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HOW TO SELL A PICKUP TRUCK: "BEAT-OR-PAY" ADVERTISEMENTS AS FACILITATING DEVICES

by Michael R. Baye and Dan Kovenock

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How to Sell a Pickup Truck: "Beat-or-Pay" Advertisements as Facilitating Devices *

Michael R. Baye
Texas A&M University & CentER

Dan Kovenock
Erasmus Universiteit Rotterdam & Purdue University

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Abstract

This paper examines the profitability of running an advertisement that promises to pay damages to customers who can find a (serious) price offer that the firm will not undercut. We show that such an advertisement can support a collusive price, and furthermore, that no other firm has an incentive to duplicate the advertisement. We also show that, under plausible conditions, such an advertisement can prevent entry into a market that would otherwise be vulnerable to entry. The results are shown to be relevant in areas that span several topics in the literature, including models of sales, brand loyalty, and entry prevention.

*We thank Eric van Damme, Arthur Robson, and Monika Schnitzer for comments on previous drafts. Any remaining errors are the responsibility of the authors.

1 Introduction

This paper examines the profitability of running an advertisement that promises to pay damages to customers who can find a (serious) price offer that the firm will not undercut. We show that such an advertisement can support a collusive price *and* attract consumers from the other firm. Furthermore, in equilibrium only one firm will send such a message, as no other firm has an incentive to duplicate an existing advertisement.

Most of the literature on price competition that allows advertising messages presumes firms are restricted to a single type of advertising message. For instance, Varian (1980) assumes that the only type of advertising message is to advertise a price. Lin (1988), on the other hand, assumes the space of advertising messages consists purely of a promise to match the price of rivals. An exception is Png-Hirshleifer (1987), who consider both price and price matching advertisements. The present paper differs from the extant literature in two important respects. First, and as noted above, we consider a type of advertising message not examined elsewhere in the literature: "beat-or-pay" commitments. Secondly, we consider a space of advertising messages that includes those considered by Varian, Lin, and Png-Hirshleifer. Thus we are able to compare the viability of beat-or-pay advertisements with others appearing in the literature, including price matching and price advertising. Among other things, our analysis reveals that the equilibria of existing pricing games are sensitive to the assumed structure and timing of advertising messages.

Before we present a formal model that incorporates beat-or-pay advertisements, it is useful to describe the model in the context of the story that motivated it. In a small town in Texas there are two rival pickup truck dealers, which we will call Billy Bob and Bobby Joe. Consumers in the town view the two dealers (and their products) as perfect substitutes. Each Sunday, Billy Bob and Bobbie Joe run advertisements that list prices for new pickup trucks. However, one Sunday Billy Bob deviated from this practice by running the advertisement reproduced in Figure 1.

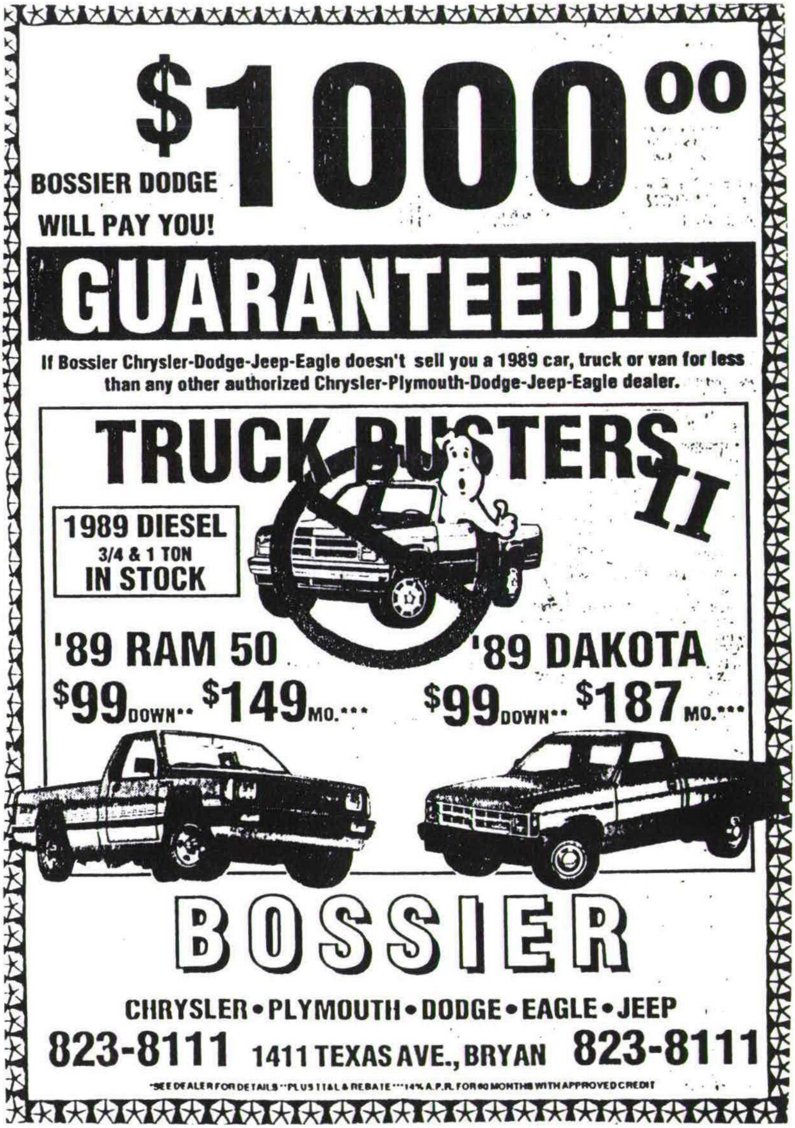

Figure 1: Source: *Bryan-College Station Eagle* Tuesday, July 25, 1989, Page 10B.

This paper seeks to determine why Billy Bob would choose to run such an add, Bobby Joe's optimal response, and the impact on profits and consumer welfare of the resulting Nash equilibrium. We consider games with alternative assumptions about the timing of advertising and pricing decisions, and conclude by relating our results to the existing literature on brand loyalty and entry.

2 The Basic Model

For simplicity and without loss of generality, consider a market serviced by two firms who produce at zero cost. In the market there are two types of consumers: (1) uninformed consumers, who do not read the newspaper, and (2) informed consumers, who do read the newspaper. There are $2U$ uninformed consumers and I informed consumers. For simplicity, we assume consumers have a zero-one demand, such that each consumer will purchase one unit of product if the price is less than or equal to r, and zero units if the price is greater than the reservation price, r. Each firm sells identical products, which we will refer to as pickups.

Since the uninformed consumers do not read the local newspaper, they go to one of the dealers and purchase a pickup if the price is less than or equal to r. We assume the uninformed consumers allocate themselves evenly among the two firms, so that each dealer is guaranteed $U = 2U/2$ uninformed consumers, provided price is set at or below r. The informed consumers, on the other hand, read the newspaper and purchase from the dealer offering the most favorable deal.

Three types of advertisements are available. The first type is that assumed by Varian (1980), where a firm advertises its price in the newspaper. We call such an advertisement a *price (P)* message. The second type of advertising message is for a firm to advertise a list price but promise to match the price of any competitor. Such an advertisement is termed a *price matching (PM)* message. The third advertising message is a list price along with the statement, "We will pay you \$1000 if we do not sell you a new pickup for *less* than any other authorized dealer.[1]" We will refer

[1]The exact amount paid is not important. Of course, for such an add to not be exploitable by

to such an advertisement as a *beat-or-pay (BOP)* message.[2]

By sending a P-message, a firm commits to charging a single price to all consumers. But by sending a PM or a BOP message, a firm can explicitly price discriminate between informed and uninformed consumers. Specifically, PM's and BOP's involve a list price (paid by the uninformed) and a price ultimately paid by informed consumers (those customers who know the firm is committed to either match or beat the rival). Also note that PM's and BOP's are different from "meet-or-release," "most-favored-nation," and "best price" provisions that have been examined extensively in the contracting literature; cf. Belton (1987), Holt and Scheffman (1987), and Schnitzer (1990).[3]

A firm's strategy consists of the type of message sent and the particular price offered at each information set.[4] The next three sections characterize the Nash equilibrium strategies and profits under three different assumptions about the timing

consumers, there must be some conditions to prevent strategic consumer behavior. For example, before the $1000 will be paid, the consumer must (1) have shown the dealer a price that he refuses to undercut; and (2) return with proof of purchase at that price (the pickup and title, for instance). We assume such is the case.

[2]Other variants of beat-or-pay advertisements are possible. For example, Eric van Damme, in private conversation, has noted that in the Netherlands "kijkshops" offer payments that are a function of the difference in price. We do not explore alternative strategies here. Indeed, one of the central points that emerges from the present analysis is that many results in the literature, including those of Varian (1980) and Png and Hirshleifer (1988), are not robust with respect to changes in the space of advertising messages. Since this would appear to be a general result, our focus on only three types of advertising messages is not without loss of generality.

[3]In the contracting literature, a meet-or-release clause is a promise by a seller to meet a lower price offered to a customer, or to release the consumer from the contract. A most-favored-nation clause is a promise that a customer will receive the lowest price charged to any customer. Best-price clauses combine these two features.

[4]The difference between the present model and the models of, for instance, Varian (1980), Lin(1988), and Png and Hirshleifer (1987), is that we allow the firms to choose from among three different types of possible advertising messages. The strategy space of advertising messages (with some abuse of notation) considered in this paper is $A = \{P, PM, BOP\}$. Varian assumes the space of advertising messages is simply $\{P\}$; Lin assumes the space of messages to be simply $\{PM\}$; Png and Hirshleifer assume the space of messages is $\{P, PM\}$.

of decisions. In each case, it will be seen that a firm sending a BOP-message does very well, in equilibrium.

3 Simultaneous Advertising – Simultaneous Pricing

We first model firm behavior as a two-stage game of complete information. In stage one, firms (simultaneously) commit to one of the three types of advertising messages. This stage can be thought as the stage where the advertising department of the newspaper begins working on the general layout of an advertisement. In the second stage, firms set prices with knowledge of the first-stage decisions. One can think of this as a last-minute decision just prior to sending the advertising message.

To solve for the subgame-perfect Nash equilibrium we use backward induction, solving first for the equilibrium in each of the pricing subgames. There are a total of nine subgames, but due to the symmetric nature of the game, only six of them are distinct. These are analyzed in the subsection below. Given equilibrium payoffs for the pricing subgames, we then determine the equilibrium first-stage advertising decisions. This is done in subsection 3.2.

3.1 Equilibrium in the Pricing Subgames

The P-P Subgame

We first consider the subgame where the firms (simultaneously) submit an advertised price to the local newspaper. Each firm is assured of getting U uninformed consumers, provided of course that their price is not set above the reservation price. In addition, however, the firm setting the lowest price captures all of the informed consumers. More formally, letting p_i and p_j denote the prices of firms i and j $(i \neq j)$, the profits of firm i are given by

$$\pi_i = \begin{cases} p_i U & \text{if } p_j < p_i \leq r \\ p_i[I/2 + U] & \text{if } p_j = p_i \leq r \\ p_i[I + U] & \text{if } p_i < p_j \text{ and } p_i \leq r \\ 0 & \text{otherwise} \end{cases}$$

It is known (cf. Varian (1980); Baye, Kovenock, and de Vries (1989)) that this game has no pure-strategy Nash equilibrium. However, it does have a mixed-strategy equilibrium,[5] whereby the two firms randomize continuously on the interval $[p^*, r]$, where $p^* = rU/(I+U)$. The expected profits of the two firms are

$$E\pi_i = rU.$$

In essence, the potential rents from informed consumers are competed away via stochastic price undercutting. Profits are the same as would exist if there were absolutely no informed consumers in the market.[6]

The P-BOP Subgame

Next we examine the subgame where one firm advertises price and the other firm sends a beat-or-pay message. Equilibrium in this subgame requires that the firm sending the P-message charge a price of r, while the firm sending the BOP-message lists a price of r and sells to informed consumers at a price of $r - \epsilon$, where ϵ is the smallest unit of currency in the economy.[7]

To verify these claims, note that the informed consumers will ask the firm sending the BOP-message to undercut any price charged by the other firm. Furthermore, the firm sending the BOP-message has a strict incentive to undercut any such price above \$−1000; doing otherwise would require a payment of \$1000 to each informed consumer. Consequently, the firm sending the P-message earns profits of pU for advertising a price $p > -1000$, and profits of $p(U+I)$ for advertising a price $p \leq -1000$. The firm sending the P-message clearly maximizes profits by setting $p = r$ to earn rU.

The best response of the firm sending a BOP-message to any advertised price p is to advertise a price r and undercut p for the informed consumers if $p > -1000$. Since

[5]In fact, for this two-firm game, the equilibrium is symmetric and unique. When there are more than two firms, there are a continuum of asymmetric equilibria, but a unique symmetric equilibrium. However, all of these equilibria are payoff-equivalent; see Baye, Kovenock, and de Vries (1989).

[6]In this case, firms would charge the monopoly price, r, and earn rU.

[7]Henceforth, we shall assume ϵ is arbitrarily small.

the firm sending the P-message lists a price of r, the firm sending the BOP-message thus earns $rU + (r - \epsilon)I$, which tends to $r(U + I)$ as ϵ tends to zero.

The P-PM Subgame

Next, consider the subgame where one firm sends a P-message and the other firm sends a PM-message. Given the symmetric nature of the problem, we assume without loss of generality that firm one sends the P-message and firm two sends the PM-message.

In this subgame, it is easy to see that there does not exist a Nash equilibrium in pure strategies. However, letting F_1 and F_2 denote the cumulative distribution functions used by firms one and two to randomize prices, and defining $\underline{p} \equiv r[U/(I + U)]^{\frac{1}{2}}$, the Nash equilibrium mixed-strategies are given by

$$F_1(p) = \begin{cases} 0 & \text{if } p < \underline{p} \\ 1 + \frac{U}{I}\left[1 - \frac{r^2}{p^2}\right] & \text{if } p \in [\underline{p}, r] \\ 1 & \text{otherwise} \end{cases}$$

$$F_2(p) = \begin{cases} 0 & \text{if } p < \underline{p} \\ \left(\frac{2U+I}{I}\right)\left[1 - \frac{r}{p}\left(\frac{U}{I+U}\right)^{\frac{1}{2}}\right] & \text{if } p \in [\underline{p}, r) \\ 1 & \text{otherwise} \end{cases}$$

To verify that this is a Nash equilibrium,[8] note that the expected profit of firm one when it sets a price of p, given F_2, is

$$\pi_1 = F_2(p)pU + [1 - F_2(p)]\left[U + \frac{I}{2}\right]p.$$

With probability $F_2(p)$, firm two lists a price below p, in which case firm one sells only to the uninformed consumers at a price of p. But with probability $[1 - F_2(p)]$, firm two lists a price above p. In this case, firm two ends up matching firm one's price of p, and thus firm one sells not only to the U uninformed consumers, but $I/2$ informed consumers as well.

Similarly, the expected profit of firm two when it sets a price of p, given F_1, is

[8] We omit the proof of uniqueness.

$$\pi_2 = F_1(p)pU + \frac{I}{2}\int_{\underline{p}}^{p} x\,dF_1(x) + [1 - F_1(p)][U + I]p. \tag{1}$$

With probability $F_1(p)$, firm one lists a price below p. In this instance, firm two sells to U uninformed consumers a price of p, and matches firm one's price to sell to one-half of the informed consumers. The probability of this event, times the expected profits of selling to these later consumers are

$$F_1(p)\left[\frac{I}{2}\int_{\underline{p}}^{p} x\frac{dF_1(x)}{F_1(p)}\right] \equiv \int_{\underline{p}}^{p} x\,dF_1(x),$$

which accounts for the second term on the right-hand-side of equation 1. With probability $[1 - F_1(p)]$, firm two sets the lowest price, and services $U + I$ consumers at a price of p, which accounts for the last term in equation 1.

Substituting the asserted Nash equilibrium forms of F_1 and F_2 into the expressions for expected profits reveals that

$$\pi_1 = r\left[U + \frac{I}{2}\right]\left[\frac{U}{I+U}\right]^{\frac{1}{2}}$$

and

$$\pi_2 = r\left[U(U + I)\right]^{\frac{1}{2}},$$

which is constant on $[\underline{p}, r]$. Furthermore, for each i, π_i is lower for $p \notin [\underline{p}, r]$. Hence, each firm's profits are maximal and constant on $[\underline{p}, r]$, given the (mixed) strategy of the other firm, and thus F_1 and F_2 comprise the Nash equilibrium mixed strategies of firms one and two.

The BOP-BOP Subgame

Informed consumers make out like bandits in the equilibrium of this subgame: One firm pays each informed consumer \$1000 for having failed to undercut the rival's "best" price, while the other firm sells each informed consumer a pickup for \$−1000 (i.e., it pays each informed consumer \$1000 to take a pickup). The uninformed consumers, on the other hand, purchase at the advertised price of r.

To see why, suppose each firm promises to pay \$1000 (per informed consumer) if it fails to undercut the rival. Clearly, each firm will choose to advertise a price of

r. Let p_j be the "best" price obtained by a given informed consumer at firm j, after an arbitrary round of undercutting. Given such a price, the optimal strategy of firm i is to undercut any $p_j > -1000$. If $p_j \leq -1000$, firm i is better off refusing to beat this price, and instead paying \$1000 to the informed consumer.[9] In equilibrium, one firm therefore sells a pickup to a given informed consumer for \$−1000, while the other firm pays the given consumer \$1000 for failing to undercut the rival. Since there are I informed consumers, each firm earns profits of $rU - 1000I$.

The BOP-PM Subgame

This subgame has a continuum of Nash equilibria. In all of the equilibria, the firm sending the BOP-message earns profits of $rU - 1000I$, while the profits of the firm sending the PM-message range from $rU - 1000I$ to $r[I + U]$. Interestingly, the firm sending the BOP-message can determine the profits of the firm sending the PM-message. As subsequent analysis will reveal, the firm sending the BOP-message has an incentive to adopt a trigger strategy that credibly promises to minimize the payoff of the rival in the event this subgame is reached, in an attempt to induce the rival to "avoid" this subgame. For this reason, we focus on the equilibrium where the firm sending the BOP-message selects the equilibrium where the opponent's payoff is minimized.

To verify these assertions, note that the firm sending the BOP-message will undercut (when asked to do so by an informed consumer) any price above \$−1000; doing otherwise would require a \$1000 payment to the consumer. But the firm sending the PM-message is obligated to match any such price. Intuitively, an informed consumer has an incentive to "go back and forth" between the two firms, getting successively lower or matched prices, until the firm sending the BOP-message fails to further undercut price. Equilibrium therefore requires that each firm advertise a price of r, which is paid by the uninformed consumers. The informed consumers then have an incentive to get a quote from the firm sending the PM-message, and

[9] We are, of course, assuming that if firms continue beating prices that are even lower than \$−1000, the process ultimately terminates at even lower level profits.

taking the quote to the firm sending the BOP-message to obtain a lower price. The firm sending the BOP-message is indifferent between refusing to undercut the price charged by the rival, and undercutting, for each case ultimately results in profits of $rU - 1000I$. However, if the firm pursues the strategy of undercutting any price above \$−1000, it reduces the profits of the firm sending the PM-message to $rU - 1000I$.

The PM-PM Subgame

The final subgame to be examined is the one where each firm advertises a price and promises to match any lower price charged by a competitor. In this subgame, the profit to firm i when it lists a price of $p_i \leq r$ and firm j charges $p_j \leq r$ is

$$\pi_i = \begin{cases} p_i(U + I/2) & \text{if } p_i \leq p_j \\ p_iU + p_jI/2 & \text{if } p_i > p_j \end{cases}$$

Since this expression is increasing in p_i for any p_j, firm i's best response to any p_j is to set $p_i = r$. Hence, each firm will list a price of r in equilibrium and the informed allocate themselves evenly across firms. Each firm earns profits of $r[U + I/2]$.

3.2 Equilibrium Advertising Strategies

Given the payoffs computed above for each of the pricing subgames, we now solve for the first-stage advertising decisions. The "reduced" normal form for the advertising game is presented in Table 1. Note that the entries correspond with the equilibrium profits derived for each of the subgames.

It is clear from Table 1 that (a) the best response to a P-message is a BOP-message; (b) the best response to a BOP-message is a P-message; and (c) the best response to a PM-message is a PM-message. It follows that, for $U, I > 0$ the game has two types of subgame perfect Nash equilibria: Either each firm sends a PM-message, or one firm sends a BOP-message and the other sends a P-message. Note that *total* profits are equal in all Nash equilibria. But importantly, in the BOP-P equilibrium, the firm sending the BOP-message makes the highest possible payoff.

	P	BOP	PM
P	rU, rU	$rU, r[I+U]$	$r[U+\frac{I}{2}][\frac{U}{I+U}]^{\frac{1}{2}}, r[U(U+I)]^{\frac{1}{2}}$
BOP	$r[I+U], rU$	$rU - 1000I, rU - 1000I$	$rU - 1000I, rU - 1000I$
PM	$r[U+\frac{I}{2}][\frac{U}{I+U}]^{\frac{1}{2}}, r[U(U+I)]^{\frac{1}{2}}$	$rU - 1000I, rU - 1000I$	$r[U+I/2], r[U+I/2]$

Table 1: Payoff Matrix for Alternative Advertising Choices

While the firms do well in all equilibria (especially the firm sending a BOP-message), consumers fare poorly. In all equilibria, informed and uninformed consumers alike pay a price of r, which is the monopoly price. In the absence of PM and BOP-messages, the model reduces to that of Varian, in which case informed and uninformed consumers pay less than r with probability one. The availability of PM and BOP advertising messages thus reduces consumer welfare.

It is instructive to consider the importance of the presence of informed and uninformed consumers. When all consumers are uninformed ($I = 0$) the payoffs in each cell of the matrix are identical (and equal to rU). In this instance, any permutation of the three advertising strategies comprises a subgame perfect Nash equilibrium. Each firm essentially acts as an independent monopolist. In contrast, when all of the consumers are informed ($U = 0$), there are again two types of subgame perfect Nash equilibria: Either each firm sends a PM-message, or one firm sends a BOP-message and the other sends a P-message. The presence of informed consumers thus implies that the structure of the space of advertising messages matters, in equilibrium.

4 Sequential Advertising – Simultaneous Pricing

Suppose we alter slightly the timing of the advertising decisions. In particular, suppose firm one can commit to a particular type of advertising message before firm two. Given knowledge of firm one's decision, firm two then determines its advertising decision. Finally, given knowledge of these two moves, the two firms simultaneously set prices. This three-stage game can be solved by backwards induction, and importantly, the final stage (containing the pricing subgames) is identical to that examined in the previous section. Hence all that is required to analyze this situation is to view player one as a "Stackelberg" player with respect to advertising, given the payoff matrix in Table 1.

It follows from Table 1 that the unique subgame perfect Nash equilibrium for this three-stage game is for firm one to send a BOP-message, firm two to send a P-message, and for each firm to advertise a price of r. In equilibrium, the firm sending the beat-or-pay message earns profits of $r[U + I]$, while the firm choosing to advertise price earns profits of rU. This explains why Billy Bob found it in his interest to place the add.

5 BOP-Messages and Entry

The structure of the game considered here differs from the two above in several respects. First, we assume firm one (best thought of here as the incumbent) commits to an advertising *and* pricing decision before firm two. Given knowledge of this, firm two (the potential entrant) decides whether to enter, and if so, its advertising and pricing strategy. Secondly, instead of partitioning consumers into informed and uninformed, suppose that of the $N \equiv L + S$ consumers, $L > 0$ of them are loyal to firm one, but none of the consumers are loyal to firm two. Loyalty, in this context, means that consumers have a strict preference for the incumbent's product, irrespective of the price charged by the rival.[10] However, suppose S consumers will buy from the firm selling at the lowest price. These consumers can be thought of as "switchers." As before, each firm can produce at zero cost, and consumers have a reservation price of r. We will show that the subgame perfect Nash equilibrium for this game is for firm one to send a BOP-message and list a price of r, so that firm two gets none of the market.

Suppose the incumbent simply advertises a price. Since firm two has no loyal

[10]The interested reader should compare this with Narasimhan (1988).

customers, it will enter and undercut any positive price.[11] Hence, firm one will never make profits on the S consumers, and thus finds it in its interest to set price at r. Firm two chooses to enter and ϵ undercuts firm one to earn profits of rS.[12] Interestingly, if $S > L$, the entrant earns higher profits than the incumbent.

In contrast, suppose the incumbent chooses to advertise a price of r, and sends a PM-message. In this case the subgame perfect best response of the potential entrant is to enter and charge a price of r to get $S/2$ consumers. In this instance, equilibrium profits for the incumbent are $r[L + S/2]$ and for the entrant are $rS/2$. The possibility of sending a PM-message enhances the profit of the incumbent at the expense of the potential entrant.

In even sharper contrast, suppose the incumbent advertises a price of r, and sends a BOP-message. In this case the potential entrant has no incentive to enter the market, since the incumbent has committed to undercut any price above $\$-1000$.[13] In this case, Nash equilibrium profits of the incumbent are $r[L + S]$, while the potential entrant stays out and earns 0.

The above results imply that, when an incumbent is free to choose among P, PM, and BOP advertising messages, and there are some customers loyal to the incumbent, the incumbent can prevent entry by charging the monopoly price while promising to pay damages in the event he fails to undercut any offer. In this context, BOP advertising messages serve as a barrier to entry.

6 Concluding Remarks

This paper has examined the profitability of following an advertising strategy of promising to pay damages to customers who can find a price offer the firm will not

[11] This involves either setting p_2 an ϵ (small) below p_1, or listing $p_2 \geq p_1$ and sending a BOP-message.

[12] This is similar to results in Farrell and Shapiro (1988) and Deneckere, Kovenock, and Lee (1988).

[13] Of course, since the entrant earns zero regardless of whether he enters, he is indifferent between entering and not entering. If there is a (possibly small) entry cost, the entrant has a strict incentive not to enter.

undercut. We have shown that, when firms have the option of using one of three advertising strategies — a standard price advertisement, a price-matching advertisement, or a beat-or-pay advertisement — the beat-or-pay advertisement should be adopted by any firm having the opportunity to preempt its rival. Furthermore, it is a Nash equilibrium strategy for one firm to utilize such a strategy even when firms simultaneously determine advertising strategies. In each case, the use of beat-or-pay advertisements allows a firm to enjoy higher profits than its rival, in equilibrium.

The generality and robustness of the results reported here are a matter of perspective. On the one hand, we have demonstrated that certain advertising strategies deemed profitable in the literature are much less profitable in the face of simple and easily implementable (i.e., "any Billy Bob can do it") counter strategies. In plausible instances, a simple price advertising strategy (Varian (1980)) or price matching strategy (Png-Hirshleifer (1987)) yields firms lower profits than a beat-or-pay strategy. Hence, models of pricing which ignore advertising choice do not accurately reflect the relative ease with which real-world firms can extract rents from customers (and other firms, if foresighted enough to preempt).

On the other hand, there is a multitude of other potential advertising messages which have not been analyzed, some of which may perform as well as or better than beat-or-pay messages. Because of the richness of the set of messages that real-world firms can convey in advertising, an in-depth analysis of other messages is beyond the scope of this paper. What is evident from the present analysis is that existing results by, for example, Varian and Png-Hirshleifer, are sensitive to the assumed type and timing of advertising messages. It is also evident why someone like Billy Bob would run a beat-or-pay advertisement.

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