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## A NOTE ON THE STRATEGIC USE OF SERVICE

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*Charles Hegji*

*Evan Moore*

**Auburn University – Montgomery  
Montgomery, AL**

### **Abstract**

*We develop a model of optimal service provision and pricing in which the level of service is not viewed as a capacity choice. We study the provision of services in both a non-strategic setting, characterized by a monopoly, and in a strategic setting, a differentiated price duopoly. We find that in both settings increased services lead to increased prices. However, unlike other models, the strategic setting results in greater services than the non-strategic case. Additionally, we discuss the welfare effects for consumers and find that any gains in consumer surplus from increased service provision in the strategic setting are more than offset by the associated higher equilibrium prices.*

A problem that has received attention in the literature is the level of customer service provided by retailers. One vein of research has linked the provision of service by retailers to fair trade laws and resale price agreements between sellers. This is exemplified by the work of Telser (1960, 1990) and that of Marvel and McCafferty (1996). The argument is that since resale price agreements provide price floors in the resale market, they prevent retailers from selling at low prices to customers that have obtained product information from other sellers. Such agreements, therefore, encourage the provision of service in the form of additional product information by retailers. An implication of this reasoning is that higher service levels are generally associated with higher retail prices.

An alternative strand of research has been to regard the level of service provided by retailers as a strategic weapon. De Vany (1976), De Vany and Saving (1983), Koenigsburg (1980), Kalai et al. (1992), Stidham (1992), Li and Lee (1994), and Ilmakunnas (2002) adopt this approach. Earlier work in this area centers on service level as the firm's primary choice variable. More recent work, such as the papers of Stidham (1992), Li and Lee (1994), and Ilmakunnas (2002), study the simultaneous use of price and service capacity as strategic instruments. Ilmakunnas, for instance, develops a model of service capacity choice in which firms, after choosing capacity, compete using price in Bertrand fashion. In the Ilmakunnas model, capacity choices have a negative impact on competitors, since added capacity in one firm decreases the full price (price plus waiting cost) and leads to a flow of customers from the other firm. Two implications of this approach are a negative correlation between service

capacity and price, and an underinvestment in service capacity compared to the non-strategic case.

The present note extends this second line of research in two ways. First, we develop a model of optimal level of service in which service is not viewed as capacity. Second, we study the provision of services in a non-strategic setting characterized by a monopoly and in a strategic setting, a differentiated price duopoly. We find that in both settings increased services lead to increased prices. However, unlike the Ilmakunnas model, the strategic setting results in greater services than the non-strategic case. Additionally, the effects on consumer welfare are discussed. We conclude with a summary and implications for managers competing in the strategic setting.

### The Provision of Services under Two Settings

Consider the following demand facing producers

$$Q(P,S) = S(A-P), \quad (1)$$

where  $P$  is price,  $S$  is the per unit level of service provided in the market, and  $A$  is a shift parameter corresponding to the intercept on a linear demand curve.<sup>1</sup> According to (1), quantity demanded is inversely related to price and increases with the per unit level of service provided. Note, however, that since service is multiplied by the difference  $(A-P)$ , demand does not shift parallel with an increase in service, but rather, rotates around the price axis. This is reasonable, since it suggests that the customer must purchase the good for service to have an effect on demand. Alternatively, if  $P = A$  so that producers price themselves out of the market, the effect of service on demand will be zero.

This multiplicative form is not overly restrictive, with the interaction of price and service extending capacity models of service. Such models use an additive demand curve with separate service price and final product price, and assume that the only service provided by firms is the capacity to reduce buyer waiting times in equilibrium. This type of service is similar to added check-out lines in grocery stores. The multiplicative form of demand assumed in (1) involves service that is more closely bundled to the product and covers such things as information on product assembly or product repair. It can also cover new and attractive store displays and other types of service where costs are incorporated into product price.

The good, for sake of simplicity, is assumed to be supplied at constant marginal cost  $C$ . Service ( $S$ ) is assumed to be supplied at constant cost per unit of service  $\varphi$ . These assumptions result in a total cost of output plus service  $TC = q(C + \varphi S)$ .

We begin with the provision of service by a monopoly seller of the product. This situation is a simplification of a non-strategically operating price-setting firm. For the monopoly, begin with the profit function

$$\pi(P,S) = PQ(P,S) - C(Q,S) = PS(A - P) - (\varphi + C)S(A - P), \quad (2)$$

The monopolist maximizes (2) with respect to price and level of service. Differentiating (2) with respect to  $P$  results in the monopoly price of

$$P^* = \frac{2A + C}{3}, \tag{3}$$

Differentiating (2) with respect to  $S$  and using (3) obtains the equilibrium level of service provided by the monopolist of

$$S^* = \frac{A - C}{3\varphi}, \tag{4}$$

Equation (3) reveals that, as expected, the monopolist prices above cost. In addition price increases with the marginal cost of production and the unit cost of providing services. Equation (4) shows that the level of services provided by the monopolist decreases both with the marginal cost of providing services  $\varphi$  and the unit cost  $C$  of providing the good. Note that an increase in demand and price, resulting from an increase in the parameter  $A$ , leads to an increase in the optimal level of service. Service and price are therefore positively correlated in this non-strategic setting.

Next consider the following differentiated price Bertrand setting. Assume that for  $i, j = 1, 2$  demand is given by

$$q_i = S_i(A - P_i + \beta P_j)/2, \text{ where } 0 < \beta < 1. \tag{5}$$

The above specification is derived by assuming that without strategic interaction between firms ( $\beta = 0$  and  $S_i$  at the normalized value 1), each firm begins play with one half of the monopoly's market share. Output produced by firms  $i$  and  $j$  are substitutes with an increase in competitor price ( $P_j$ ) resulting in an increase in own quantity demanded ( $q_i$ ). The usual assumption is that demand is more sensitive to own price effects, such that  $\beta < 1$ . Note that by the above specification demand in market  $i$  is a function of services provided in that market only. An interpretation is that the level of service  $S_i$  appearing in (5) represents the net services provided by firm  $i$  relative to firm  $j$ .

The present situation can be thought of as a two-stage game. In the first stage, firms independently and simultaneously choose price. Given the equilibrium price, each firm determines its optimal level of service. Begin with profits of firm  $i$ :

$$2\pi(P_i, S_i) = S_i(A - P_i + \beta P_j)P_i - S_i(A - P_i + \beta P_j)(C + \varphi S_i) \tag{6}$$

Differentiating (6) with respect to price results in firm  $i$ 's reaction function

$$P_i = \frac{A + C + \varphi S_i + \beta P_j}{2} \quad (7)$$

Differentiating (6) with respect to the level of services  $S_i$  yields the relationship  $S_i = (P_i - C)/2\varphi$ . Use of this relationship and (7) results in the equilibrium price and level of service in the differentiated price Bertrand model:

$$P_1 = P_2 = P^* = \frac{2A + C}{3 - 2\beta} \quad (8)$$

$$S_1 = S_2 = S^* = \frac{A - C + \beta C}{\varphi(3 - 2\beta)} \quad (9)$$

Equation (7) shows that, as in the monopoly model, firms engaged in differentiated Bertrand price competition set price above marginal production cost and the total cost of providing service. This reaction function shows that, as in the non-strategic case, price and service are positively correlated. This positive correlation is also evident in the equilibrium price and level of service in equations (8) and (9). Both service and price increase with an increase in the demand parameter  $A$ .

The level of service provided by a Bertrand firm decreases as the marginal cost of providing service  $\varphi$  increases. Note that since  $\beta < 1$ , the level of service provided also decreases with the marginal production cost  $C$ .<sup>2</sup>

Both price and the amount of service provided by the Bertrand firm relative to the monopoly are immediately apparent. A comparison of equations (3) and (8) reveals that the equilibrium price for the Bertrand firms is higher than in the non-strategic case. This characteristic of the differentiated price Bertrand model is well known, its source being evident in the Bertrand reaction function. Equation (7) shows that the firm's price responds positively to an increase in the competitor's price. This complementarity of strategic responses results in higher equilibrium prices than in the non-strategic case.

Comparing equations (5) and (8) reveals that the equilibrium level of service in the Bertrand model is greater than in the non-strategic case. This differs from Ilmakunnas' (2002) model and is a direct result of service being bundled to the product rather than sold as capacity units. Suppose that the competitor increases service provided to its customers. This allows the competitor to increase price. Since the firm's own price is complementary to the competitor's price, the firm will increase its price allowing the firm to increase service to compensate for the corresponding decrease in quantity demanded. The end result will be a level of service greater than the non-strategic monopoly case.

A related question is whether the consumer benefits from this strategic competition. Consumers gain from the competition in the differentiated price Bertrand model due to greater service, but lose due to higher prices compared to the non-strategic case. Without an explicit consumer utility function in goods and service, a reasonable approximation of consumer welfare is consumer surplus. For the monopoly this is given by  $CS = (1/2)(A - P^*)q^*$ , where  $P^*$  and  $q^*$  are the profit-maximizing price and quantity, where quantity is a function of service provided by the monopoly. The consumer surplus for the differentiated Bertrand model is similarly computed, with  $q^*$  being the sum of the quantities produced by both firms, quantity again being a function of the level of service provided by the firm.

The total consumer surplus for the Bertrand firms ( $CS_B$ ) and of the monopoly market ( $CS_M$ ) are

$$CS_B = \frac{(A - C + \beta C)^2(A(1 - 2\beta) - C)}{2\varphi(3 - 2\beta)^3} \tag{10}$$

$$CS_M = \frac{1}{2\varphi} \left[ \frac{A - C}{3} \right]^3 \tag{11}$$

By design  $CS_B = CS_M$  when  $\beta = 0$ .<sup>3</sup> However, as  $\beta$  increases from 0 to 1 the consumer surplus in the Bertrand market decreases. This is evident as the derivative of (10) with respect to  $\beta$  is

$$\frac{\delta CS_B}{\delta \beta} = - \frac{\beta(2A + C)^2(A + (\beta - 1)C)}{\varphi(3 - 2\beta)^4} \tag{12}$$

which is negative. In other words, the consumer surplus in the Bertrand market is less than that of the non-strategic monopoly setting for all feasible values of  $\beta$ .<sup>4</sup> An inspection of equation (12) also reveals that the decrease in  $CS_B$  increases as  $\beta$ , a measure of product differentiation, increases. Gains to consumers from increased service provision are more than offset by price increases in the Bertrand market.

**Summary and Managerial Implications**

In this note we have developed a model of optimal service level provision in which service is not viewed as capacity. The demand function used in the analysis involves a multiplicative relationship between service and pricing. Such a function allows service to be viewed as more closely bundled to the product as opposed to an offering that can be purchased in addition to the product.

We find that the service provision and prices in the strategic Bertrand market are greater than that of a non-strategic monopoly market. We show that any gains

in consumer surplus from increased service provision in the Bertrand market are more than offset by the associated higher equilibrium prices. This analysis reveals that consumer surplus is greater in the non-strategic case. Additionally, consumer surplus is further decreased in the Bertrand market as product differentiation increases.

Managers of firms competing in the Bertrand markets realize higher profits due to the strategic complementarities of pricing and service. However, although higher service levels lead to higher equilibrium prices in this strategic setting, consumer surplus decreases. As consumers become aware of their decrease in welfare due to the higher product price, product switching may begin to occur. Additionally, higher prices due to higher service levels may encourage entry into the market by new firms.<sup>5</sup> This would likely hurt the long run profitability of existing firms. The bottom line for managers is that although competition in the provision of service may at times seem attractive, in that increased services allow for higher prices, price competition should be considered the preferred long-run strategy.

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### Footnotes

<sup>1</sup> A close variant of this demand has been suggested as a vehicle for studying customer service by Pepall, Richards, and Norman (2002, p. 487). The multiplicative demand function has been used in models for quality as well. This type of demand indicates that increases in services raise consumer reservation prices and the maximum market size.

<sup>2</sup> This restriction ( $\beta < 1$ ) is standard with differentiated Bertrand models indicating that responsiveness to changes in the product's own price is greater than responsiveness to changes in the rival's price.

<sup>3</sup> See the discussion surrounding equation (5).

<sup>4</sup> We point out that while  $0 < \beta < 1$  is a standard assumption,  $\beta < 1.5$  is necessary to ensure positive equilibrium prices.

<sup>5</sup> Although the model presented is static, this is the likely result in a dynamic model with entry.

**Dr. Charles Hegji, Ph.D.** (Washington University St. Louis) is a Distinguished Research Professor in the Department of Economics at Auburn University Montgomery. He has been with the department since 1985 and is currently a full professor. His primary teaching interests are in Managerial Economics, Principles of Microeconomics, and Statistics. His primary area of research is in firm strategy and market structure. He also enjoys publishing electronic music; you may listen to his music at [www.acidplanet.com](http://www.acidplanet.com) under the artist name DrH.

**Dr. Evan Moore, Ph.D.** (Virginia Polytechnic Institute and State University) joined the Department of Economics at Auburn University Montgomery in 2002 and is currently an assistant professor. His primary teaching interests are Industrial Organization, Principles of Microeconomics, and the Economics of Decision Making. His primary areas of research include industrial organization and experimental economics. He has a coauthored work forthcoming in the *American Economic Review*.