CERTIFICATION AND EXCHANGE IN VERTICALLY CONCENTRATED MARKETS

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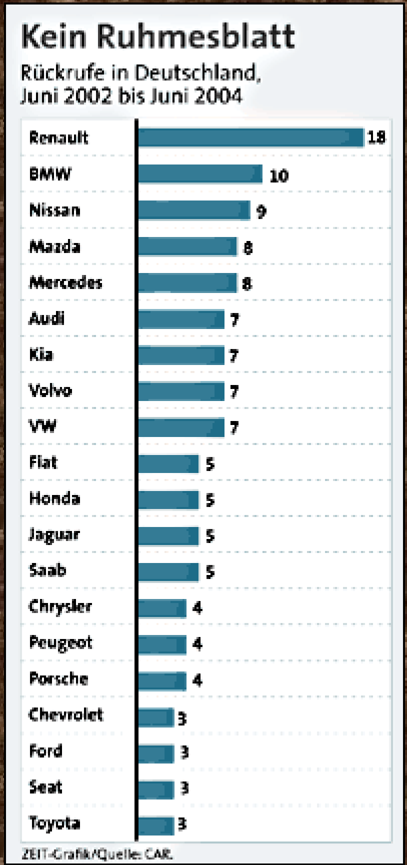
Motivation

- 2005: Biggest loss of Mercedes Car Group
  - Quality problems braking systems
    - Repair-costs: 500 Million Euro (680.000 cars)
  - Quality problems battery control unit software
    - 1.3 million cars
  - Reputation cost: laughing stock in Germany
- Parts delivered by BOSCH
  - quality management of supplied goods

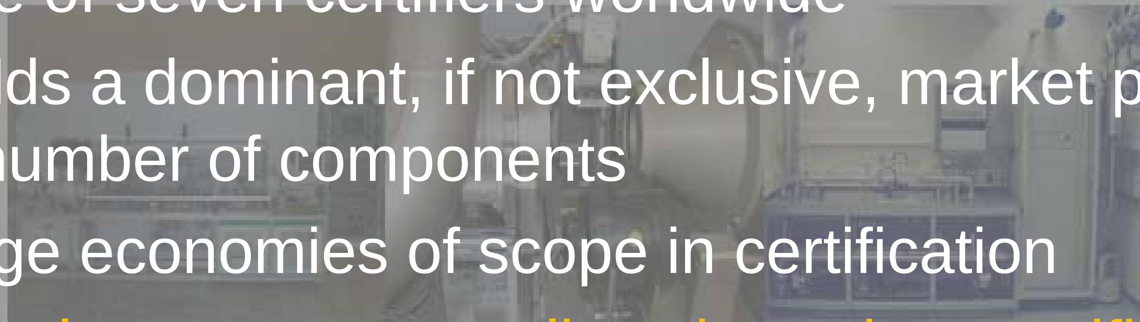
Motivation



- Recalls in automobile industry due to increased outsourcing
- Informational asymmetries between upstream and downstream producer
- Role for external certification

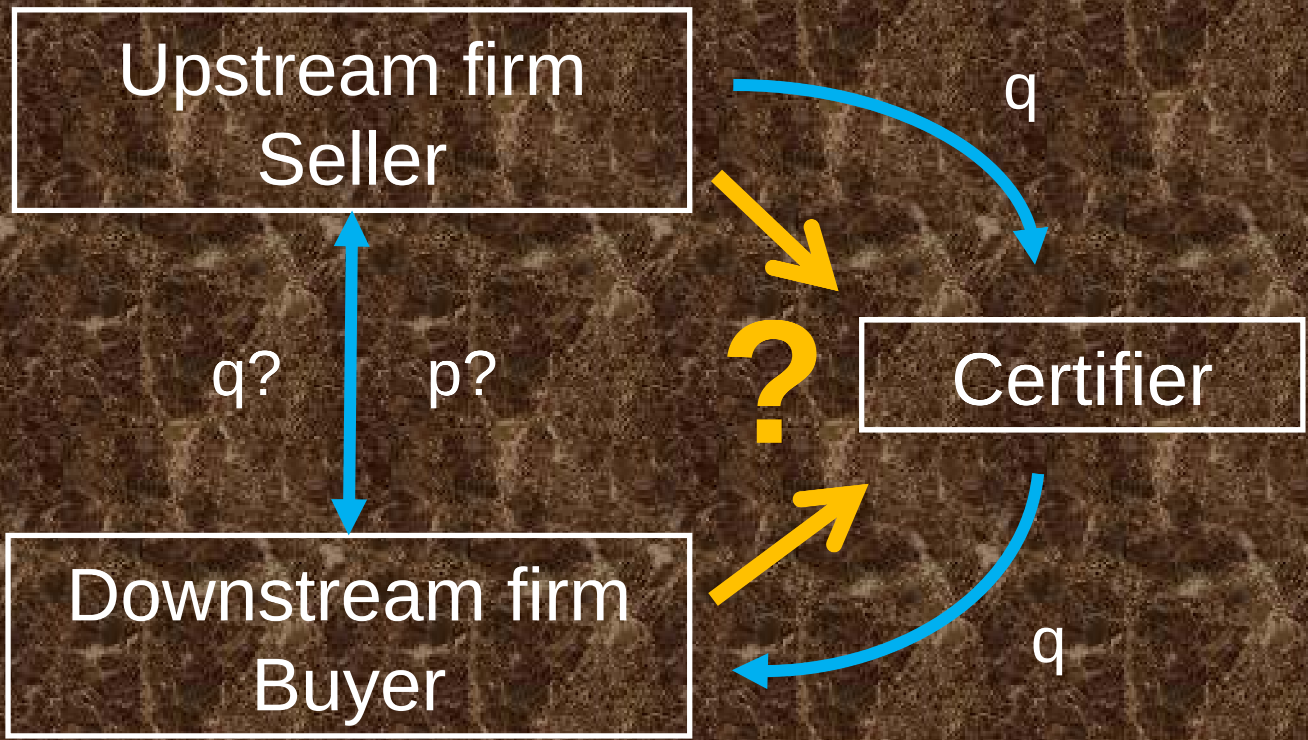
Motivation

- EDAG: independent certifier of car modules and systems
- Interview:
  - one of seven certifiers worldwide
  - holds a dominant, if not exclusive, market position in a number of components
  - large economies of scope in certification
  - mostly upstream supplier who orders certification



Motivation

Role of certification in a bilateral monopoly?



Model

- Seller: $Pr\{q_h\}=\lambda$; $Pr\{q_l\}=1-\lambda$ with $q_h>q_l$
- Production cost quality q_i is c_i, where $c_h>c_l=0$
- Lemons problem: $c_h>q^e=\lambda q_h+(1-\lambda)q_l$
- With asymmetric information q_h-seller does not sell his good
- Certification: An external certifier can reveal the sellers quality credibly at a cost c_c
  - q_h-seller has a demand for certification
  - buyer has a demand for certification

The Game

<u>Buyer certification</u>

1. Certifier sets p_c
2. Nature picks q_i
3. Seller sets price p
4. Buyer decides to buy certification
5. Buyer decides about buying the good

<u>Seller certification</u>

1. Certifier sets p_c
2. Nature picks q_i
3. Seller sets price p
4. Seller decides to buy certification
5. Buyer decides about buying the good

<u>Questions:</u>

1. Which game does the certifier like better?
2. Which game delivers higher social welfare?
3. What are the driving differences behind the two models?

Results/Intuition

Buyer certification

- Certification is an inspection device
- Inspection game
- Mixed equilibrium
- Both goods are certified with positive prob.
- q_l good sometimes not sold in EQ
- Inefficient

Seller certification

- Certification is a signaling device
- Signaling game
- Pure equilibrium
- Only q_h goods are certified
- All goods are sold in EQ
- Efficient

Buyer certification

- Optimal pricing behavior certifier?
- Inspection device: Buyer certifies to prevent cheating
- Demand for certification high when
  - Buyer's uncertainty about quality is large: $\mu=1/2$
  - Intermediate price of the good: $p=(q_h+q_l)/2$
- Certifier tries to induce this outcome

Buyer certification

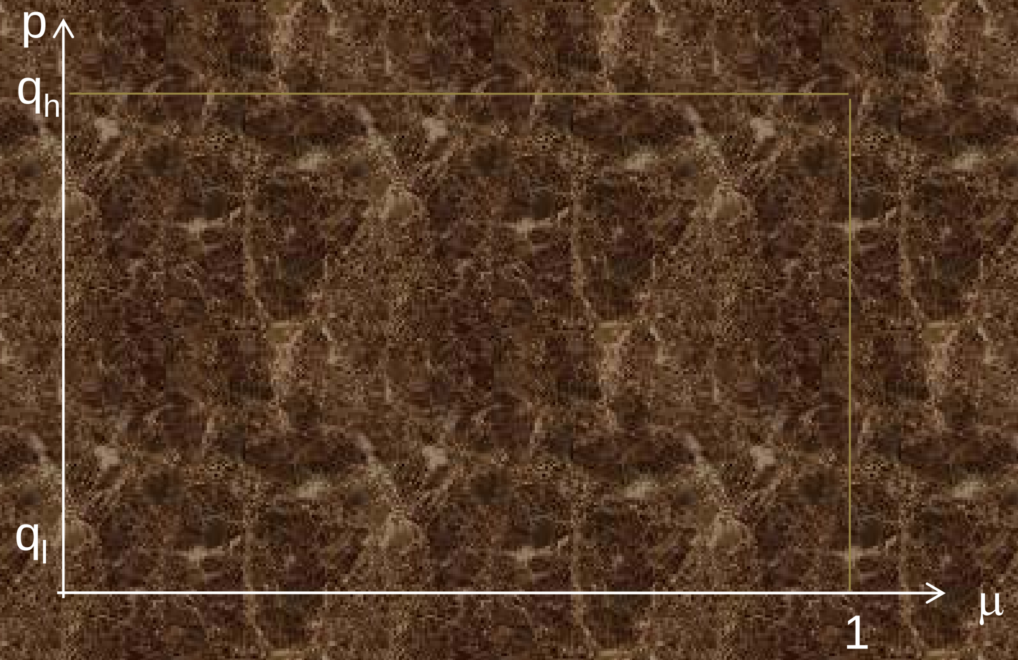
- Buyer's strategy: certifying and buying
  1. s_{nb}: no certification, always buying
  2. s_{nn}: no certification, no buying
  3. s_{ch}: certify, buy only h quality
  4. ~~s_{cb}: certify, always buy~~
  5. ~~s_{cl}: certify, buy only l quality~~
- Decision conditional on p_c, p, and belief μ

Buyer's behavior

$U(s_{nb})=\mu q_h+(1-\mu)q_l-p$

$U(s_{nn})=0$

$U(s_{ch})=\mu(q_h-p)-p_c$



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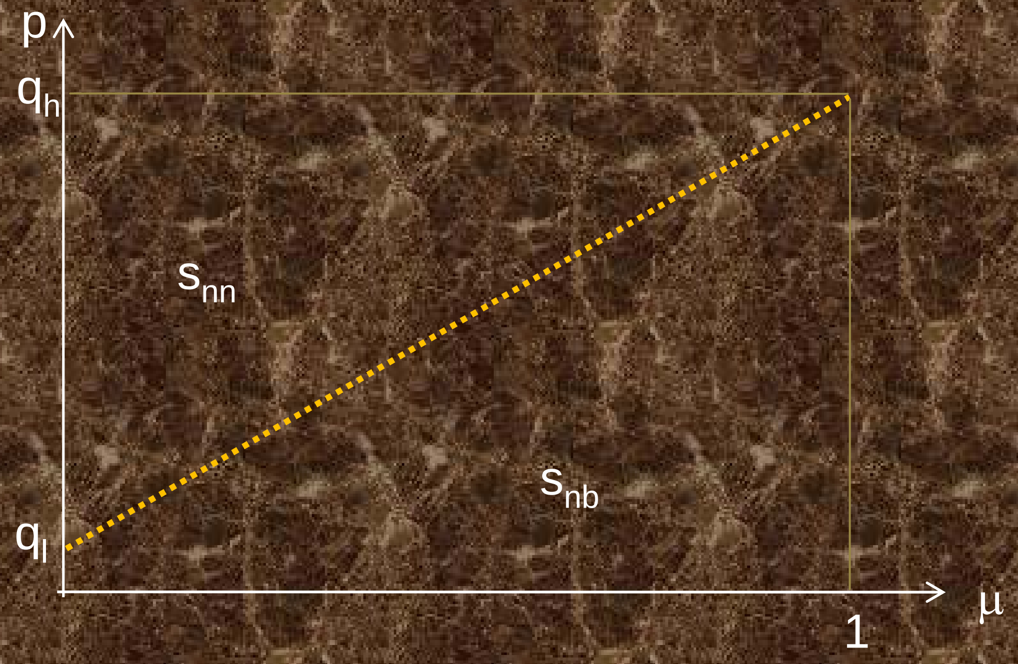

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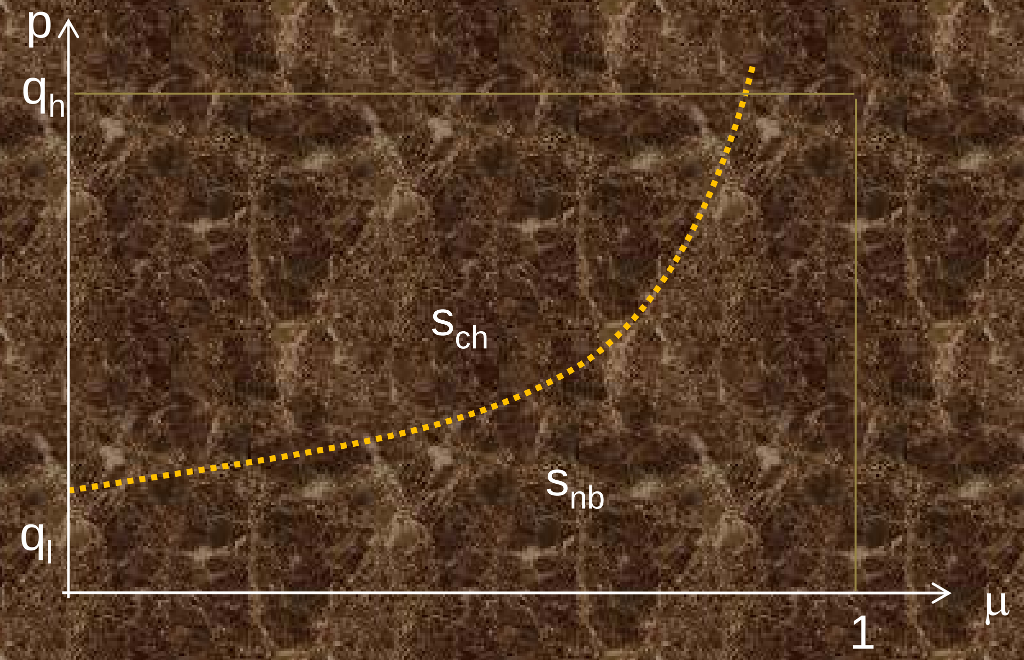

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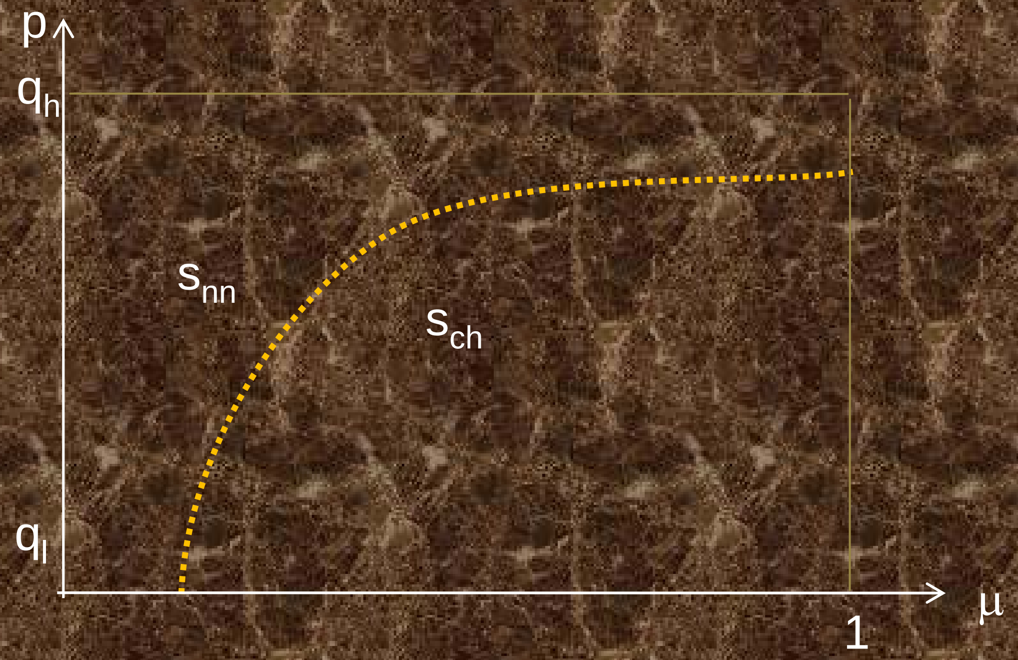

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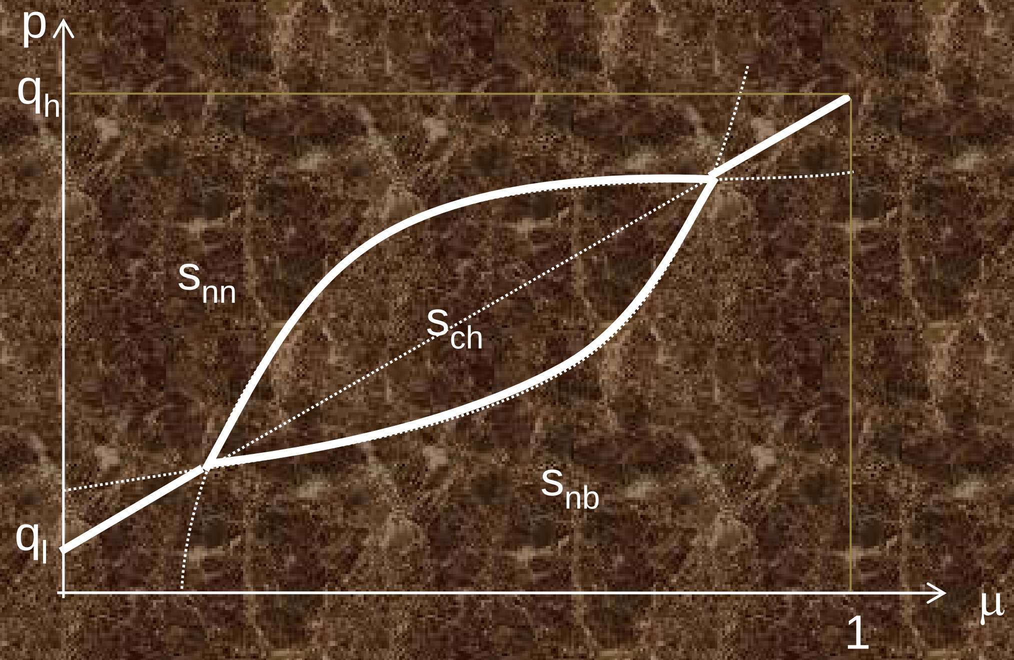

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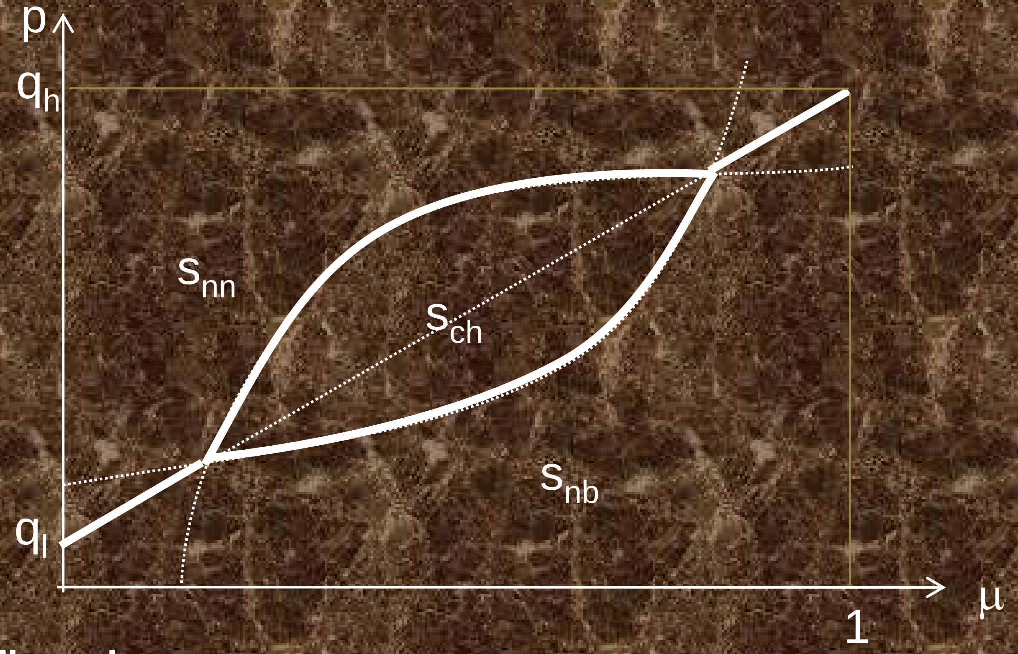

<u>Willingness to pay for certification</u>

$\Delta U_1=U(s_{ch})-U(s_{nb})=\mu(q_h-p)-(q^e-p)$

$\Delta U_2=U(s_{ch})-U(s_{nn})=\mu(q_h-p)$

Buyer's willingness to pay: $\min\{\Delta U_1,\Delta U_2\}$

$\max_{(p,\mu)} \min\{\Delta U_1,\Delta U_2\}$ $\quad p=(q_h+q_l)/2;\ \mu=1/2$

Buyer's behavior

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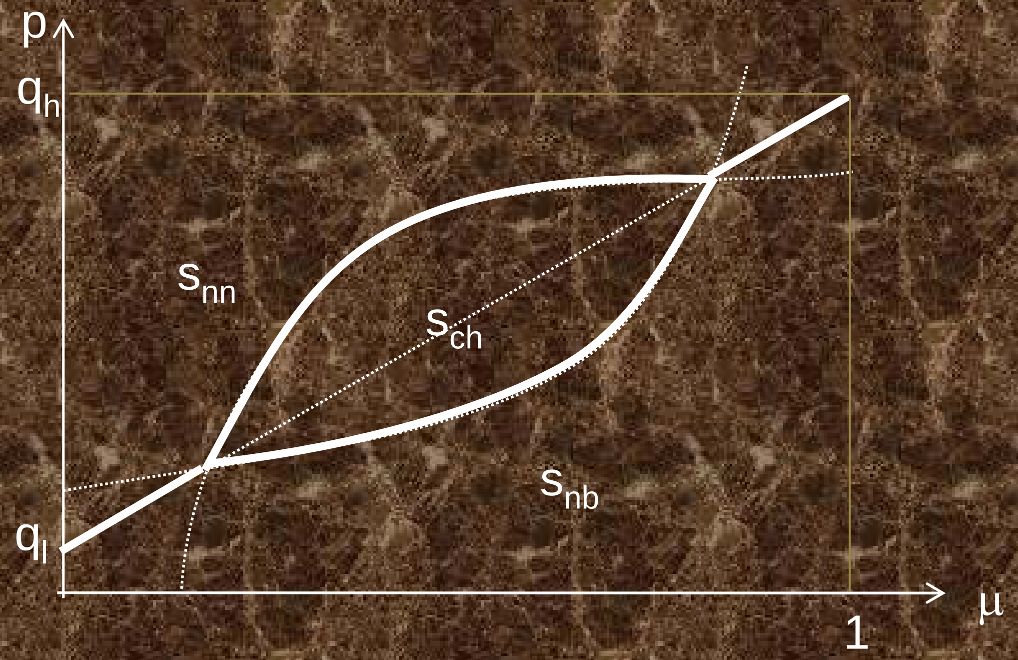
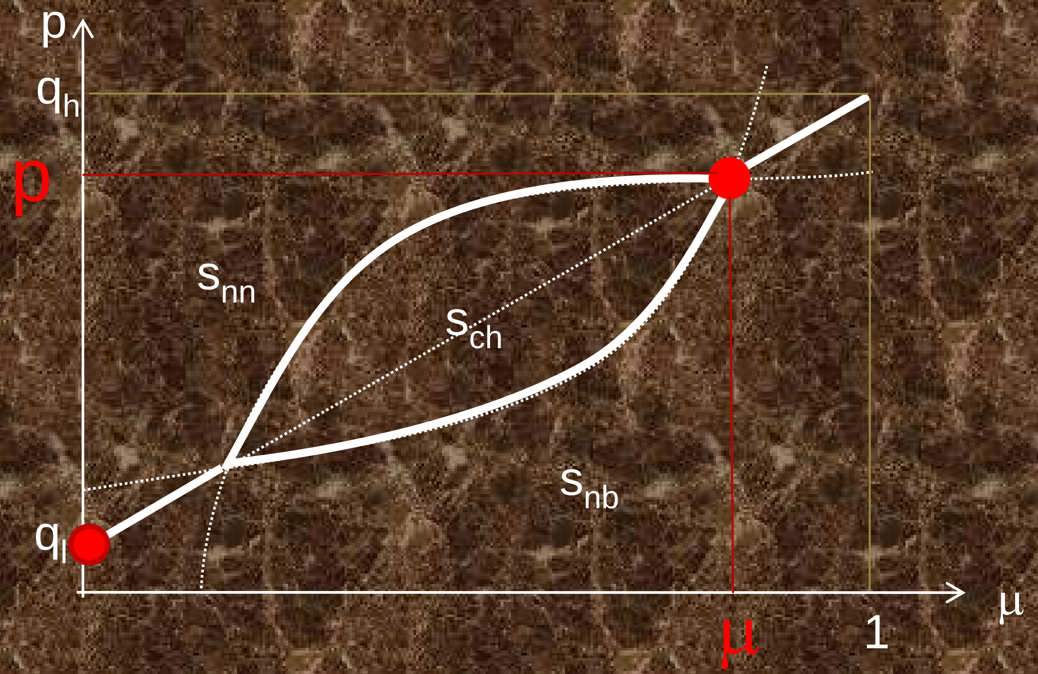


Buyer certification equilibrium

$U(s_{nb}) = \mu q_h + (1-\mu) q_l - p$

$U(s_{nn}) = 0$

$U(s_{ch}) = \mu(q_h - p) - p_c$



Result: Given $\mu > \lambda$ and an equilibrium refinement $(q_l, 0)$ together with (p, μ) is the unique equilibrium outcome:

- q_h-seller always sets price p
- q_l-seller randomizes between price q_l and p
- upon seeing price p, buyer certifies at random

Details

Lemma: In any PBE $(\sigma_l^*, \sigma_h^*, \mu^*, \sigma^*)$ of the subgame $\Gamma(p_c)$ we have
i) $\sigma_l^*(p) = 0$ for all $p \notin [q_l, q_h]$
ii) $\sigma_h^*(p) = 0$ for all $p < q_l$;
iii) $\Pi_l^* \geq q_l$;
iv) $\Pi_h^* < q_h - c_h$.

Refinement: A Perfect Bayesian Equilibrium $(\sigma_h^*, \sigma_l^*, \mu^*, \sigma^*)$ satisfies the Belief Restriction if, for any $\mu \in (0,1]$ and any out–of–equilibrium price p, we have

$$\Pi_l(p,\mu) < \Pi_l^* \wedge \Pi_h(p,\mu) > \Pi_h^* \;\Rightarrow\; \mu^*(p) \geq \mu.$$

- Bester&Ritzberger(2001); extends Cho-Kreps: μ=1

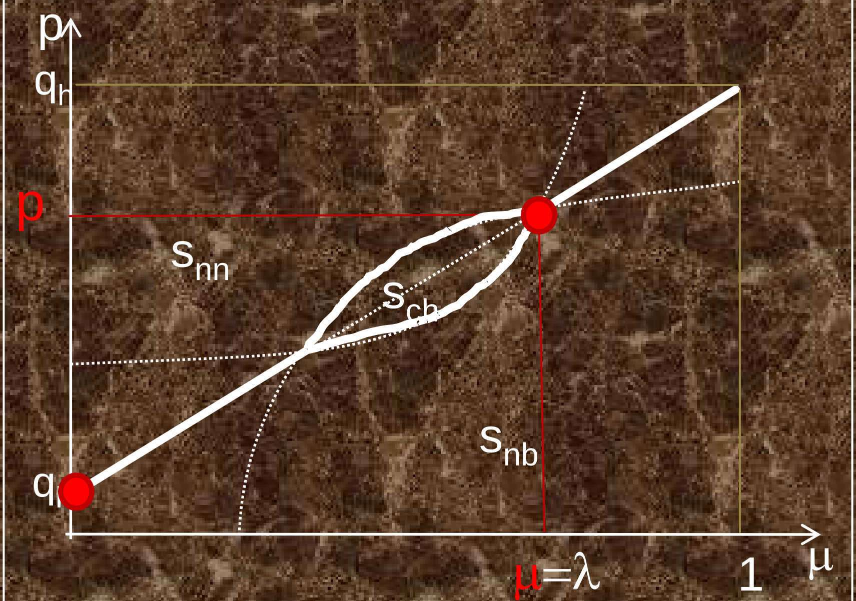
Lemma: Any Perfect Bayesian Equilibrium $(\sigma_l^*, \sigma_h^*, \mu^*, \sigma^*)$ of the subgame $\Gamma(p_c)$ that satisfies B.R. exhibits

i) $\sigma_h^*(p) = 0$ for all $p < \tilde{p}$;

ii) $\Pi_h^* \geq \tilde{p} - c_h$.

Optimal p_c buyer certification

- $\lambda > 1/2$

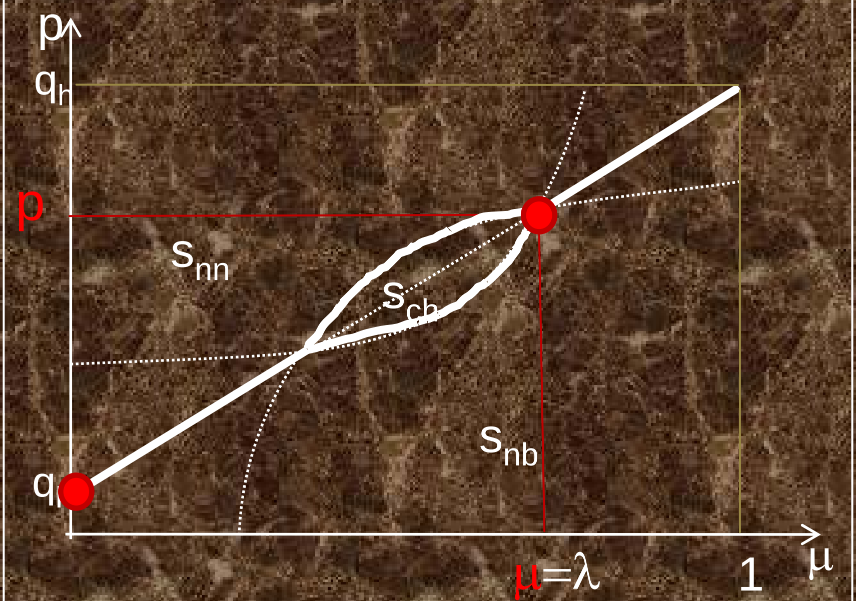


- $p_c = (q_h - q_l)(c_h - q_l)/\Delta q$
- randomization degenerated

- $\lambda < 1/2$

Optimal p_c buyer certification

- $\lambda > 1/2$



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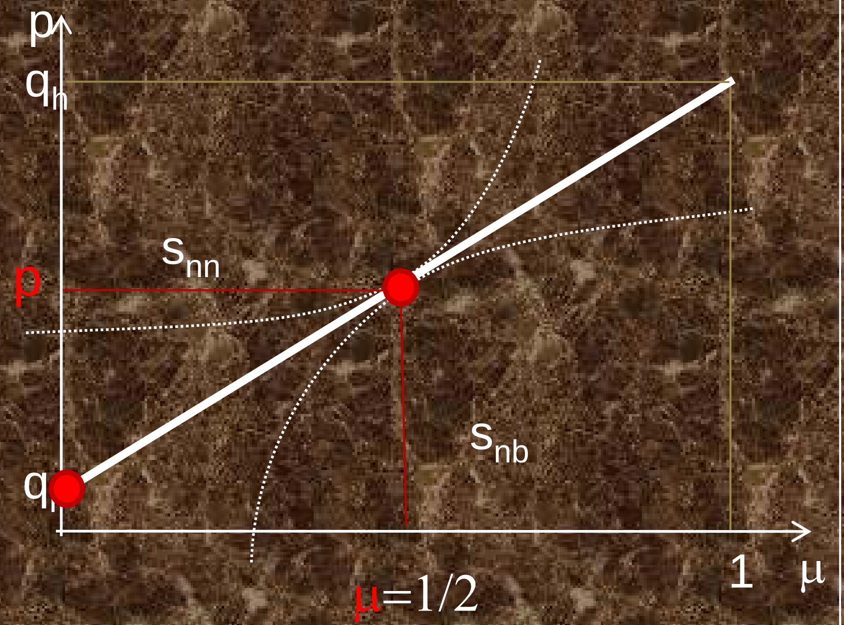

- $p_c=\Delta q/4$
- actual randomization

Seller certification

- q_h-seller certifies to prove q_h and price $p=q_h$.
- $\Pi_h(p_c)=q_h-c_h-p_c$
- $\Pi_l(p_c)=q_l$
- Optimal $p_c=q_h-c_h$
- In Eq: $\Pi_h=0; \Pi_l=q_l$
- $\Pi_c=\lambda(q_h-c_h-c_c)$

Comparison

- Certifier's profit larger with seller certification.
- Welfare?
  - no certification
    - q_h good not sold / no certification costs
  - buyer certification
    - q_l good not always sold / probabilistic certification
  - seller certification
    - All goods always sold / probabilistic certification

buyer certification maximizes welfare

Conclusions

- Certification by informed party better for
  - certifier
  - welfare
  - no need for governmental intervention
- Certification by informed party:
  - signaling high quality
- Certification by uninformed party:
  - inspection game