Imperfect Durability and The Coase Conjecture

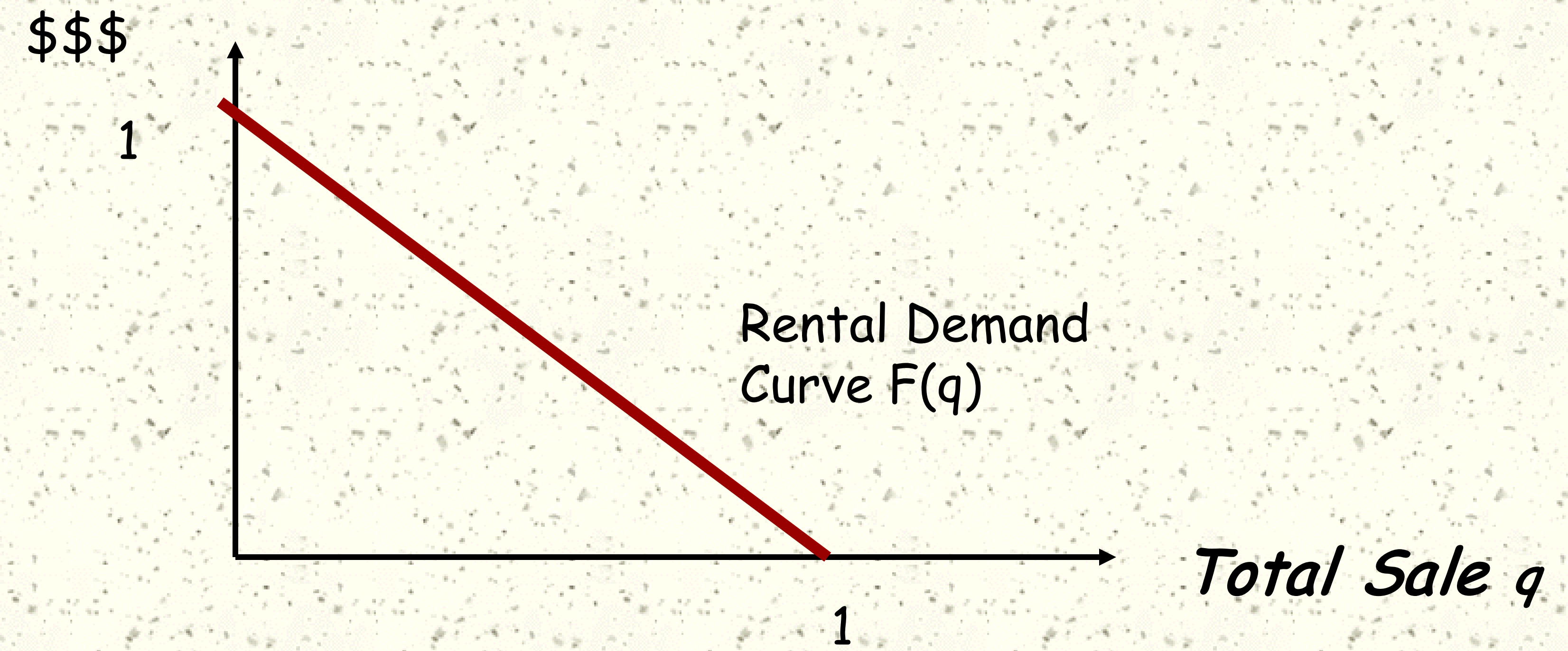
Speaker: Meng-Yu Liang
(Assistant Research Fellow in Academia Sinica)

Co-author : Raymond Deneckere
(Madison,UW)

A Durable-good Monopoly Rental market

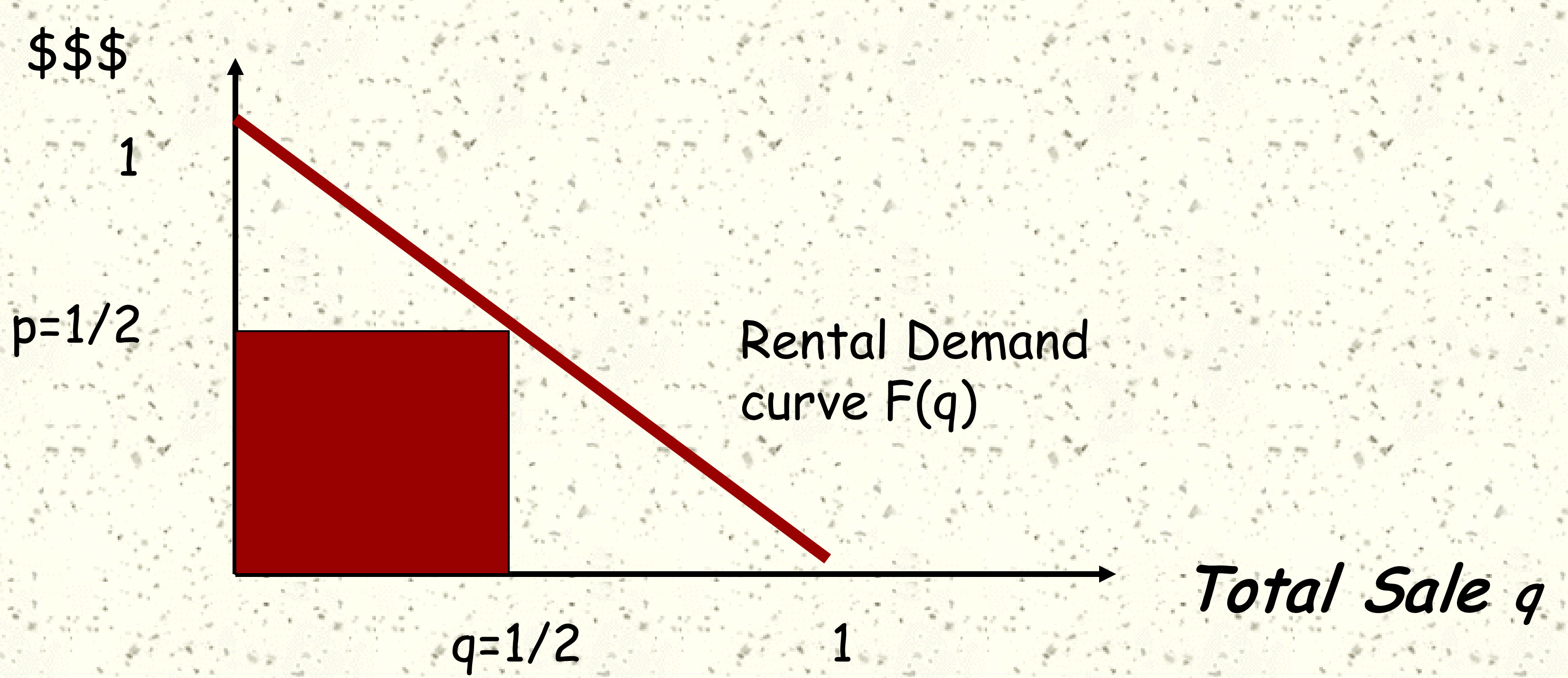
Define the flow benefit of services consumer *q* derives from one unit of the durable good as F(q)

Marginal Cost = 0



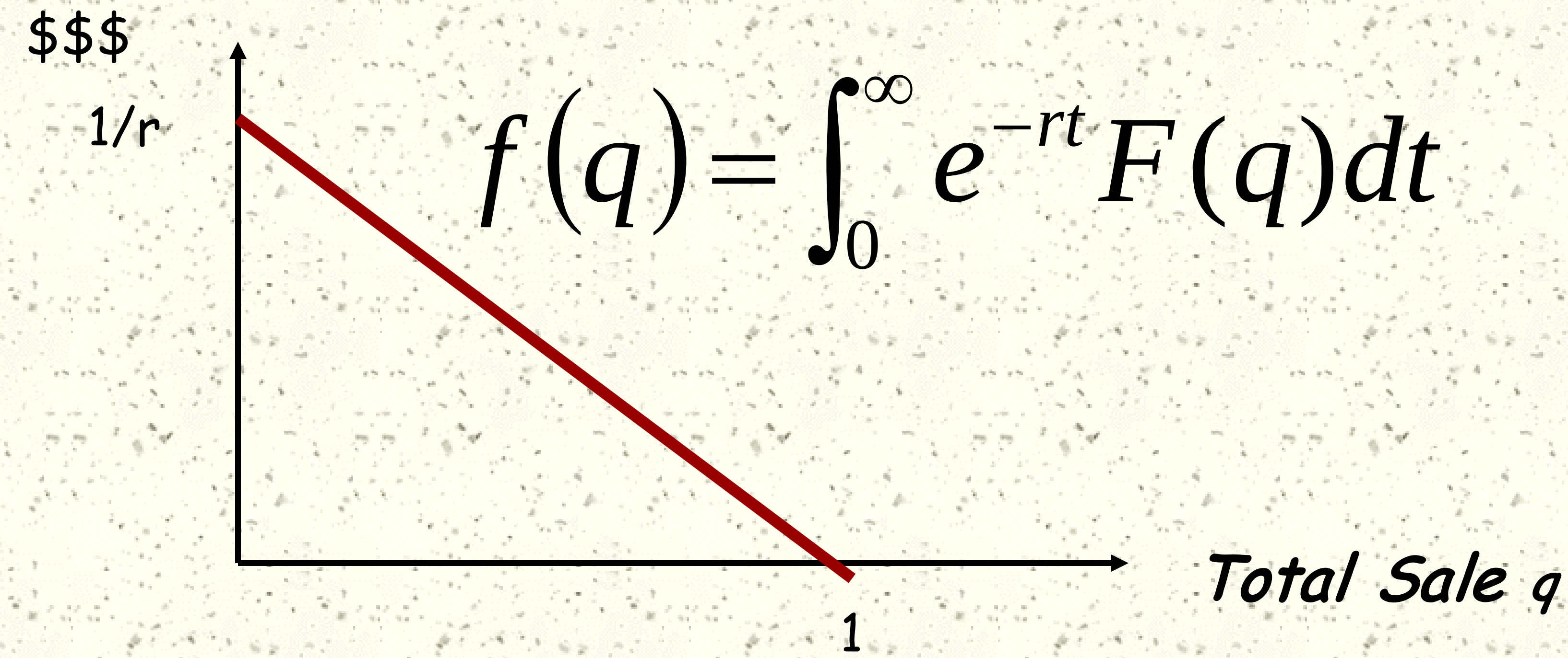
A Durable-good Monopoly Rental market

Optimal Rental price is 1/2



A Durable-good Monopoly sale market

Let $f(q)$ be consumer q 's willingness to pay for the privilege of a one-time opportunity of acquiring one unit of the durable good. Let r be the interest rate.



$$f(q) = \int_0^\infty e^{-rt} F(q)\,dt$$

Coase Conjecture on a durable-good monopoly sale market

When z, the time interval between successive trades, *goes to* 0,

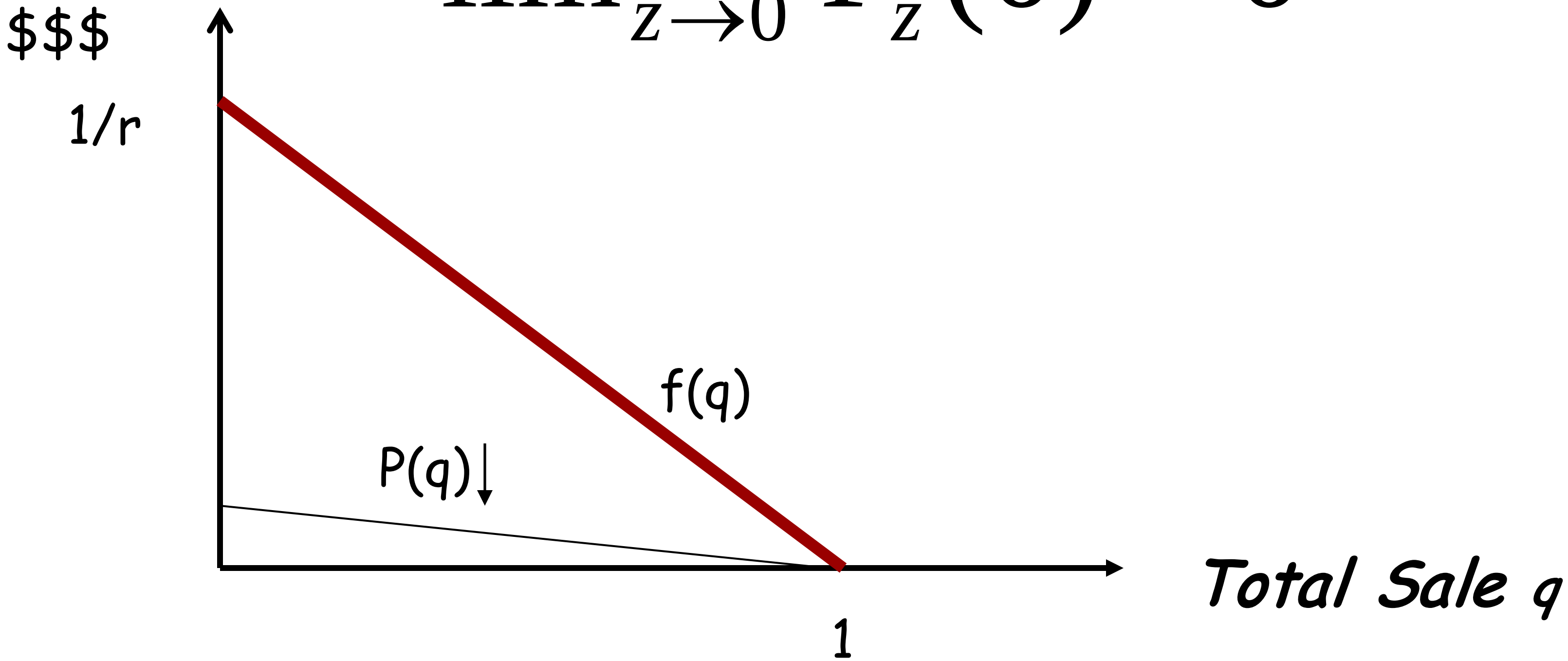
Zero Profit	The seller's profit tends to zero
Efficiency	All potential gains from trade are realized almost instantaneously.

The Coase Conjecture holds if

a) The monopolist's pricing strategy cannot depend on a single consumer's strategy. (Measure zero deviation won't affect the whole course of the game.)

b) Consumer's strategies depend on the current price offer only .

$$\lim_{z\to 0} P_z(0) = 0$$

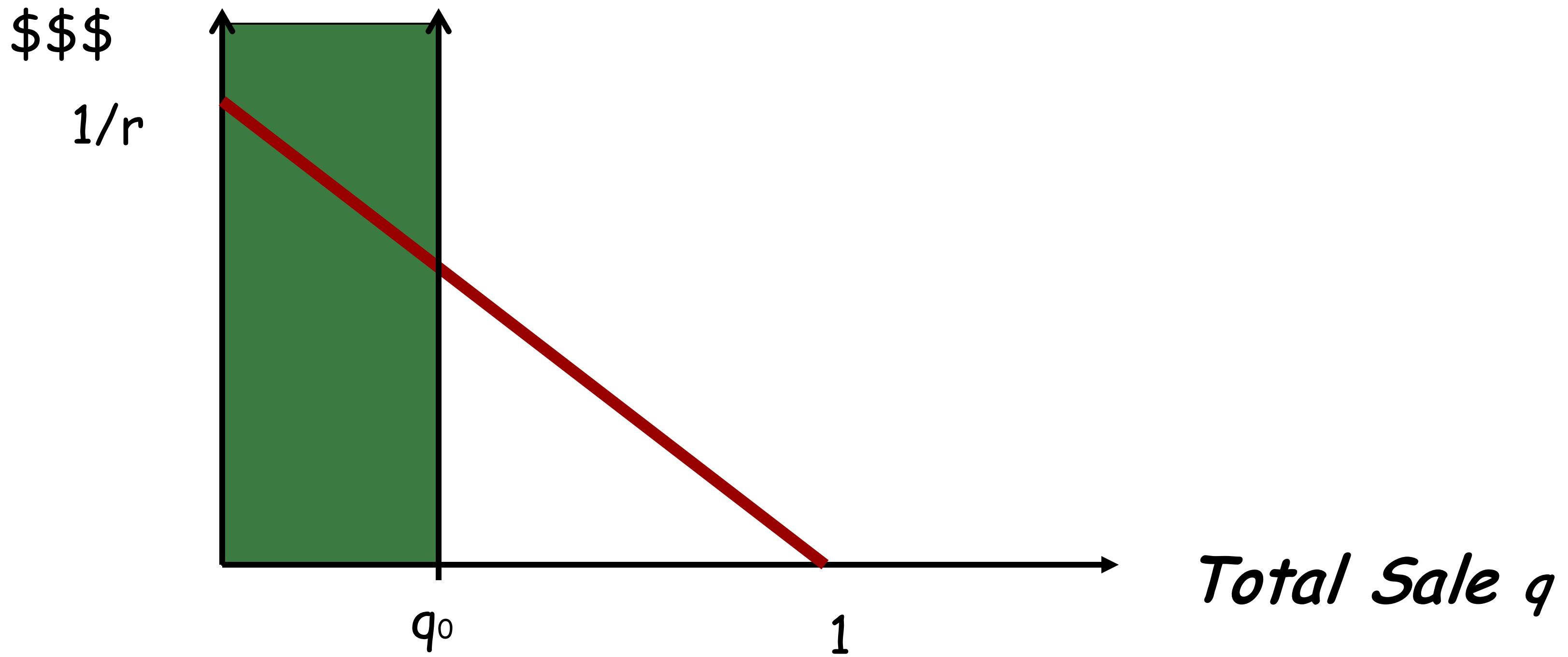


For linear demand curve, after consumers in $[0,q_0]$ have purchased the durable goods, the residual demand is just a rescaled of the original one.

→Infinite periods of sales

→Folk's theorem argument can apply

→Coase Conjecture need not hold

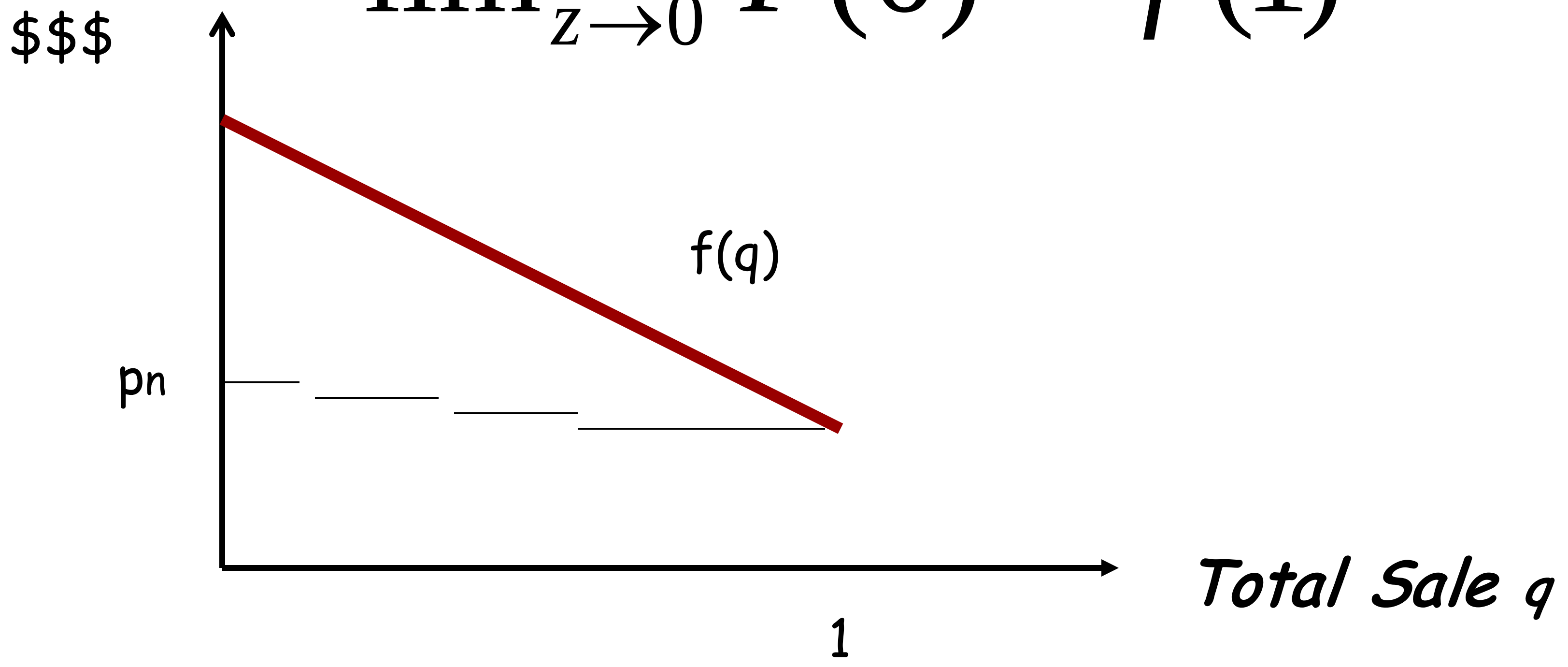


When there is a gap, i.e., f(q)>0, the Coase Conjecture holds if

a) The monopolist's pricing strategy cannot depend on a single consumer's strategy. (Measure zero deviation won't affect the whole course of the game.)

b) ~~Consumer's strategies depend on the current price offer only .~~

$$\lim_{z \to 0} P(0) = f(1)$$



Literature Review

- Coase Conjecture
  - Bond and Samuelson (1984) have demonstrated that Coase's logic extends to products of limited durability, by constructing a stationary equilibrium that satisfies the Coase Conjecture, even when the durability is arbitrarily low.
  - Bond and Samuelson (1987) revisit the linear demand example, extending Ausubel and Deneckere's (1989) construction of reputational equilibria to markets for products with limited durability.
  - Karp(1996) considers a continuous time model, and shows that for any positive depreciation rate there exists a continuum of stationary equilibria, only one of which satisfies the Coase Conjecture.

- Durability choice
  - Early papers on this topic by authors such as Levhari and Schmalensee argued that durability choice is similar to output choice and thus that a durable goods monopolist will choose inefficiently low levels of durability.
  - But in a set of classic papers in the 1970s Peter Swan showed that durability choice is not similar to output choice and showed that, across a variety of settings, a durable goods monopolist has an incentive to choose socially optimal durability and avoid interfering in secondhand markets.

- Swan’s argument :
  - A monopolist’s durability choice problem is distinctly different than an output choice problem because of the monopolist’s incentive to minimize the cost of the flow of “service units” provided, the monopolist chooses the socially optimal durability level for its output.
  - Extending the argument to the operation of secondhand markets yields that the monopolist also prefers the efficient operation of secondhand markets.

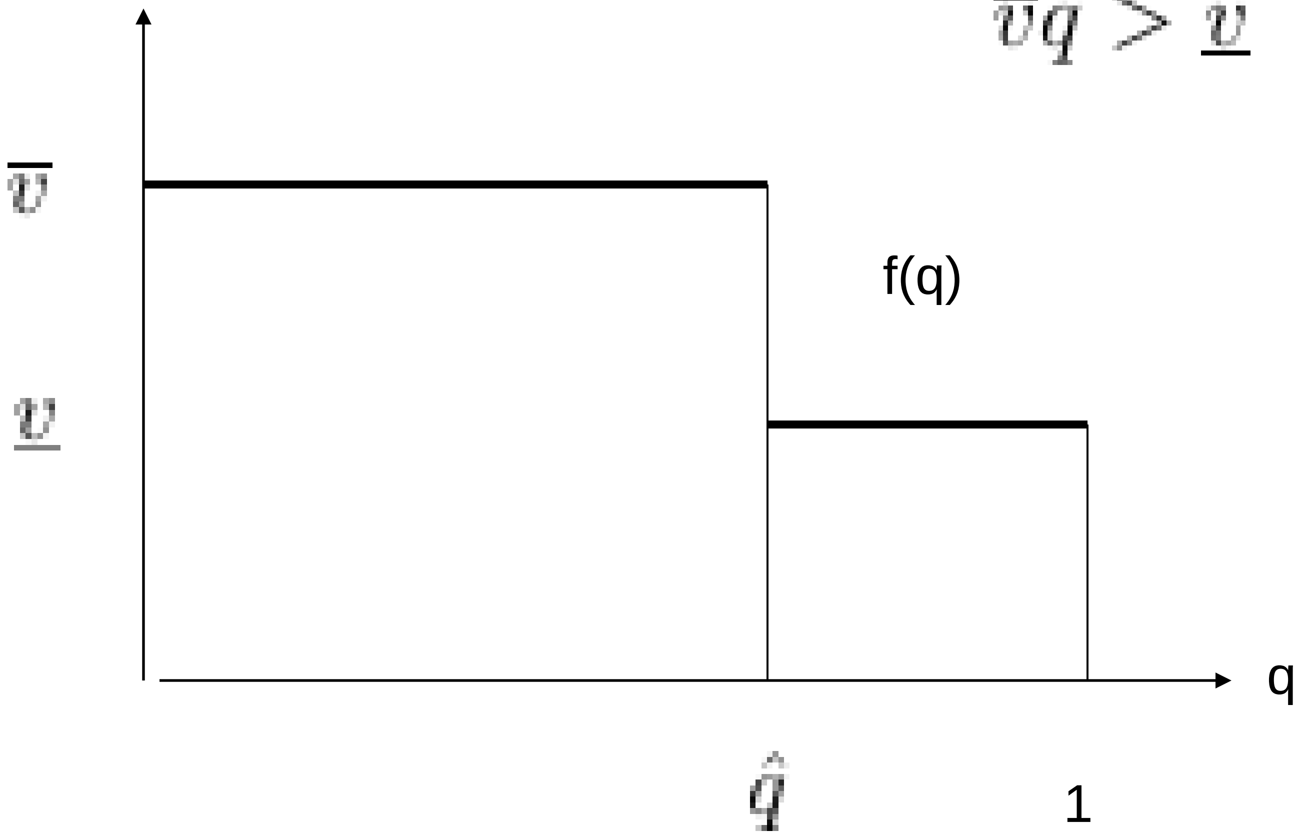
- Bulow (JPE 1982, QJE 1986) develops and analyzes a durable goods monopoly model which shows how time inconsistency works in a two-period setting. The argument is that time inconsistency is a result of the durability of the product, so reduced durability serves to reduce the negative effects of time inconsistency.

Model:

- a market for an imperfectly durable good which depreciates stochastically along a continuous time path, but is offered for sale at discrete points in time, spaced a length of time z>0 apart.
- The durable good (zero cost) is indivisible and provides either full services or no service at all.
- The probability that the good is still working after a length of time length t equals $e^{-\lambda t}$.
- The fraction that depreciates within one period μ=1 - $e^{-\lambda z}$
- Common discount rate δ = e^{-rz}
- *Consumers and monopolist are infinitely-lived*

Since there is always a replacement sale, the Folk's theorem arguments can be applied here. (Bond and Samuelson 87) Hence, we only consider the stationary equilibrium of this game to see whether the Coase Conjecture holds (i.e. $P_z(0)=0$ as z goes to 0) for all the stationary equilibria of this game.

$$\overline{v}\hat{q} > \underline{v}$$



Stationary equilibrium : a subgame perfect equilibrium in which consumer's accept/reject decision depend only on the current price.

Let $P(\cdot)$ be consumers' acceptance function. If p' is the expected price for next period, then

$$\begin{aligned} P(q) &= \int_0^z F(q)e^{-(\lambda+r)s}\mathrm{d}s + \delta(1-\mu)p' \\ &= (1-\delta(1-\mu))f(q) + \delta(1-\mu)p' \end{aligned}$$

All trades (for both new and used goods) happen at the beginning of every period.

State variable q : the measure of the consumers who hold durable goods before trade.

Stationary triplet

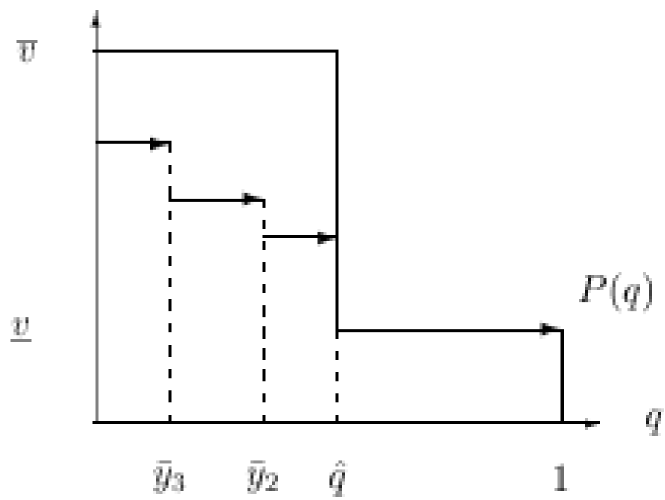
$$R(q) = \max_{q' \in [(1-\mu)q, 1-\mu]} \{P(\frac{q'}{1-\mu})(\frac{q'}{1-\mu} - q) + \delta\, R(q')\}$$

$$t(q) = \min\{T(q)\}$$

$$P(q) = (1 - \delta(1-\mu))f(q) + \delta(1-\mu)\, P(\frac{t(q)}{1-\mu})$$

Theorem 3-1:

If $0 < \underline{v} \leq \hat{q}\overline{v}$ and $\mu \leq \bar{\mu}$, then there exists a stationary equilibrium satisfies the Coase Conjecture.

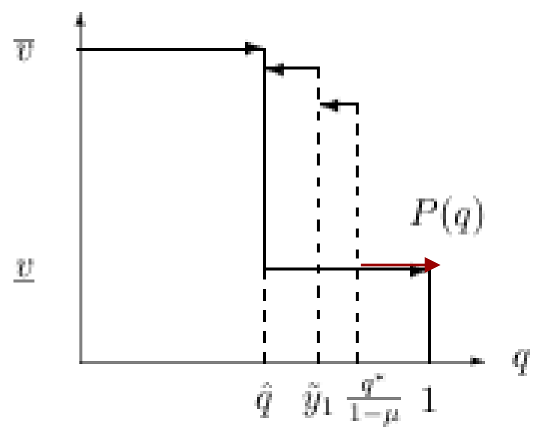


One steady state $(\underline{v}, 1)$

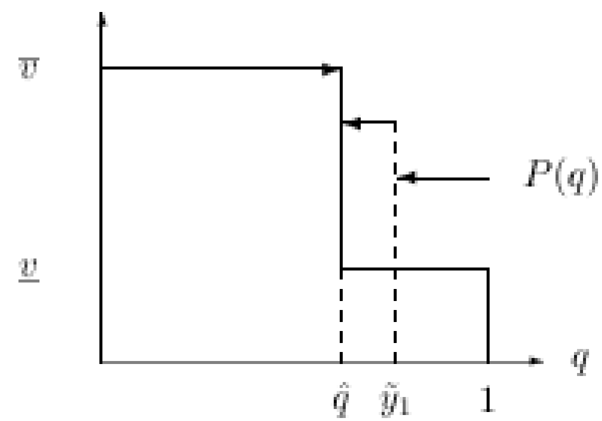
Theorem 3-2:

When $0 < \underline{v} \le \hat{q}\overline{v}$ and $\mu \ge \underline{\mu}$, there exist a stationary equilibrium

in which the monopolist can earn the static monopoly profits.



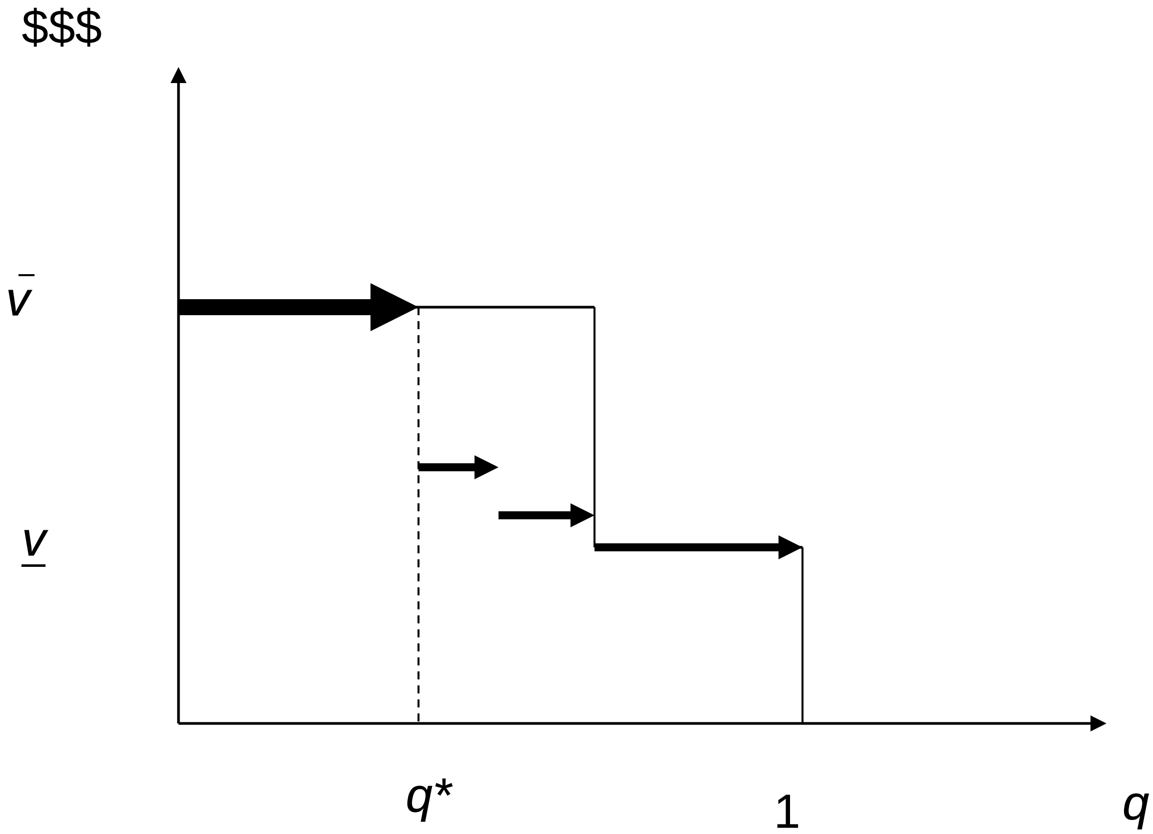
Two steady states $(\overline{v}, \hat{q})$ and $(\underline{v}, 1)$



One steady state $(\overline{v}, \hat{q})$

Theorem 3-3: (Reputational equilibrium)

There is at most one reputational equilibrium. This equilibrium exists if and only if $\underline{\mu}<\mu<\bar{\mu}$



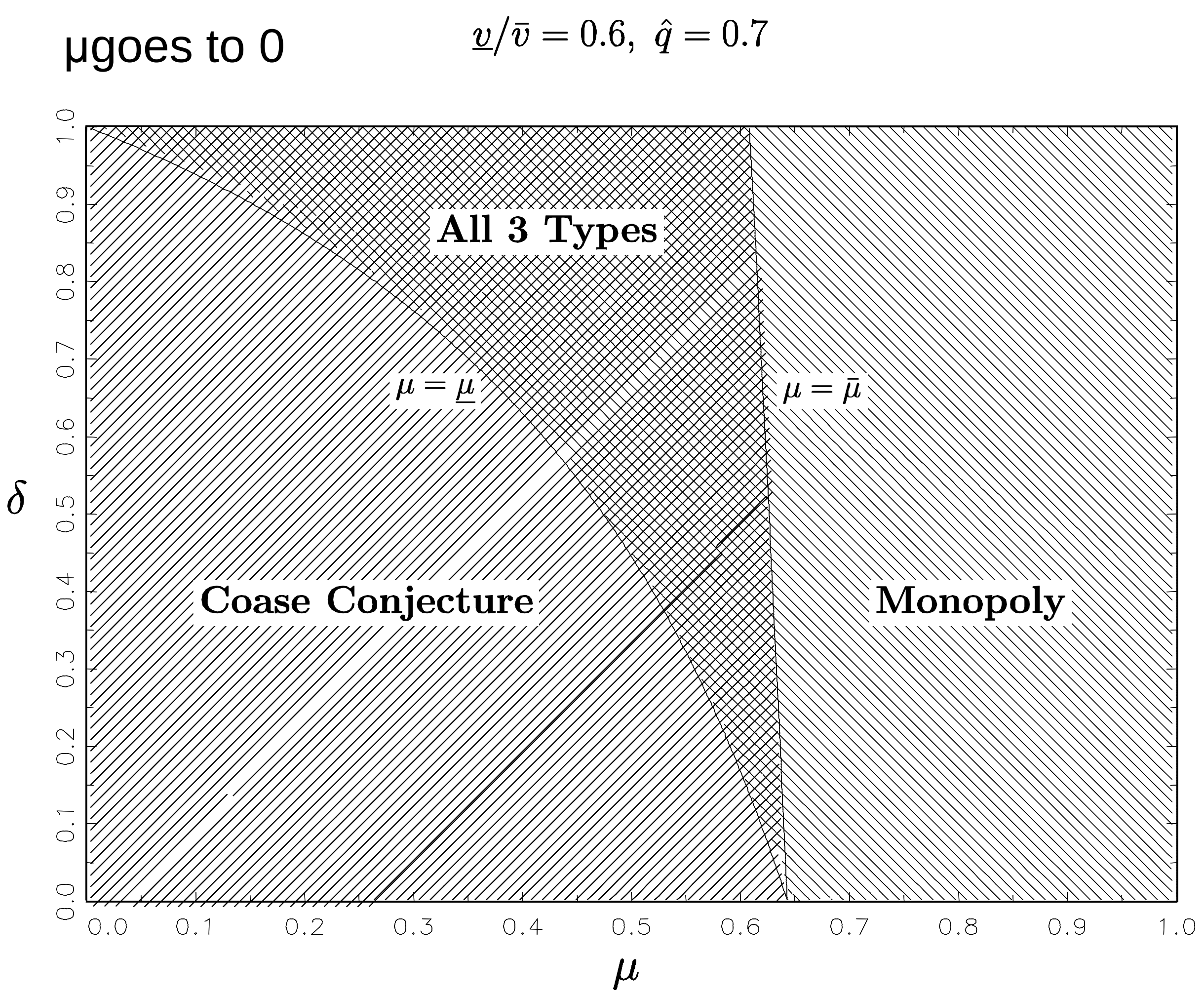
Two steady states $(\bar{v}, q^*)$ and $(\underline{v}, 1)$

- the steady state output in the reputational equilibrium falls below the monopoly quantity. Hence in durable goods markets welfare losses due to monopoly power may be larger than in markets for perishables.

When z goes to 0, for any (r,λ) there always exists a Coase-type equilibrium, but the monopoly type equilibrium only exist when λ/r is sufficiently big.

μgoes to 0

δ goes to 1

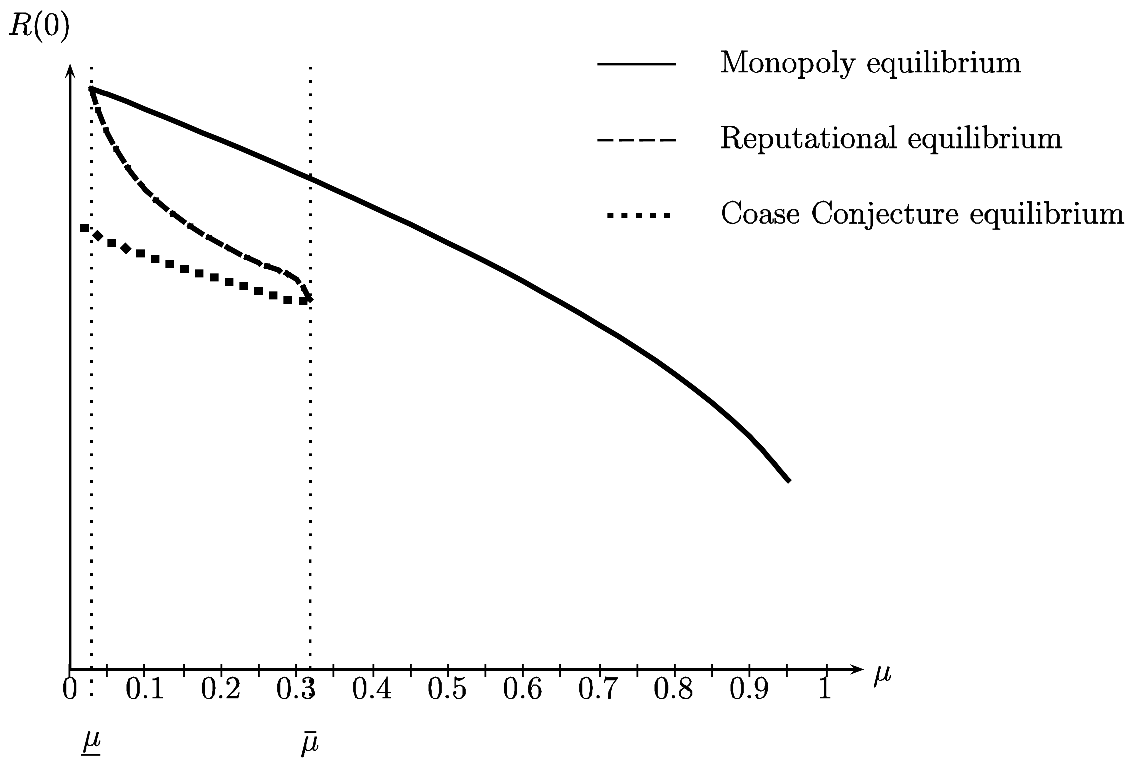


- This paper provides a novel method to completely characterize the set of all the stationary equilibria of this game using discrete time approach.

Unlike in a world of perfect durability, it matters whether this is accomplished by letting the period length vanish, or whether this is accomplished by letting players become infinitely patient. In the first case, replacement demand becomes very small in any given period, whereas in the second case replacement demand can be substantial in a period.

For example, when $\underline{v}/v$=0.6, q=0.8, and δ =.95 then $\underline{\mu}(\delta)$=2.9 and $\mu(\delta)$=31.8. Thus when the real interest rate is 5% per year the monopoly equilibrium will exist if the turnover is less than 34 years, and will be the unique equilibrium if the turnover is less than 3 years.

Equilibrium profits as a function of μ



- Either the inherent durability of the product is low enough that the manufacturer can fully exercise his market power, or else the manufacturer can restore his margins and profitability through planned obsolescence (or any of the other techniques described in the paper).

- Theorem 4 : *Let f be any demand function taking on a finite number of values. Then for any* $0 \leq \mu < 1$ *and* $0 \leq \delta < 1$ *there exists at least one stationary equilibrium.*

- Theorem 5
  - *(i) For every* $\delta < 1$ *there exists* $\underline{\mu}(\delta) > 0$ *such that for* $\mu \in [0; \underline{\mu}(\delta))$ *the Coase Conjecture equilibrium is the unique stationary equilibrium.*
  - *(ii) For every* $\delta < 1$ *there exists* $\overline{\mu}(\delta) < 1$ *such that for all* $\mu \in (\overline{\mu}(\delta), 1]$ *every stationary equilibrium is of the monopoly type.*
  - *(iii) For every* $\delta < 1$ *there exists* $\underline{\mu}(\delta)$, $\overline{\mu}(\delta)$
  - *such that for all* $\mu \in (\underline{\mu}(\delta), \overline{\mu}(\delta))$ *there is a reputational equilibrium whose smallest steady state falls below the monopoly quantity q**
  - *(iv) If the monopoly quantity q* cannot be a steady state, then no* $q < q^*$ *can be a steady state.*