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Detailing versus Direct-To-Consumer Advertising in the Prescription Pharmaceutical Industry

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Abstract

The pharmaceutical industry has always used sales representatives to target physicians (detailing), who are a key link in sales and market share for prescription pharmaceuticals. Since August of 1997 when the Food and Drug Administration eased the restrictions on Direct-to-consumer advertising (DTCA), there has been a dramatic increase in the use of DTCA by pharmaceutical firms to target end customers (patients). DTCA seems to have two different effects on pharmaceutical markets. The first is to inform patients about the availability of drugs for some ailments, thus expanding the market (constructive). The second is to persuade patients to talk about specific brands when they meet physicians, with the objective of influencing market share (combative). We consider both effects of DTCA in the presence of a detailing program in a competitive environment. We incorporate the dynamics of physician-patient interaction in a game-theoretic model where firms decide on the form of DTCA to adopt (constructive or combative) and then compete in the marketplace by choosing detailing and DTCA levels. We answer four questions: What is the impact of adopting DTCA on competitive intensity? How do optimal detailing levels for a firm change with the adoption of DTCA? How should the DTCA strategy for a firm vary depending on whether it is stronger or weaker in its degree of influence in the physician's office? Finally, under what conditions would competing firms voluntarily decide to pursue constructive DTCA?

(Key Words: Pharmaceutical Marketing, Detailing, Game Theory)

1 Introduction

The pharmaceutical market is characterized by very large promotional expenditures. Traditionally, these promotions have been aimed at physicians who are responsible for prescribing medications to patients. Besides detailing by sales reps to inform physicians, firms have also used advertising in medical journals to reach physicians and are now using eDetailing (electronic detailing), a variant of traditional detailing. In addition to promoting the product to physicians, firms have also promoted their brands directly to patients¹. A change in the Food and Drug Administration's (FDA) regulation in August of 1997 has led to a major shift in this direct-to-consumer advertising (DTCA) of prescription drugs. Prior to this regulatory change, any DTC promotion that contained brand name and medical claims had to provide a "brief summary" of drug effectiveness, its side effects, and any contraindications. Consequently, advertising on television was very expensive. As a result of this change in regulation, firms can now advertise the brand and medical claims without this summary. Firms only need to include a "major statement" of the most important risks and refer patients to other sources for more comprehensive information (Iizuka and Jin, 2005). This has made TV advertising relatively affordable and cost effective. As a result of this change, DTCA in the US pharmaceutical industry has increased from \$800 million in 1996 to more than \$ 4.2 billion in 2005.²

As firms spend huge amounts of money on DTCA, managers wonder what exactly does

¹Henceforth, we will use the term "patient" instead of "consumer" or "customer". It is implied in this context that the patient is the eventual consumer of the product.

²*November 2006 Report* by US Government Accountability Office.

DTCA do (Rosenthal, et al. 2003, Iizuka 2005)? It has been suggested that DTCA can help in expanding the market, in gaining market share, and in improving drug compliance by patients (Wosinska, 2005). Empirical evidence suggests that DTCA has a significant impact on the category or product class sales (Wosinska 2003, Narayanan, Desiraju and Chintagunta 2004, Iizuka and Jin 2005). At the same time, much of pharmaceutical advertising is at the brand level and patients' requests for specific drug brands may influence physicians' prescribing decisions. Studies suggest that patient requests have a substantial impact on physician behavior (Herzenstein et al., 2004). A recent FDA study by Aikin et al(2004) showed that 59% of physicians prescribe in the product class that their patients ask for and 46% prescribe the brand that the patients ask for. However, Iizuka and Jin (2006) show that in the non-sedating antihistamines category, DTCA has no impact on product choice. In addition, though there is positive interaction between DTCA and detailing, this effect is very small.³

⁴ Overall, it seems that DTCA has both market expanding and share increasing effects with significant ambiguity about the relative strengths of these effects. It is important to recognize that market expansion occurs due to *constructive* advertising while share increase occurs due to *combative* advertising. In the pharmaceutical industry context, *constructive* advertising provides information about the disease itself including information on symptoms, possible remedies and side effects with much less emphasis on the brand being advertised. In *combative* advertising, the basic assumption is that the patients know about the particular disease and the currently available drugs, and hence advertising emphasizes the advantages

³The DTCA and detailing interaction effect in Iizuka and Jin (2006) is statistically insignificant.

⁴For a more comprehensive review of the empirical literature in this area, we refer the readers to Manchanda et al. (2005).

of the brand being advertised relative to other competing brands. For example, the early advertisements for Viagra were targeted at informing the patient about the existence of an oral pill for erectile dysfunction (constructive), while the later advertisements by competitors such as Cialis emphasized the “36 hour” nature of the pill which was unique compared to other competing drugs in the market (combative). While recognizing the two effects of advertising is an important task, a greater managerial concern is the problem of resource allocation across detailing and DTCA for a pharmaceutical firm operating in a competitive market. Several questions regarding firm strategies arise in this setting. We list them below:

- The use of DTCA might definitely provide some benefit to a firm in a monopoly setting. However, as with many productive investments, it is less clear that DTCA will benefit firms in a competitive setting. In particular, under what conditions would competing firms get locked in a prisoner’s dilemma when given the option to offer DTCA?
- A related issue is faced by consulting firms (e.g., Health Products Research & ZS Associates) who advise pharmaceutical firms on issues regarding pharmaceutical promotion. These consulting firms reveal that managers in pharmaceutical firms are concerned about the impact of increasing DTCA on the overall promotional spend. Initially, the managers may believe that they can take money out of detailing and move the same to DTCA and experience a net profit gain in the process without increasing the promotional spend. However, analysis of promotional sensitivity data by the consulting firms has revealed that introduction of DTCA may increase the return-on-investment (ROI) of detailing because of synergies. Hence detailing levels should be increased to utilize this phenomenon optimally. This in turn suggests an increase in the promotional ex-

penditure, contrary to what the managers are expecting. Consequently, the important question is: what conditions would cause detailing spend to increase / decrease with the introduction of DTCA?

- Wosinska(2003) claims that given the unequal power of firms in a particular market, firms with a lower degree of influence in the physician's office should not invest in DTCA since the firm stronger in detailing will capture a larger fraction of the market growth due to DTCA. However, the real world throws up exceptions to this rule. For instance, for the past few years, the product with the highest DTCA spend is Lunesta⁵ (indicated for insomnia) which is manufactured by Sepracor. They have marketed this drug successfully with a relatively small sales force as compared to Sanofi-Aventis which produces the major competing product Ambien.⁶ Does this imply that Sepracor's DTCA strategy is incorrect or can we explain this strategy as an equilibrium outcome of a rational decision in a competitive environment?
- Finally, many questions have been raised regarding the negative impact of DTCA, particularly combative DTCA, on patient welfare. The solution that is frequently suggested by various interest groups is to legally enforce constructive DTCA on firms. For example, the American Medical Association currently condones DTCA advertising on a case-by-case basis and recently adopted a policy that calls for DTCA to emphasize patient education about individual diseases rather than specific brands (Sheehan, 2003). But it does not seem that such enforcement is *always* necessary. For example, AstraZeneca has volunteered to pursue balanced and socially responsible advertising

⁵<http://www.pharmalive.com/magazines/medad/view.cfm?articleID=3522>

⁶Boston Business Journal, January 20, 2006

("constructive" advertising) for its products⁷. Under what conditions would competing firms voluntarily decide to pursue constructive DTCA?

We seek an answer to these questions by considering both constructive and combative effects of DTCA in the presence of a detailing program in a competitive environment. We incorporate the dynamics of physician-patient interaction in a game-theoretic model where firms decide on the form of DTCA to adopt (constructive or combative) and then compete in the marketplace by choosing detailing and DTCA levels. The rest of the paper is organized as follows. In Section 2, we review literature related to the problem under consideration. In Section 3, we set up the general model. In Section 4, we describe the procedure for analysis of the equilibrium outcome. Section 5 describes key results when the firms are homogeneous in terms of their degree of influence in the physician's office while Section 6 discusses the main results for heterogeneous firms. All proofs for the propositions in Sections 5 and 6 are provided in Appendix A. In Section 7, we conclude and give directions for future research.

2 Related Literature

The literature on constructive / cooperative advertising versus combative advertising has a long history in marketing. Friedman (1984) posits that advertising can be cooperative to the extent that it benefits all the firms in the industry and not just the firm that is advertising. This occurs when advertising increases consumer awareness of a certain product

⁷<http://www.astrazeneca-us.com/content/aboutAZ/healthIssuesPerspectives/astrazeneca-dtc-advertising.asp>

category without influencing preferences (Marshall 1921; Chen et al 2009). On the other hand, combative advertising is done by a firm with the intention of increasing its market share without expanding the pie or the market (Marshall 1921). Grossman and Shapiro (1984) posit that in markets with differentiated products there is too much constructive advertising. Soberman (2004) shows that constructive advertising allows competing firms to charge either higher or lower prices depending on the level of differentiation between them. The effect of combative advertising is modeled in a variety of ways in the literature (Dixit and Norman 1978, Becker and Murphy 1993, Chen et al 2009). It can increase market share by increasing the perceived value for the product or by redistributing the weights on the product attributes in a manner that is beneficial to the firm. Depending on the cost of advertising, combative advertising can lead to higher or lower levels of price competition. Bass et al. (2005) focus on the optimal allocation of resources across time between generic (constructive) and brand (combative) advertising. We adapt the notion of constructive / combative advertising to the pharmaceutical industry. We focus on optimal allocation of resources across constructive and combative DTCA in a competitive environment where the firms use another form of promotion (detailing) to target the primary decision maker (the physician).

Literature on DTCA in the pharmaceutical market is more recent (e.g., Rosenthal et al. 2003, Narayanan, Desiraju, and Chintagunta 2004, Wosinska 2005). Empirical evidence suggests that DTCA has a significant impact on the category or product class sales (Wosinska 2003, Narayanan, Desiraju and Chintagunta 2004, Iizuka and Jin 2005). However, patient requests have a substantial impact on physician behavior (Herzenstein et al., 2004). Conse-

quently, DTCA not only affects product class sales but also positively impacts market share (Narayanan, Desiraju and Chintagunta, 2004). A positive impact on market share can occur only when a physician decides to incorporate knowledge about a patient's exposure to DTCA into the final prescription decision even though the physician may have enough information to prescribe a product using detailing information alone. This can happen only when the physician perceives DTCA to have a positive impact on patient welfare. Patient welfare has multiple dimensions. The most obvious one is the dimension of clinical fit as evaluated by the physician during physician-patient interaction. However, the medical and public health literature documents several other dimensions of patient welfare. DTCA has a positive impact on patient adherence/compliance to prescription medications (Holmer 2002, Wosinska 2005). DTCA may also lead to better patient outcomes through a mediated placebo effect (Almasi, 2006). We incorporate both category enhancing and share enhancing aspects of DTCA in our model. Further, we model the interaction between DTCA and detailing in the physician's office where the physician makes a final prescription decision based on a combination of clinical fit information provided by detailing and DTCA enabled patient preference information obtained during physician-patient interaction.

Literature is now evolving to analyze the effects of detailing and DTCA on a firm's profits. A recent example is Amaldoss and He (2008) who study the effect of DTCA and detailing on a firm's profits in a competitive setting using an aggregate demand model. On the other hand, we study the strategic interaction between detailing and DTCA and its implications on firm profits through an examination of the dynamics of physician-patient interaction.

3 The General Model

3.1 Modeling Sales

Given that physicians play a central role in the sale of a prescription drug, it is important to understand the impact of detailing on sales even without the use of DTCA. We address this issue first.

Impact of Detailing

Physicians make a decision for a patient based on their perception of clinical fit with respect to a particular product. We also assume that clinical fit has more to do with medical evaluation and is independent of any patient preference metrics such as dosage levels and usage patterns (a patient may be clinically less suited for a particular product as compared to another and yet the patient may prefer that product simply because it is easy to use). Denote the detailing levels of the two firms by α_1 and α_2 . Based on a Hotelling line model of clinical fit, we derive the market share expressions of each firm⁸. Denote the market share of firm 1 by S and assume that firm 1 is the stronger firm without loss of generality. Firm 1's market share is given by:

$$S = \frac{\theta}{2} + \left(\frac{\alpha_1 - \alpha_2}{2} \right) \quad (1)$$

In this specification, θ represents heterogeneity in physician office influence across the two firms and we require $\theta \in [1, 2]$. When θ hits its upper limit, the weaker firm's detailing has no impact on its own market share. We assume that even with zero detailing, the physician

⁸The exact derivation is available in Appendix B.

is able to provide a prescription to all patients based on information gathered through her own efforts. This implies complete market coverage. Thus, the share for product 2 is given by:

$$1 - S = \left(1 - \frac{\theta}{2}\right) + \left(\frac{\alpha_2 - \alpha_1}{2}\right) \quad (2)$$

When the firms are homogeneous in terms of their degree of influence in the physician's office, we simply set $\theta = 1$. Note that we have not used price in determining the share term. In pharmaceutical markets, price setting is a result of many complex factors such as characteristics of the drug, prevalent health care policy and managed care issues. Price competition in pharmaceutical markets usually happens when firms want their drugs to be included in the formulary of various health insurance companies. The latter want the payments for the insurees' treatments to be minimized. Consequently, price competition in the physician's office occurs only when at least one of the competing products is a generic. We restrict attention to competition between two patented products produced by different pharmaceutical firms but used for the same indication. Hence, we assume that the market share outcome in the physician's office is inelastic in price for all further analysis.

Impact of Constructive DTCA

The effect of constructive DTCA is to expand the market. Consider a category that is completely new (such as erectile dysfunction a few years ago) or a category that is not considered life threatening enough for most patients to be aware of the latest possible prescription treatments (such as adult attention deficit disorder). In such a case, the purpose of DTCA is to inform patients about the existence of prescription treatment, thus encouraging them to see a

physician for advice. We normalize the total number of patients to 1. Of these, some patients are aware about the existence of prescription treatment for their condition and will consult a physician on their own irrespective of advertising exposure. We denote these patients by $(1 - \phi)$. The remaining patients can potentially approach a physician if they are exposed to constructive DTCA. These patients are denoted by ϕ . Let δ_i be the DTCA level of firm i , where $i = 1$ and 2 respectively. Let these DTCA levels lie in the range $[0,1]$. We assume that all patients are exposed to advertising from both firms. The higher is the spending by a firm the greater is its DTCA effectiveness.⁹ Further, the content of these advertisements influences whether the effectiveness is constructive or combative. Let k_i be the level of combative content and $1 - k_i$ the level of constructive content in the DTCA level δ_i by firm i . Hence, the constructive DTCA effectiveness is $(1 - k_i) \delta_i$ and the combative DTCA effectiveness is $k_i \delta_i$ for firm i . Since constructive advertising from both firms is about the disease rather than any specific brand, the patient cannot distinguish between such advertising from either firm (assuming that the patient attaches equal credibility to the information provided by both firms). Thus, we can add the advertising intensities of both firms to give the overall constructive advertising intensity which then determines the expected number of patients who approach the physician. All of ϕ will be captured only when the constructive DTCA effectiveness of both firms combined (denoted by the expression $(1 - k_1) \cdot \delta_1 + (1 - k_2) \cdot \delta_2$) reaches one.¹⁰ Denote the total effective market size by M . Given a duopoly with firm 1 at a DTCA level of δ_1 and firm 2 at a DTCA level of δ_2 , the total market for each firm would

⁹For example, higher spending enables a firm to buy more tv spots. This in turn increases the effectiveness of DTCA for the firm. We assume that the choices among tv spots are all of equal quality.

¹⁰This is merely a benchmark and a change in this assumption does not affect the main results.

be:

$$M = (1 - \phi) + ((1 - k_1) \cdot \delta_1 + (1 - k_2) \cdot \delta_2) \cdot \phi \quad (3)$$

When solving for the equilibrium, we need to impose the constraint $(1 - k_1) \cdot \delta_1 + (1 - k_2) \cdot \delta_2 \leq 1$ in order to ensure that the total effective market size M does not exceed 1.

Impact of Combative DTCA

Combative advertising provides brand-specific information such as efficacy, side effects and other miscellaneous information such as mode and frequency of consumption. While the past literature (Narayanan, Desiraju and Chintagunta, 2004) has confirmed the positive impact of DTCA on market share, the exact mechanism that causes this impact merits attention. An important question to answer is: why would the physician change her decision to prescribe a drug based on advertising information provided by a firm to the patient? Does the final decision take into account prior detailing information provided? Physicians are concerned about maximizing patient welfare. Patient welfare has multiple dimensions. The most obvious one is the dimension of clinical fit as evaluated by the physician during physician-patient interaction. However, the medical and public health literature documents several other dimensions of patient welfare. Lack of adherence / compliance to prescribed medication results in a large number of premature deaths and increased hospitalization rates (Loden & Schooler 2000, Sullivan, Kreling & Hazlet 1990). Noncompliance occurs even in the face of severe potential consequences (Cramer 2001). Thus, increasing adherence/compliance to prescribed regimens is an important objective of the physician as well. Physicians believe that patient exposure to DTCA advertising increases their comfort level and improves ad-

herence/compliance (Aikin et al 2004, Holmer 2002, Wosinska 2005). Thus, DTCA can alter the physician's prescription decision if the physician believes that the adherence/compliance benefits outweigh the clinical cost incurred by switching the drug. A similar effect can occur if DTCA improves the placebo effect in patients (Almasi, 2006). The placebo effect is an apparent improvement in health that is not due to any treatment but rather due to the patient's belief that she will improve. This effect is well documented in the medical literature (Beecher, 1955). Borsook & Becerra (2005) provide a extensive review of medical literature in this area. Shiv et al (2005) show that marketing actions can mediate the placebo effect even in a non-medical context. Thus, DTCA can again alter the physician's prescription decision if the placebo benefits outweigh the clinical fit costs.

However, the extent of non-clinical patient benefits may vary depending on patient preferences. Pharmaceutical products may have attributes that are not the same as those that physicians look for in terms of clinical fit. These attributes relate to product characteristics that are directly relevant to patients such as dosage levels, mode of use (pill or injection, chewable or non-chewable), effectiveness patterns (drowsy or non-drowsy, cholesterol reduction through diet absorption or genetic sources) and firm image. We divide the patient population based on the strength of their preferences for certain product attributes. Some patients do not have strong preferences about the attributes of the product they use. Such patients simply want to make a well-informed decision during a physician visit. Consequently, when they meet with a physician, they talk about all brands that they have been exposed to through advertising. Further, the nature of the conversation reveals to the physician that the patient does not have strong preferences regarding a particular product. We

label these patients as “*weak preference*” patients and there are a λ proportion of them in the market. Since all patients are exposed to advertising from both firms, each “*weak preference*” patient talks to the physician about both products. The amount of time and effort spent by a patient on a particular brand increases with the advertising intensity level $k_i\delta_i$ of that brand. Thus, if both firms offer combative advertising of equal intensity, then the “*weak preference*” patient spends an equal amount of time on both brands during the physician-patient interaction. Finally, the physician has to make a prescription decision based on the patient’s conversation and her own knowledge based on detailing. Since the nature of the conversation reveals to the physician that the patient does not have a strong preference for any product, any information provided by the patient complements the information available with the physician and this then impacts the physician’s decision. Specifically, in the context of the Hotelling model of patient fit discussed earlier, the location of the marginal patient (indifferent between product 1 and 2) shifts from S to S' . The extent of the shift depends on relative combative DTCA levels. Here S' gets a prescription for product 1 while $1 - S'$ gets a prescription for product 2. The ratio S' is a result of the combined information provided by detailing and DTCA such that a particular firm’s detailing and DTCA positively impact each other. Consequently, the ratio S' is given by:

$$S' = S + \Delta S_1 - \Delta S_2$$

where ΔS_1 is the increase in share due to combative DTCA of firm 1 while ΔS_2 is the increase in share of firm 2 due to its own combative DTCA (manifests as a decrease in share of firm 1 due to complete market coverage). The expressions for ΔS_1 and ΔS_2 must exhibit the following properties in order to describe a synergistic or complementary relation-

ship between detailing and combative advertising: it should be increasing in S and $1 - S$ respectively (greater the baseline share due to detailing, greater is the impact of combative advertising); it should be increasing in $k_1\delta_1$ and $k_2\delta_2$ respectively (greater a firm's combative advertising intensity, greater is the positive share impact); there should be positive interaction between both baseline share due to own detailing and own advertising level. A suitable set of expressions for ΔS_1 and ΔS_2 are:

$$\Delta S_1 = \frac{1}{2} \cdot k_1\delta_1 \cdot S \quad (4)$$

$$\Delta S_2 = \frac{1}{2} \cdot k_2\delta_2 \cdot (1 - S) \quad (5)$$

Other patients have strong preferences about the attributes of the product they want to use. They form a $1 - \lambda$ proportion of the total market. Such patients initiate a discussion with a physician only if they have been sufficiently exposed to the product for which they have a strong preference such that they are convinced about this preference. They talk with the physician exclusively about that product. The nature of the conversation reveals to the physician that the patient has a strong preference for a particular product. We label such patients as “*strong preference*” patients. Conviction about a product can arise only when the patient understands the major attributes of the product and concludes that these attributes fit her preferences. To incorporate this aspect into the analysis, suppose that the “*strong preference*” customer population $(1 - \lambda)M$ is divided into two equal segments such that each segment has a fundamental preference for one product over the other¹¹. An individual

¹¹ Assuming that these two segments are not equal in size or that they do not include all strong preference patients $(1 - \lambda)M$ does not affect the main insights. For instance, some patients may prefer a benchmark drug offered by a firm that is not a strategic player in our analysis.

patient typically does not have knowledge about this split of the patient population. Within each segment, customers vary in their cognitive capacity to understand product attributes effectively through advertising (Anand & Sternthal 1989, Kohle & Kim 2006). Term the cognitive barrier to understanding product attributes as x . Greater advertising intensity overcomes this barrier and helps patients understand the attributes of a product. Assume that x is distributed uniformly from 0 to 1. A patient of type x understands the attributes of product i if $k_i \delta_i - x \geq 0$. This allows us to derive the number of patients who speak with the physician about products 1 and 2 ($\frac{k_1 \delta_1}{2}$ and $\frac{k_2 \delta_2}{2}$ respectively)¹². Since the nature of the "*strong preference*" patient's conversation reveals to the physician that the patient has a strong preference for a particular product, the physician prescribes the patient-preferred brand.¹³ Thus, in the context of the Hotelling model of patient fit, rather than shifting the location of the marginal patient, a fraction of the patients whom the physician was to prescribe a particular product get the opposite drug because of the revelation of these strong preferences. The flow of patients is split as follows. A "*strong preference*" patient population $(1 - \lambda) M$ arrives. Without a conversation about a particular brand, the physician splits the flow into product 1 prescriptions $S \cdot (1 - \lambda) M$ and product 2 prescriptions $(1 - S) \cdot (1 - \lambda) M$. Cross-flow occurs if the physician-patient conversation reveals a conflict between the physician's original decision (without the conversation) and patient preference. This cross-flow captures the extent of poaching from the competitor's default share via patient persuasion rather than complementarity with detailing information. The precise structure

¹²The exact derivation of these expressions is provided in Appendix B

¹³We could assume that doctor is persuaded only a fraction of the time but assuming that would add another parameter to the model without changing most of the insights.

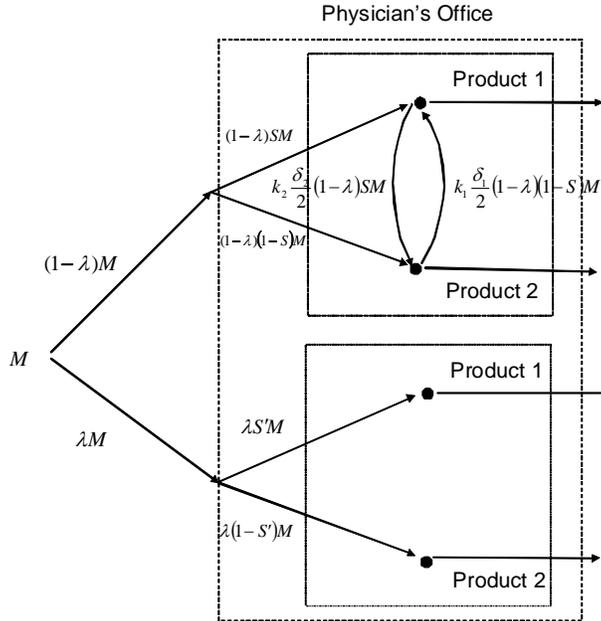


Figure 1: Patient flow in the physician's office

and magnitude of patient flow is described in figure 1. It is pertinent to note that unlike in the "*strong preference*" patient case, there is no cross-flow (poaching) in the case of "*weak preference*" patients. Rather, the original detailing split is modified by the presence of combative DTCA. The difference in flow pattern arises due to a fundamental difference in the nature of interaction across the two patient types: in the "*weak preference*" case, DTCA results in a shift in the location of the marginal patient while in the "*strong preference*" case, the physician switches the product based on knowledge about the patient's strong preferences.

Thus, by incorporating combative DTCA and both types of patients, we can rewrite the

sales equations of the two firms as:

$$DTCSales_1 = (1 - \lambda) M \left[\left(1 - k_2 \frac{\delta_2}{2}\right) S + k_1 \frac{\delta_1}{2} (1 - S) \right] + \lambda M \left[\left(1 + k_1 \frac{\delta_1}{2}\right) S - k_2 \frac{\delta_2}{2} (1 - S) \right] \quad (6)$$

$$DTCSales_2 = (1 - \lambda) M \left[\left(1 - k_1 \frac{\delta_1}{2}\right) (1 - S) + k_2 \frac{\delta_2}{2} S \right] + \lambda M \left[\left(1 + k_2 \frac{\delta_2}{2}\right) (1 - S) - k_1 \frac{\delta_1}{2} S \right] \quad (7)$$

Now that we have the complete sales function, we can incorporate this to build the overall profit function for each firm.

3.2 Modeling Profit

We assume that the two competing firms offer similar products at the same price. For example, Viagra by Pfizer and Cialis by Lilly ICOS are prescription medicines for the same ailment and are priced comparably. It is also common for pharmaceutical firms to decide on promotional levels assuming a price for the product. For a given price p , the objective of the firm then becomes one of balancing marginal revenue due to promotion and marginal cost of promotion. Changing the price affects the margin of a sale and consequently, the optimal promotional level.¹⁴

Next, we specify the costs of promotion for each firm. Each firm incurs a variable cost of DTCA (includes both constructive and combative elements) that increases with the levels of DTCA δ . Further, a convex quadratic specification is assumed for δ . This implies that

¹⁴This is also the sequence of actions commonly recommended by consulting firms (Health Products Research and ZS Associates) in the pharmaceutical market.

the cost of DTCA increases at an increasing rate. One possible reason for this increase can be that higher investments in DTCA are at the cost of taking money away from other projects or borrowing more from the financial markets at a higher rate. A similar quadratic specification is also assumed for detailing where the higher detailing level is coming at the expense of less leisure time for the sales person and hence is costlier. Note that we have always referred to α and δ as the detailing and DTCA levels. We will continue to use this nomenclature, though it should be clear that the cost associated with a detailing or DTCA level is a quadratic function. Consequently, we can derive the profit for each firm, if they offer DTCA:

$$\pi_1 = p \cdot DTCSales_1 - \frac{\alpha_1^2}{2} - \frac{\delta_1^2}{2} \quad (8)$$

$$\pi_2 = p \cdot DTCSales_2 - \frac{\alpha_2^2}{2} - \frac{\delta_2^2}{2} \quad (9)$$

All variables, market shares, market size and price are bounded above and below by 1 and 0 respectively¹⁵.

4 Procedure for Equilibrium Analysis

We now consider the outcome of a duopoly in which each firm decides on an advertising mix (defined by the variables k_1 and k_2) consisting of constructive and combative DTCA and then competes in the market for customers. The variables k_1 and k_2 can lie in the range $[0, 1]$. However, when these variables are in the interior of the range $[0, 1]$, the profit functions given by equations (8) and (9) and corresponding first order conditions become very non-linear

¹⁵The price p used here is price normalized to product value and lies in the range $[0, 1]$.

functions of the key detailing and DTCA variables. Consequently, closed form solutions are not possible for equilibrium detailing and DTCA levels. One way to resolve this issue is to restrict the firms' advertising mix choice to the extreme values. This implies that the variables k_i can only take on integer values 0 or 1 and hence firms offer either constructive or combative advertising only. This allows us to extract the key insights of the model using analytical methods. The interior mix of constructive and combative DTCA can be solved for numerically if required. Given this restriction to integer variables, there are 4 possible outcomes for the first stage of the game: 1) Both firms offer constructive DTCA: (N, N) case, 2) Both firms offer combative DTCA: (M, M) case, 3) The stronger firm (firm 1) offers combative DTCA while the weaker firm (firm 2) offers constructive DTCA: (M, N) case and finally 4) The stronger firm (firm 1) offers constructive DTCA while the weaker firm (firm 2) offers combative DTCA: (N, M) case. Before evaluating which one or more of these cases occur at equilibrium, the equilibrium detailing, DTCA and profit levels for both firms for a given advertising strategy needs to be calculated. Further, to perform comparative statics, a benchmark case where both firms offer only detailing should be evaluated. We label this case as (D, D) . Each of these cases has a unique pure strategy equilibrium in detailing and DTCA levels. The closed form expressions in each case are provided in Appendix A.

Based on the analysis of each of these outcomes in the second stage of the overall game, we are in a position to analyze the equilibrium strategy that firms adopt. With this objective, we lay out the 2 by 2 matrix with the possible firm strategies and the corresponding equilibrium profit payoffs.

<i>Firm 1 / Firm 2</i>	Constructive	Combative
Constructive	$\pi_1^*(N, N), \pi_2^*(N, N)$	$\pi_1^*(N, M), \pi_2^*(N, M)$
Combative	$\pi_1^*(M, N), \pi_2^*(M, N)$	$\pi_1^*(M, M), \pi_2^*(M, M)$

The diagonal entries are the profits to each firm under symmetric DTCA decisions. Equilibrium conditions can be written for each of the four possibilities. As an illustration, a symmetric equilibrium with both firms offering constructive DTCA is observed when neither firm has the incentive to unilaterally deviate from a constructive DTCA strategy. The two conditions that are required for this are:

$$\pi_1^*(N, N) \geq \pi_1^*(M, N) \tag{10}$$

$$\pi_2^*(N, N) \geq \pi_2^*(N, M) \tag{11}$$

Similar conditions can be written for the other 3 outcomes. In order to extract key insights, we focus on the equilibrium for two cases: first, when the firms are homogeneous in their degree of influence in the physician’s office and second, when the firms are heterogeneous in this influence.

5 Key Results: Homogeneous Firms

With firms homogeneous in their degree of influence in the physician’s office, we set $\theta = 1$ and evaluate different equilibrium possibilities. Homogeneity ensures that the set of conditions that determine all possible equilibria reduce to just two in number. The symmetric

equilibrium with both firms offering constructive DTCA requires:

$$\pi_1^*(N, N) \text{ or } \pi_2^*(N, N) \geq \pi_1^*(M, N) \text{ or } \pi_2^*(N, M) \quad (12)$$

Similarly, the symmetric equilibrium with combative DTCA requires:

$$\pi_1^*(M, M) \text{ or } \pi_2^*(M, M) \geq \pi_1^*(N, M) \text{ or } \pi_2^*(M, N) \quad (13)$$

The asymmetric equilibria (M, N) or (N, M) occur when both the above conditions are violated. Characterization of equilibrium outcomes provides straightforward insights: at any given price p , firms are locked in a unique symmetric equilibrium with constructive DTCA when ϕ is high and a unique symmetric equilibrium with combative DTCA when ϕ is low. When the category is new (high ϕ), firms receive greater return through constructive DTCA but when the category matures, firms do not have an incentive to invest in constructive DTCA and would rather compete through combative DTCA. For an intermediate range of ϕ , multiple equilibria may occur implying that firms would both offer either constructive or combative DTCA.

While the equilibrium outcomes are clear enough for a given p and ϕ , it is less clear whether the use of DTCA relaxes or intensifies competition. This relates to the first question posed in the introduction. At high ϕ , both firms prefer constructive DTCA and since this DTCA merely adds to a common pool that benefits all competing firms, the issue of increased competition does not arise. However, at low ϕ , firms prefer combative DTCA. Depending on λ , the proportion of “*weak preference*” patients, this DTCA may either be in synergy with or substitute for detailing. Further, the final impact on profit will also be moderated by price p . Thus, evaluating whether a combative DTCA equilibrium might actually be a

prisoner’s dilemma for the firms is a fruitful exercise. This evaluation requires a comparison between profits in the (N, N) and (M, M) outcomes. To see a clear analytical version of this result, we evaluate the profits of the two firms for these outcomes at $\phi = 0$. At this value of ϕ , there is no untapped market and offering constructive DTCA is of no value to either firm. Thus, the constructive DTCA outcome (N, N) reduces to the pure detailing outcome (D, D) . The next proposition highlights equilibrium properties given that firms still have the option to adopt combative DTCA.

Proposition 1 *At $\phi = 0$, a symmetric combative DTCA equilibrium occurs for all prices.*

At this equilibrium:

Each firm makes higher profit than if combative DTCA were not offered if:

$$0 \leq \lambda < \frac{1}{2} - \frac{(2 - \sqrt{3})}{p}$$

but is locked in a prisoner’s dilemma otherwise.

If the proportion of “*weak preference*” patients is low, combative DTCA and detailing act predominantly as substitutes. Thus, when each firm makes the detailing decision, it does so with the knowledge that a certain fraction of its customers will be poached by the competition through combative DTCA. This allows the firm to lower its detailing investment. However, it recovers lost share by adopting combative DTCA to poach from its competitor and this strategy costs less than the money saved through detailing. Thus, the use of combative DTCA helps to relax harmful detailing competition. However, this effect disappears as the fraction of “*weak preference*” patients increases or when price is too low. As the

fraction of “*weak preference*” patients increases, the synergy between detailing and DTCA increases. However, since this effect occurs for both firms, competition in the physician’s office intensifies and profits are negatively affected. To see the impact of price on this outcome: we observe that the right hand side of the range in proposition 1 is greater than 0 only for $p > 2(2 - \sqrt{3}) = 0.54$. This implies that when the margin is low, even a poaching DTCA strategy does not provide the necessary ROI to increase profits. This allows us to answer the *first* question that we had posed: under what conditions would competing firms get locked in a prisoner’s dilemma, when given the option of offering DTCA? The answer is that for low ϕ , high p and low λ , competing firms offer combative DTCA at equilibrium but do not get into a prisoner’s dilemma. For low ϕ , low p and high λ , a prisoner’s dilemma is observed. A prisoner’s dilemma is never observed for high ϕ since both firms adopt constructive DTCA. Now that we have the equilibrium results with DTCA, we are ready to make an assessment of the impact of DTCA on equilibrium *detailing* levels. This can be done by comparing the equilibrium detailing levels with and without DTCA for different values of the primitive parameters ϕ , p and λ .

Proposition 2 a) *At high ϕ , both firms adopt constructive DTCA. This **increases** the equilibrium detailing levels as compared to the case when no DTCA was offered.*

b) *At low ϕ , both firms adopt combative DTCA. This **decreases** the equilibrium detailing levels when $\lambda < \frac{1}{2}$ and **increases** the equilibrium detailing levels when $\lambda > \frac{1}{2}$ as compared to the case when no DTCA was offered. When $\lambda = \frac{1}{2}$, there is **no change** in detailing levels.*

Suppose that two firms that have traditionally used detailing but not DTCA decide to make

DTCA a part of the promotional mix. Should they expect their detailing to increase or decrease as a consequence of this decision? The above proposition clarifies. We infer that when a product is at an early stage of the product lifecycle, a firm should expect to increase its detailing investment when it introduces DTCA since the type of DTCA used by all competing firms would be constructive. The constructive DTCA will result in more patients walking up to the physician. To reap the benefit of this DTCA effort via increased prescriptions by physicians for its own product, the firm will need to inform the physicians about its product. This is achieved by increasing the detailing effort. This would mean an increase in overall promotional spend as compared to the "no DTCA" case. For a mature product category, the firm should expect all competing firms to use combative DTCA. The effect of combative DTCA is that the patients talk to their physician about the advertised products and this reduces the need for detailing investment only if the majority of patients are of the "*strong preference*" type and consequently DTCA and detailing act as substitutes. However, if a majority of patients are of the "*weak preference*" type, the use of combative DTCA bolsters the effectiveness of a firm's own detailing. The resultant competition forces both firms to increase detailing investment. Thus, the original intuition of marketing managers that scarce promotional dollars can be simply shifted from detailing to DTCA gets validation only in the case of a mature product category with a majority of "*strong preference*" patients. In all other cases, the detailing requirement goes up and so does total promotional expenditure.

The results in proposition 2 enable us to answer the *second* question that we had posed: how does the optimal detailing level change with the introduction of DTCA? When both firms adopt constructive DTCA, the equilibrium detailing level increases. However, when

both firms adopt combative DTCA, detailing level goes down when the majority of patients are of the "*strong preference*" type and goes up when the majority of the patients are of the "*weak preference*" type.

6 Key Results: Heterogeneous Firms

We now turn our attention to the case where firms are heterogeneous in their degree of influence in the physician's office. The closed form solutions for the equilibrium detailing and DTCA levels and corresponding profit functions of each firm for the different cases $((M, M), (N, M), (M, N), \text{ and } (N, N))$ are given in Appendix A. Substituting the closed form detailing and DTCA levels into the profit functions provides analytical expressions for profits for all cases. Equilibrium analysis reveals that general trends are analogous to the homogeneous firms case. For large ϕ (early stage product category), both firms are more likely to offer constructive DTCA while for low ϕ (mature product category), both firms are more likely to offer combative DTCA. However, since firms are heterogeneous, the possibility that firms adopt asymmetric strategies merits special attention. For low ϕ , the incentive for either firm to adopt constructive DTCA is low since there are few untapped patients who can be captured by use of such DTCA. For instance, at $\phi = 0$, the symmetric combative DTCA outcome is the only pure strategy equilibrium. Thus, an asymmetric equilibrium will never be observed for low ϕ . Hence, we analytically investigate the possibility of an asymmetric equilibrium at high ϕ , specifically at $\phi = 1$. There are two possible asymmetric outcomes: (M, N) and (N, M) and we investigate the possibility of both these equilibria at $\phi = 1$ as

a function of θ , the heterogeneity parameter. Further, we investigate how this relationship between asymmetric equilibria and θ is moderated by price p and patient composition λ . We can analytically derive the θ threshold that determines the asymmetric equilibrium for given values of p and λ . We evaluate the asymmetric equilibrium for reasonably separated values of p and λ .¹⁶ The next proposition clarifies these results.

Proposition 3 *Given $\phi = 1$, a unique asymmetric pure strategy equilibrium with the stronger firm offering constructive DTCA and the weaker firm offering combative DTCA may be observed ((N, M) equilibrium). The specific condition required on θ for different p and λ combinations is:*

	$\lambda = 0$	$\lambda = 1$
$p = 1$	$\theta \geq 1.16$	$\theta \geq 1.23$
$p = \frac{1}{2}$	$\theta \geq 1.60$	$\theta \geq 1.77$

The first observation is that a unique asymmetric equilibrium is observed when firms are sufficiently heterogeneous. Further, the only form this asymmetric equilibrium can take is one where the stronger firm offers constructive DTCA while the weaker firm offers combative DTCA: (N, M) equilibrium. The (M, N) equilibrium is never observed. The reason for this is as follows: since the stronger firm has a greater degree of influence in the physician's office, it has strong reasons to invest in constructive DTCA at high ϕ and capture a large fraction of this additional market through detailing. However, the weaker firm can counteract by

¹⁶Values for p and λ different from those selected will lead to different θ thresholds for the asymmetric equilibrium.

either poaching from the stronger firm (via the "*strong preference*" patients) or by increasing own detailing effectiveness through the complementary effect of combative DTCA (via the "*weak preference*" patients) given by equation (5). It chooses to do so when heterogeneity is sufficiently high. The exact heterogeneity threshold at which this occurs is moderated by both price and proportion of patient types.

To understand the impact of the parameters p and λ , we will analyze the incentives of each firm to unilaterally deviate from the (N, M) equilibrium. Although the stronger firm's incentive to choose constructive DTCA is somewhat reduced by the competing firm's ability to capture some of the additional customers through combative DTCA, this attenuation is lower than the corresponding gains at high ϕ . Thus, the stronger firm does not have the incentive to unilaterally deviate. To shed light on the weaker firm's incentive to deviate, we analyze the revenue term which equals *price* \times *share* \times *market size* of the weaker firm in the (N, M) and (N, N) equilibria. In the (N, M) equilibrium, the weaker firm invests in combative DTCA that improves its own share while the stronger firm invests in constructive DTCA that improves the market size. As price increases, the stronger firm's ROI on constructive DTCA increases. Thus, given the stronger firm's constructive advertising strategy, the market size is increasing in price. The weaker firm's ROI on combative DTCA is then super-linear in price since price also affects the market size in addition to margin given the competitor's advertising strategy. Consequently, as price increases, the weaker firm's incentive to poach from the stronger firm and free-ride on the stronger firm's constructive DTCA increases sharply. In the (N, N) equilibrium, both firms invest only in constructive DTCA to increase market size. Since detailing levels are equal, the share term is simply a function of θ

alone. Consequently, the ROI on the weaker firm's (constructive) DTCA is a linear function in price. This difference in ROI of the weaker firm's DTCA as a function of price across the (N, M) and (N, N) equilibria explains the greater likelihood of the asymmetric equilibrium (N, M) at higher prices. This manifests itself as a lower θ threshold for the switchover point from constructive to combative DTCA as p increases.

The λ parameter determines what fraction of combative DTCA is used to increase own detailing effectiveness versus poaching from the competition via patient persuasion. As observed in the homogeneous firms case, increasing own detailing effectiveness intensifies competition in the physician's office and lowers profits (the prisoner's dilemma occurs at higher λ). If λ is high and the weaker firm only uses combative DTCA, its detailing strength moves closer to that of the stronger firm and detailing competition intensifies. This does not occur when λ is low because the "*strong preference*" patients ensure that the weaker firm can poach from the competition, without experiencing equivalent poaching from the stronger firm. Thus, the weaker firm is more likely to switch to combative DTCA when λ is low and this again manifests in terms of a lower θ threshold. While the above results clarify scenarios when we might observe asymmetric equilibria, the heterogeneity of firms also poses questions about DTCA levels in symmetric equilibria. The next proposition highlights these results.

Proposition 4 *a) At high ϕ and low enough $\theta \neq 1$, both firms adopt constructive DTCA. Consequently, the stronger firm offers a higher level of DTCA than the weaker firm ($\delta_1^* > \delta_2^*$) and makes higher profits ($\pi_1^* > \pi_2^*$).*

b) At low ϕ , both firms adopt combative DTCA. Consequently, the weaker firm offers a higher level of DTCA than the stronger firm if $\lambda < \frac{1}{2}$ and a lower level when $\lambda > \frac{1}{2}$. The levels are exactly equal at $\lambda = \frac{1}{2}$ and are the same as if the firms are homogeneous. However, the stronger firm always makes higher profit ($\pi_1^* > \pi_2^*$)

The first part of the proposition discusses an early stage product category (high ϕ). When a firm knows that it is more influential in the physician's office, it can capture a greater share of any market expansion that occurs. Hence, it has a greater incentive to invest in market expansion. Using the same logic, the weaker firm has less incentive to invest in market expansion. The net outcome is that the stronger firm makes a higher profit. This result explains the policy prescription by Wosinska (2003) that firms with weaker influence in the physician's office should invest less in DTCA since a larger part of the category expansion is captured by the stronger firm. Of course, this is valid only for an early stage product category. As the product category matures, the equilibrium advertising strategy for the firms changes from constructive to combative and this results in other outcomes.

The second part of the proposition discusses a mature product category. Suppose a firm knows that its competitor is more influential in the physician's office. It has two different ways of counteracting this effect using DTCA. If the proportion of "weak preference" patients is high (high λ), it uses DTCA to increase the effectiveness of its detailing through the complementary effect of combative DTCA as given in equation (5). However, since the ROI on combative DTCA depends on detailing strength (because of the physician-patient interaction), it can never completely overcome the stronger firm. Consequently, for high λ ,

the weaker firm invests to a lesser extent in combative DTCA as opposed to the stronger firm. If the proportion of "*weak preference*" patients is low (and consequently the proportion of "*strong preference*" patients is high), then the weaker firm has a larger pool of the competitor's patients that it can influence and convert to its product through combative DTCA. Hence, its investment levels in combative DTCA are larger. Using the same logic, the stronger firm has less incentive to invest in combative DTCA for it can convince the physicians to prescribe its product via more productive detailing. This result could be one of the important factors that drives the aggressive use of combative DTCA for Lunesta by Sepracor. This addresses our *third* question: when would weaker firms adopt larger levels of DTCA as compared to stronger firms? The basic answer is that if heterogeneous firms attain an equilibrium with both firms adopting combative DTCA and the proportion of "*strong preference*" patients is high, the weaker firm invests more in DTCA, although it earns lower profits.

Results from propositions 3 and 4 convey an answer to the *fourth* question: when would firms pursue constructive DTCA voluntarily? Clearly, firms are more likely to adopt constructive DTCA during the early phase of the product lifecycle when ϕ is high. Even at high ϕ , one is more likely to see the stronger firm pursuing constructive DTCA. The weaker firm deviates from this strategy when the firms are sufficiently heterogeneous in their degree of influence in the physician's office (high θ), product margin is high (high p) and the proportion of "*strong preference*" patients is high (low λ). Further, even when the weaker firm uses constructive DTCA, it invests less than the stronger firm. This provides some guidance to regulatory authorities on when they might have to spend time and money to direct firms to adopt and

perhaps increase the level of constructive DTCA.

7 Discussion

A large body of empirical literature is developing around the ROI implications of DTCA in the pharmaceutical market. Much of this literature aims at measuring the ROI that DTCA provides when compared to the commonly used promotional tool of detailing. Some effort has gone into addressing issues such as how these elements of the promotional mix might interact and what specific implications these methods of promotion may have in the physician's office. However there is little theoretical or empirical work in this area that formalizes how firms in a competitive environment would allocate resources across detailing and DTCA. Our work formulates a theoretical approach towards answering this problem with the view that the results of our theory may provide empirically testable hypotheses.

We study the impact of DTCA in a competitive environment where firms also use detailing. Based on empirical and anecdotal evidence, we assume two effects that DTCA might have in pharmaceutical markets. These two effects are titled *constructive* and *combative* respectively. While constructive DTCA informs patients about the existence of a product, combative DTCA encourages product purchase by making competing products appear less substitutable. Of course, the physician makes the final decision on the prescription and hence, even if a patient talks to a physician about a particular brand, it is essential that the physician has enough information on the brand through detailing to make a decision in the

brand's favor. We take this factor into account in our model.

Our results reveal different insights depending on the type of DTCA. When firms are homogeneous in terms of degree of influence in the physician's office, they will tend to use both detailing and constructive DTCA when there is a large enough untapped market. However, when the untapped market is small the firms will adopt detailing and combative DTCA. When the equilibrium involves combative DTCA, the firms may get locked in a prisoner's dilemma if the price is too low or the proportion of "*weak preference*" patients is too high. Otherwise, the use of combative DTCA allows firms to relax unhealthy detailing competition. The level of detailing goes up when both firms adopt constructive DTCA. In contrast, the level of detailing can go either up or down when both firms adopt combative DTCA. It goes up when a majority of patients are "*weak preference*" resulting in positive synergies between detailing and combative DTCA. It goes down when a majority of patients are "*strong preference*" resulting in detailing and DTCA substituting for each other. These insights help in guiding managers as to when they should expect a reduction or increase in detailing effort while increasing DTCA spending.

Next, we study the case where there is heterogeneity in degree of influence in the physician's office. If the firms were to offer only constructive DTCA, then the stronger firm ends up spending more on DTCA because it can reap the benefits of market expansion through more productive detailing. However, if both firms were to offer combative DTCA then the weaker firm spends more on DTCA if a majority of patients are of the "*strong preference*" type while the opposite holds when a majority of patients are of the "*weak preference*" type.

The weaker firm realizes that it can overcome its shortcoming in the physician's office by convincing the patients to ask the physicians for its product, particularly when many patients have strong preferences. Further, for an early stage product category, symmetric equilibrium outcomes may no longer hold when firms are sufficiently heterogeneous. In particular, the weaker firm deviates from a constructive advertising strategy when the firms are sufficiently heterogeneous, price / product margin is high and the proportion of "*strong preference*" patients is high. The effects of heterogeneity and the presence of "*weak preference*" patients counterbalance each other. When heterogeneity is high, the weaker firm prefers to switch to combative DTCA. However, when the number of "*weak preference*" patients increases, then a switch to combative DTCA by the weaker firm increases the intensity of detailing competition. To avoid this, the weaker firm prefers to continue with constructive DTCA. These results inform policy makers about situations when external intervention may be required to encourage and increase the use of constructive DTCA.

This research can be extended in many interesting directions. One promising avenue is to study the dynamics of DTCA and detailing in a competitive setting where a branded product competes with a generic product. Further, a study incorporating the role of "branded" generic drugs (example, Pfizer deciding to sell the generic version of Zoloft through its generic division, Greenstone Ltd.) would help in understanding the realignment of detailing and DTCA to deter entry. The generic brand in such a context is analogous to a private label brand in the consumer packaged goods industry.

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