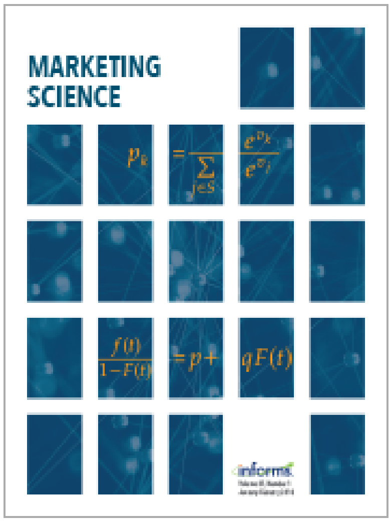

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Consumer Heterogeneity and Competitive Price-Matching Guarantees

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Research Note: Consumer Heterogeneity and Competitive Price-Matching Guarantees

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Abstract

Price-matching guarantees are widely used in consumer and industrial markets. Previous studies argue that they are a marketing tactic that facilitates implicit price collusion. This is because once a store adopts this marketing tactic, its rivals can no longer steal its customers by undercutting its price, and hence they have little incentive to initiate price cuts. While a store with price-matching guarantees has no fear of losing customers to rivals' price cuts, it has every incentive to raise its own price to charge a higher price to its loyal consumers. A growing body of legal literature uses this argument today to justify calls for antitrust actions against stores employing this marketing tactic.

However, this theoretical conclusion baffles practitioners and industry experts. In practice, sellers typically embrace this marketing tactic in response to heavier competition and a growing bargain consciousness among shoppers. The introduction of price-matching guarantees by a store is frequently interpreted by industry observers as the initiation of a price war rather than a signal of price collusion. This assertion is supported in many instances by the fact that stores that introduce price-matching guarantees also roll back their prices and typically suffer subsequent loss of profits. Most ironically, the favorite examples used by researchers to illustrate how price-matching guarantees can enforce price collusion, Crazy Eddie and "Nobody Beats the Wiz," have subsequently either gone bankrupt or filed for federal bankruptcy protection.

In this study we show that price-matching guarantees can indeed facilitate competition: The expected prices and profits can be strictly lower when all stores adopt price-matching guarantees than when they are not allowed to. This is because the adoption of price-matching guarantees generates not only a competition-dampening effect, which has been recognized in the literature, but also a competition-enhancing effect. This latter effect comes from the fact that price-matching guarantees encourage price search by those consumers who prefer to shop at a particular store but are mindful of saving opportunities. These consumers will have incentives to obtain the rival store's price when their favorite store offers price-matching guarantees to avail themselves of the lowest possible price at their favorite store. As a result, price-matching guarantees reduce the number of purchases at the store from those consumers who would have paid the full price and thus prompt a store to price more aggressively to bid for more incremental sales. This competition-enhancing effect can more than offset the competition-dampening effect in markets where consumers differ in their price search costs and store loyalty. Thus, our study casts doubt on the advisability of blanket prohibition on price-matching guarantees.

Our argument relies only on consumer segmentation and on the phenomenon of periodic sales, both of which are common in retail markets. We arrive at our conclusion by incorporating *bargain shoppers* and *opportunistic loyals* into the standard sales-promotion models. In contrast, the past literature on price-matching guarantees ignores the ubiquitous phenomenon of sales in retail markets and overlooks those consumers who prefer to shop at a particular store, but are alert to saving opportunities. As a result, it is troubled by two awkward conclusions. On the one hand, price-matching guarantees simply remove rivals' incentives to undercut in price and, hence, also their incentives to run sales. This implies that the adoption of price-matching guarantees in a market will eliminate the phenomenon of sales, which is obviously counterfactual. On the other hand, in equilibrium no consumer actually invokes price-matching guarantees, as each player has incentives to close any price gap in the market. This is obviously false, based on our casual observations and our conversations with store managers.

Theoretical research on the subject thus far has been overwhelmingly one-sided, and empirical or experimental studies are conspicuously lacking. We hope that our conclusion will spark further research in both directions. A healthy debate will broaden our perspective on an issue of great importance in formulating public policies and in managerial decision making.

(Price Guarantees; Price Promotions; Competitive Strategy)

1. Introduction

Many manufacturers and retailers today promise to match the lowest advertised price their customers can

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find. The predominant view in the literature holds that price-matching guarantees facilitate collusion.[1] This is because once a store adopts this marketing tactic, its rivals can no longer steal its customers by undercutting its price, and hence they have little incentive to initiate price cuts.[2] While a store with price-matching guarantees has no fear of losing customers to rivals' price cuts, it has every incentive to raise its own price to charge a higher price to its loyal consumers.[3]

A growing body of legal literature uses this argument today to justify calls for antitrust actions against stores employing this marketing tactic (Simons 1989, Sargent 1993, Edlin 1997). Yet, the view that price-matching guarantees facilitate collusion is rarely shared by industry experts and practitioners. Furthermore, it is not supported by empirical evidence[4] and is beset by some conspicuous inconsistencies, all of which raise the question: Can price-matching guarantees in fact facilitate competition?

In practice, sellers typically embrace this marketing tactic in response to ''heavier competition and a growing bargain consciousness among shoppers'' (Schwadel 1989). The introduction of price-matching guarantees by a store is frequently interpreted by industry observers as the initiation of a price war rather than a signal of price collusion (*Financial Times* 1996, *The Times* 1996). This assertion is supported in many instances by the fact that stores that introduce price-matching guarantees also roll back their prices and typically suffer subsequent loss of profits.[5] Indeed, the favorite examples used by researchers to illustrate how price-matching guarantees can enforce price collusion, Crazy Eddie and ''Nobody Beats the Wiz,'' have subsequently either gone bankrupt or filed for federal bankruptcy protection (*New York Times* 1997).

In this paper, we show that price-matching guarantees can indeed facilitate competition: The expected prices and profits can be strictly lower when all stores adopt price-matching guarantees than when they are not allowed to. This is because the adoption of price-matching guarantees generates not only a competition-dampening effect, which has been recognized in the literature, but also a competition-enhancing effect. This latter effect comes from the fact that price-matching guarantees encourage price search by those consumers who prefer to shop at a particular store but are mindful of saving opportunities. These consumers will have incentives to obtain the rival store's price when their favorite store offers price-matching guarantees to avail themselves of the lowest possible price at their favorite store. As a result, price-matching guarantees reduce the number of purchasers at the store from those consumers who would have paid the full price and thus prompt a store to price more aggressively to bid for more incremental sales. This competition-enhancing effect can more than offset the competition-dampening effect. Thus, our study casts doubt on the advisability of blanket prohibition of price-matching guarantees.

Some recent studies have begun to look into the competitive effects of price-matching guarantees and conclude that they may not be effective in facilitating price collusion. These studies provide some valuable insights into the countervailing factors such as ''has-

[1]For a detailed discussion on the widespread application of price-matching guarantees, see Edlin (1997).

[2]Salop (1986) pointed out that price-matching guarantees can lead to price collusion by removing rivals' incentives to initiate price cuts. Since then, a number of studies have reaffirmed the view in a variety of models. See, for instance, Belton (1987), Doyle (1988), and Zhang (1995).

[3]See Png and Hirshleifer (1987), Lin (1988), and Edlin (1997) for a review of the literature.

[4]Hess and Gerstner (1991) is the only study we are aware of that examines empirically the role of price-matching policy in coordinating and raising retail prices. However, the stores in their study promise only to adjust their future prices to match the lowest-priced supermarket and do not reward consumers with refunds on current or previous sales.

[5]For example, Montgomery Ward & Co. pledged in 1987 for the first time ''to match any other store's advertised price, including sale prices, on any brand name merchandise.'' The company carried and accompanied the policy with permanent price reductions of ''20 percent to 50 percent below last year's prices.'' See *PR Newswire* on February 17, 1989. More recently, Tops Appliance City introduced its low price guarantee policy in 1995 with about 10% price rollbacks for most categories, which apparently contributed to its substantial loss for the year. See Beatty (1995), Halverson (1995), and Veilleux (1996). Many other similar stories are also reported about retailers such as Circuit City and Silo.

sle cost'' and ''price-beating'' that reduce the effectiveness of price-matching guarantees in sustaining supracompetitive prices in a market.[6] However, they offer little to endorse the marketing tactic because they do not, as Edlin (1997) points out, ''identify any benefits.''

Corts (1996) recently has taken a step further by arguing that price competition can indeed become more intense as competing firms adopt price-matching or price-beating policies. However, this can happen only under two rather problematic, yet critical, conditions. First, the sophisticated consumers who take advantage of price-matching guarantees and who do not mind switching stores must have a more inelastic demand than the unsophisticated consumers who ignore price-matching guarantees. Second, if sophisticated consumers incur any hassle cost (however small it might be) to invoke price-matching guarantees, this competitive outcome disappears. More recently, Jain and Srivastava (1998) have used a similar framework to arrive at a similar conclusion.

Our argument relies only on consumer segmentation and on the phenomenon of periodic sales, both of which are common in retail markets. In the next section, we lay out the details of our basic model. The following two sections solve the basic model and analyze the two opposing effects to show that price-matching guarantees can indeed facilitate competition. Finally, we conclude with suggestions for future research.

2. Model

Consider a market consisting of two risk-neutral competing stores, denoted A and B, respectively, each of which sells an identical product at a constant marginal cost. We assume that the marginal costs for both stores are the same and are set to zero without loss of generality.

[6]By introducing ''hassle costs'' that consumers incur to redeem price-matching guarantees, Hviid and Shaffer (1999) show that a market is as competitive with price-matching guarantees as without. Corts (1995) arrives at the same conclusion by expanding a firm's strategy options from merely price-matching to include price-beating.

All consumers in the market buy one unit of the product and have an identical reservation price R, which we normalize to 1. To capture the phenomenon of consumer segmentation without obfuscating our theoretical analysis, we assume that each consumer is characterized by two attributes: store loyalty and search cost for finding price information. In terms of store loyalty, a consumer may or may not have a strong preference for shopping at a particular store. In the former case, a consumer's utility from shopping at his or her favorite store is such that no feasible price difference in the market can induce the consumer to switch stores. In the latter case, a consumer's preference is not so strong, such that the consumer's store choice is predicated on price only.

Not all consumers search for price information. Previous studies have shown that many economic, demographic, and psychological factors determine consumer search behavior (Ratchford 1982, Urbany et al. 1996), and hence imputed search costs vary among consumers. We assume that a consumer's search cost can be low, medium, or high, such that there exist in the market three distinct groups of consumers with qualitatively different search behavior. The search cost in our model is the cost a consumer incurs to find out about a store's price without visiting the store in person. For instance, when buying a TV, a consumer may make phone calls, surf the Internet, browse newspapers, etc., to find out about the price at one store or prices at two competing stores and then visit only one store to complete the shopping.

The consumers with a low search cost are those whose search costs are so low that they choose to become informed of all the prices before they go out to shop. We set search costs for these consumers to zero. The consumers with high search costs are those who never bother to find out about any price before they go out to shop. We set this cost as infinity. The consumers with medium search cost are those who search a little but cannot stand doing it exhaustively. In the context of two stores, these are the people who find out about the price at only one store.[7] We operationalize the search behavior of these consumers by

[7]In a multifirm context, these consumers only search for the prices at a subset of firms.

Table 1 Consumer Segmentation and Segment Size

High Loyalty		Opportunistic loyals (θ)	Loyals (γ)
Low Loyalty	Switchers (α)	Bargain shoppers (β)	
	Low Search Cost	Medium Search Cost	High Search Cost

letting their first search be free and the second infinite.

The cost a consumer incurs in physically visiting a store is assumed to be the same regardless of which store the consumer visits and hence is sunk as far as, say, buying a TV is concerned. We further assume that the consumers with strong store loyalty have higher search costs than those without. This assumption is quite reasonable, as a high search cost can certainly cause strong store loyalty (Stigler and Becker 1977) and price-insensitive consumers tend to have a higher time cost (Narasimhan 1984). This assumption is implemented in our model by assuming that loyal consumers' search costs are either medium or high and the rest either low or medium. Thus, we have four distinct segments in the market, as illustrated in Table 1. We summarize the implied optimal shopping behavior of each segment below.

- *Switchers:* This segment of consumers, α in size, has little store loyalty and does an extensive price search before they shop, i.e., searching price information of both stores. Therefore, they always buy at the store that has the lowest price (Narasimhan 1988, Simester 1997). Price-matching policies have no effect on their purchase behavior.
- *Loyals:* This segment of consumers, with a size of γ, is loyal to one particular store and never bother to search for any price. They always buy from their favorite store whether or not there is a price-matching policy in the market. We assume that half of these consumers are loyal to Store A, the other half to Store B.
- *Bargain Shoppers:* This segment of consumers, with a size of β, has little loyalty but does only a limited search, i.e., gather price information from only one store in the context of our two-store model. Therefore, they will search strategically based on their price expectations. Given that their price expectations are rational, if neither store offers price-matching guarantees, half of these consumers seek price information from each store and compare that price with their price expectation for the other store. They then go to the store with the lowest (expected) price. If only Store A (B) offers price-matching guarantees, all these consumers optimally search for price information from Store B (A) and purchase at A (B) so that they pay the lower price of the two stores. If both stores offer price-matching guarantees, half of these consumers search for price information from one store but purchase at the other. Once again, they all pay the lower price of the two stores.
- *Opportunistic Loyals:* This segment of consumers, θ in size, has a strong preference for one store or another, and hence they always shop at their favorite store. For simplicity, we assume that half of these consumers are loyal to Store A and the other half to Store B. However, they can engage in limited price search. When their favorite store offers price-matching guarantees, they ascertain the price of the rival store and if it is less, they ask their favorite store to match the lower price. This segment is akin to brand-loyal consumers being deal prone and redeeming coupons of their favored brands. There is ample evidence to support its existence in practice (Bawa and Shoemaker 1987, Neslin 1990).

For simplicity, we normalize the number of consumers in the market to one so that the size of each consumer group is the same as the fraction the group represents in the market, or $\alpha + \beta + \gamma + \theta = 1$. If consumers are indifferent between redeeming price-matching guarantees and shopping at the lower-price store, we assume that they will shop at the lower-price store.

Given these four consumer segments, the competing stores play a two-stage game. In the first stage, each store decides simultaneously whether to adopt price-matching guarantees. If Store i chooses to institute price-matching guarantees (or strategy M_i), it commits itself to sell the product in the subsequent stage at the minimum of both listed prices, or $\min\{p_A, p_B\}$, to those consumers who can show evidence of the competing store's price and hence invoke the price-matching guarantee. Those who cannot or do not invoke the price-matching guarantee will pay the listed price. We show elsewhere that our main conclusion is not altered if we allow a store to match its competitor's price automatically, or to beat it.[8] In the second stage, the choice of each store in the first stage is known to all consumers and to both stores. Each store simultaneously decides what price to set, and then consumers search and shop.

Such a two-stage setup is commonly used in the literature on price-matching guarantees. The solution concept we use is the subgame perfection (Selton 1975). We now proceed to derive the subgame-perfect equilibrium for our game by solving the game backwards.

3. Price-Matching Guarantees and Pricing Strategies

Because each store independently chooses whether or not to institute the price-matching policy in the first stage, there are four subgames in the second stage in which the competing stores make their pricing decisions. We now derive the equilibrium in each pricing subgame.

3.1. Neither Store Offers a Price-Matching Guarantee ($\bar{M}_A$, $\bar{M}_B$)

If neither store has instituted price-matching guarantees, for any price a store sets below 1, its loyal consumers $(\gamma + \theta)/2$, including both *loyals* and *opportunistic loyals,* will patronize the store, and all *switchers* (α) will also buy from the store if its price is the lowest. *Bargain shoppers* will optimally search once for a store's price information. They will then compare the actual price they obtain with the expected price of the other store and buy at the store that offers the most expected consumer surplus.

Using the same arguments in Varian (1980) and Narasimhan (1988), we can show that no pure-strategy equilibrium exists in this subgame, but a mixed-strategy equilibrium does. In this mixed-strategy equilibrium, each store periodically runs "sales," as in Varian (1980) and Narasimhan (1988), to compete for the price-sensitive *switchers* and *bargain shoppers.* However, because of the existence of *bargain shoppers,* the mixed-strategy equilibrium in our model is far more difficult to derive than that of the previous models. To facilitate our derivation, we will focus our attention on the symmetric equilibrium in this subgame. In this equilibrium, half of *bargain shoppers* ($\frac{1}{2}\beta$) search each store, and each store's pricing strategy and payoffs are identical. Let $\mathcal{F}^1(p)$ denote the probability that a store's price is below p and let π^1 denote a store's payoffs in this subgame. For simplicity of notation, we also define $H(p) = 1 - \mathcal{F}^1(p)$ as the probability that a store sets a price higher than p. Furthermore, let $m_A = E(p_A)$ and $m_B = E(p_B)$ denote the expected prices for Stores A and B, respectively. Of course, in this symmetrical equilibrium, we must have $m_A = m_B = m$, where m will depend on segment sizes. Then, $H(m) = h$ is implicitly defined, where h is simply the probability that a store charges a price higher than its average price.

The key to solving for the mixed-strategy equilibrium lies in recognizing that the support of a store's price distribution consists of two ranges: (p_b, m) and $(p_n, 1)$, where $p_n = m$ if $\beta = 0$, but $p_n > m$ if $\beta > 0$. The support is not connected when $\beta > 0$, because any price immediately adjacent to the mean price on the high side is always dominated by the mean price and hence cannot be in the price support. We can see the dominance by noting that whenever a store charges a price that is ever so slightly higher than m, it will lose to the rival store all of those *bargain shoppers* who have searched the store's price and hence is better off charging m, the price that *bargain shoppers* expect to get at the rival store. This implies that if a price higher than m is ever set when $\beta > 0$, it must be sufficiently higher than m so that additional profits from loyal customers purchasing at the store can compensate for the loss of *bargain shoppers.* Using the same argument in Varian (1980) and Narasimhan (1988), we can further show that the distribution function defined on the support has no mass point. This implies that we must have $H(m) = H(p_n)$, since the equilibrium probability density for any price $p \in (m, p_n)$ is zero.

To derive the symmetric mixed-strategy equilibrium, we need to make sure that all prices in the support generate the same expected profit. If a store sets a price $p \in (p_n, 1)$, it will sell to one half of the loyal consumers in the market at that price, which amounts

[8] See Chen et al. (2000).

to $[(\gamma + \theta)/2]p$ in profits. It will also sell to all *switchers* at that price if the rival store happens to charge a higher price, which happens with probability $H(p)$. Thus, the store makes an expected profit of $\alpha H(p)p$ from *switchers.* In addition, the store will also sell to one half of *bargain shoppers* who have searched the rival store for price information, and the rival store's price happens to be higher than what these *bargain shoppers* expect to pay at this store (m), which happens with probability h. The expected profit from this segment is then $(\beta/2)h$. By summing up the profits from all these segments, we have

$$p\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \alpha H(p)\right] = \pi^1, \qquad (p_n < p < 1). \quad (1)$$

Similarly, if a store sets a price $p \in (p_b, m)$, it will get the same expected profits from each segment as in the previous case. However, the store will now also sell to the other half of *bargain shoppers* who know the store's below-average price and expect to pay a higher price m at the rival store. Thus, in equilibrium we must also have

$$p\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha H(p)\right] = \pi^1, \qquad (p_b < p < m). \quad (2)$$

Equations (1) and (2) each define a first-order ordinary differential equation, which can be easily solved using the boundary conditions (the regularity conditions) $H(1) = 0$, $H(p_b) = 1$, and $H(m) = H(p_n)$, and also the definition $H(m) = h$. A store's payoffs and price support will be functions of exogenous segment sizes and the implicit parameter h. We have

$$\pi_i^1 = \frac{\gamma+\theta}{2} + \frac{\beta}{2}h,$$

$$m = \frac{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h\right)}{\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha h\right]}, \quad (3)$$

$$p_b = \frac{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h\right)}{\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha\right]},$$

$$p_n = \frac{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h\right)}{\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \alpha h\right]}. \quad (4)$$

Recall that m is simply the expected price for a store and we must have, by definition

$$\int_{p_b}^{m} p\frac{-\partial H(p)}{\partial p}\,dp + \int_{p_n}^{1} p\frac{-\partial H(p)}{\partial p}\,dp.$$

By substituting into this equation the solutions of m, p_n, and p_b and integrating out the right side of the equation, we can obtain the equation below that implicitly defines h,

$$\frac{\alpha}{\left[\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha h\right]} = \ln\left[\frac{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha\right)}{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h + \frac{\beta}{2} + \alpha h\right)}\right] + \ln\left[\frac{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2} + \alpha h\right)}{\left(\frac{\gamma+\theta}{2} + \frac{\beta}{2}h\right)}\right]. \quad (5)$$

If $\beta > 0$, we can use Equation (5) and solve numerically for h. The computation is facilitated by the fact that by definition we have $h \in [0, 1]$. The solution always exists and is unique. Indeed, we can show $0 \le h \le ½$. Then, all other endogenuous variables are determined.

We can readily check that if $\beta = 0$, we have $m = p_n$ so that the two ranges of the price support are connected. Then both the distribution function and a store's payoff converge to those in Narasimhan (1988) as expected. However, for $\beta > 0$, our model extends previous analysis on sales by Varian (1980) and Narasimhan (1988). Our analysis shows that when *bargain shoppers* exist in the market, a store runs either deep-discount sales or small-discount sales to reconcile its conflicting objectives of attracting more *switchers* and capturing more surplus from loyal customers and *bargain shoppers. Bargain shoppers* introduce two opposing incentives in this subgame. On the one hand, they motivate a store to run deep-discount sales (charging a below-average price) to make sure that those *bargain shoppers* who know the store's price are not led by their price expectations to shop at the rival store. This effect is enhanced when there are more *switchers* and fewer loyal consumers in the market.

On the other hand, some *bargain shoppers* know only the rival's price and are led by their price expectations to shop at the store in question. These consumers would motivate the store to charge an above-average price, as these shoppers become captive consumers once they walk into the store. This effect is stronger when there are fewer *switchers* and more loyal consumers in the market. Thus, the role of *bargain shoppers* in this competitive pricing game more closely resembles that of loyal consumers (*switchers*) when there are more (fewer) loyal consumers and fewer (more) *switchers.* This tension of opposing incentives creates an interesting phenomenon in which not all feasible middle-discount ranges are used by a store. This insight can potentially provide a better explanation for the observed phenomenon of sales and serve as a theoretical foundation for more future empirical testing (Villas-Boas 1995).

3.2. Only Store A Offers Price Matching (M_A, $\bar{M}_B$)

If only Store A offers price-matching guarantees, we can again show that no pure-strategy equilibrium exists, but a mixed strategy equilibrium does. In equilibrium, both stores have identical price support from p_b to 1. Furthermore, if q_i denotes Firm *i*'s probability mass at 1, we must have $q_A q_B = 0$, i.e., at most one store can have a probability mass at 1.

To solve for the equilibrium, let $H_A(p) = 1 - \mathcal{F}_A^2(p)$, $H_B(p) = 1 - \mathcal{F}_B^2(p)$, $H_A(1) = q_A$, and $H_B(1) = q_B$. Furthermore, let π_A^2 and π_B^2 denote each respective store's expected payoffs in this subgame. If Store A charges a price p_A, where $p_b < p_A \le 1$, Store A's *loyals,* with a size of $\gamma/2$, will purchase from Store A at that price and the store makes a profit of $(\gamma/2)p_A$ from them. All *switchers* will purchase at Store A when Store B's price is higher than Store A's, which happens with probability $H_B(p_A)$. Thus, Store A makes an expected profit of $\alpha p_A H_B(p_A)$ from *switchers.* All *bargain shoppers* in the market, with a size of β, and all those *opportunistic loyals* who prefer to purchase at Store A, with a size of $\theta/2$, will optimally take advantage of Store A's price-matching policy by obtaining Store B's price information but purchasing at Store A. By doing so, they will pay $\min[p_A, p_B]$ at Store A. Therefore, the expected profit from this group of consumers will be

$$\left(\beta + \frac{\theta}{2}\right)\min[p_A, p_B],$$

which is equal to

$$\left(\beta + \frac{\theta}{2}\right)\left[H_B(p_A)p_A + \int_{p_b}^{p_A} -p_B\, dH_B(p_B)\right].$$

By summing up these segment payoffs, in equilibrium we must have,

$$\pi_A^2 = \left[\frac{\gamma}{2} + \left(\alpha + \beta + \frac{\theta}{2}\right)H_B(p_A)\right]p_A + \left(\beta + \frac{\theta}{2}\right)\int_{p_b}^{p_A} -p_B\, dH_B(p_B). \tag{6}$$

Similarly, if Store B charges a price p_B, where $p_b < p_B \le 1$, Store B's loyal consumers, altogether $\frac{\gamma + \theta}{2}$ in size, will purchase at Store B and pay p_B. At that price, *switchers* will shop at Store B with probability $H_A(p_B)$. Store B will not attract any other consumers. Thus, in equilibrium, we must have

$$\pi_B^2 = \left[\frac{\gamma + \theta}{2} + \alpha H_A(p_B)\right]p_B. \tag{7}$$

We can solve (6) and (7), along with the regularity conditions $H_A(p_b) = 1$, $H_B(p_b) = 1$, and $q_A q_B = 0$, for the unique equilibrium distribution and payoff functions. Let

$$\lambda = \left(\frac{\gamma}{2} + \frac{\theta}{2} + \alpha\right)\left(\frac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} - \left(\frac{\gamma}{2} + \frac{\theta}{2}\right).$$

Depending on whether λ is positive or negative, either Store A or Store B has a mass point on the highest possible price in this market. Then, the payoff functions in this subgame are as follows:

$$\pi_A^2 = \begin{cases} \left(\dfrac{\gamma}{2} + \alpha + \beta + \dfrac{\theta}{2}\right)\dfrac{\dfrac{\gamma + \theta}{2}}{\dfrac{\gamma + \theta}{2} + \alpha} & \text{if } \lambda < 0 \\ \left(\dfrac{\gamma}{2} + \alpha + \beta + \dfrac{\theta}{2}\right)\left(\dfrac{\alpha + \beta + \dfrac{\theta}{2}}{\dfrac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} & \text{if otherwise,} \end{cases}$$

$$\pi_B^2 = \begin{cases} \dfrac{\gamma + \theta}{2} & \text{if } \lambda < 0 \\ \left(\dfrac{\gamma}{2} + \dfrac{\theta}{2} + \alpha\right)\left(\dfrac{\alpha + \beta + \dfrac{\theta}{2}}{\dfrac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} & \text{if otherwise.} \end{cases}$$

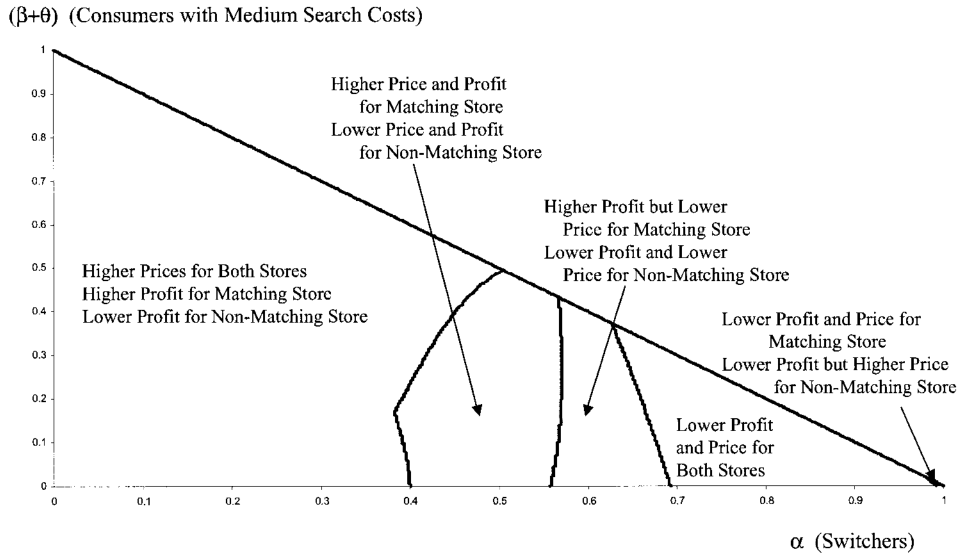
The equilibrium distribution functions, along with expected prices, are complex, and they are given in the appendix. However, all comparative statics can easily be analyzed through numeric computations. Figure 1 illustrates how each store's expected profit and price change as a result of a store unilaterally adopting the price-matching policy.

In this subgame, Store A's price-matching policy enables it to attract all *bargain shoppers* and gain a market share advantage. The existence of *bargain shoppers* is what motivates a store to adopt price-matching guarantees. These *bargain shoppers* come to Store A to purchase not because they expect the store to have the lowest price, but because the store's price-matching guarantees provide the insurance that they will always get the best bargain available in the market. Indeed, because these customers pay the minimum of the two stores' prices, Store A is better off letting the rival store set the price for *bargain shoppers* by charging high prices more often so as to offer them as few bargains as possible. This is the competition-dampening effect, an effect that has been given prominent attention in the literature. This effect is stronger the fewer *switchers* there are in the market.

However, like any other marketing tactic that is designed to appeal to a particular segment of a multisegment market, price-matching guarantees cause their own ''side effect.'' The competition-dampening effect is tempered by the concurrent competition-enhancing effect, an effect that has not been recognized in the literature but could qualitatively change our assessment of price-matching guarantees as a facilitating practice. While price-matching guarantees draw *bargain shoppers* to Store A, they also allow Store A's *opportunistic loyals* to get the same deals as *bargain shoppers.* This unintended ''leakage'' occurs because price-matching guarantees enable these otherwise loyal consumers to benefit from their ability to conduct a limited price search, paying the lowest price available in the market. As a result, the store no longer needs to be as concerned about the discounted purchases of these *opportunistic loyals* when running sales, and hence it is motivated to compete more aggressively for *switchers.* This competition-enhancing effect is stronger when there are more *switchers* and *opportunistic loyals* in the market.

In this subgame, while Store B is always worse off in terms of profitability, Store A is not always better off relative to the equilibrium in which neither store offers price-matching guarantees. Depending on

Figure 1 Unilateral Price Matching*



*The graph is drawn with θ/(β+θ)=50%. Expected prices and profits are used. Comparisons are made relative to the case where neither offers price-matching guarantees.

whether the switching segment is sufficiently large, Store A may not want to offer price-matching guarantees unilaterally because this policy can trigger more intense price competition and enable some loyal customers to have the same deals as what the more price-sensitive *switchers* and *bargain shoppers* get.

All of the analysis carries over naturally to the subgame in which Store B offers to match the rival's price but Store A does not ($\bar{M}_A$, M_B). For brevity, we omit details for this subgame.

3.3. Both Stores Offer Price Matching (M_A, M_B)

If both stores offer price-matching guarantees, we can show that they have an identical price support from p_b to 1 in equilibrium and neither store's price distribution has a mass point. Let $H_A(p) = 1 - \mathcal{F}_A^4(p)$ and $H_B(p) = 1 - \mathcal{F}_B^4(p)$. In equilibrium, we will have $H_A(p) = H_B(p) = H(p)$ and $\pi_A^4 = \pi_B^4 = \pi^4$. This unique equilibrium can be simply derived as follows.

If a store charges a price p, where $p_b < p \leq 1$, the store's *loyals*, $\gamma/2$ in size, will purchase from the store at that price. All *switchers*, α in size, will purchase from the store at that price if the rival store has a higher price, which happens with probability $H(p)$. Those *opportunistic loyals* who prefer to purchase at the store, $\theta/2$ in size, will take advantage of the store's price-matching policy by obtaining price information from the rival store while still purchasing at their favorite store. These consumers will pay $\min(p_A, p_B)$. All *bargain shoppers*, β in total, will also take advantage of the price-matching policies in the market by obtaining the price information of one store but purchasing at the other. They will likewise pay $\min(p_A, p_B)$, and the two competing stores share these consumers equally since they are symmetrical. Thus, in equilibrium, we must have

$$\pi^4 = \left[\frac{\gamma}{2} + \left(\alpha + \frac{\beta}{2} + \frac{\theta}{2}\right)H(p)\right]p + \left(\frac{\beta}{2} + \frac{\theta}{2}\right)\int_{p_b}^{p} -p\, dH(p). \tag{8}$$

We can solve (8), along with the regularity conditions $H(p_b) = 1$ and $H(1) = 0$, for the equilibrium distribution and payoff functions. They are as follows:

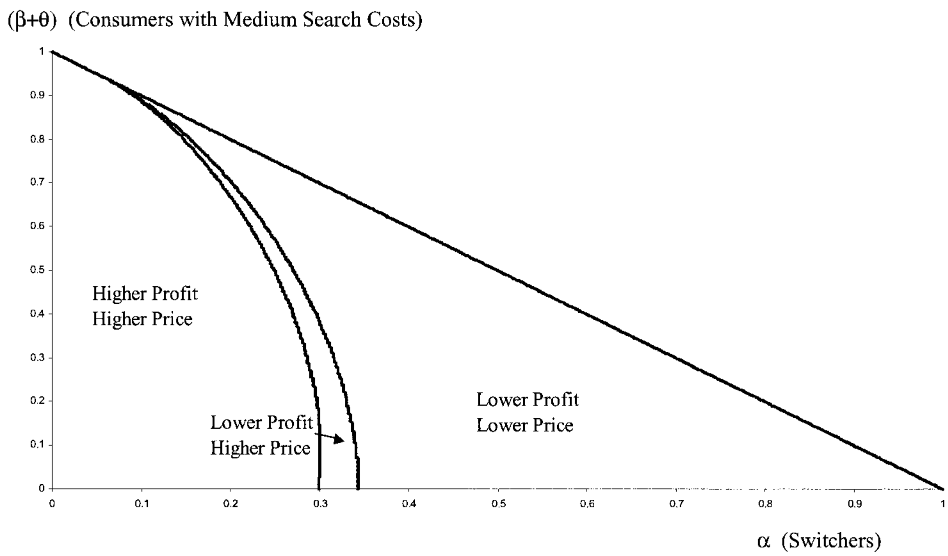
$$\pi^4 = \left(\frac{\gamma}{2} + \alpha + \frac{\beta}{2} + \frac{\theta}{2}\right)\left(\frac{\alpha + \frac{\beta}{2} + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+(\beta/2)+(\theta/2)]\}}, \tag{9}$$

$$p_b = \left(\frac{\alpha + \frac{\beta}{2} + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+(\beta/2)+(\theta/2)]\}}, \qquad \mathcal{F}^4(p) = 1 - \frac{\frac{\gamma}{2}}{\alpha + \frac{\beta}{2} + \frac{\theta}{2}}(p^{-\{[\alpha+(\beta/2)+(\theta/2)]/\alpha\}} - 1), \tag{10}$$

$$E(p) = \frac{\left(\frac{\gamma}{2} + \alpha + \frac{\beta}{2} + \frac{\theta}{2}\right)\left(\frac{\alpha + \frac{\beta}{2} + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+(\beta/2)+(\theta/2)]\}} - \frac{\gamma}{2}}{\frac{\beta}{2} + \frac{\theta}{2}}. \tag{11}$$

em

Figure 2 Competitive Price Matching vs. No Price Matching*



*The graph is drawn with $\theta/(\beta+\theta)=50\%$. Expected prices and profits are used. Comparisons are made relative to the case where neither offers price-matching guarantees.

In this equilibrium, all consumers with medium search costs, consisting of both *opportunistic loyals* and *bargain shoppers* ($\alpha + \beta$ in total), will redeem on price-matching guarantees and they are indistinguishable to a store. That is why Equations (9)–(11) all depend on the sum of those two segment sizes. We can readily verify that the equilibrium distribution and payoff functions converge, respectively, to those in Narasimhan (1988) when $\theta = \beta = 0$.

Relative to the case in which neither store has price-matching guarantees, the competing stores can become better off under competitive price-matching guarantees, as shown in Figure 2. For any given number of consumers who can take advantage of price-

Table 2 First-Stage Game

	$\bar{M}_B$	M_B
$\bar{M}_A$	π^1, π^1	π^3_A, π^3_B
M_A	π^2_A, π^2_B	π^4, π^4

matching guarantees, the stores are better off, in terms of a higher expected price and profit, if the number of *switchers* is sufficiently small and hence the number of *loyals* is sufficiently large. Or, in other words, they are better off when the competition-dampening effect dominates. However, the competition-dampening effect is *not* always dominant. The competing stores can be worse off when there exist a sufficiently large number of *switchers* and a sufficiently small number of *loyals* such that the competition-enhancing effect dominates. Thus, the composition of consumers in the market determines whether price-matching guarantees will facilitate price collusion or competition. Interestingly, as we see from Figure 2, when their prices fluctuate, stores may suffer from a lower profit even when their expected prices rise as a result of competitive price-matching guarantees. In the retailing context where the phenomena of sales is prevalent, this means that even if price-matching guarantees facilitate price collusion, they do not necessarily benefit stores or hurt consumers, as more consumers may be purchasing at low price points. Therefore, the price alone is not the right litmus test to evaluate the welfare implications of price-matching guarantees.

The question, then, is whether this competitive outcome can arise in equilibrium when all stores can freely choose whether to offer price-matching guarantees. We take up this question next by examining a store's strategic choice in the first stage.

4. Price-Matching Guarantees and Competition

The strategic decision for a store in the first stage is to either institute price-matching guarantees (M_i) or not to ($\bar{M}_i$). The payoffs that both stores are facing in the first stage are given in Table 2. Since all variables in payoff functions take on a value between 0 and 1 subject to the constraint of $\alpha + \beta + \gamma + \theta = 1$, we can numerically derive all possible equilibria for our game. As an illustration, in Figure 3 we plot the equilibria for the first-stage game on a two-dimensional plane with α and $(\beta + \theta)$ as axes.

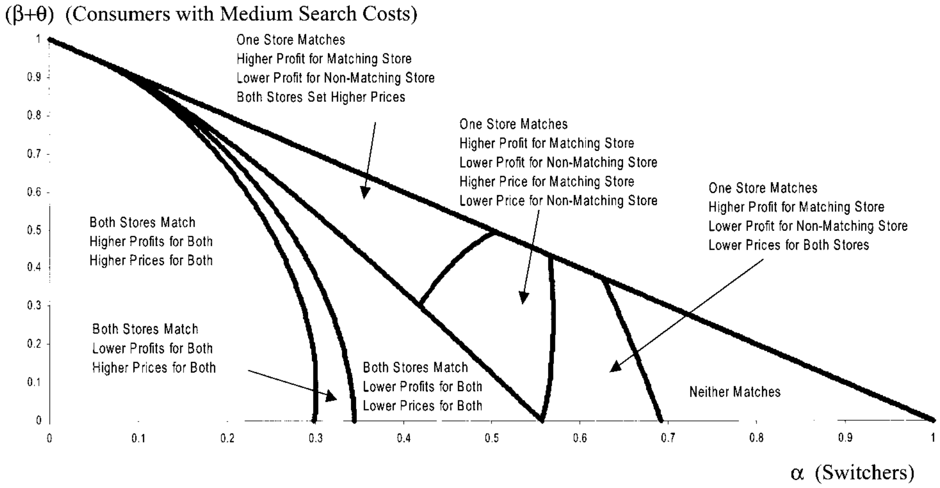
From Figure 3 we can readily see that the competing stores may both choose to offer price-matching guarantees. Indeed, by replotting Figure 3 while varying the proportion of *opportunistic loyals* among consumers with medium search costs, i.e., $\theta/(\beta + \theta)$, we can generalize this conclusion: For any given positive number of consumers who can take advantage of price-matching guarantees, the equilibrium in which both stores offer price-matching guarantees always exists, as long as the number of *switchers* (α) is sufficiently small, or, equivalently, the number of *loyals* (γ) is sufficiently large. A small number of *switchers* and a large number of *loyals* will ensure that a store gains from unilaterally acquiring *bargain shoppers* regardless of whether the rival store also adopts price-matching guarantees. Most important, however, stores are not always better off under competitive price-matching guarantees.

Proposition 1. *The adoption of price-matching guarantees by competing stores can lower average prices and profits rather than raise them.*

Competitive price-matching guarantees can facilitate price competition precisely because of the competition-enhancing effect that we have identified previously. Proposition 1 thus casts serious doubt on the wisdom of outlawing price-matching guarantees. Our analysis further suggests that a store needs to decide judiciously whether or not to embrace price-matching guarantees. The key determinant in a store's decision is, of course, the composition of consumers in a market.

Proposition 2. *For a given number of consumers willing to redeem price-matching guarantees, (1) when the number of loyals is large, price-matching guarantees will be offered by both stores; (2) when the number of switchers is large, no store will offer price-matching guarantees; and (3) when the number of switchers and loyals is about the*

Figure 3 Competitive Equilibrium*



*The graph is drawn with $\theta/(\beta+\theta)=50\%$. Expected prices and profits are used. Comparisons are made relative to the case where neither firm is allowed to offer price-matching guarantees.

same, only one store will offer a price-matching guarantee, and it will have greater profits than the one that doesn't.

Intuitively, the more *switchers* (*loyals*) there are in a market, the more (less) intense the postadoption competition for *switchers* becomes. In other words, more *switchers* (*loyals*) increase (diminish) the competition-enhancing effect of price-matching guarantees and diminish (increase) the competition-dampening effect. Thus, the gain in market share that a store achieves by instituting price-matching guarantees cannot (can) compensate for the loss from lower prices, and hence the store will have little (every) incentive to institute such a policy. This means that price-matching guarantees are not, contrary to what the existing literature suggests, a universal marketing tactic that can be applied profitably to any industry or market.

5. Conclusion

Our analysis in this paper shows that competitive price-matching guarantees need not facilitate collusion, as is commonly alleged in the literature, and that they can indeed intensify price competition. We arrive at this conclusion by incorporating *bargain shoppers* and *opportunistic loyals* into the standard sales-promotion models. With this richer, more realistic consumer composition, price-matching guarantees spawn not only the widely recognized competition-dampening effect whose existence hinges on *bargain shoppers,* but also the competition-enhancing effect arising from the existence of *opportunistic loyals.* When the competition-enhancing effect dominates, as in the case where many consumers are price shoppers (more *switchers*), the competitive force unleashed by price-matching guarantees will bring down the average price level in the market.

The literature on price-matching guarantees in the past went amiss on two accounts, leading to the extreme conclusion that price-matching guarantees only facilitate collusion. First, past studies ignore the ubiquitous phenomenon of sales in retail markets. By ignoring the phenomenon of sales, the past literature is troubled by two awkward conclusions. On the one hand, price-matching guarantees simply remove rivals' incentives to undercut in price and hence also their incentives to run sales. This implies that the adoption of price-matching guarantees in a market will eliminate the phenomenon of sales, which is obviously counterfactual. On the other hand, in equilibrium no consumer actually invokes price-matching guarantees, as each player has incentives to close any price gap in the market. This is obviously false based on our casual observations and our conversations with store managers.

Second, and perhaps more important, the previous literature simply ignores those consumers who prefer to shop at a particular store, but are alert to saving opportunities. These are the consumers who are best positioned and most willing to take advantage of price-matching guarantees. Past marketing research has shown that loyal consumers can also be deal-prone in terms of their search behavior (Blattberg and Neslin 1990), and any reasonable segmentation scheme based on consumer choice strategies must incorporate this segment (Blattberg and Sen 1976, McAlister 1986).

Theoretical research on the subject thus far has been overwhelmingly one-sided, and empirical or experimental studies are conspicuously lacking. We hope that our conclusion will spark further research in both directions, and especially empirical research. A healthy debate will broaden our perspective on an issue of great importance in formulating public policies and in managerial decision making.

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Appendix

For $\lambda < 0$, we have

$$E(p_A^2) = \frac{\gamma + \theta}{2\alpha} \ln \frac{\frac{\gamma + \theta}{2} + \alpha}{\frac{\gamma + \theta}{2}},$$

$$E(p_B^2) = \frac{\left(\frac{\gamma}{2} + \alpha + \beta + \frac{\theta}{2}\right)\frac{\frac{\gamma+\theta}{2}}{\frac{\gamma+\theta}{2} + \alpha} - \frac{\alpha}{\alpha + \beta + \frac{\theta}{2}}\left[\frac{\left(\frac{\gamma}{2} + \alpha + \beta + \frac{\theta}{2}\right)}{\left(\frac{\frac{\gamma+\theta}{2}}{\frac{\gamma+\theta}{2} + \alpha}\right)^{-\{[\alpha+\beta+(\theta/2)]/\alpha\}}} - \frac{\gamma}{2}\right] - \frac{\gamma}{2}}{\beta + \frac{\theta}{2}},$$

$$q_A = 0,$$

$$q_B = \frac{\frac{\left(\frac{\gamma}{2} + \alpha + \beta + \frac{\theta}{2}\right)}{\left(\frac{\frac{\gamma+\theta}{2}}{\frac{\gamma+\theta}{2} + \alpha}\right)^{-\{[\alpha+\beta+(\theta/2)]/\alpha\}}} - \frac{\gamma}{2}}{\alpha + \beta + \frac{\theta}{2}},$$

$$p_b = \frac{\frac{\gamma + \theta}{2}}{\frac{\gamma + \theta}{2} + \alpha},$$

$$\mathcal{F}_A^2(p) = 1 - \frac{\gamma + \theta}{2\alpha}\left(\frac{1}{p} - 1\right),$$

$$\mathcal{F}_B^2(p) = 1 - \frac{\dfrac{\left(\dfrac{\gamma}{2} + \alpha + \beta + \dfrac{\theta}{2}\right)}{\left(\dfrac{\dfrac{\gamma+\theta}{2}}{\dfrac{\gamma+\theta}{2} + \alpha}\right)^{-\{[\alpha+\beta+(\theta/2)]/\alpha\}}} p^{-\{[\alpha+\beta+(\theta/2)]/\alpha\}} - \dfrac{\gamma}{2}}{\alpha + \beta + \dfrac{\theta}{2}}.$$

For $\lambda \geq 0$, we have

$$E(p_A^2) = \left(\frac{\gamma}{2} + \frac{\theta}{2} + \alpha\right)\left(\frac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} \frac{\ln\left(\dfrac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}}}{a}$$

$$+ \frac{\left(\dfrac{\gamma}{2} + \dfrac{\theta}{2} + \alpha\right)\left(\dfrac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} - \left(\dfrac{\gamma}{2} + \dfrac{\theta}{2}\right)}{\alpha},$$

$$E(p_B^2) = \frac{\left(\dfrac{\gamma}{2} + \alpha + \beta + \dfrac{\theta}{2}\right)\left(\dfrac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} - \dfrac{\gamma}{2}}{\beta + \dfrac{\theta}{2}},$$

$$q_A = \frac{\left(\dfrac{\gamma}{2} + \dfrac{\theta}{2} + \alpha\right)\left(\dfrac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} - \left(\dfrac{\gamma}{2} + \dfrac{\theta}{2}\right)}{\alpha},$$

$$q_B = 0,$$

$$p_b = \left(\frac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}},$$

$$\mathcal{F}_A^2(p) = 1 - \left[\left(\frac{\gamma}{2} + \frac{\theta}{2} + \alpha\right)\left(\frac{\alpha + \beta + \frac{\theta}{2}}{\frac{\gamma}{2}} + 1\right)^{-\{\alpha/[\alpha+\beta+(\theta/2)]\}} \frac{1}{ap} - \frac{\gamma + \theta}{2\alpha}\right],$$

$$\mathcal{F}_B^2(p) = 1 - \frac{\frac{\gamma}{2}}{\alpha + \beta + \frac{\theta}{2}}\left(p^{-\{[\alpha+\beta+(\theta/2)/\alpha]\}} - 1\right).$$

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