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Abstract

We examine the role low-price guarantees allegedly play in supporting supracompetitive prices. We find that when firms can commit to matching *or* beating any lower price announced by a competitor, all Nash equilibria yield Bertrand selling prices. This result casts doubt on the robustness of the conclusions of models which restrict attention to meet-the-competition clauses only.

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I Introduction

Many firms in consumer goods markets advertise that they will not be undersold. To back up their claims, they offer consumers low-price guarantees in which they promise to match or beat any lower price announced by a competitor. A typical advertisement reads as follows:

> If, after your purchase, you find the same model advertised or available for sale for less ... we, Newmark & Lewis, will gladly refund (by check) 100% of the difference, plus an additional 25% of the difference ... .[1]
> – from Newmark & Lewis's Lifetime Low-Price Guarantee

Although these low-price guarantees seemingly promote vigorous competition, a substantial literature (e.g. Salop, 1986; Kalai and Satterthwaite, 1986; Belton, 1987; Doyle, 1988; Logan and Lutter, 1989) suggests otherwise. Using static oligopoly models, they show that "meet-the-competition" clauses (hereafter MCC) can facilitate collusion. A representative story posits a price-setting homogeneous product industry, which in the absence of MCC, finds itself mired in marginal cost pricing. With MCC, however, there exists a Nash equilibrium in which all firms announce the monopoly price and promise to match any lower price offered by rivals. Since each firm's MCC renders rival firms' unilateral price cutting impossible, the collusive outcome is obtained in equilibrium. It is simply not possible for any firm to increase its market share by deviating from the monopoly price. Notice that each firm independently has an incentive to announce the monopoly price and adopt a price matching policy, and that it is a weakly dominant strategy to do so. When all firms have such policies, supracompetitive pricing is supported. This insight, introduced by Salop (1986), generalizes to differentiated products and asymmetric demands and costs.

The same insight would seem to apply to 'beat-the-competition" clauses (hereafter BCC), in which a firm promises to refund more than 100% of a price difference between it and a lower priced

[1] As quoted in Dixit and Nalebuff (1991:103). Several other examples can be found in Sargent (1993). Some firms offer to match a lower price plus give free extended warranty service. Others say they will beat a competitor's lower price by 10% or its free. Still others promise to have the lowest price over a thirty day period or else they will refund the difference – plus 10%, etc.

rival. For example, Dixit and Nalebuff (1991;103) consider whether *Crazy Eddie*, a competitor of *Newmark & Lewis* (low-price guarantee quoted above), would want to undercut rather than keep matching *Newmark & Lewis'* supracompetitive price. They note that if he were to do so, all consumers would simply buy from *Newmark & Lewis* at the higher price and then claim their rebate worth 125% of the difference. Hence, they conclude "*Crazy Eddie* is worse off than where he started. So why bother?"

But Dixit and Nalebuff err in attempting to extend Salop's insight about MCC to a regime in which firms can commit to beating any lower price announced by a competitor. To see where the above intuition fails, consider again the representative story in which the collusive outcome is allegedly supported with all firms announcing the monopoly price combined with MCC. While it is true that these price matching clauses eliminate the incentives for unilateral price cutting deviations, they are ineffective at preventing a firm from effectively lowering its selling price by *raising* its announced price and adopting a BCC. Such a strategy is profitable because in addition it ensures that rival firms' low-price guarantees are not activated. The same intuition applies to any alleged equilibrium selling prices in excess of marginal cost.[2]

The remainder of the paper is organized as follows. Section II considers MCC in a static duopoly pricing game in which products are asymmetrically differentiated. Section III extends the strategy space to permit firms to choose between MCC and BCC, and section IV concludes.

II Meet-the-Competition Clauses

Consider a price setting, differentiated product, duopoly game in which each firm simultaneously chooses its selling strategy to maximize its profit Π_i, $i = 1,2$. In this section, we allow firm i's selling strategy to consist of a posted price and possibly a guarantee to match any lower posted price by its rival. Selling prices to consumers are then determined as follows. In the event firm i does not offer

[2]The fallacy in the Dixit and Nalebuff analysis is that they assume *Crazy Eddie* is not smart enough to realize he can cheat on *Newmark & Lewis* by adopting a BCC and then raising his price. Ditto for *Newmark & Lewis*.

a price matching guarantee, its selling price S_i is equal to its posted price P_i. If firm i does offer an MCC, its selling price may differ from its posted price according to the mapping $S_i = \min(P_1, P_2)$. Thus, an MCC commits a firm to sell at the lowest posted price in the market. All consumers have perfect information regarding each firm's selling strategy and make their purchase decisions solely based on selling prices.

With symmetric demands and identical costs, it is well known that universal adoption of MCC leads to supracompetitive pricing. With asymmetric demands (or costs), however, it is somewhat harder to sustain collusion in the sense that barring an equilibrium in which the only firm to adopt MCC has a strictly lower posted price, so that MCC is redundant, there may be no Nash equilibria with MCC. Nevertheless, we show that whenever Nash equilibria with MCC and identical selling prices exist, all selling prices must be supracompetitive.[2]

As an aid to understanding our results, we illustrate the Bertrand Nash equilibrium and some key price pairs in figure 1 below. Let $BR_i(P_j)$ denote the Bertrand best reply of firm i, which solves $\max_{P_i} \Pi_i(P_i, P_j)$. We assume $BR_i(P_j)$ is single valued, continuous, and differentiable, and that $BR_i'(P_j) \in (0,1)$. Then the intersection of each firm's Bertrand best reply function yields the unique Bertrand price pair, $\mathbf{P^B} = (P_1^B, P_2^B)$. Now define the points $\mathbf{P^{Ai}} = (P^{Ai}, P^{Ai})$ as the intersection between firm i's Bertrand best reply function and the 45° line. Also define the points $\mathbf{P^{Ci}} = (P^{Ci}, P^{Ci})$ as the price pairs which maximize firm i's profit along the 45° line, i.e. P^{Ci} solves $\max_P \Pi_i(P,P)$. Finally, define the price pair $\mathbf{P^m} = \left(\min(P^{C1}, P^{C2}), \min(P^{C1}, P^{C2})\right)$. Under symmetry, of course, $\mathbf{P^m}$ is the joint profit maximizing or collusive price and $\mathbf{P^B} = \mathbf{P^{Ai}}$.

Insert figure 1

As shown in figure 1, we assume, without loss of generality, that $\mathbf{P^{A1}} > \mathbf{P^B} > \mathbf{P^{A2}}$.[3] The price pairs $\mathbf{P^{Ci}}$ are not depicted. As for $\mathbf{P^m}$, there are two possible orderings illustrated by points

[2]We are interested in combinations with MCC and identical selling prices because otherwise MCC are redundant.
[3]In our notation, $\mathbf{Z} >> \mathbf{Y}$ if $z_i > y_i, \forall i$ and $\mathbf{Z} > \mathbf{Y}$ if $z_i \geq y_i, \forall i$.

D and E respectively: either $\mathbf{P^{A1}} >> \mathbf{P^m} >> \mathbf{P^{A2}}$ (point D), or $\mathbf{P^m} > \mathbf{P^{A1}}$ (point E). Note that $\mathbf{P^{A2}} > \mathbf{P^m}$ cannot arise.

Before characterizing the set of selling prices that can be supported with MCC in a Nash equilibrium, two observations should be noted. First, firm i's MCC prevents firm j from unilaterally undercutting its price. Hence, if firm j posts a lower price, sales of firm i's product will be made at the same price. While this reduces the incentive to undercut, it may not eliminate it as neither firm can be forced to accept a selling price in excess of its most preferred point on the 45° line. Second, firm i's MCC does not prevent firm j from unilaterally raising its price. Hence, if firm j desires to have a higher selling price than firm i, it can do so merely by not adopting an MCC of its own and posting a higher price. The proof of the following lemma uses both observations.

Lemma 1 *Nash equilibria exist with MCC and $S_1 = S_2$ if and only if $P^{A1} \leq S_1 = S_2 \leq P^m$.*

Proof: See the appendix.

Since asymmetry between firms implies $\mathbf{P^{A1}} >> \mathbf{P^B}$, all selling prices with MCC are strictly bounded above the Bertrand price pair. Hence, the following proposition is implied by lemma 1.

Proposition 1 *Whenever Nash equilibria exist with MCC and identical selling prices, the selling prices are supracompetitive.*[4]

Selling prices in excess of Bertrand can be supported with MCC because the practice does not allow firms unilaterally to undercut their rival's posted price.[5] Put differently, MCC implicitly incorporate the aggressive punishment responses necessary to support collusion. It is ironic that low-price guarantees in this model do not in any sense imply that actual selling prices are low.

[4]This result, while standard in the symmetric case, has not been previously shown in the asymmetric case. Indeed, it contrasts with Logan and Lutter (1989), who find that with MCC it is possible for one firm's selling price to rise and the other firm's selling price to fall relative to Bertrand. Their result arises from their extensive form game in which firms choose whether to adopt MCC prior to their choice of posted prices.

[5]The *sine qua non* of facilitating practices is that they mitigate incentives to cheat from supracompetitive prices. In addition to meet-the-competition clauses, other alleged examples of facilitating practices are most-favored-customer clauses, in which buyers are guaranteed that a seller has offered the same terms to other buyers, and a related variant in which the seller grants rebates to buyers if at some point in the future it lowers prices. Key articles addressing these practices include Cooper (1986), Png (1991), Cooper and Fries (1991), and Besanko and Lyon (1993).

An immediate corollary of lemma 1 is that under symmetry, Nash equilibria with MCC and identical selling prices always exist. This is because under symmetry, $P^{C1} = P^{C2} > P^{A2} = P^{A1}$, and the conditions of the lemma are satisfied. In the absence of symmetry, however, Nash equilibria with MCC may not exist except in the uninteresting case in which only firm 2 adopts the clause and selling prices are Bertrand. For any situation in which MCC forces selling prices to be identical, lemma 1 implies that when $P^m < P^{A1}$, at least one firm can improve its profit by deviating.[6]

III Beat-the-Competition Clauses

We extend the strategy space in this section so that firms can commit either to matching or beating any lower price announced by a competitor. A low-price guarantee by firm i is defined as a promise to the consumer to refund $1 + \lambda_i$ times the difference between firm i and firm j's posted price whenever firm i has the higher price.[7] Thus, a BCC (MCC) corresponds to λ_i greater than (equal to) zero. Selling prices to consumers are determined as follows. In the event firm i does not offer a low-price guarantee, its selling price S_i is equal to its posted price P_i. If firm i offers an MCC, its selling price may differ from its posted price according to the mapping $S_i = \min(P_1, P_2)$. Finally, if firm i offers a BCC, its selling price may differ from its posted price according to the mapping $S_i = \min(P_i, P_i - (1 + \lambda_i)(P_i - P_j))$, where $\lambda_i > 0$.

Sargent (1993) argues that BCC is more anticompetitive than MCC in the sense that it is more effective at facilitating collusion. One interpretation of his claim is that BCC supports supracompetitive pricing even when P^m is below P^{A1}. Another interpretation of his claim is that BCC leads to higher selling prices than can arise with MCC. Consider the latter case. Suppose $P^{C1} > P^{C2}$

[6]An additional insight from the asymmetric game is that when the conditions of lemma 1 are satisfied, an equilibrium with MCC exists in which only firm 1 adopts the clause but not in which only firm 2 adopts the clause. To see this, note that if firm 2 were the only firm adopting MCC and selling prices were in the interval $[P^{A1}, P^m]$, firm 2 could increase its profit by unilaterally dropping its MCC clause and pricing so as to be on its Bertrand best reply function. It is straightforward to demonstrate that an MCC equilibrium exists in which only firm 1 adopts MCC. In this case, it can be shown that $S_1 = S_2 = P^{A1}$.

[7]Our analysis holds equally well for cases in which firms offer consumers non monetary rewards such as extended warranties for repair service as long as consumers attribute some positive monetary value to the reward.

and recall that the price pair $\mathbf{P^{C1}}$ could not be supported as an equilibrium in the previous section. The reason was that in any such proposed equilibrium with posted prices equal to P^{C1} and both firms adopting MCC, firm 2 could increase its profit by unilaterally deviating to a lower posted price P^{C2}, thereby forcing selling prices to be at the point on the 45° line which maximizes its profit. If a BCC with a sufficiently high λ_1 is feasible, however, it seems that firm 1 can render such a deviation by firm 2 unprofitable. Intuitively, firm 1's BCC commits it to an aggressive punishment response in the event firm 2 has a lower posted price.

The fallacy in the intuition, however, is that firm 2 can also adopt a BCC, and if it does, it can lower its selling price without ever activating firm 1's low-price guarantee. For example, at the price pair $\mathbf{P^{C1}}$, firm 2 can profitably deviate by *raising* its posted price. The gap in posted prices, coupled with its BCC, ensures that firm 2's selling price is *below* firm 1's posted price. Thus, the price pair $\mathbf{P^{C1}}$ cannot be supported as a Nash equilibrium when the strategy space includes BCC.

Before characterizing the set of selling prices that can be supported in a Nash equilibrium to the game when BCC are feasible, note that for any posted price by firm i, firm j can always ensure $S_j = BR_j(P_i)$. For instance, if $BR_j(P_i) > P_i$, firm j can set $P_j = BR_j(P_i)$ and not adopt a clause of its own. Alternatively, if $BR_j(P_i) \leq P_i$, firm j can adopt a BCC and set $P_j \geq P_i$ such that $S_j = P_j - (1+\lambda_j)(P_j - P_i) = BR_j(P_i)$. The proof of the following lemma uses these insights.

Lemma 2 *In any Nash equilibrium to the game in which the strategy space is extended to include BCC,* $S_i = P_i = BR_i(P_j)$, $i = 1, 2$, $i \neq j$.

Proof: See the appendix.

Since $S_i = P_i = BR_i(P_j)$ from lemma 2, an immediate corollary is that in any Nash equilibrium, selling prices must be $\mathbf{P^B}$. It is trivial to show that such an equilibrium exists, yielding the following surprising proposition.

Proposition 2 *When the strategy space is extended to include BCC, all Nash equilibria yield Bertrand selling prices.*

Supracompetitive pricing simply cannot be supported. Comparing propositions 1 and 2, it is seen that the addition of BCC dramatically alters the qualitative conclusion. Price matching clauses are rendered impotent in the presence of BCC, because although they eliminate the incentives for unilateral price cutting deviations, they cannot prevent a firm from lowering its selling price by *raising* its posted price and adopting BCC.

Additional insight is obtained by noticing that lemma 2 and proposition 2 together imply that when BCC is feasible, any low-price guarantee observed in equilibrium must necessarily be redundant in the sense that it is of no consequence in supporting the equilibrium. It is the threat of such clauses and not their actual implementation that drives the competitive outcome.

IV Conclusion

We have found that the feasibility of beat-the-competition clauses undermines the ability of low-price guarantees to facilitate collusion. Intuitively, adding BCC to the strategy space augments the capabilities of firms in two ways. First, it allows them to commit to an even more aggressive punishment response than MCC in the event a rival sets a lower posted price. Second, it enables them to undercut their rival's posted price by *raising* their own price. It is the first intuition which underlies claims that BCC belong to the class of facilitating practices. It is the second intuition which undermines the received wisdom.

Since we know of no instance in which MCC is legal but BCC is not, there is no *apriori* reason to restrict firms to price matching clauses, and hence our results cast serious doubt on the assertions by some that low-price guarantees belong to the class of facilitating practices. Since these guarantees are observed in reality, they must serve some other purpose.

Two other motivations have been given in the literature for why firms may adopt MCC. One is to engender price discrimination by separating informed consumers from the uninformed (Png and Hirschleifer, 1987). Those consumers who are aware of low prices offered by some segment of the industry can obtain the same deal (MCC) at a high price firm, while those consumers who are unaware of low prices elsewhere pay a high price. A second possible motivation for MCC is to facilitate the information gathering necessary to sustain collusion in a repeated game context. In this story, consumers unwittingly provide firms with the timely information they need for early detection of deviations from cartel pricing.

The introduction of BCC in the price discrimination story may have the added effect of inducing consumers to want to identify two different firms, the one with the lowest posted price and the one with the highest price/refund combination. When consumer information is derived from search, this effect would almost certainly alter consumer search behavior. By rewarding search, BCC could increase the amount of searching done by each consumer and/or increase the number of consumers searching. Thus, the net effect of BCC in this type of model may be procompetitive.

Beat-the-competition clauses seemingly have an advantage over price matching clauses in the repeated game information gathering story in that the premium payed to consumers through BCC for price information may increase the speed with which cheating is observed. If so, then BCC may well facilitate collusion. However, the net effect of BCC is unclear because its introduction also alters firms' punishment strategies as well as their payoffs from deviations. Moreover, this motivation for low-price guarantees seems less relevant in consumer goods markets where prices to consumers are clearly posted.[8]

More work is clearly needed to examine the competitive effects and merit of these two alternative explanations for low-price guarantees, especially since one's initial intuition with beat-the-competition clauses can be so misguided.

[8] Hess and Gerstner (1990) report that coinciding with their adoption of MCC, retail grocers in Raleigh N.C. routinely sent employees disguised as consumers into their rivals' stores to record posted prices. Were MCC adopted solely for the purpose of information gathering, the firms' additional employee expense would have been unnecessary.

Appendix

Proof of lemma 1:

To establish the existence of Nash equilibria when the conditions of the proposition hold, suppose both firms adopt MCC and post prices $P_1 = P_2 \in \left[P^{A1}, P^m\right]$. It is straightforward to verify that these selling strategies are best replies to each other and hence constitute Nash equilibria.

To establish the necessity of the conditions, notice that for any pair of proposed equilibrium selling strategies which yield identical selling prices strictly less than P^{A1}, either $P_2 = S_2$ or $P_2 > S_2$. In either case, firm 1 can increase its profit by not adopting MCC and unilaterally raising its posted price to $BR_1(P_2)$ if $P_2 < P^{C1}$ or to P^{C1} if $P_2 \geq P^{C1}$. Now consider a proposed equilibrium pair of selling strategies which yield identical selling prices greater P^m. Then by the definition of P^m, at least one firm can increase its profit by unilaterally lowering its posted price to P^m. This is so regardless of whether the rival has an MCC clause. Hence, $P^{A1} \leq S_1 = S_2 \leq P^m$ is necessary for the existence of a Nash equilibrium with MCC and identical selling prices. *QED*

Proof of lemma 2:

To show that $S_i = BR_i(P_j)$ in every Nash equilibrium, we note from the text that $S_i = BR_i(P_j)$ is achievable and that $\Pi_i(S_i, S_j) \leq \Pi_i(S_i, P_j) \leq \Pi_i(BR_i(P_j), P_j)$, where the first inequality is because $P_j \geq S_j$ and uses the definition of substitute goods, and the last inequality is by the definition of $BR_i(P_j)$ and is strict if $S_i \neq BR_i(P_j)$.

To show that $S_i = P_i$ in every Nash equilibrium, we proceed by establishing a contradiction. Since neither firm's posted price can be below its selling price, and since it is not possible for both firms' posted prices to be greater than their respective selling prices, assume, without loss of generality, that a Nash equilibrium, $(\tilde{P}_k, \tilde{S}_k)$, $k = 1, 2$, exists in which $\tilde{P}_j > \tilde{S}_j = BR_j(\tilde{P}_i)$ and $\tilde{P}_i = \tilde{S}_i = BR_i(\tilde{P}_j)$. Now consider a different posted price $P_i^* > \tilde{P}_j$ by firm i such that the resulting selling price $S_i^* = \tilde{P}_j - \lambda_i(P_i^* - \tilde{P}_j) = BR_i(\tilde{P}_j)$. This yields profit for firm i equal to $\Pi_i(BR_i(\tilde{P}_j), \tilde{P}_j)$, which is strictly greater than the profit under the supposed equilibrium $\Pi_i(BR_i(\tilde{P}_j), \tilde{S}_j)$. *QED*

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Figure 1: Asymmetric Case with Key Price Pairs