Marketing Science

Strategic Pricing and Detailing Behavior in International Markets

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We study three determinants of the levels of price and detailing effort across geographic markets: the within-market response to each variable, the nature of interfirm strategic interactions both within that market and across markets. We empirically examine the interactions of Prozac, Zoloft, and Paxil across the United States, the United Kingdom, Germany, France, and Italy. Our results indicate that all three factors driving marketing mix interactions are at play in this product category. The U.S. market is less price-sensitive than the European markets. Detailing elasticities are comparable across the United States, Germany, and Italy, while the United Kingdom and France show greater elasticity. For the U.S. market, we find that almost all deviations from Nash pricing and detailing levels are due to within-market interactions. In the U.K. market, deviations from Nash prices come about due mostly to across-market interactions—both with the United States as well as the rest of Europe, whereas deviations from Nash detailing levels are mainly due to across-market interactions with the United States. For Italy, we observe that both within and across-market interactions affect price and detailing levels. Overall, the pattern of interactions makes observed prices more similar across countries than prices implied by the estimated elasticities. This underscores the importance of considering within- and across-market interactions in developing multimarket strategy.

Key words: marketing strategy; international marketing; competition
History: This paper was received June 20, 2001, and was with the authors 7 months for 3 revisions; processed by Scott A. Neslin.

Introduction

The issue of global versus local marketing strategies has long occupied the attention of international marketers. Which of these two approaches (or the numerous hybrid strategies in between) should a company adopt? The answer to this complex question depends on many factors. In this paper we argue that when determining its marketing mix strategy, a firm needs to consider the following three issues: (1) the heterogeneity of aggregate *market response* across markets or regions, (2) the role of *across-market* strategic *interactions* when the same firms compete with each other in several distinct markets, and (3) the role of *within-market strategic interactions* among the firms in any given geographic market.

On one hand, variance in response to marketing mix activities can have important implications, leading to differentiated offerings and targeted marketing efforts. Essentially, heterogeneity in market response favors the local (or the regional) approach. On the other hand, empirical evidence suggests that when companies compete with each other in multiple markets, the level of competitiveness is softened (e.g., Parker and Roller 1997, Shankar 1999). This could imply, for instance, that price competition will be less severe and the levels of marketing effort expended will be less than those under noncooperative behavior. For example, consider two firms competing with each other in two distinct regions of the world, and let the market in one region be more price sensitive than in the other. Adopting a regional strategy, companies may price more aggressively in the more price-sensitive region; however, the fear of reprisal in the less price-sensitive market may temper such aggressiveness. The net result may be a strategy that is "global"—less aggressive pricing in all markets (see Bernheim and Whinston 1990 for a theoretical analysis).

When studying competitive interactions among firms *across* markets, it is also important to account for the nature of the firms' strategic interactions *within* those markets. Measuring across-market interactions without properly accounting for within-market interactions could result in erroneously attributing the estimated strategic interactions to effects of across-market interactions, when in reality they are a reflection of how firms interact within specific markets.

In this paper we empirically explore the above three factors by examining 12 years of data from five major geographic markets: the United States, the United Kingdom, Germany, France, and Italy— on the marketing mix interactions of three brands in the SSRI[1] subcategory of the antidepressant market. We consider Prozac, Zoloft, and Paxil, which are the main competitors in this market. In our context, across-market interactions refer to interactions of these brands across the five geographic markets.[2] The strategic variables we focus on are price and detailing. Our analysis is intended as a starting point for academics and practitioners who are contemplating the global marketplace.

More specifically, on the demand side we estimate the response of brand sales to marketing mix activities in each geographic market. The elasticity estimates obtained enable us to identify heterogeneity across markets in their responsiveness to marketing activities. On the supply side we study the strategic pricing and detailing behavior of firms across markets. We assume that each firm maximizes profits from its brand across all geographic markets.[3] We assume that the pricing and detailing behavior within a market depends not only on the nature of demand but also on two sets of interactions: (1) the nature of interfirm interactions *within* that market, and (2) the nature of these interactions *across* markets. We then estimate both sets of interactions from the data to determine which of the two, if any, has an impact on the strategic behavior of firms. Each firm sets its price and detailing levels accounting for the market response and the behavior of the other firms.

Section 2 discusses the drivers of pharmaceutical pricing across markets with implications for our empirical analysis. Section 3 reviews the relevant empirical research on pricing and detailing in pharmaceutical markets. We then discuss our model, the data, and estimation-related issues. Results of our analysis are in the penultimate section, and the final section concludes the paper.

[1] Selective serotonin reuptake inhibitor drugs.

[2] Although the firms studied in our analysis also compete in multiple product categories, those data are not available to us (see Shankar 1999 for such a study). To check whether this might be a major problem, we computed the percentage of each firm's revenues coming from their antidepressant brands. We found that Prozac accounted for 28% of Eli Lilly's revenues in 1999, Zoloft accounted for 11% of Pfizer's revenues, and Paxil accounted for 13% of Smith Kline's revenues. While these large proportions could mitigate the effects of cross-category interactions, future research needs to explore this issue.

[3] It is important to note that the analysis of strategic pricing/detailing does not require the assumption of profit or revenue maximization, per se. However, the exact functional form of the firm's behavior is derived based on this assumption.

Pricing in Pharmaceutical Markets and Empirical Implications

The pharmaceutical market is driven by the five Ps: pharmaceutical companies, payers (e.g., insurance firms), providers, patients, and public policy. Pricing in this market tends to be extremely complex. Firms base their pricing decisions on the therapeutic benefits provided to patients, competitive pressures, internal objectives, and government regulation (Kolassa 1997). The extent to which each of these factors influences prices varies across products and geographic markets. While incorporating all these factors is beyond the scope of this paper, it is important to check whether the analysis can account for the effects of these factors.

1. The End Consumer Seldom Pays for the Product, So Why Are Prices Relevant?

Prices set by firms influence organizations such as HMOs (in the U.S. market), which determine the approved list of drugs to be prescribed by affiliated doctors ("formularies").[4] Hence, they influence doctors' prescribing behavior, thereby affecting demand. We do not have information on any price agreements between HMOs and pharmaceutical firms because we observe only average prices charged by manufacturers in the market. *In the estimation of our demand function, we treat the effects of such organizations as unobserved influences on the demand for each of the products considered; and we allow these unobserved factors to be correlated with the observed prices.* In this way, we account for the influence of such agencies on the sales and prices of the products while estimating the influence of market prices on aggregate demand.

2. Do Firms Use Price as a Strategic Variable?

While there is little argument that firms use detailing as a strategic variable (to build awareness for the product and to influence physicians' prescription behavior), there is considerable evidence that indicates that the same is true for price. Firms have used skimming, penetration, and parity pricing strategies for drugs. For instance, Prilosec (the first proton pump inhibitor) was launched at a substantial premium to existing H2 antagonists. In contrast, Prevacid (TAP's later entry) was launched at a 10% discount to Prilosec; similarly, Sandoz launched Lescol (a cholesterol medication) at half the price of Mevacor (Merck's market leader) and got a significant share of the market. Next, Claritin and Accupril (ACE inhibitor)

[4] Note that the European market does not have formularies. However, governments do maintain "positive" and "negative" drug lists. The positive lists reflect drugs that will be reimbursed, while the negative lists reflect drugs that will not be reimbursed. Some countries have a tiered system, in which some drugs will be reimbursed at higher rates than others. We discuss the role of the government subsequently.

were priced at parity with the market leaders at launch. These examples suggest that price is indeed a strategic variable in pharmaceutical markets.

3. Regulatory Authorities in Europe Have a Greater Influence Over Pricing Decisions

The United Kingdom and Germany are not highly regulated, whereas France and Italy are (Danzon and Chao 2000). There are several different forms of regulation. France, Italy, and Spain use direct price regulation, where government approval is required for the pricing of new products. France sets a manufacturer-specific budget or revenue growth limit that the government negotiates with each manufacturer. Germany, Holland, and Denmark use reference price limits, where a single reimbursement price is set on drugs grouped into a therapeutic cluster. In the United Kingdom, there is rate of return regulation.[5] Governments also use cross-market reference pricing based on prices charged in other countries.

Mitigating the above factors are the following: (a) The United Kingdom allows pricing flexibility, and products are typically introduced first in the U.K. market before other European markets (see Table 2), leading to cross-referencing effects; (b) while governments often use generics to drive down the prices of branded products, in the subcategory data we analyze there is no generic competition; and (c) prices change over time differently for different firms. With these factors in mind, we now outline our expectations regarding the three determinants of pricing:

Market Response. First, the downward pressures on price seem greater in the European market because of the governments' active role there. Further, in the product category we study (i.e., antidepressants), Europeans (particularly Germans) have long used less expensive alternative medications such as St. John's Wort to combat depression. These factors suggest that the European market is likely to be more price sensitive than the U.S. market.

Within-Market Interactions. For pharmaceutical products, the U.S. market is larger than the European market (Table 1) and contributes more to firm profits. This, combined with lower price sensitivity as described above, could motivate firms to be less aggressive on pricing in the U.S. market. Note, however, that in other product categories, firms such as Merck (Vasotec) and Sandoz (Lescol) have successfully resorted to penetration pricing (rather than cooperative pricing) strategies in the U.S. market. Such contrasting forces are likely to apply even in

Europe: The higher price sensitivity in Europe may result in aggressive pricing. However, the higher external pressure to lower prices may give firms a greater incentive to price "cooperatively." Our empirical approach allows us to distinguish a range of within-market interactions among firms, varying from cooperative to aggressive strategies.

Across-Market Interactions. At least three important factors affect the magnitude and sign of the across-market interactions: (1) the administration of the pricing and detailing function at the firm level (see Busse 2000, Haveman and Nonnemaker 2000), (2) the order of entry of brands into markets, and (3) the threat of aggressive pricing in one market on possible punishment by rivals in other markets (the multimarket contact effect). Conversations with employees of one of the firms included in our analysis revealed that the local market affiliate and a global pricing team set prices jointly. This raises the possibility of finding across-market strategic interactions. Next, order of entry could influence across-market interactions via the practice of cross-country reference pricing by certain European governments. Finally, in terms of the threat of retaliation due to multimarket contact, the smaller relative size of the European markets (Table 1) makes it less likely for interactions here to influence marketing mix choices in the U.S. market. However, it does imply that U.S. interactions could influence firms' actions in Europe. By employing an econometric specification that allows a general pattern of across-market interactions, we aim to identify which of these interactions affect prices and/or detailing levels.

Our goal in the above discussion was to provide a basis for the empirical results that may arise. However, it should be clear that there is a need for theoretical work to develop testable propositions in this important area of research.[6]

Previous Empirical Research

Here we discuss papers that estimate the demand functions for branded products in various subcategories of pharmaceuticals (e.g., antihypertensive and antiulcer drugs) and that consider both prices and marketing efforts (e.g., detailing, journal advertising, etc.) of competitors. All these papers focus on oligopolistic competitors but confine their attention to the U.S. market.

Using yearly data for the period 1988–1993, Rizzo (1999) investigates whether detailing increases or

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[5] That is, companies are free to set launch prices as long as return on capital is 17%–21%. The trade press reports that firms often overcome this restriction via creative accounting.

[6] See, e.g., Cabral and Villas-Boas (2001) for a recent analysis of multiproduct oligopolists. Perhaps future theoretical research can extend such work to include both pricing and detailing interactions across markets.

decreases the price elasticity of demand. Detailing affects sales via two routes: The first, the effect of the current period detailing, is captured in the detailing-flow coefficient; the second, the impact of the cumulative detailing level, is captured in the detailing-stock coefficient. In contrast to the findings of Hurwitz and Caves (1988), who provide only indirect evidence that detailing reduces price elasticity (by negatively affecting generic entry), Rizzo shows direct evidence that detailing reduces price elasticity of demand. King (2000) focuses on the impact of marketing on the level of product differentiation in the antiulcer-drug market. He shows that detailing reduces the level of product differentiation among competing products;

in that market and time period. Category sales are a function of category-level marketing activities as well as variables that account for the diffusion of the product over time. The conditional share equation reflects the share of each of the three focal brands in the SSRI subcategory and a fourth "all-other brand," which represents all the other antidepressants available in the market.[7]

Conditional Share Model

The share of brand j in period t is given by the mixed logit model (McFadden and Train 2000): For $j = 1, 2, \ldots, K$,

$$S_{jt} = \int_z \frac{\exp\left(\alpha_j + \beta P_{jt} + \gamma \sqrt{D_{jt}} + \delta \mathrm{OME}_{jt} + SD_t \lambda + \varepsilon_{jt}\right)}{\exp(\alpha_{K+1} + \beta P_{K+1, t} + \varepsilon_{K+1, t}) + \sum_{k=1}^{K} \exp\left(\alpha_k + \beta P_{kt} + \gamma \sqrt{D_{kt}} + \delta \mathrm{OME}_{kt} + SD_t \lambda + \varepsilon_{kt}\right)} f(\Theta) \, d\Theta. \quad (1)$$

consequently, consumer welfare may be enhanced because lowered differentiation leads to a greater level of competitiveness in the market, resulting in lowered prices. This finding contrasts with Rizzo's (1999) observation that detailing tends to diminish price elasticity of demand.

Berndt et al. (2000) address specific aspects of the antidepressant drug market. Using a unique data set—which combines the results from a survey of a panel of over 300 physicians with price, marketing efforts, and quantity data from IMS—they empirically examine the impact of (a) product quality attributes and (b) the variety of these attributes available in the marketplace, on the diffusion of new antidepressant medications in the United States. They find that marketing elasticities with respect to quality measures are significant and product sales are more responsive to physicians' perceptions of side effects than to perceived effectiveness.

Finally, to provide an additional context for the interpretation and validation of our empirical findings, we refer to four meta-analytic studies on market response (price and advertising elasticity) parameters (see Assmus et al. 1984, Farley et al. 1982, Tellis 1988, Farley and Lehmann 1994). Farley and Lehmann (1994) summarize the earlier analyses and provide average values of the elasticity estimates in the United States and Europe. We will refer to these estimates while discussing our empirical results.

Model Formulation

We decompose the sales of each of the focal brands in a given time period and geographic market as the product of category sales and the share of that brand (Leeflang et al. 2000, p. 58). Here category sales (in units) denote the sales of all antidepressants (both the subcategory we consider and other antidepressants)

The first K brands are the focal brands of interest and $K + 1$ is the all-other antidepressants brand. α_j is the intrinsic preference for brand j, $j = 1, 2, \ldots, K + 1$. For identification purposes, we set α_{K+1} to zero, and hence each of the other preferences are relative to that for brand $K + 1$. β is the price sensitivity parameter, P_{jt} is the price of brand j in period t, γ is the detailing sensitivity parameter, D_{jt} is the level of detailing of brand j in period t, δ is the sensitivity of brand share to other marketing investments. Both detailing and OME are measured as the expenditure levels on those instruments. The square-root on detailing allows for diminishing returns to detailing and enables us to study how firms set detailing budgets (discussed later). OME_{jt} is the level of other marketing investments (samples, journal advertising, etc.). SD_t are seasonal dummy variables, and λ is the associated vector of three coefficients (for four seasons). The seasonal effects have to be interpreted as effects relative to those on the all-other brand.

The only available marketing mix variable for the all-other brand is price. We introduce the term $\varepsilon_{K+1, t}$ to capture the effects of unobserved brand and time-specific factors (including other marketing variables) that affect share. The only assumption we make on this term is that it is mean zero. In other words, the mean effect over time of detailing for brand $K + 1$ is absorbed into the intercept term α_{K+1}, with the time-varying component reflected in $\varepsilon_{K+1, t}$. Notice from Equation (1) that we have also introduced the term ε_{jt} for the other K brands. These represent factors, potentially correlated with prices and detailing, that could influence a brand's sales and include (a) the influence

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[7] Note that the country or market subscript c is suppressed for expositional purposes, but all estimated demand parameters are country-specific.

of HMOs and governments, (b) gray market activities, and (c) other factors such as the publication of medical studies, newspaper articles about newly discovered side effects, etc. All these factors are reflected in ε_{jt}, and we assume that this is a mean zero term.[8]

The parameters α_j, β, γ, and δ are not fixed but are draws from some distribution. $\Theta = \{\alpha_j, \beta, \gamma, \delta, j = 1, 2, \ldots, K\}$ denotes the vector of parameters, and $f(\Theta)$ denotes the joint density of the distribution of these parameters. z denotes the region of support of the mixing distribution that results in the choice of brand j. There are three main reasons for the "mixing" of the logit with the distribution of Θ. The first reason is to account for cross-sectional variation stemming from aggregation across heterogeneous decision makers. Medication choice decisions are made via a combination of physicians, patients, and insurance plans. Heterogeneity in these groups is captured via $f(\Theta)$. The second reason is that the mixed logit model does not suffer from the IIA property. A third advantage of the mixed logit model is that the predicted shares can be shown to be arbitrarily close to those obtained from more complex models (e.g., the probit, McFadden and Train 2000). We assume $\Theta \sim \text{MVN}(\underline{\Theta}, \Sigma)$ where $\underline{\Theta}$ and Σ are estimated.

Category Sales Model
Denote by Q_{jt} the sales of brand j in quarter t. Then "category" sales are an aggregation of sales across brands. The category sales in quarter t are given by $CQ_t = \sum_{j=1}^{K+1} Q_{jt}$; and, Q_{jt} is related to S_{jt} as follows. $S_{jt} = Q_{jt} / \sum_{k=1}^{K+1} Q_{kt}$. The category sales level will depend on the prices, detailing, and other marketing activities of all brands in the category. In addition, it would depend on factors such as seasonality (SD_t). To capture possible diffusion effects resulting from the introduction of new brands and category growth, we include linear and nonlinear trend terms (t and t^2) that can be seen as a second-order approximation to some more general specification for diffusion. The IMS data we use in the empirical analysis report a category price for each quarter, which is the share-weighted price of the individual brands. We denote this price as CP_t. Category detailing (CD_t) and other marketing expenditures ($COME_t$) are obtained by summing the values across all brands. The category sales regression model is given as follows.

$$\ln(CQ_t) = \omega + \nu \ln(CP_t) + \rho \ln(CD_t) + \varphi \ln(COME_t)$$
$$+ \sum_{s=1}^{3} \kappa_s SD_{st} + \tau_1 t + \tau_2 t^2 + e_t. \tag{2}$$

ω, ν, ρ, φ, κ_s, τ_1, and τ_2 are parameters to be estimated. e_t is the random error term. Note that category price and detailing are likely to be endogenous, i.e., correlated with the error term. Further, e_t could be correlated with ε_{jt} from Equation (1). We address both these issues in our estimation (please see the section on "Estimation Issues").

Strategic Implications for Pricing and Detailing
Our objective is to understand the nature of pricing and detailing interactions among the three focal brands across the major markets where they compete. By assuming that manufacturers maximize the profits from their brands, we obtain the equations to estimate firms' choices of pricing and detailing levels. The nature of any given interbrand interaction is then recovered as a parameter estimated from the corresponding pricing or detailing equation (see Vilcassim et al. 1999). Based on the assumption of profit-maximizing behavior of firms, each of these equations can be written as a function of costs, the interaction parameters, and the demand parameters. The demand parameters are available from the demand function estimates. With cost estimates, all the interaction parameters can be estimated from the pricing and detailing equations.

We assume that the manufacturer of brand j sets prices and detailing levels in each quarter (t) to maximize the profits it can obtain from that brand across the different markets (c) in which the product is sold. Hence, the firm's objective function can be written as follows.[9]

$$\Pi_{jt} = \sum_{c=1}^{C} \left[(p_{jt}^c - c_{jt}) Q_{jt}^c - D_{jt}^c \right]. \tag{3}$$

In the above equation, Π_{jt} denotes the profits for firm j in time period t, c_{jt} is the cost per unit of brand j, and $Q_{jt} = S_{jt} * CQ_t$. S_{jt} and CQ_t are obtained from Equations (1) and (2). Superscript c refers to the geographic market. Because the demand functions across countries are independent, the firm's first-order conditions for profit maximization are given by the following expressions.

$$\frac{\partial \Pi_{jt}}{\partial p_{jt}^c} = Q_{jt}^c + (p_{jt}^c - c_{jt}) \frac{\partial Q_{jt}^c}{\partial p_{jt}^c} = 0;$$
$$\frac{\partial \Pi_{jt}}{\partial D_{jt}^c} = (p_{jt}^c - c_{jt}) \frac{\partial Q_{jt}^c}{\partial D_{jt}^c} - 1 = 0. \tag{4}$$

If the firms in the market are engaged in Nash-Bertrand behavior, then the terms $\partial Q_{jt}^c / \partial p_{jt}^c$ and

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[8] If any of the factors (a) through (c) above are time *invariant*, then the effects of these factors will be captured via the brand intercepts, α_j.

[9] In principle, detailing (and other marketing expenditures) may have carryover effects. This would require our demand model in (1) to reflect these effects and would also result in a dynamic firm problem. These issues are beyond the scope of this paper.

$\partial Q_{jt}^c / \partial D_{jt}^c$ in the above equation would be Qp_{jt}^{cj} and Qd_{jt}^{cj}, the derivatives of the sales of brand j with respect to the price and detailing of brand j, respectively. However, interfirm interactions can induce deviations from such behavior. To accommodate a range of possible interactions among the brands, we write the derivatives in Equation (4) as follows.

$$\frac{\partial Q_{jt}^c}{\partial p_{jt}^c} = Qp_{jt}^{cj} + \sum_{\substack{k=1 \\ k \neq j}}^{K} \theta_{kj}^{pc} Qp_{jt}^{ck}; \qquad \frac{\partial Q_{jt}^c}{\partial D_{jt}^c} = Qd_{jt}^{cj} + \sum_{\substack{k=1 \\ k \neq j}}^{K} \theta_{kj}^{dc} Qd_{jt}^{ck},$$

(5)

where Qp_{jt}^{ck} has the interpretation of the (standard) derivative of the sales of brand j in country c with respect to the price of brand k in that country, with a similar interpretation for the detailing derivative. The terms θ_{kj}^{pc} and θ_{kj}^{dc} are referred to as interaction parameters for price and detailing, respectively. To help interpret these parameters, we focus on the price parameter. The pricing first-order condition from (4) can be written as follows.

$$p_{jt}^c - c_{jt} = -Q_{jt}^c \div \frac{\partial Q_{jt}^c}{\partial p_{jt}^c},$$

where $\partial Q_{jt}^c / \partial p_{jt}^c$ is given by (5). We know that $Qp_{jt}^{cj} < 0$ and that $Qp_{jt}^{ck} > 0$. So a value of $\theta_{kj}^{pc} < 0$ reduces the value of $\partial Q_{jt}^c / \partial p_{jt}^c$. In other words, the brand j's share becomes *more* sensitive to the price of brand j. Consequently, the firm charges a price lower than it would under Nash-Bertrand behavior. In this case, the interaction between brand j and k is considered "competitive" (relative to Nash-Bertrand). The opposite is the case when $\theta_{kj}^{pc} > 0$. With detailing, we know that $Qd_{jt}^{cj} > 0$ and that $Qd_{jt}^{ck} < 0$. When the interaction parameter θ_{kj}^{dc} is greater than 0, then the demand for brand j is less detailing sensitive leading to lower detailing investments or a more "cooperative" market.[10] Note from (5) that we have assumed that the within-market, cross-instrument interactions are all zero. In other words, $\theta_{kj}^{pd,c}$ and $\theta_{kj}^{dp,c} = 0$ for all c, k, and j. We make this assumption because of a lack of sufficient data to characterize all possible interactions in the market.

[10] Our approach is based on the literature on "conjectural variations." However, we use the interaction parameters neither as an approximation nor as a reduced form of a dynamic model (Corts 1999). Rather, our objective is to study deviations of pricing and detailing behavior from the Nash baseline. This enables us to refer to firm behavior as "cooperative" or "competitive," but in a static and not a dynamic sense. Our choice of terminology—interaction parameters—is to distinguish the interpretation from that typically associated with conjectural variations parameters.

When across-market interactions are also present, the interactions between a firm and its competitors in geographic market z can influence their interactions in market c. To accommodate such interactions, we can rewrite the firm's pricing first-order conditions as follows (with an analogous equation for detailing).

$$\frac{\partial \Pi_{jt}}{\partial p_{jt}^c} = Q_{jt}^c + (p_{jt}^c - c_{jt})\left(Qp_{jt}^{cj} + \underbrace{\sum_{\substack{k=1 \\ k \neq j}}^{K} \theta_{kj}^{pc} Qp_{jt}^{ck}}_{\text{Within-Market Interaction}} \right)$$

$$+ \underbrace{\sum_{\substack{z=1 \\ z \neq c}}^{C}\left((p_{jt}^z - c_{jt})\sum_{\substack{k=1 \\ k \neq j}}^{J} \theta_{kj}^{pzc} Qp_{jt}^{zk} \right)}_{\text{Across-Market Contact Effect}} = 0.$$ (6)

In Equation (6), the within-market interaction term is identical to that in Equation (5) with a similar interpretation for the interaction parameters. We also have interaction parameters, denoted by θ_{kj}^{pzc}, that represent the interaction between brands j and k across markets c and z. If the sales of brand j in market z are very sensitive to the price of brand k in that market (i.e., Qp_{jt}^{zk} is large and positive in sign), then the term θ_{kj}^{pzc} reflects how this sensitivity influences the pricing of brand j in market c. $\theta_{kj}^{pzc} > 0$ indicates that a high level of such sensitivity enables brand j to make a higher level of markup in market c. In this case we say that contact in markets c and z results in more cooperative behavior between brands j and k in market c. The opposite is the case if $\theta_{kj}^{pzc} < 0$. Hence this set of interaction terms captures the effects of across-market contact on strategic pricing behavior. The formulation also allows for asymmetric effects. Contact in markets c and z could result in more cooperative pricing in market c but more competitive pricing in market z. Estimating both sets of interaction parameters, within and across markets, in Equation (6) enables us to distinguish between the effects of intramarket and intermarket interactions of firms.

Overview of the Data
Our data, obtained from IMS, comprise observations in the United States, the United Kingdom, France, Italy, and Germany on Prozac, Zoloft, and Paxil. These molecules are considered as substitutes in prescribing, albeit imperfect ones. There are other medications, including Tofranil, Elavil, Nardil, Parnate, Effexor, Remeron, Nefazadone, Wellbutrin, Zyban, Trazodone, and St. John's Wort, that are not SSRIs. While we do not have the brand-level data for these antidepressants, we have data on the aggregation across these brands (the "all-other" brand in the analysis).

Table 1 Average Sales, Prices, Detailing, and Other Marketing Expenditures of Each Product

	USA	Germany	Italy	U.K.	France
Prozac					
Sales	162.13	2.47	3.65	18.88	32.92
Price	1.62	1.48	0.99	1.18	0.84
Detailing	9.73	0.45	0.66	0.97	1.51
OME	1.61	0.05	0.04	0.24	0.18
Zoloft					
Sales	140.05	1.99	1.77	7.3	9.47
Price	1.59	1.0	0.92	1.40	0.70
Detailing	12.22	0.71	0.15	0.85	1.43
OME	3.0	0.14	0.018	0.28	0.26
Paxil					
Sales	110.46	1.66	4.04	16.70	21.94
Price	1.59	1.48	1.20	1.26	0.65
Detailing	12.21	0.44	0.42	1.06	1.45
OME	2.43	0.14	0.07	0.3	0.26
All other antidepressants					
Sales	851.15	253.37	93.09	182.40	261.44
Price	0.24	0.19	0.27	0.13	0.19

Note. OME refers to other marketing expenditures; sales are in standard dose equivalents (millions); prices, detailing (in millions), and OME (in millions) are in equivalent unadjusted U.S. dollars.

For each brand, the data set tracks in each country, the unit sales (thousands of standard dose units), average price (the average selling price charged by the manufacturer—this is not the retail price), detailing expenditures, and expenditures on other marketing efforts such as advertising in professional medical journals. The data points are in terms of quarterly observations, beginning in the first quarter of 1988 (when Prozac, the first entrant was introduced) and ending in the last quarter of 1999. Descriptive statistics for the data are in Table 1. The U.S. market is about four times as large as the aggregation of the four European markets in terms of unit sales of the three antidepressants, although sales of other antidepressants is almost equal across the two continents.

A possible reason for the lower penetration in Europe is that the drugs were introduced later in the European markets. In Table 2, we provide the introduction timing of the drugs into the different markets. We see from Table 2 that Prozac was indeed introduced into the United States about three quarters prior to its introduction into the European market (specifically in Italy). While Italy is a comparatively small market, the product is launched in the United Kingdom the very next quarter, and the United Kingdom is one of the largest markets in Europe for antidepressants. Turning to Zoloft and Paxil, we find that these brands are introduced earlier in the U.K. market than they are in the U.S. market. However, they are introduced much later into some of the other European countries, potentially resulting in lower penetration rates there.

A second reason for the finding of lower penetration of SSRI antidepressants in the European market could be the marketing activities by the three firms. We find the prices in less regulated markets—Germany and the United Kingdom—to be higher than those in France and Italy. However, prices in the United States are higher than those in the European markets, even relative to the prices of the "all other" brand. A striking difference across markets is in the expenditures on detailing and on other marketing activities, which are three to four times larger in the United States than in Europe as a whole. These argue for a greater penetration of SSRIs in the U.S. market. A third reason for a lower penetration in Europe could be that Europeans, especially in Germany, have long used alternative natural medications such as St. John's Wort to treat depression. This makes it more difficult for allopathic medications, such as those being considered here, to penetrate the market.

Estimation Issues

Methodology

We use the generalized method of moments (GMM) based methods laid out in Berry (1994) and Nevo (2001) to obtain estimates for the parameters of the demand function in Equations (1) and (2). In step 1 of the estimation procedure, we allow each of the five countries to have its own unique demand parameters. In a second step, we estimate the parameters from the pricing and detailing equations from the conditions in (6). We use a two-step procedure, rather than simultaneously estimating the demand and supply parameters, for the following reasons.

First, in terms of its econometric properties, the two-step estimator is unbiased and consistent but not efficient. This is as long as endogeneity is properly accounted for in the estimation of the first-stage demand parameters. The inefficiency occurs because the additional information in the pricing and detailing equations is not exploited in the estimation. While

Table 2 Introduction Timing of the Brands

	USA	Germany	Italy	U.K.	France
Prozac	First quarter, 1988	Second quarter, 1990	Fourth quarter, 1988	First quarter, 1989	First quarter, 1989
Paxil	First quarter, 1993	Third quarter, 1992	First quarter, 1993	First quarter, 1991	First quarter, 1994
Zoloft	First quarter, 1992	First quarter, 1997	Third quarter, 1993	Fourth quarter, 1990	First quarter, 1996

most of the early research in this area focused on simultaneous estimation (Berry et al. 1995), more recent work (Nevo 2001) has increasingly preferred the two-step approach. The reason is that using this approach, any misspecification in the pricing and detailing equations will not contaminate the estimates of the demand parameters. So at a minimum, the demand elasticities and the computed measures obtained will be correct.

Instruments

As the error terms ε_{jt} and e_t in Equations (1) and (2) could be correlated with included variables, e.g., price and detailing, in the model it results in an endogeneity problem. This issue is resolved using GMM—by instrumenting for the endogenous variables. We use two sets of instruments for prices in the estimation. The first set has variables that could potentially drive the costs of producing the drugs and includes the producer price index (PPI) for "preparations, ethical (prescription) psychotherapeutics" from Bureau of Labor Statistics (BLS), as well as the cost for packaging materials. For the European market, PPIs were purchased from Haver Analytics/Eurostat Data Shop, New York. These latter data are defined at the level of "manufacture of pharmaceutical preparations." Because the PPI denotes the "average" price across three classes of drugs in the United States (many more in Europe): minor tranquilizers, major tranquilizers, and antidepressants, and all brands in each class, it may be reasonable to assume that its correlation with the errors in the demand functions for a subcategory of antidepressants is small. In the estimation, we allow these instruments to differentially influence prices of the various brands by interacting them with the brand intercepts in the estimation. Further, we use lagged values of the producer price indices as additional instruments.

The second set of instruments consists of cost measures obtained from the companies' balance sheets. To obtain these cost estimates, we refer to the consolidated balance sheets of the firms manufacturing these pharmaceutical products. We then use the ratio of the cost of sales (from the balance sheet) to revenues as a measure of the marginal cost-to-price ratio.[11] Because each of these firms manufactures multiple products, we are in effect assuming that the ratio of production costs to prices is equal across all drugs. This is not unreasonable, especially because this ratio is not very large in the pharmaceutical industry. In other manufacturing industries such an assumption might be less tenable. The other issue to note is that the balance sheet data for firms consolidates activities across all

countries. To obtain our cost estimates, therefore, we assume that the revenue to cost of sales ratio in the balance sheet will equal the price to cost ratio for our data aggregated across all geographic markets. Then to get the actual cost estimates, we divide the aggregated price data (across all markets) by the balance sheet ratio. With these estimates, we have variation across brands but not across geographic regions. The estimates do vary by quarter. We use these cost estimates for our strategic pricing and detailing analysis as well, and we perform extensive sensitivity analyses there.

To check whether the above two sets are reasonable instruments for prices, we carried out the ancillary regression of the endogenous variable (price) on the entire instrument matrix. The lowest value of R^2 obtained was 0.385 (France). This provided some reassurance that we have reasonable price instruments. We could also use lagged values of the endogenous variables as instruments with the proviso that these would not be appropriate in the presence of serial correlation in the error terms of the category sales and share equations.

For detailing in a given market, we use an index of wages obtained from BLS and from EUROSTATIS-TICS. In addition, we use lagged values of the wage indices as instruments. Note that the use of lagged indices as instruments for price and detailing is not problematic even in the presence of serial correlation in the unobserved attributes as we are not using lagged endogenous variables as instruments in the estimation. To check whether the instruments for detailing are reasonable, we once again ran the ancillary regression. In this case, the lowest value of R^2 obtained was 0.348 (U.K.). While slightly lower than the value for price, this is nevertheless a reasonable level of fit given the nature of data at hand.

The Heterogeneity Distribution

Recall that the set of parameters, $\Theta = \{\alpha_j, \beta, \gamma, \delta, j = 1, 2, \ldots, K\}$ is assumed to be heterogeneous. With three SSRI brands (and an outside good), and three marketing variable effects, this implies estimating three mean parameters and $7 * 6/2 = 21$ covariance matrix parameters. Given the limited amount of data available to us, estimating all these parameters would be infeasible. So we make the following assumptions: (1) Brand preferences are correlated; (2) there is no heterogeneity in the δ parameter (the effect of the "other marketing expenditures" variable); and (3) price and detailing sensitivities are uncorrelated. Further, each of these is uncorrelated with brand preferences. This reduces the number of parameters from 21 to 8 (6 parameters for the covariance matrix of brand preferences and 1 parameter each for the variance in price and detailing sensitivities).

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[11] This item represents costs directly allocated by the company to production, such as material, labor, and overhead.

Results

To facilitate easy access to the various estimation results, we organize the material here into two main sections, each with a number of subparts. In the first section we discuss the variation in market response; here, in addition to discussing the parameter estimates of the conditional share and the category sales equations, we provide estimates of elasticities and returns on investment. In the second section, we discuss the interaction parameters' estimates; first, we indicate how parameter sensitivity to varying production costs is assessed and highlight the general nature of results. Subsequently, under three separate subheadings we discuss within-market interactions, across-market interactions between the United States and Europe, and across-market interactions within Europe. We end the section by assessing the impact of strategic interactions on margins.

Market Response Heterogeneity

Demand Parameters

Table 3 provides the results for each of the geographic markets considered for the conditional share equations. Table 3 indicates that, Prozac has the highest mean intrinsic preference level in three countries: Germany, the United Kingdom, and France. Zoloft is the most preferred in the United States, whereas Paxil comes out on top in Italy.

We find that the mean price coefficient for the U.S. market is smaller than that for each of the European markets. Further, the estimates themselves are comparable in magnitude across the four European countries. The mean detailing effects are all of the correct sign (positive), implying that a higher level of detailing results in a higher conditional share for that brand. We had to drop the other marketing expenditure (OME) variable from the analysis of the U.S. and U.K. markets because it was highly correlated with detailing (correlation > 0.85) in those markets.[12]

Table 3 also provides the estimates of the standard deviation parameters for the estimated heterogeneity distribution. We see from Table 3 that the extent and nature of heterogeneity varies across the different geographic markets. In particular, the U.S. and U.K. markets are characterized by significant preference heterogeneity only, with the former exhibiting heterogeneity in Prozac preferences and the latter in Zoloft preferences. Germany shows preference and price-sensitivity heterogeneity, whereas Italy has preference and detailing-sensitivity heterogeneity. Finally,

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[12] Note that this implies that the detailing elasticities reported subsequently need to be interpreted as reflecting the effects of detailing and OME.

Table 3 Estimates of Mean Parameters (Standard Errors) from Share Equations

Variable	USA	Germany	Italy	U.K.	France
Mean Parameters					
Prozac preference	−1.34	−0.79	−2.68	−0.95	−5.50
	(0.55)	(0.81)	(0.45)	(0.46)	(1.35)
Zoloft preference	−1.3	−3.48	−1.93	−2.27	−7.90
	(0.49)	(1.10)	(0.43)	(1.04)	(3.53)
Paxil preference	−1.51	−2.61	−0.97	−1.03	−6.51
	(0.45)	(1.0)	(0.37)	(0.40)	(2.09)
Price	−1.5	−6.57	−6.25	−4.27	−5.05
	(0.22)	(1.39)	(0.25)	(0.34)	(1.28)
Detailing	0.06	0.73	0.24	0.29	4.17
	(0.02)	(0.20)	(0.25)	(0.18)	(0.53)
Other marketing	*	−0.31		*	0.48
		(0.20)	*		(0.22)
Standard Deviation Parameters					
Prozac	1.72	0.85	2.08	0.67	0.93
	(0.39)	(0.49)	(0.31)	(0.35)	(0.56)
Zoloft	0.56	1.51	0.37	1.79	
	(0.31)	(0.61)	(0.37)	(0.53)	*
Paxil	0.39	1.99	1.20	0.59	
	(0.34)	(0.64)	(0.41)	(0.38)	*
Price	*	2.21			
		(0.51)	*	*	*
Detailing			1.44	0.25	
	*	*	(0.42)	(0.17)	*

Note (a) Detailing scaled by 0.001. (b) For the preference parameters, the standard deviation parameters are the square roots of the diagonal of the covariance matrix of brand preferences; for price and detailing, they are directly obtained from the estimation. (c) Estimates of the seasonal effects are available from the authors; here, for expositional ease, we do not discuss them. Asterisk denotes NOT significant at the 5% level of significance.

France shows little evidence of statistically significant heterogeneity parameters.

The results from the category demand regressions in Table 4 indicate that the effects of marketing activities on the total antidepressant category are quite small. Because the parameters for price, detailing, and OMEs can be directly interpreted as elasticities, we find that the only countries with substantive price effects are the United States and Germany. However,

Table 4 Estimates of Parameters (Standard Errors) from Category Demand Equations

Variable	USA	Germany	Italy	U.K.	France
Mean Parameters					
Intercept	12.3	11.12	11.43	11.87	12.37
	(0.45)	(0.35)	(0.04)	(0.10)	(0.10)
Price		−0.35			−0.09
	*	(0.21)	*	*	(0.05)
Detailing	0.09		0.02		
	(0.04)	*	(0.01)	*	*
Other marketing			−0.02		0.003
	*	*	(0.01)	*	(0.002)

Note. Estimates of the trend terms and seasonal effects are available from the authors; here, for expositional ease, we do not discuss them. Asterisk denotes NOT significant at the 5% level of significance.

even here the effects are not statistically significantly different from zero. For detailing we find the effects for the U.S. and Italian markets to be statistically significant, although small in magnitude for the latter market.

Price and Detailing Elasticities

To get a better understanding of the effects of marketing activities across the five markets, we compute the elasticities corresponding to the estimates in Tables 3 and 4 and report them in Table 5. Table 5 reveals large differences across markets in the effects of price. All the European markets have larger magnitudes of own-price elasticities for all three brands. While there are some differences among the European countries, these differences are not that large. In particular, the own price elasticities for Zoloft and Paxil are quite similar for Germany, Italy, and the United Kingdom, with Prozac's elasticity being comparable in magnitude across Germany and the United Kingdom. Own-price elasticities for France are lower than those for the other European markets. Prozac's own price elasticity is similar for Italy and France. It is

worthwhile contrasting these elasticity estimates with those reported in Farley and Lehmann (1994, p. 119). They report an average price elasticity of −1.96 in the United States and −1.62 in Europe.

Next, for three of the five countries being analyzed (namely, the United States, Germany, and Italy) the own-detailing elasticities are quite comparable in magnitude. The U.K. elasticities are uniformly higher for the three brands when compared to those from the above group. The elasticities from the French market are several orders of magnitude larger than those for the other markets. This could be due to pre-SSRI antidepressants not being actively detailed, resulting in a large marginal value of detailing for the SSRIs. While Farley and Lehmann (1994) do not consider detailing, they report an average advertising elasticity of 0.21 in the United States and 0.31 in Europe. Finally, note that cross-brand elasticities are quite small; this observation is consistent with the magnitude of the sales for all other brands.

Return on Investment

An alternative approach to looking at the own-detailing elasticities above is in terms of a "return on investment" or ROI measure (Association of Medical Publications 2001). For a marketing variable like detailing, this would refer to the average increase in revenues per quarter if that brand invests an additional $1 on detailing. In other words, computing the ROI measure requires translating elasticities into revenue terms. In Table 6, we provide the ROI measures.

Table 6 shows that we have three distinct groups of countries with different levels of detailing ROI. The lowest levels correspond to Germany and Italy, where the values range from $0.56 to $1.79. The next level is for the United States and the United Kingdom, where the range is from $4.51 to $9.13. Both these ranges lie within the bounds discussed in the study conducted by the Association of Medical Publications (2001). The one key outlier appears to be the French market. Consistent with our earlier finding of large detailing elasticities, we find that the ROI for this country ranges from $5.22 to $19.33.

Table 5   Price and Detailing Elasticities

	USA	Germany	Italy	U.K.	France
Price Elasticities					
Prozac own	−1.02	−2.62	−1.70	−2.31	−1.57
Prozac price on Zoloft share	0.11	0.07	0.13	0.19	0.27
Prozac price on Paxil share	0.22	0.12	0.05	0.24	0.22
Zoloft price on Prozac share	0.06	0.03	0.05	0.08	0.05
Zoloft own	−1.17	−2.42	−2.31	−2.86	−1.68
Zoloft price on Paxil share	0.13	0.04	0.04	0.11	0.04
Paxil price on Prozac share	0.08	0.11	0.06	0.18	0.15
Paxil price on Zoloft share	0.09	0.07	0.12	0.19	0.18
Paxil own	−1.24	−2.69	−2.82	−2.85	−1.74
Detailing Elasticities					
Prozac own	0.20	0.17	0.22	0.55	2.43
Prozac details on Zoloft share	−0.02	*	*	*	−0.42
Prozac details on Paxil share	−0.05	−0.01	*	*	−0.35
Zoloft details on Prozac share	−0.02	*	*	*	−0.08
Zoloft own	0.28	0.3	*	*	2.33
Zoloft details on Paxil share	−0.03	*	*	*	−0.07
Paxil details on Prozac share	−0.02	−0.02	*	*	−0.21
Paxil details on Zoloft share	−0.02	*	*	*	−0.25
Paxil own	0.30	0.23	0.32	0.59	2.32

*Denotes NOT significant at the 5% level of significance.

Table 6   Detailing Return on Investment Measures*

	Prozac	Zoloft	Paxil
USA	9.13	5.97	4.51
Germany	1.79	0.89	1.31
Italy	0.58	0.56	1.48
U.K.	8.50	4.58	6.79
France	19.3	5.22	18.4

*The ROI measure for detailing reflects the average increase in revenues per quarter caused by an increase in detailing by $1 from the prevailing level of detailing in each quarter.

The question raised by the above ROI estimates is: Why are firms not spending even more on detailing than they currently are? A potential concern with increasing investments could be that physicians might react negatively to a reduction in time being spent with patients because of the sales calls. A second reason (discussed below) is that firms within markets, by and large, are behaving cooperatively toward each other along the detailing variable. Escalating expenditures, while fruitful in the short run, could result in a competitive backlash that firms may not want to encourage. Based on the heterogeneity in these results, we note that it is difficult to argue for global pricing and detailing strategies for the brands across the markets considered here.

Strategic Interaction Parameters

Some Observations on Our Approach
Recall from Equation (6) that once we have the demand estimates from each market along with the prices, detailing, and the cost estimates, we can estimate the interaction parameters for that market. Two points are worth noting before we present the results of this analysis: (1) Assuming that our costs in Equation (6) are measured with error, to each of the markup equations we add an error term that will be the econometric error in the estimation. Then using the markup equations, the interaction parameters can be estimated. (2) The costs used in this analysis come from balance sheet data. The average estimated costs in U.S. dollars are 0.35 for Prozac, 0.26 for Zoloft, and 0.44 for Paxil. These translate into margins of 67%, 75%, and 58%, respectively. We carried out sensitivity analysis in the range ±$0.15 at 5-cent increments for each brand.

In studying the within and across-market strategic interactions, we are unable to analyze interactions within and across all five countries. Doing so would require estimating 30 parameters for price interactions and 30 parameters for detailing interactions *for each country*. We do not have the observations to accomplish this. Consequently, we impose the following restrictions.

(a) For the U.S. market, we estimate within market interactions and we assume that the across-market interactions are the same for all European countries in their interactions with the United States. This reduces the number of parameters from 30 for each marketing variable to 12.

(b) For the U.K. and Italian markets, we estimate three sets of interactions: within market, interactions with the United States and interactions with the rest of Europe (France, Italy, and Germany combined in the case of United Kingdom and France, Germany, and the United Kingdom in the case of Italy).

(c) We are unable to estimate strategic interactions for France and Germany because of paucity of data.

Overall Results
Table 7 provides the estimates for the interaction parameters for both within- and across-market interactions for price and detailing. The overall conclusions that can be drawn from Table 7 are the following. First, both within- and across-market interactions appear to be playing a role in the pricing and detailing behavior of firms in these product markets. Second, the effects vary across markets and across brands within a market. Third, for the U.S. market, almost all the deviations from Nash pricing and detailing levels are because of within-market interactions. In other words, the interactions among brands

Table 7   Estimates of Interaction Parameters

U.S. Market	Price		Detailing	
	Within U.S.	From Europe	Within U.S.	From Europe
Effect on				
Prozac of Zoloft	−4.34	*	24.5	*
Prozac of Paxil	2.96	*	−9.22	*
Zoloft of Prozac	2.38	*	11.7	*
Zoloft of Paxil	*	*	*	*
Paxil of Prozac	−0.87	*	4.54	*
Paxil of Zoloft	1.63	6.66	3.22	*

U.K. Market	Price			Detailing		
	Within U.K.	From U.S.	From R.O.E.	Within U.K.	From U.S.	From R.O.E.
Effect on						
Prozac of Zoloft	*	*	*	*	2.09	*
Prozac of Paxil	*	*	*	*	*	*
Zoloft of Prozac	*	0.79	2.54	*	1.25	*
Zoloft of Paxil	*	−0.51	−3.17	6.94	−0.80	*
Paxil of Prozac	8.95	2.12	*	*	*	*
Paxil of Zoloft	*	−3.35	4.03	*	*	*

Italian Market	Price			Detailing		
	Within Italy	From U.S.	From R.O.E.	Within Italy	From U.S.	From R.O.E.
Effect on						
Prozac of Zoloft	−12.7	0.38	*	*	0.26	−0.3
Prozac of Paxil	*	*	0.28	*	*	*
Zoloft of Prozac	7.06	*	*	*	*	*
Zoloft of Paxil	*	*	*	*	*	*
Paxil of Prozac	33.4	*	0.49	10.7	0.29	*
Paxil of Zoloft	*	*	*	2.62	*	−1.39

Note. A positive (negative) parameter for price implies that the interaction is such that it serves to raise the markups or margins of a firm above (below) those corresponding to Nash-Bertrand behavior. Similarly, a positive (negative) parameter for detailing implies that the interaction is such that detailing levels are lowered (raised) relative to Nash levels. Asterisk denotes NOT significant at the 5% level of significance. R.O.E. = Rest of Europe. For the United Kingdom this includes France, Germany, and Italy. For Italy, it includes the United Kingdom, France, and Germany.

in the European market have no significant impact on the way in which the same firms price and detail in the U.S. market.

Fourth, in the U.K. market, deviations from Bertrand-Nash prices come about mostly because of across-market interactions—both with the United States as well as the rest of Europe, whereas deviations from Nash detailing levels are mainly because of across-market interactions with the United States. Fifth, in the case of Italy, we observe both within- as well as across-market interactions, although the total number of statistically significant interactions is the same as in the United Kingdom. Sixth, there is an asymmetry in competitive interactions both within and across markets, as well as across marketing activities, i.e., interactions between brands A and B within a geographic market can serve to reduce the margins (detailing levels) for one brand but increase the margins (detailing levels) for the other. Also, while the interaction between A and B within a market can result in an increase in A's margin (detailing levels) in that market, it can also lead to a reduction of A's margin (detailing levels) in a different market.

Within-Market Interactions
Examining the within-market interactions among firms, we note the following. On the price variable, the interactions between Prozac and Zoloft are quite consistent across markets. In particular, while Zoloft behaves competitively toward Prozac (−4.34 in the United States, 0 in the United Kingdom, and −12.7 in Italy), Prozac appears to be behaving cooperatively with respect to Zoloft (2.38 in the United States, 0 in the United Kingdom, and 7.06 in Italy). On the detailing variable on the other hand, both players spend at the Nash level in the United Kingdom and Italy, but spend below that level in the United States. In other words, the firms are behaving cooperatively toward one another on the detailing variable.

The pricing interactions between Prozac and Paxil differ between the U.S. and European markets. In the U.S. market, Paxil behaves cooperatively toward Prozac (2.96) but Prozac behaves competitively toward Paxil (−0.87). However, in both European markets, Paxil's interactions with Prozac lead the latter to make Bertrand-Nash margins. Prozac on the other hand, prices cooperatively with respect to Paxil in those markets (8.95 in the United Kingdom and 33.39 in Italy). On the detailing variable, the interactions in the U.S. market are opposite to that along the pricing variable.[13] In particular, Paxil behaves com-

petitively with respect to Prozac, with the former behaving in a manner such that Paxil has to spend less than its Nash detailing levels. Finally, for Zoloft-Paxil interactions, we find that price and detailing, the two brands behave either consistent with Nash levels or more cooperatively across all three geographic markets.

To summarize the within-market interactions, we find that these interactions are asymmetric within the different brand pairs, they vary across geographic markets, and they also vary across the marketing variables price and detailing (see Putsis and Dhar 1998 for results from grocery products). The idiosyncratic nature of these interactions further reinforces the view that geographic- and product-market analyses need to explicitly allow for these differences.

Across-Market Interactions Between the United States and Europe
From Table 7, we see that interactions within Europe have no influence (with one exception) on pricing and detailing decisions in the U.S. market. We do find, however, that interactions in the U.S. market do seem to have some influence on pricing and detailing in the U.K. and the Italian markets. In the case of the Italian market, across-market interactions in the United States seem to soften competition in the Italian market (all three significant parameters are positive with values of 0.38, 0.26, 0.29). This does lend some credence to the multimarket contact theory that competing in multiple markets tends to soften competition.

The Italian results do not bear out when looking at the effects on U.K. prices and detailing levels. Here we find that of the six statistically significant nonzero parameters, three are positive, and three are negative. Hence across-market interactions can also serve to make firms interact more competitively toward one another. We do, however, find some consistent patterns in these interactions. In particular, the interactions between Prozac and Zoloft are almost symmetric and consistent across the two marketing variables (0, 0.79, 2.09, and 1.25). For these firms, across-market interactions do seem to be softening competitive intensity (multimarket contact effect). For the Prozac-Paxil pair, only one of four (across price and detailing) interaction parameters is statistically significant (2.12), so there is little evidence of across-market interactions in this case (or some evidence of softening competition in the U.K. market). It is the Zoloft-Paxil interactions in the United States that are making the interactions between these two brands more competitive in the U.K. market. Specifically, three of four interactions are negative (−0.51, −3.35, −0.80, 0). Hence, the increased level of competition can be isolated to this brand pair.

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[13] We believe this difference in how firms are competing on price and detailing is an intriguing observation. This could be because price and detailing affect demand via different processes. Previous research (e.g., Desiraju and Moorthy 1997) identified that price and marketing effort have different implications in the context of channel management. More theoretical research is warranted here.

Across-Market Interactions Within Europe

The last sets of interactions we look at are those within the European market. Here the interactions of interest are between the United Kingdom and the rest of Europe (France, Germany, and Italy) and between Italy and the rest of Europe (France, Germany, and the United Kingdom). From Table 7 we see that detailing interactions in the rest of Europe have no effect on detailing levels in the United Kingdom. However, the same is not true about price. For the Prozac-Zoloft pair, across-market interactions raise Zoloft's margins above those corresponding to Bertrand-Nash levels, with Prozac's margins staying at the benchmark Bertrand-Nash levels. Next, the Prozac-Paxil interaction parameters are both zero implying Bertrand-Nash interactions. Finally, we see asymmetry in the Zoloft-Paxil interactions with Zoloft behaving cooperatively and Paxil behaving competitively relative to the benchmark. Taken together with the across-market interactions between the United States and Europe, these results seem to indicate that the Zoloft-Paxil pair accounts for a majority of across-market increase in competitive levels. Finally, for the Italian market, we find all across-market interactions within Europe to be either Bertrand-Nash or cooperative for the price interactions and either Bertrand-Nash or competitive for the detailing interactions. Deviations from Nash are few in this case.

Do Strategic Interactions Make Price-Cost Margins Across Markets More or Less Similar?

Having discussed the individual interaction parameters, we now address the question: Do the within- and across-market interactions make the firms' policies more similar ("global") or less similar ("regional") across markets? In Table 8 we show the price-cost margins for each of the brands in each of the five countries. Two values are shown. The first is the predicted margin. This is the margin obtained based only on the nature of the elasticity structure within market (Table 5) by setting all the interaction parameters (within and across market) to zero. The second is the "actual" margin obtained from the average prices in Table 1 and the assumed marginal costs for each brand. From Table 8 it is clear that in almost all cases (with one exception in the case of France), the actual margins for a given brand across countries are more homogenous than the predicted margins that do not account for the interaction parameters. If pricing were based only on the demand parameters within each market, the resulting prices would look more heterogeneous than they actually are. This provides some evidence that the interaction parameters serve to make pricing more homogenous across markets.

Table 8 Predicted* and Actual Price-Cost Margins (= (Price − Cost)/Price)

	Prozac		Zoloft		Paxil	
	Predicted	Actual	Predicted	Actual	Predicted	Actual
USA	0.98	0.78	0.86	0.84	0.81	0.72
Germany	0.38	0.76	0.41	0.74	0.37	0.70
Italy	0.59	0.65	0.43	0.72	0.35	0.63
U.K.	0.43	0.70	0.35	0.82	0.35	0.65
France	0.64	0.58	0.6	0.63	0.58	0.32

*Predicted refers to the case where all the within- and across-market interaction parameters are set to zero.

Conclusion

In this paper, we focus on firms that compete with each other in multiple international markets. Overall, we find considerable heterogeneity in preferences and market response across markets. This favors a regional approach to strategy. What is interesting, though, is our finding that the regional approach is sometimes tempered by global considerations because of the simultaneous deliberation of competitive interactions within and across multiple markets. This is in the true spirit of a global approach to strategy. Our results indicate that all three factors driving marketing mix interactions are at play in the product market analyzed. The effects of within- and across-market interactions vary across markets and across brands within a market.

We also find an asymmetry in competitive interactions both within and across markets as well as across marketing activities—the interactions between brands A and B within a geographic market can serve to reduce the margins (detailing levels) for one brand but increase the margins (detailing levels) for the other. Also, while the interaction between A and B within a market can result in an increase in A's margin (detailing levels) in that market, it can also lead to a reduction of A's margin (detailing levels) in a different market.

Our data and analysis also reveal some evidence of "home market" advantage for firms. Looking at the raw data, we see that Prozac (from Eli Lilly based in the United States) charges a higher price than Paxil (from Glaxo Smith Kline in the United Kingdom) in the United States, whereas the reverse is the case in the United Kingdom. Another indicator is that firms tend to behave more aggressively toward their competitors in the home market as opposed to overseas markets. In the U.S. market, Paxil behaves cooperatively toward Prozac, but Prozac behaves competitively toward Paxil. However, in the European markets, Paxil's interactions with Prozac lead the latter to make Bertrand-Nash margins. Prozac, on the other hand, prices cooperatively with respect to Paxil in those markets. So, at least on the

pricing variable, Prozac and Paxil seem to be behaving aggressively in their home markets and cooperatively in overseas markets.

Clearly, additional research in this area will be useful. Our finding of differences in the effects of multimarket contact across differentiated brands calls for further theoretical research to explore the conditions under which multimarket contact may not lead to cooperative behavior among competing firms. Next, in addition to the category we study, the companies in our analysis compete in several other product categories. An analysis of the impact of such competition seems to warrant attention. We anticipate that our effort here will help spark further work in this important area of research.

Acknowledgments

References

Assmus, Gert, John U. Farley, Donald R. Lehmann. 1984. How advertising effects sales: A meta-analysis of econometric results. *J. Marketing Res.* **21**(1) 65–74.

Association of Medical Publications. 2001. ROI analysis of pharmaceutical promotion (RAPP): An independent study. Scott A. Neslin, http://www.rappstudy.org.

Berndt, E. R., A. Bhattacharjya, D. N. Mishol, A. Arcelus, T. Lasky. 2000. Variety, order of entry and marketing efforts: An analysis of the diffusion of new antidepressant medications. Working paper, MIT, Cambridge, MA.

Bernheim, D., M. D. Whinston. 1990. Multimarket contact and collusive behavior. *Rand J. Econom.* **21** 1–26.

Berry, Steven T. 1994. Estimating discrete-choice models of product differentiation. *Rand J. Econom.* **25**(2) 242–253.

Berry, Steven T., James Levinsohn, Ariel Pakes. 1995. Automobile prices in market equilibrium. *Econometrica* **63**(4) 841–891.

Busse, M. 2000. Strategic coordination of pricing in the cellular telephone industry. *J. Econom. Management Strategy* **9**(3) 287–320.

Cabral, Luis M. B., J. Miguel Villas-Boas. 2001. Multiproduct oligopoly and Bertrand supertraps. Working paper, University of California, Berkeley, CA.

Corts, K. S. 1999. Conduct parameters and the measurement of market power. *J. Econometrics* **88**(2) 227–250.

Danzon, P. M., L. W. Chao. 2000. Cross-national price differences for pharmaceuticals: How large, and why? *J. Health Econom.* **19** 159–195.

Desiraju, Ramarao, Sridhar Moorthy. 1997. Managing a distribution channel under asymmetric information and performance requirements. *Management Sci.* **43**(12) 1628–1644.

Farley, John U., Donald R. Lehmann. 1994. Cross-national "laws" and differences in market response. *Management Sci.* **40**(1) 111–122.

Farley, John U., Donald R. Lehmann, Michael J. Ryan. 1982. Patterns in parameters of buyer behavior models: Generalization from sparse replication. *Marketing Sci.* **1** 181–204.

Haveman, Heather A., Lynn Nonnemaker. 2000. Competition in multiple geographic markets: The impact on growth and market entry. *Administrative Sci. Quart.* **45** 233–267.

Hurwitz, Mark A., Richard E. Caves. 1988. Persuasion or information? Promotion and the shares of brand name and generic pharmaceuticals. *J. Law Econom.* **31**(2) 299–320.

King, Charles. 2000. Marketing, product differentiation, and competition in the market for antiulcer drugs. Harvard Business School Working Paper Series No. 01-014, Boston, MA.

Kolassa, E. M. 1997. *Elements of Pharmaceutical Pricing*. The Pharmaceutical Products Press, New York.

Leeflang, Peter S. H., Dick R. Wittink, Michel Wedel, Philippe A. Naert. 2000. *Building Models for Marketing Decisions*. Kluwer, Norwell, MA.

McFadden, D. F., K. Train. 2000. Mixed MNL models for discrete response. *J. Appl. Econom.* **15**(5) 447–470.

Nevo, A. 2001. Measuring market power in the ready-to-eat cereal industry. *Econometrica* **69**(2) 307–342.

Parker, P. M., L. H. Roller. 1997. Collusive conduct in duopolies: Multimarket contact and cross ownership in the mobile telephone industry. *Rand J. Econom.* **28** 304–322.

Putsis, W. P., R. Dhar. 1998. The many faces of competition. *Marketing Lett.* **9**(3) 269–284.

Rizzo, John A. 1999. Advertising and competition in the ethical pharmaceutical industry: The case of antihypertensive drugs. *J. Law Econom.* **42** 171–198.

Shankar, Venkatesh. 1999. New product introduction and incumbent response strategies: Their interrelationship and the role of multimarket contact. *J. Marketing Res.* **36** 327–344.

Tellis, Gerald J. 1988. The price elasticity of selective demand: A meta analysis of econometric models of sales. *J. Marketing Res.* **25** 331–342.

Vilcassim, Naufel J., Vrinda Kadiyali, Pradeep K. Chintagunta. 1999. Investigating dynamic multifirm market interactions in price and advertising. *Management Sci.* **45**(4) 499–518.