All Units Discounts and Double Moral Hazard

Daniel P. O'Brien

Bureau of Economics, U.S. Federal Trade Commission
Visiting Professor, Kelley School of Business
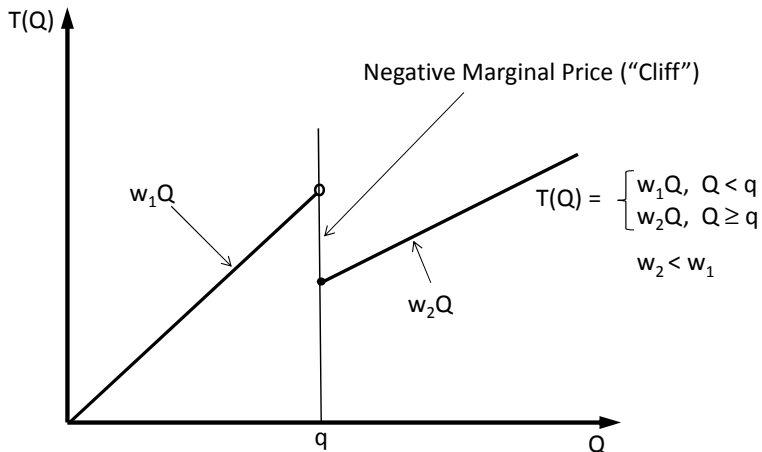
April 23 2013

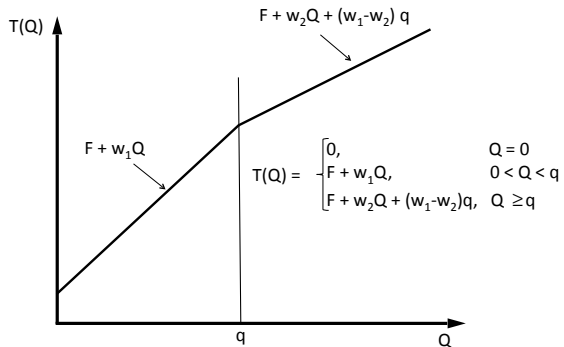# What is An All-units Discount?

- Discount on all units, conditional on reaching a threshold

What Is An All-Units Discount?

$T(Q)$

Negative Marginal Price ("Cliff")

w_1Q

$T(Q) = \begin{cases} w_1Q, & Q < q \\ w_2Q, & Q \geq q \end{cases}$

$w_2 < w_1$

w_2Q

q

Q

Comparison with Continuous Two-Block Tariff

$$T(Q) = \begin{cases} 0, & Q = 0 \\ F + w_1 Q, & 0 < Q < q \\ F + w_2 Q + (w_1 - w_2)q, & Q \geq q \end{cases}$$
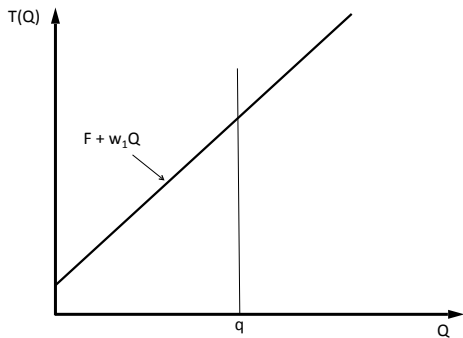
Why are All Units Discounts Interesting?

- Potentially exclusionary:

  "In general terms, retroactive rebates may foreclose the market significantly, as they may make it less attractive for customers to switch small amounts of demand to an alternative supplier, if this would lead to loss of the retroactive rebates." (EC's "...Guidance on the Commission's Enforcement Priorities...," 2009, para 40)

- Arise in antitrust cases (e.g., Intel, Church & Dwight, Michelin, British Airways, Tomra, others)

- Little rigorous economic literature

  - Practice not mentioned in either IO Handbook chapter on price discrimination (Varian, 1989; Stole, 2007)
  - Agency literature sometimes finds discontinuous payment schemes, but has not connected them to all-units discounts

A Motivating Question

- An upstream firm with market power sells through a downstream firm that also has market power.

  What issues do they face?

  Incentive problems:

    - Double marginalization
    - Downstream investment incentives
    - Upstream investment incentives

  Competition problems:

    - How to beat competitors that are in
    - How to knock competitors out and keep entrants out

- What contracts will firms use to address these issues?

A Motivating Intuition

- To begin answering, start at the beginning with the simplest problem–bilateral monopoly.
  - If all-units discounts have a motivation apart from controlling entry, we need to know this.

- Intuitively, it seems like all-units discounts might be useful to address the incentive problems.
  - The cliff provides strong retailer incentives to expand output;
  - Retail incentives are provided with positive wholesale margins, preserving upstream incentives to invest.

- *This paper*: Is this intuition correct? Do all-units discounts have useful incentive properties under double moral hazard?

Summary of Results

- I compare all-units discounts and continuous tariffs under double moral hazard in three cases:
    - Bilateral monopoly with certain investment returns
    - Bilateral monopoly with uncertain investment returns
    - Bilateral monopoly facing threat of small scale entry

- *Summary of Findings*:
    - Under certain returns, all-units discounts and declining block tariffs are optimal contracts, and both out-perform two-part tariffs.
    - Under uncertain returns, all-units discounts dominate continuous tariffs.
    - All-units discounts are a stronger entry deterrent than continuous tariffs, but foster more efficient demand-enhancing investment.

Two Literatures

Agency Literature:
- One-Sided Moral Hazard (Holmstrom, 1979)
- Moral Hazard in Teams and Partnerships (Holmstrom, 1982 et cet.)
- Screening (Mirlees 1971; Mussa & Rosen 1978)
- Myriad extensions

IO/Antitrust Economics Literature:
- Successive Monopoly (Spengler, 1950)
- Demand-Enhancing Investment (Telser, 1960; Marvel, 1982; Mathewson & Winter, 1984)
- Exclusion (Salop & Sheffman, 1983; Aghion & Bolton, 1987; Mathewson & Winter, 1987; Whinston, 1989; Hart & Tirole, 1990; RRW 1991)
- Myriad extensions

"Please Talk to Each Other"

Some Related Conversations
- Romano (1994)
- Kolay, Ordover & Shaffer (2004)
- Chao & Tan (2014)
- This Paper

The Model

Primitives – Certain Returns Case

$Q(P, x, I)$ is demand where

P is retail price; x is retail investment; I is upstream investment

$I \in \{0, I^*\}$, i.e., *lumpy* investment.

$$\text{Demand} = \begin{cases} D(P, x) & \text{with investment} \\ D^0(P, x) & \text{with no investment} \end{cases}$$

Two-stage Game

Stage 1: Firms agree to a fixed fee S (possibly negative; paid up front) and an additional tariff $T(Q)$.

Stage 2: Manufacturer chooses I and retailer chooses (P, x) to maximize their respective profits.

Look for sub-game perfect Nash equilibria.

- Because firms divide profits with S, their problem is to maximize joint profits subject to incentive constraints.

(GCP) $\max_{P,x,\ T(\cdot)\in\mathcal{T}} \Pi = PD - cD - V(D) - r(x) - m(I^*) \ s.t.$

$$(P,x) = \underset{(P',x')}{\operatorname{argmax}} P'D - V(D) - T(D) - r(x'), \qquad (1)$$

$$T(D) - cD - m(I^*) \geq T(D^0) - cD^0 \qquad (2)$$

- Optimal contract solves (GCP).

Two-Part Tariffs

Proposition 1

A two-part tariff is generally not an optimal contract.

Explanation

- A single dimensional incentive device (wholesale price) is generally insufficient to provide incentives for both the upstream and downstream firms.
- Special case of moral hazard in teams problem examined by Holmstrom (1982) and many others.

All-Units Discounts – Main Result

Proposition 4

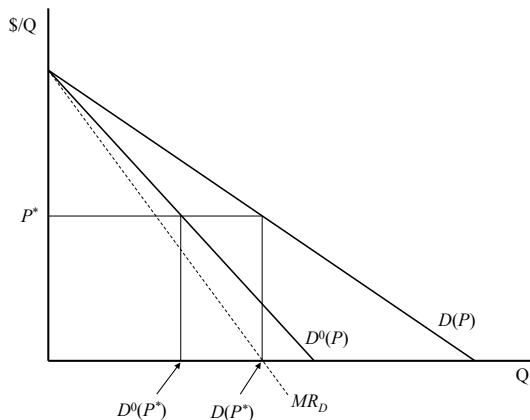An all-units discount with two price tiers is an optimal contract.

Explanation

Step 1: A two point forcing contract is an optimal contract.

Step 2: The optimal two-price all-units discount yields the same price and investment as the optimal two-point forcing contract.
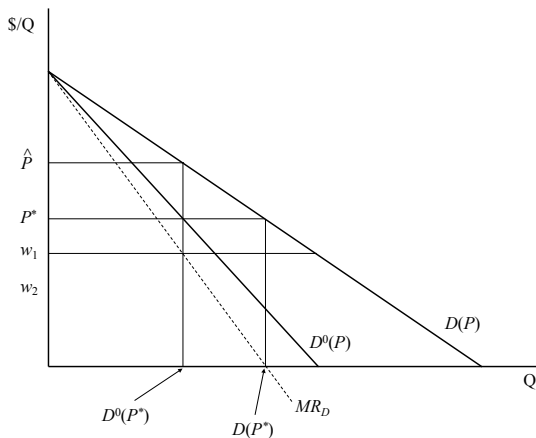
Step 3: Therefore, all-units discounts are optimal contracts.

Two-Point Forcing is Optimal

- In equilibrium, manufacturer chooses $D(P^*)$ or $D^0(P^*)$.
- No loss in restricting the retailer to the same two choices.
- $\implies$ Two-point forcing is an optimal contract.

All-Units Discount is Equivalent to Two Point Forcing

- All-units discount yields same two choices.
- w_1, w_2 set to generate same transfer.
- $\implies$ All-units discount is also an optimal contract.

Two-Block Tariffs

Proposition 5

A two-block tariff is an optimal contract.

Explanation

Step 1: Set the marginal price in low price block equal to the shadow price faced by retailers in the optimal all-units discount.

Step 2: Set the high price so the manufacturer and retailer are choosing between the same two quantities.

Step 3: Set the block threshold to compensate the manufacturer for investment.

- ► Wholesale prices that are inframarginal to retailers are "marginal" for manufacturer investment.

Summary of Certain Returns Case

- Both two-price all-units discounts and two-block tariffs are optimal contracts and dominate two-part tariffs.

- However, bilateral monopoly is not rich enough to distinguish between them.

- Perhaps transaction costs determine the choice.

Uncertain Investment Prospects and Returns

$$\text{Demand} = \begin{cases} D(P, x) & \text{with probability } \theta \\ D^0(P, x) & \text{with probability } 1 - \theta \end{cases}$$

Two cases:

Uncertain Prospects. θ is the probability an upstream investment opportunity arises and is taken after the contract is signed.

Uncertain Returns: θ is the probability an upstream investment pays off.

Proposition 6

1. If the retailer's only decision is price, then a two-price all-units discount supports the first best.
2. If upstream investment causes an iso-elastic shift in demand, a two-price all-units discount, possibly with a commitment and penalty for breach, supports the first best.
3. Two block tariffs need not support the first best.

Explanation of Dominance Result

Explanation when $c = 0$, $V = vD$, no downstream investment

Step 1: Offer the tariff

$$T^*(Q) = \left\{ \begin{array}{ll} w_1 Q & \text{if } Q < D^0(P^*), \\ w_2 Q & \text{if } Q \geq D^0(P^*). \end{array} \right.$$

Step 2: Set $w_2 = P^* - v$, w_1 sufficiently high.

Step 3: The upstream firm then invests optimally.

Step 4: The retailer prices to sell at least D^0 even if investment is unsuccessful.

Step 5: With a two-block tariff, the first best arises only if a measure of the average wholesale price equals upstream marginal cost, zero.

- This can't happen if $w_1 > w_2 \geq 0$, which is required to induce upstream investment.

Step 6: Conclusion is that all-units discounts dominate two-block tariffs.

- Result does not require lumpy investment.

- Uncertainty gives the problem somewhat different character than the certainty case.

  - Firms exploit risk.

  - Downstream firm invests enough to reach the threshold even if upstream investment does not materialize or is not successful.

Small Scale Upstream Entry

Game with Entry:

Stage 1: Contract signed, as before.

Stage 2: Price and investment decisions, as before, and downstream firm considers whether to purchase q_E units from another source (entrant) at price w_E.

Accommodation/Deterrence Decision:

- If the contract induces firms to purchase q_E from the entrant at w_E, firms "accommodate" entry.

- Otherwise, firms "deter" entry.

Entry Game Outcome Based on Value of w_E

	All Units Discount	Two-Block Tariff
Price		
	• Automatically deters inefficient entry	• Automatically deters inefficient entry
w_1^A		
	• Two-price all-units discount that deters inefficient entry distorts investment. • Three-price all-units discount deters inefficient entry efficiently.	• Deter entry if w_E is relatively high, distorting investment. • Accommodate entry if w_E relatively low, distorting investment.
c		
	• Accommodate efficient entry	• Accommodate efficient entry
0		

Recapitulation, Implications, and Conclusion

- All-units discounts have useful efficient properties in the presence of double moral hazard.
  - Generally dominate two-part tariffs.
  - Dominate continuous tariffs when demand is uncertain.

- Given a threat of small scale entry, I found:
  - All-units discounts accommodate more efficient entry.
  - All-units discounts are a stronger deterrent of inefficient entry than continuous tariffs.
  - Unlike continuous tariffs, all-units discounts deter entry without distorting investment.

- When all-units discounts are useful, they provide incentives for downstream output expansion while keeping upstream margins high enough to support investment.