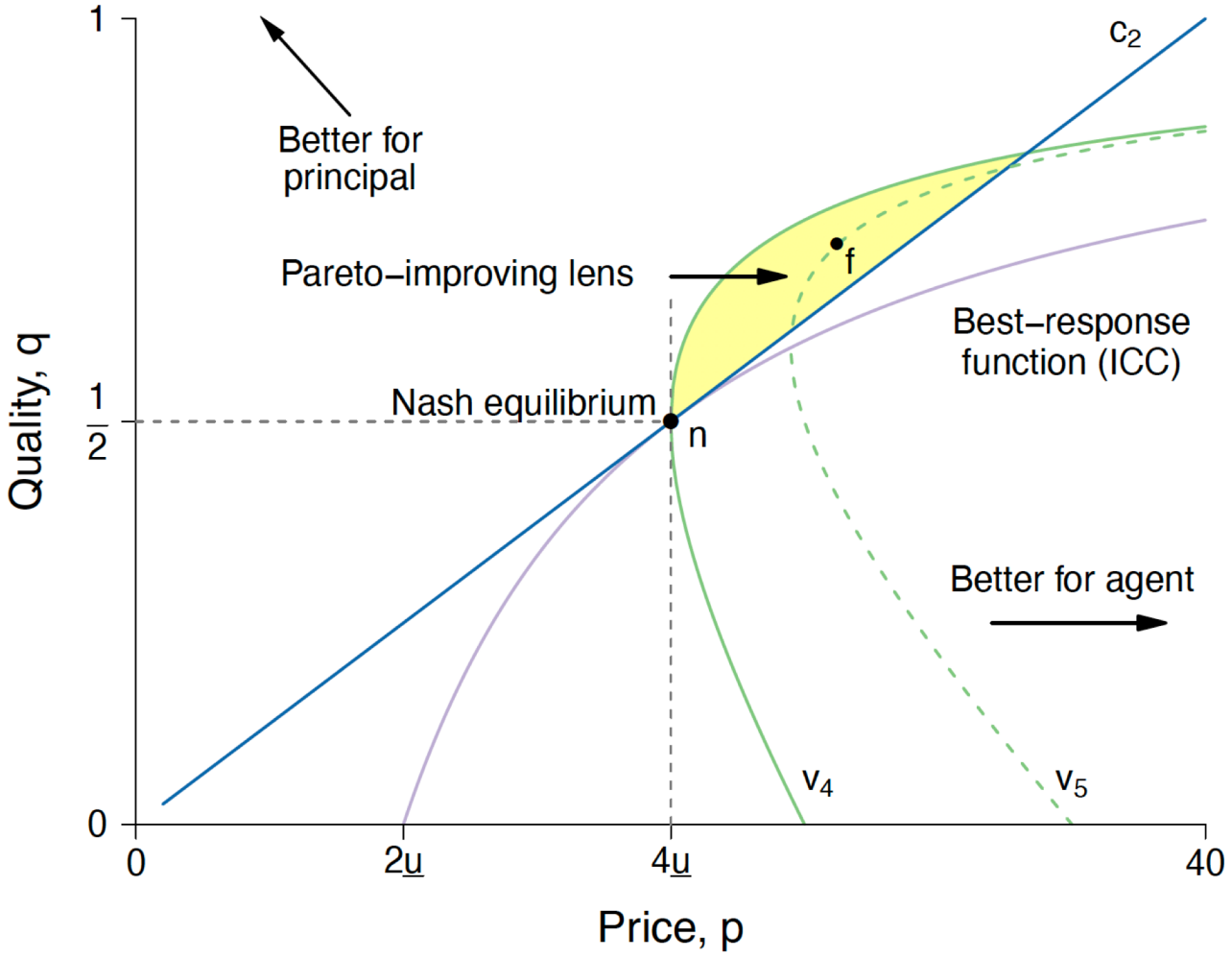
- P prefers *steeper* iso-profit curves (higher q/p)
- For P, $c_1 > c_2 > c_3$

Nash equilibrium of the Benetton model



N.E. = *point of tangency between the principal's iso-profit curve and the agent's BRF.*

- *Not Pareto-efficient*: iso-value curve and iso-profit curve are not tangent.
- *Both* would be better-off with higher quality and higher price!
- But this is not feasible, because of incentives (no Pareto-improving point is on the agent's BRF).



Mathematical derivation of p^N

- We need to find the *p* that maximizes *q/p*, subject to the Agent's BRF.
- The BRF says that *q=q(p)*, therefore we can rewrite the problem as just

$$Maximise \quad \frac{q(p)}{p}$$

- Taking the derivative with respect to p, we obtain (by the quotient rule):

$$\frac{d\left(\frac{q(p)}{p}\right)}{dp} = \frac{q_p \cdot p - q(p)}{p^2}$$

- To maximise q/p, we set this derivative equal to zero and solve for p:

$$\frac{q_p \cdot p - q(p)}{p^2} = 0 \quad \rightarrow \quad q_p = \frac{q(p)}{p}$$

  - From the Agent's BRF, we have $q(p) = 1 - \frac{2\underline{u}}{p}$ and $q_p = \frac{2\underline{u}}{p^2}$

- $q_p = \frac{q(p)}{p} \quad \rightarrow \quad \frac{2\underline{u}}{p^2} = \frac{1}{p} - \frac{2\underline{u}}{p^2} \quad \rightarrow \quad p^N = 4\underline{u}$

Mathematical derivation of q^N and t^N

- The Principal sets his equilibrium (profit-maximizing) price

$$p^N = 4\underline{u}$$

- Agent's BRF then determines quality q^N

$$q^N = 1 - \frac{2\underline{u}}{p^N} = 1 - \frac{2\underline{u}}{4\underline{u}} = 0.5$$

- So the probability of contract termination after each delivery t^N is

$$t^N = 1 - q^N = 1 - 0.5 = 0.5$$

- The expected number of period that the contract will last T^N is

$$T^N = \frac{1}{t^N} = \frac{1}{2} = 2$$

A comparison with complete contracts

- What if quality were contractual? (a world without asymmetric information)
- Assume Principal can make a TIOLI offer to Agent, specifying a price (p^c) and an exact amount of quality (q^c).
- TIOLI offer should just satisfy A's participation constraint: offer him slightly more utility than the fallback: $u=z+\varepsilon$
- As usual, we neglect this small ε and assume that the agent will accept if he gets utility at least equal to the fallback position.
- The participation constraint is

$$u(p^c, q^c) = z$$

- Assuming for simplicity that in absence of the contract the Agent would get zero utility (z=0) the participation constraint becomes just

$$u(p^c, q^c) = 0$$

A comparison with complete contracts

- Principal will offer a contract specifying the price and quality levels (p^c and q^c) that maximize quality per dollar (q/p)….
- ….subject to the constraint that the utility of the agent cannot be lower than 0 (otherwise Agent will not accept the contract).
- So the problem for Principal in choosing p^* and q^* is:

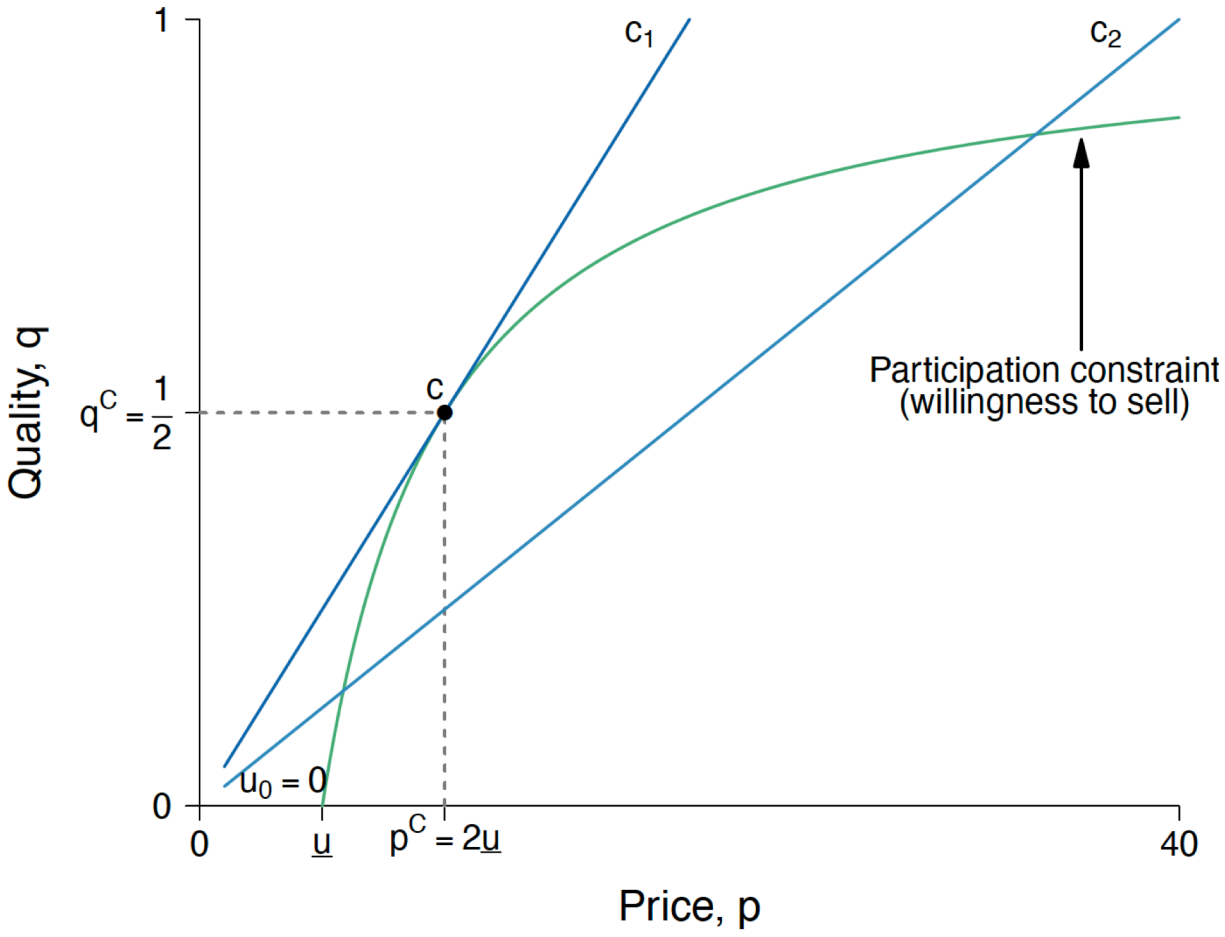
$$Maximize \quad \frac{q}{p} \qquad subject\ to \quad u(p,q) = p - \frac{\underline{u}}{(1-q)} = 0$$

- As shown in M-Note 10.7 in the textbook, the solution is

$$p^c = 2\underline{u}, \qquad q^c = 0.5$$

- With a complete contract that can specify a exact quality level, the Principal ends up paying half the price (relative to the case with incomplete contract), for the same quality level!

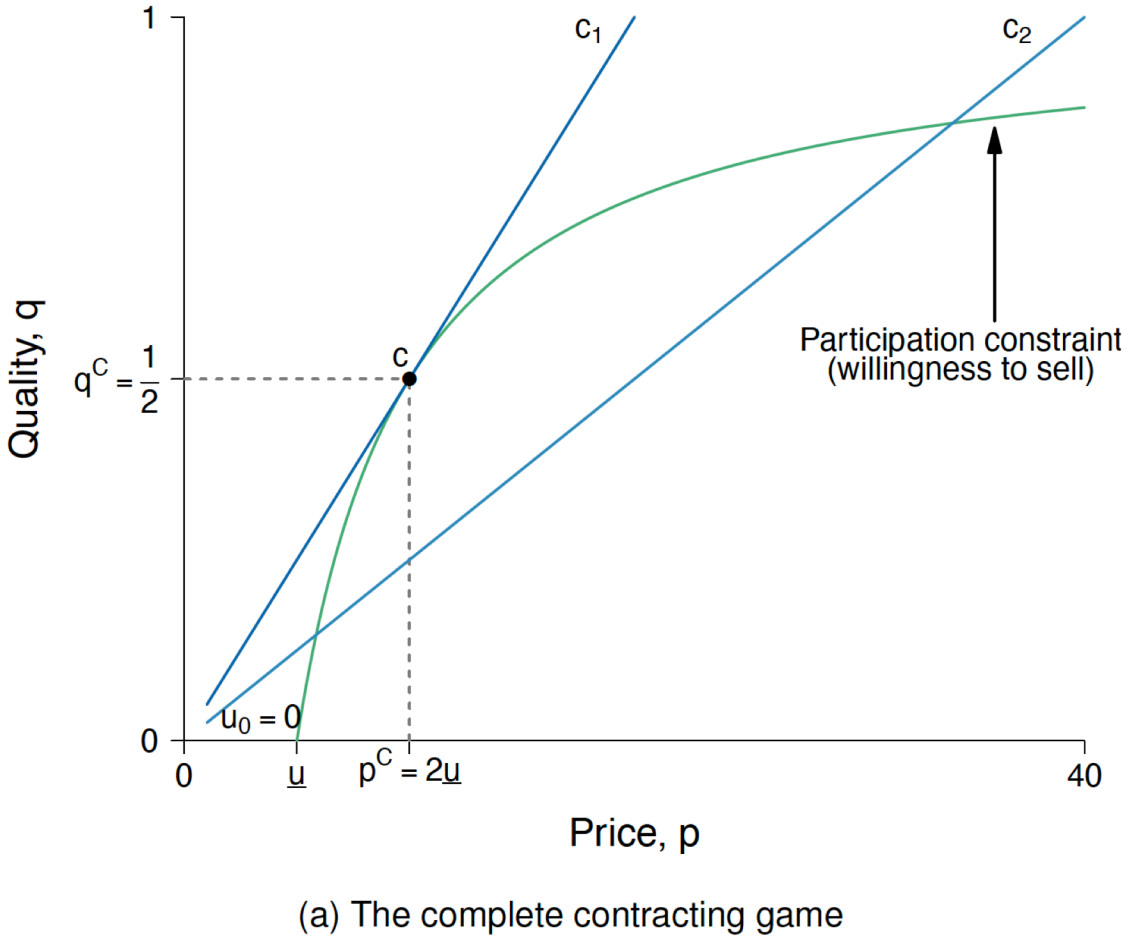
Nash Equilibrium with complete contracts and TIOLI power



(a) The complete contracting game

- Each blue line represents a *q/p* ratio (like an indifference curve for the principal).
- Steeper blue lines are associated with higher *q/p* (better for the principal).
- The green increasing curve is a indifference curve for the agent…
- …specifically, it is the one associated with its fallback utility (u=z=0).
- Principal wants to be on steepest possible q/p line.
- But cannot choose points to the left of the Agent's participation constraint.
- Principal offers point **c**: tangency between the Agent's participation constraint and the Principal's *q/p* curve.

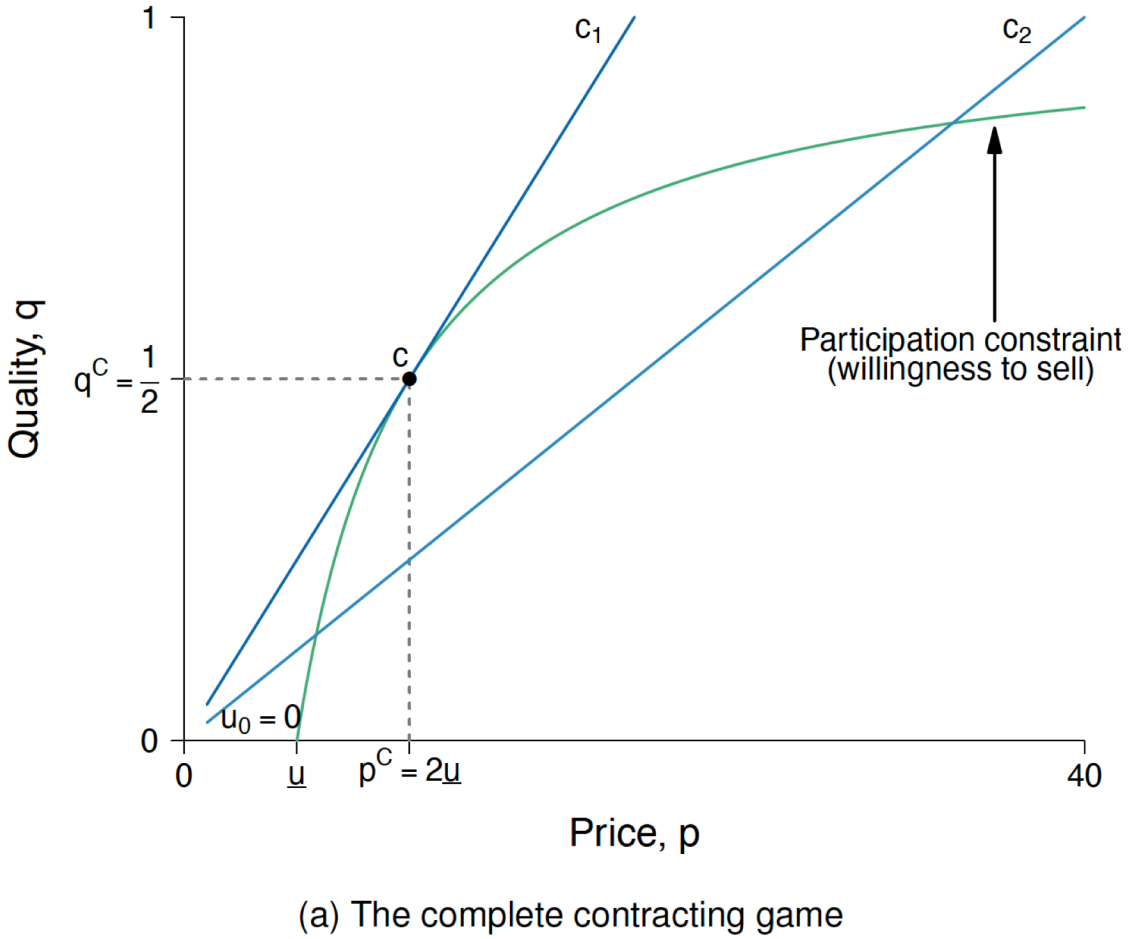
Nash Equilibrium with complete contracts



(a) The complete contracting game

With a complete contract, the principal (buyer) chooses the point of tangency between the participation constraint (the agent's indifference curve that gives the same utility as the fallback position) and the steepest possible q/p line, resulting in point ***c****.*

Nash Equilibrium with complete contracts and TIOLI power



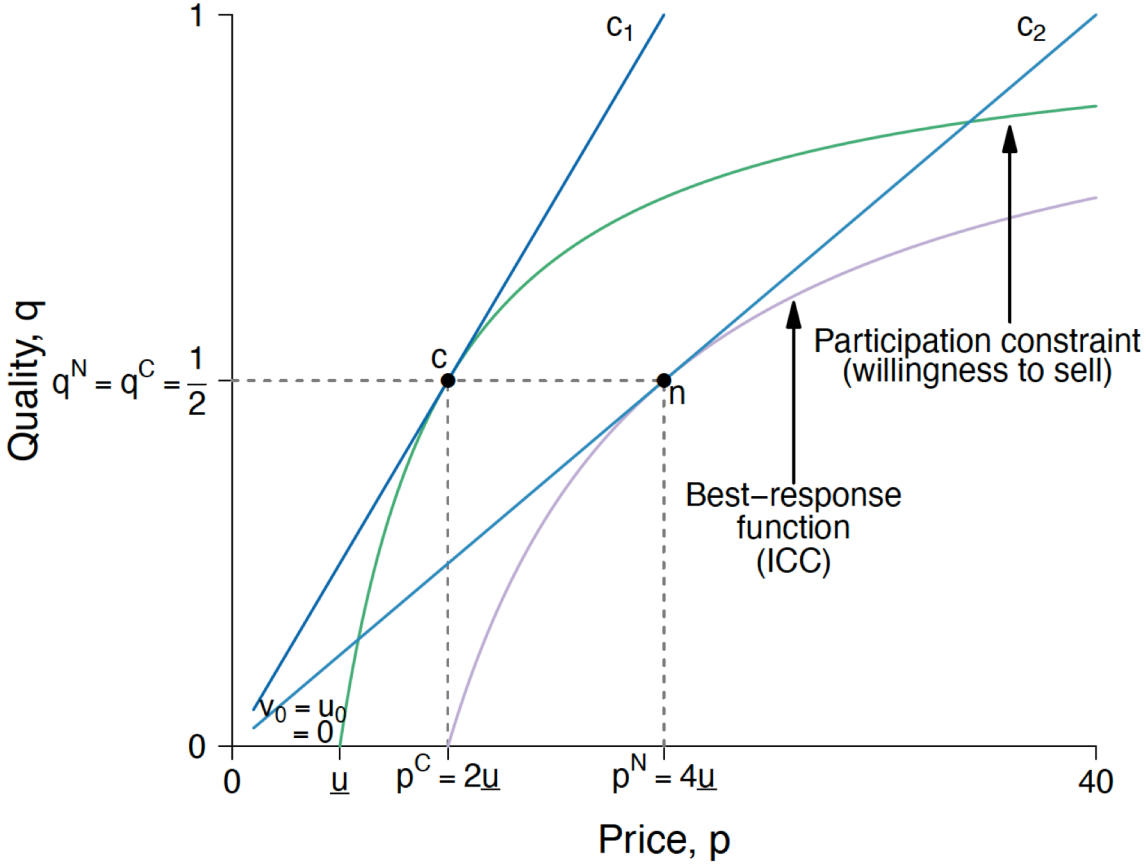
(a) The complete contracting game

The complete contracts equilibrium with TIOLI power is Pareto-efficient.

The equilibrium outcome (q^c,p^c) is a point of tangency between the indifference curves of Principal & Agent.

*This means that at the equilibrium point **c**, the MRS(q,p) is the same for the two participants in the exchange -> Pareto-Efficient.*

Nash Equilibrium with complete contracts and TIOLI power



(b) Both complete and incomplete contracting

Comparison with the incomplete-contract case:

Equilibrium with incomplete contract (quality level cannot be specified): point **n**
> it's a point of tangency between Agent's BRF & Principal's q/p line

Equilibrium with incomplete contract (quality level cannot be specified): point **c**
> it's a point of tangency between Agent's p.c. & Principal's q/p line

The Principal is better off with complete contracts;
But the Agent is better off with incomplete contracts.

Features of the incomplete contract equilibrium (1/2)

- *Pareto inefficient*: both would be better-off with higher quality & higher price. But this is not possible, because of the incentive-compatibility constraint (only points on the BRF are feasible).
- *Agent gets a 'rent':* unlike in the complete-contracts case, the agent receives utility higher than his next best alternative (or fallback position).
  - Remember (Section 1) that we call 'rent' the increase in utility someone gets over their fallback position.
- *Market does not clear :* because buyer offers a rent, people are not indifferent between producing for the buyer and the next best alternative. But only some get the contract.

Features of the incomplete contract equilibrium (2/2)

- *Short-side power*: buyer uses its short-side power, threatening to end the relation, in order to induce the agent to put effort in providing a higher quality good.
- *Durable transactions*: unlike the complete-contracts case (where buyer can change seller randomly every period), here the principal/buyer wants to establish a durable relation with a single agent/seller.
  - Without a durable transaction, the Principal wouldn't be able to use the threat of terminating the relation in order to elicit quality.

5 – Power in economic relations

- Definition of power:

B has power over A if, by imposing or threatening sanctions, B can affect A's actions in ways that further B's interest, while A lacks this capacity with respect to B.

- With incomplete contracts, *power* plays a big role in economic transactions, also if formally all participants have the same rights.
- The principal/buyer offers a rent and a durable relation in order to acquire *short-side power* over the seller/agent….
- ….then uses this power (threatening termination) to increase its profits by inducing the agent to provide higher quality.