

# Why do larger buyers pay lower prices? Intense supplier competition

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## Abstract

The paper provides a theoretical explanation of the common claim that larger buyers pay lower prices. In the model, suppliers compete more aggressively for the business of larger buyers, much as they do in ‘boom’ periods of Rotemberg and Saloner. © 1998 Elsevier Science S.A.

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## 1. Introduction

The popular press frequently reports that, relative to small buyers, large buyers have more ‘clout’ in their negotiations with suppliers.<sup>1</sup> It is commonly reported, for example, that retail superstores are able to extract price concessions from manufacturers (see, e.g., Schiller and Zellner, 1992). The formal empirical literature generally supports these claims.<sup>2</sup>

This paper provides a simple theory explaining why large buyers may obtain low prices from suppliers. To my knowledge it is the first theory that—consistent with the intuition from the popular press—suggests buyer ‘clout’ stems from intense supplier competition. In intuitive terms, suppliers are successful in elevating price above marginal cost when selling to the typical buyer. When an unusually large buyer appears on the market, however, suppliers are so keen to serve the buyer that they tend to underbid each other aggressively. In more formal terms, the model uses an idea that

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<sup>1</sup>For early case studies in the economics literature, see Adelman (1959) (groceries) and McKie (1959) (tin plate). For examples in the business press, see Cox (1994), Strauss (1987) and Wolfe and Asch (1992). For newspaper accounts, see Meyers (1994) (ski resorts) and Greer (1993) and Miller (1993) (health care alliances).

<sup>2</sup>Brooks (1973), Buzzell et al. (1975), Lustgarten (1975), McGuckin and Chen (1976), Clevenger and Campbell (1977) and more recently Boulding and Staelin (1990) provide inter-industry studies. Chipty (1995) develops an econometric model of the cable television industry. See Scherer and Ross (1990), chapter 14, for a summary.

Rotemberg and Saloner (1986) developed to explain how prices vary with macroeconomic shocks<sup>3</sup> and applies the idea to the case of buyers of varying sizes. The idea is that tacit collusion is difficult to sustain when current demand is high relative to expected future demand since the current benefit from undercutting may exceed the future loss from any punishment for undercutting (e.g., marginal-cost pricing in all future periods). In order to prevent undercutting, the equilibrium collusive price must be reduced in high demand periods relative to the collusive price if demand did not fluctuate. In the present paper, the appearance of a large buyer on the market evokes a similar response from suppliers as does a boom in demand in Rotemberg and Saloner.

The existing theory tends to ignore issues of supplier competition by positing a monopoly supplier. In the bargaining models of Stole and Zwiebel (1996a), (1996b) and Chipty and Snyder (1997), large buyers pay lower per-unit prices if the surplus generated by negotiations between the supplier and buyers is concave in quantity (e.g., if the supplier's cost function exhibits decreasing returns to scale). The model of Maskin and Riley (1984) of nonlinear pricing by an asymmetrically-informed monopolist generates global quantity discounts if consumer demand exhibits an appropriate sorting condition. In the bargaining model of Horn and Wolinsky (1988), product-market competition among buyers may affect input prices charged by suppliers.<sup>4</sup>

The most closely related papers are Katz (1987) and Snyder (1996). While there is no explicit competition among suppliers in Katz (1987), the threat of competition from large buyers who integrate backward may discipline the prices charged by the supplier. Snyder (1996) examines the effect of buyer merger on prices charged by tacitly-colluding suppliers. The model is complicated by the facts that buyers are infinitely-lived and can alter the timing of their purchases strategically. Besides being simpler, the advantage of the present approach is its close tie to the ideas of Rotemberg and Saloner, ideas which have spread to many subfields of economics including industrial organization and macroeconomics.

## 2. Model

This section develops a model similar to Rotemberg and Saloner (1986), the main difference being that the random variable determining the strength of demand, originally interpreted to be a macroeconomic shock, is here reinterpreted as buyer size. Consider an industry with  $N$  suppliers, indexed by  $i = 1, \dots, N$ . Suppliers produce an homogeneous product at constant marginal and average cost equal to  $c$ . Each period, a different buyer appears on the market. Let  $t \in N$  be an index for both periods and buyers. Buyers can be interpreted as consumers of a final good produced by the suppliers; alternatively, buyers can be interpreted as downstream firms which require an intermediate input produced by the suppliers. In any period other than  $t$ , buyer  $t$  is not present in the market.

The number of periods is potentially infinite. Let  $\delta$  be the suppliers' discount factor. This discount factor can embody a required rate of return on capital as well as an exogenous probability the game ends after each period. Each period, suppliers choose prices  $p_t^i$ . Let  $h_{t-1} = \{p_\tau^i | \tau = 1, \dots, t-1; i =$

<sup>3</sup>See also Haltiwanger and Harrington (1991), Kandori (1991) and Bagwell and Staiger (1997) on extensions to Rotemberg and Saloner involving the business cycle.

<sup>4</sup>See also McAfee and Schwartz (1994) and the survey by Rey and Tirole (1996).

$1, \dots, N\}$  be the history of supplier play up to and including period  $t - 1$ , and let  $H_{t-1}$  be the set of such histories. A strategy for supplier  $i$  is a function  $p_i^i: H_{t-1} \rightarrow R^+$ .

The strategy for buyer  $t$  is assumed to be completely determined by its demand function  $D(p_t, s_t)$ , where  $p_t = \min\{p_i^i | i = 1, \dots, N\}$  is the lowest supplier price and where  $s_t$  is the size of buyer  $t$ . Assume  $\partial D / \partial p_t < 0$ , implying that the law of demand holds; and assume  $\partial D / \partial s_t > 0$ , implying that larger buyers have greater demand. If several suppliers tie for the low price, the buyer is assumed to purchase an equal share from each. Random variable  $s_t$  is drawn from the distribution  $F$  on the interval  $[\underline{s}, \bar{s}]$ . Assume  $s_t$  is observable to all players once buyer  $t$  enters the market.

Characteristic of supergames, there are a multiplicity of subgame-perfect equilibria in the present game.<sup>5</sup> We will examine the *extremal equilibrium*: the subgame-perfect equilibrium maximizing the suppliers' joint profit. Let  $p^m(s_t)$  be the price which maximizes the suppliers' joint profit; i.e.,  $p^m(s_t) = \arg \max_p \{(p - c)D(p, s_t)\}$ . Let  $\Pi^m(s_t)$  be the suppliers' joint monopoly profit; i.e.,  $\Pi^m(s_t) = [p^m(s_t) - c]D(p^m(s_t), s_t)$ . The following two parametric assumptions will rule out trivial cases:

$$N < \frac{1}{1 - \delta}, \quad (1)$$

$$\frac{\Pi^m(\bar{s})}{E_s(\Pi^m(s))} > \frac{\delta}{(1 - \delta)(N - 1)}, \quad (2)$$

where  $E_s(\cdot)$  is the expectation operator. It turns out that if (1) is violated, the only subgame-perfect equilibrium involves marginal-cost pricing; if (2) is violated, the extremal equilibrium involves monopoly pricing for all buyer sizes. The following proposition follows from the results of Rotemberg and Saloner:

**Proposition 1.** *The price charged by all suppliers in the extremal equilibrium,  $p^*(s_t)$ , depends only on  $s_t$  and thus is independent of  $h_{t-1}$ . There exists  $s^* \in (\underline{s}, \bar{s})$  such that  $p^*(s_t) = p^m(s_t)$  for  $s_t \leq s^*$  and such that  $p_t^*$  declines with  $s_t$  for  $s_t > s^*$ .*

The proposition states that, among buyers that are larger than the cutoff size  $s^*$ , larger buyers pay lower prices to suppliers. The proposition does not imply that price is monotonic in size, however. For buyers smaller than  $s^*$ , whether price is increasing or decreasing in size depends on how the monopoly price  $p^m(s_t)$  varies with  $s_t$ , which in turn depends on how an increase in  $s_t$  affects the slope of the demand curve. If  $\partial^2 D / \partial p_t \partial s_t$  is non-negative (or indeed if  $\partial^2 D / \partial p_t \partial s_t$  is not too negative), then the monotone comparative statics results of Milgrom and Roberts (1994) can be used to show that  $dp^m / ds_t > 0$ . If  $dp^m / ds_t > 0$ , then price will be non-monotonic in buyer size: price first increases with buyer size up to the cutoff  $s^*$ , and then decreases.

### 3. Examples

In the first example, there are two types of buyers: a fraction  $\alpha$  are small, with size  $s_t = 1$ ; the remaining  $1 - \alpha$  are large, with size  $s_t = 2$ . Suppose demand is given by  $D(p_t, s_t) = s_t - p_t$ . Suppose,

<sup>5</sup>See, e.g., Fudenberg and Maskin (1986).

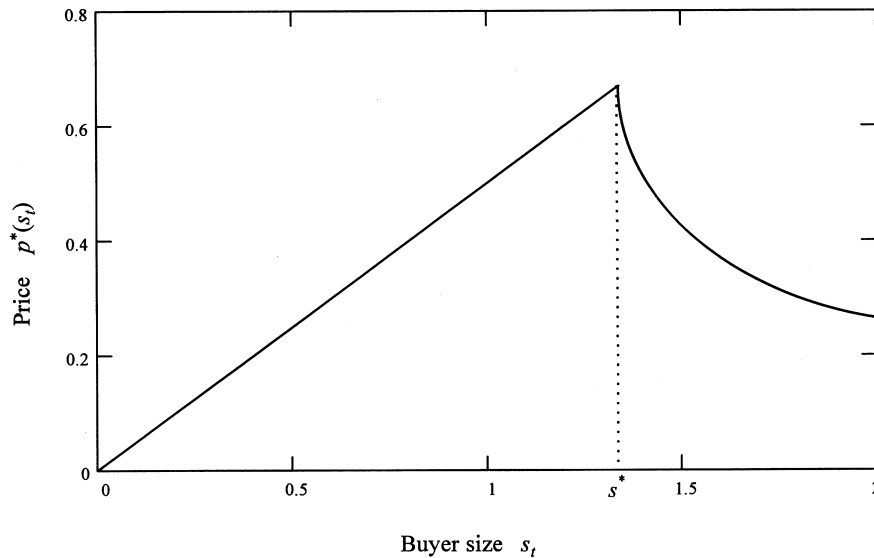


Fig. 1. Extremal equilibrium price in an example.

further, that  $c = 0$ ,  $N = 6$ ,  $\delta = 0.9$ , and  $\alpha = 0.75$ . It can be shown that the extremal equilibrium price charged the small buyers is 0.5 the monopoly price. Large buyers are charged 0.38, 24% below the extremal equilibrium price for the small buyers and 62% below the monopoly price for the large buyers. The main point to draw from this two-type example is that price may decrease with buyer size.

In the second example, there is a continuum of buyer sizes, uniformly distributed on the interval  $[0,2]$ . All the other parameters are the same as in the first example. The extremal-equilibrium prices are shown in Fig. 1. Buyers are charged the monopoly price up to size  $s^* = 1.33$ . Above this level, price falls with size. The smallest buyers pay the lowest prices; moderately-sized buyers pay the highest prices; the largest buyers pay a price between the two. The main point to draw from this continuum-of-types example is that, though price declines with size for an interval of the largest buyers, the largest buyers do not necessarily pay the lowest prices.

The Introduction stated that the discussion in the popular press tends to focus on the setting in which buyers are retailers, some of which are superstores. In this setting, the first example may be the most relevant: demand tends to be of a moderate level, made up by purchases of typical retailers. High demand periods occur when the superstore makes its purchase.

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