

# Promotion and Market Share in the Proton Pump Inhibitor Market: A Case Study

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**ABSTRACT.** This case study of the proton pump inhibitor market examines prescription volume, promotional spending, and their interrelatedness between the years 2000 and 2004. Our results show that share of voice and share of market are strongly correlated ( $r^2$  values from 0.79 to 0.91) and that the temporal relationship is clear: share of market follows share of voice. Exogenous market factors such as generic entry and over-the-counter entry disrupt the relationship between share of market and share of voice and influence the decision to advertise. For example, generic entry increased pantoprazole (Protonix®) advertising ( $p < 0.05$ ) while over-the-counter availability decreased rabeprazole (Aciphex®) and pantoprazole advertising ( $p < 0.01$  and  $p < 0.05$ , respectively). In comparing the different promotional media, direct-to-

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consumer advertising did not statistically significantly increase prescription volume, but physician-directed advertising was related to an additional 43,662 prescriptions for every 1% increase in share of voice ( $p < 0.001$ ). For marketing managers, our study demonstrates the relationship between share of voice and share of market and sheds light on the relative effectiveness of advertising strategies in the proton pump inhibitor market. doi:10.1300/J058v17n03\_04 [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <<http://www.HaworthPress.com>> © 2006 by The Haworth Press, Inc. All rights reserved.]

**KEYWORDS.** Advertising, promotional effectiveness, promotional spending, generic entry

## INTRODUCTION

Pharmaceutical promotion has undergone considerable scrutiny as the cost of prescription medications continues to rise. The pharmaceutical industry spent \$30 billion on advertising and promotions in 2003, and that number remains on an upward trend (1). These promotional efforts have been shown to influence which medications physicians prescribe and the way patients use medications (2, 3). Pharmaceutical promotion is especially important in oligopolistic markets, where only a few brands compete. When the difference in therapeutic efficacy between competing drugs is small in such markets, companies are able to use promotional efforts to push their brand. When a newcomer drug enters such an established drug market, it may be difficult for the marketing team to overcome the pioneer brand's hold of market share. To overcome this barrier to entry, companies often spend large amounts of money on promotion (4). However, it is difficult to know how to budget advertising expenditures and which promotional efforts are most effective.

Pharmaceutical promotion comes in several forms, such as physician visits (detailing), direct-to-consumer (DTC) advertising, drug sampling, and medical journal advertising. Detailing historically has received the largest share of any promotional budget. In a survey of 2,700 physicians, the Kaiser Family Foundation showed that three quarters of physicians rate information from pharmaceutical representatives as either "very" or "somewhat" useful (5). A literature review by Wazana

showed a number of interesting relationships between detailing and physician prescribing (6). Physician detailing was shown to cause greater prescribing of newer single-source medications and fewer generics, leading to greater medication costs. Furthermore, although detailing increased physicians' awareness of medications, it tended to cause physicians to prescribe nonrationally. A frequent component of detailing involves the provision of free prescription samples to physicians. In a study performed by Mizik and Jacobson, detailing and sampling were both shown to have a modest effect in increasing physician prescribing (7).

Despite evidence of effectiveness with physician-directed promotions, a recent study suggests that managers who continue to increase their sales force are experiencing diminished effectiveness with this approach (8). As an alternate venue of marketing efforts, DTC advertising has witnessed significant expansion during the past decade. To illustrate, spending on DTC advertisements increased from approximately \$800 million in 1996 to \$2.7 billion in 2001 (9). Although spending on DTC advertisements has grown over the past decade, DTC advertisements tend to be focused in a handful of disease areas. Studies which have investigated the effect of DTC advertising within these therapeutic markets have shown them effective at increasing prescription sales. In the non-sedating prescription antihistamine market, for example, DTC advertising has been shown to increase both brand share and category sales (10). The same study also concluded that DTC advertising had a positive synergistic effect with detailing, although the return on investment for DTC advertising was not as high as for detailing (10).

Another medium frequently used by pharmaceutical firms for advertising is professional journals. A study by PERQ/HCI Research concluded that journal ads provide positive return on investment, especially in conjunction with pharmaceutical detailing (11). Similarly, in the ROI Analysis of Pharmaceutical Promotion study, 391 different drugs' sales and marketing data were analyzed monthly from 1995 to 1999 (12). Regression analysis determined that the median (or average) return on investment (ROI) was \$1.72 for detailing, \$0.19 for DTC advertising, and \$5.00 for journal advertising. The authors concluded that DTC is overused and journal advertising is underused (12). Conversely, other studies have shown that journal advertising does not increase ROI, and when analyzed together with promotional efforts at meetings and events, journal advertising decreases the ROI of detailing and DTC (10). When looking at relative media value, which is defined as "the relative ability of the next exposure to communicate a message as part of a normal media

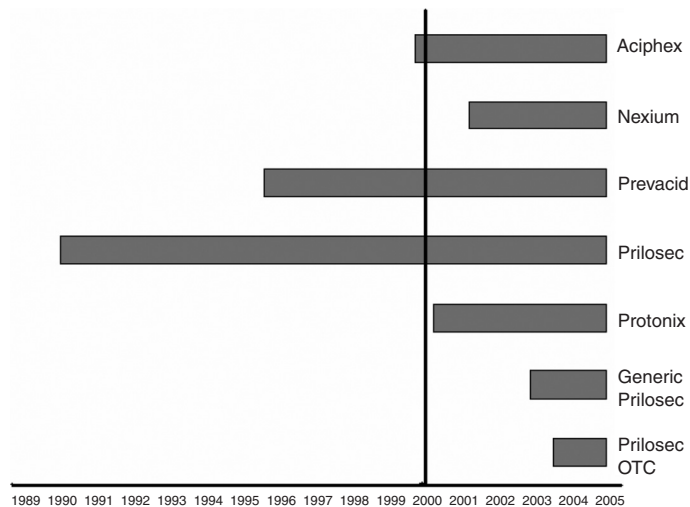
mix,” journal advertising seems to be less effective than DTC advertising and detailing (13).

In reviewing the literature, it seems apparent that each of the different types of promotional spending employed by pharmaceutical firms has a positive relationship with prescription sales. For most pharmaceutical markets, we believe that the amount of money spent on advertising by a drug manufacturer in relation to its competitors’ spending will influence its prescription market share. In this article, we use this concept to evaluate promotional spending in relation to prescription volume in the pharmaceutical market using a single drug class as a case study. We examine the impact of various forms of promotional spending using a share of voice (SOV) and share of market (SOM) approach. SOV is a term used to describe the fraction of promotional spending between competitors in the same therapeutic class. SOM, which is also known as share brand, describes the fraction of prescriptions written for one drug in relation to all prescriptions written in that therapeutic class.

Evaluation of SOV and SOM is based on the premise that competing products can affect market share through their promotional voice. This is especially important in an oligopolistic, highly competitive market because competitors will keep track of each others’ advertising and counter by changing their advertising budget (14). For example, if a competing company’s brand is the sole DTC advertiser for a given therapeutic market, then consumers are less likely to become aware of other firms’ products. Similarly, if a company has five salesmen for every competitor’s salesman, then physicians will have more exposure to the first company’s brand. Past studies which have looked into the relationship between SOV and SOM have shown a high correlation between the two (15). Authors have also concluded that gaining SOM requires a very high SOV and that losing SOV causes a decrease in SOM (15). Using SOM and SOV allows for managers to plan their current and future expenditures based on the market environment, not inwardly on revenue, expense, and profit values.

As a case study, we examine promotional spending and prescription volume data for the proton pump inhibitor (PPI) market (Figure 1), where the competing brands are believed to be similar in scientific efficacy (16). By looking at past trends (between the years 2000 and 2004), we test the correlation between SOV and SOM in the PPI market. Because promotion is not the only factor likely to influence prescription sales, we also investigate the role of other market variables that may have influenced advertising expenditures and prescription volume. The specific goals of this study are to determine the relationship between

FIGURE 1. Proton Pump Inhibitor Market Timeline.



SOM and SOV, to determine the influence of exogenous market factors on the decision to advertise, and to examine the relationship between advertising and prescription volume conditioned on the effect of these exogenous market factors.

## METHODS

### Data Sources

We studied the PPI market (rabeprazole, Aciphex®, Eisai Inc.; esomeprazole, Nexium®, AstraZeneca; lansoprazole, Prevacid®, Tap Pharm; omeprazole, Prilosec®, AstraZeneca; Prilosec OTC®, AstraZeneca; pantoprazole, Protonix®, Wyeth) by combining data representing US prescription volume, promotional spending, and drug approval dates. Estimates of PPI prescription volume (Uniform System of Classification class 23420) were obtained from IMS Health's National Prescription Audit Plus™ (NPA Plus) for the time period spanning January 2000 through October 2004. The NPA Plus estimates the number of prescriptions dispensed nationally using data collected from 34,000 independent,

chain, mass merchandiser, food store, mail service, and long-term care pharmacies. Our analysis is based on a random selection of more than 20,000 of these pharmacies. All stores contributed prescription drug data, but only half of the stores contributed information on over-the-counter (OTC) sales. We aggregated data across strengths and product formulations and created summary estimates for each molecular entity, keeping generic and OTC entities separate from brand-name, prescription-only entities.

Promotional spending data for the PPI class also were obtained from IMS Health for a comparable time period. The IMS Health Integrated Promotional Services data reflect dollars spent on provider detailing, patient samples, journal advertising, and DTC advertising for each product in this class. We aggregated promotional spending at the molecular level but still kept OTC and generic spending separate. Promotional data were matched to prescription volume data at this level.

### *Prescription Volume and Promotional Spending*

We graphed trends in prescription volume and advertising expenditures in the PPI market between January 2000 and October 2004. These illustrations were used to visualize market dynamics with regard to prescription volume and promotional spending. To explore the relationship between promotional spending and market share, we calculated SOV and SOM for each product during each month for the time period being studied. We calculated SOV for specific promotional media (i.e., detailing, sampling, journal, DTC advertising) and for aggregate promotion by dividing product-specific promotional spending by the sum of all promotional spending in the market. Similarly, SOM was calculated by dividing product-specific prescription volume by the sum of all prescriptions in the market for corresponding time intervals. We plotted the SOV against the SOM by year from 2000 to 2004. For each year, we added a regression line forcing the intercept through zero. The  $r^2$  value of this regression line was used as a rough estimate of the strength of this relationship. We also plotted the relationship between SOV and SOM over time for each drug. By doing so, we were able to visualize not just the correlation between the two parameters but also the time effect SOV can have on SOM and vice versa. This time model also helped illustrate the potential impact of dynamics other than SOV in the market, such as generic and OTC entry.

### ***Predictive Models***

One of the goals of this paper was to examine the impact of various promotional strategies on prescription volume. A primary concern in the estimation of prescription volume resulting from advertising was the direction of causality. Previous analyses have attempted to control for this endogeneity issue by using an instrumental variables approach (17). Although effective in removing endogeneity from the advertising/volume relationship, we were unable to ascertain an effective instrument for this study. Instead, we attempted to investigate for the presence of endogeneity using interrupted time-series analyses (18, 19). These models examined the impact of two separate external market dynamics (generic and OTC PPI market penetration) on the level of advertising for both DTC and physician-directed promotions. The basic regression model for the interrupted time-series analyses was:

$$y = b_0 + b_1 \text{Month} + b_2 \text{Gen Entry} + b_3 \text{Gen Month} \\ + b_4 \text{OTC Entry} + b_5 \text{OTC Month}$$

The dependent variable ( $y$ ) was modeled separately for DTC and physician-directed advertising. Month is a continuous variable equal to the month of observation from month 1 (January 2000) to month 58 (October 2004). Gen Entry is a dummy variable equal to 0 for months preceding entry of generic omeprazole and 1 for any month after. Gen Month is a continuous variable counting the number of months after generic omeprazole market entry. OTC Entry is a dummy variable equal to 0 for months preceding Prilosec OTC entry and 1 for any month after. OTC Month is a continuous variable counting the number of months after Prilosec OTC entry. In the model,  $b_2$  and  $b_4$  capture a one-time change in prescription volume or promotional spending associated with OTC or generic entry into the PPI market, respectively. Change in the level of monthly promotional spending associated with generic and OTC entry are captured by coefficients  $b_3$  and  $b_5$ , respectively. We specified Prais-Winsten regression procedures to control for autocorrelation and robust standard errors to control for heteroscedasticity in each time-series regression.

We next used a fixed effects panel model to estimate the effect of individual PPI advertising behavior on prescription volume. The benefit of using a fixed effects model for this study was that it allowed for estimation of the effect of advertising among each individual PPI



medication on prescription volume while controlling for individual PPI heterogeneity patterns. The model was specified to allow assessment of multiple types of promotional voice on PPI sales. The basic model was summarized as:

$$Y_{it} = \alpha_i + \text{Month}_{it}\beta_1 + \text{DTC}_{it}\beta_2 + \text{JOURN}_{it}\beta_3 + \text{DTAIL}_{it}\beta_4 \\ + \text{SMPL}_{it}\beta_5 + \text{GEN}_t\beta_6 + \text{MKT}_{it}\beta_7 + \varepsilon_{it}$$

where  $Y_{it}$  represents monthly medication sales for each PPI drug ( $i$ ) in month  $t$ ;  $\alpha_i$  is the intercept for each individual PPI drug;  $\text{Month}_{it}$  indicates the observation month ranging from 1 to 58;  $\text{DTC}_{it}$  represents the promotional voice for DTC advertising;  $\text{JOURN}_{it}$  represents the promotional voice for journal advertising;  $\text{DTAIL}_{it}$  represents the promotional voice related to physician detailing;  $\text{SMPL}_{it}$  represents the promotional voice related to the provision of samples to physicians;  $\text{GEN}_t$  is a 0-1 dummy variable representing months prior to and after generic entry of omeprazole, respectively; and  $\text{MKT}_{it}$  indicates the number of years the PPI has been on the market for each monthly observation. The coefficients of interest were  $\beta_2$  to  $\beta_5$  which represented PPI sales conditioned upon the effect of the other advertising covariates.

We tested for the presence of multicollinearity among advertising variables a priori using Pearson's correlations and found potential collinearity between detailing and sampling ( $r = 0.83$ ). We therefore reorganized the dependent variables into physician-directed advertising (detailing, sampling, and journal) and consumer-directed advertising. A separate regression using these two advertising variables was also specified using fixed effects panel estimation. All analyses were conducted using STATA-SE version 9.0.

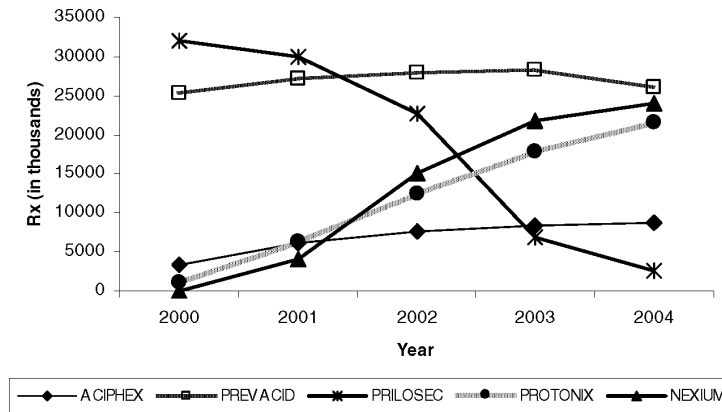
## RESULTS

### *Descriptive Analysis of Prescription Volume and Promotional Spending*

After aggregating annual prescription data, we looked for trends and prominent changes in the PPI market (Figure 2). Prescription volume for Prilosec—the market leader in 2000 with 32 million prescriptions written—steadily decreased until it was the least prescribed PPI with



FIGURE 2. Annual Prescription Volume.

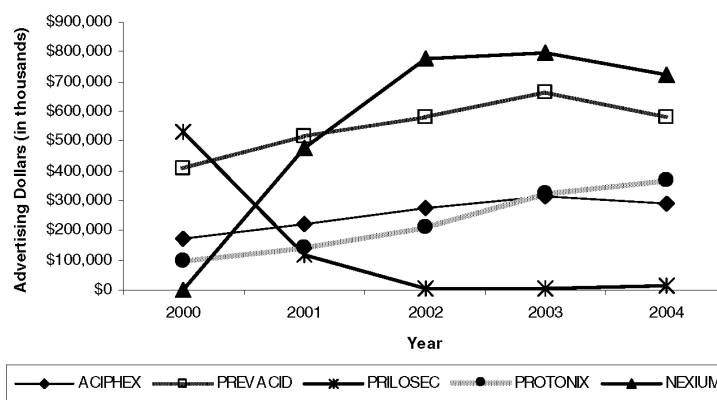


2 million prescriptions written in 2004. Nexium entered the market in February of 2001, and its prescription volume rose to 24 million by 2004, giving it the second largest market share behind Prevacid. Protonix's prescription volume also increased during this time period after being introduced to the market in February of 2000. Aciphex and Prevacid's prescription volume remained planar during the four-year period.

We analyzed annual promotional expenditures in the PPI market, noting changes that might explain trends in prescription volume and changes which might be explained by other market variables, such as generic and OTC entry (Figure 3). AstraZeneca, the maker of both Prilosec and Nexium, stopped promotional spending for Prilosec after its patent expiration in November of 2002. In contrast, Nexium came to market in February of 2001, and AstraZeneca launched an aggressive promotional campaign. Promotional expenditures for Prevacid, Protonix, and Aciphex steadily increased during this time period. However, in 2003 when Prilosec OTC was introduced, promotional spending on Prevacid and Aciphex decreased slightly, while spending on Protonix continued to increase.

The strength of correlation between SOV and SOM in the PPI market was assessed both graphically and through an  $r^2$  value. We observed a relatively unstable correlation between SOV and SOM for the entire PPI market during the years of 2001 through 2003. This period was likely one of transition within the PPI market with Nexium's market entry in February of 2001 and Prilosec's patent expiration in November of 2002. Given instability within the PPI market, we conducted our

FIGURE 3. Annual Advertising Dollars.



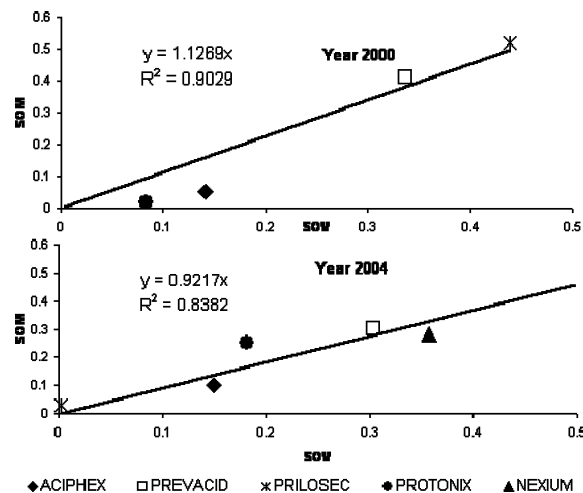
analysis excluding Prilosec and Nexium data between the years 2001 and 2003. After exclusion of Prilosec and Nexium data in the years 2001-2003, recalculated  $r^2$  values showed strong correlations between SOV and SOM in the PPI market for years 2000-2004. The  $r^2$  values were 0.9029, 0.9084, 0.8464, 0.7894, and 0.8382 for the years of 2000, 2001, 2002, 2003, and 2004, respectively, with the intercept forced through zero. The relationship between SOV and SOM in the PPI market was plotted for years 2000 and 2004 (Figure 4). We did not graph the years 2001-2003 because of the transition being made with Prilosec coming off patent and Nexium being introduced to the market.

Graphing the trends of SOV and SOM for each PPI drug over time allowed us to see the similarities between the two values (Figure 5). For Nexium, a sharp rise in SOV was followed by a rise in SOM. In contrast, Prilosec experienced a sharp drop in SOV followed by decreasing SOM. Prilosec and Nexium exemplify the temporal phenomenon that a change in SOV is followed by a change in SOM of the same direction. Prevacid and Aciphex both had small variations of SOV and SOM over the five-year period. Protonix had an increasing trend toward a larger SOV and SOM.

### Predictive Models

Figure 6 shows graphically the effect of generic omeprazole entry on DTC advertising. Visual inspection of this figure suggests no association

FIGURE 4. Share of Voice versus Share of Market for the Years 2000 and 2004.

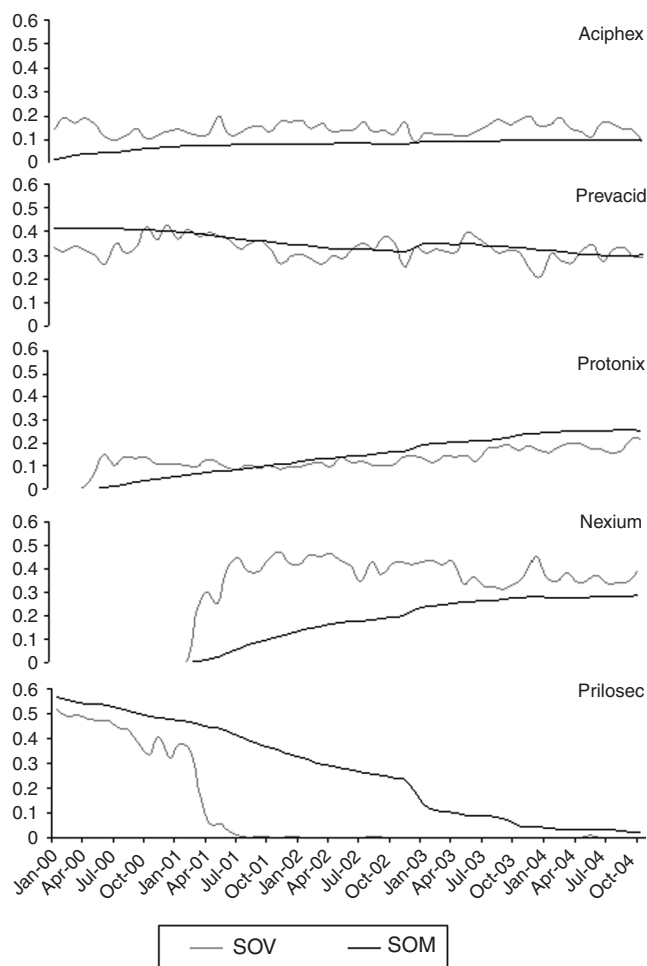


between generic or OTC entry and the level of spending for DTC advertising among any of the proton pump inhibitors examined. This is confirmed in the interrupted time-series regressions seen in Table 1. Non-significance of coefficients from the interrupted time-series analysis of DTC advertising and prescription volume suggests no association between either generic or OTC entry of omeprazole and spending on DTC advertising.

Unlike the DTC advertising analysis, Figure 7 suggests an association between generic and OTC penetration and the level of physician-directed promotion for certain PPI drugs. There was evidence of a potential drop in physician-directed promotions associated with generic PPI entry for Nexium and Prevacid. Similarly, OTC penetration appears to have been associated with a decline in physician-directed promotion for Protonix and Aciphex.

Visual observations from Figure 7 were tested for significance using the interrupted time-series analysis shown in Table 2. Significance of the variable “Month” suggests an increase in monthly physician-directed advertising prior to generic market penetration for Aciphex, Protonix, and Nexium. Nonsignificance of the “Generic Entry” and “OTC Entry” coefficients suggests no evidence of a disruption in the continuity of the time trend associated with generic or OTC market entry. Looking

FIGURE 5. Timeline Plots of SOM and SOV for the PPIs.



at the “Generic Month” coefficient, there was a significant increase in monthly physician advertising for Protonix after generic penetration of omeprazole. This contrasts to the “OTC Month” coefficient which showed a decline in physician advertising associated with OTC penetration of Prilosec.

FIGURE 6. Monthly Direct-to-Consumer Advertising.

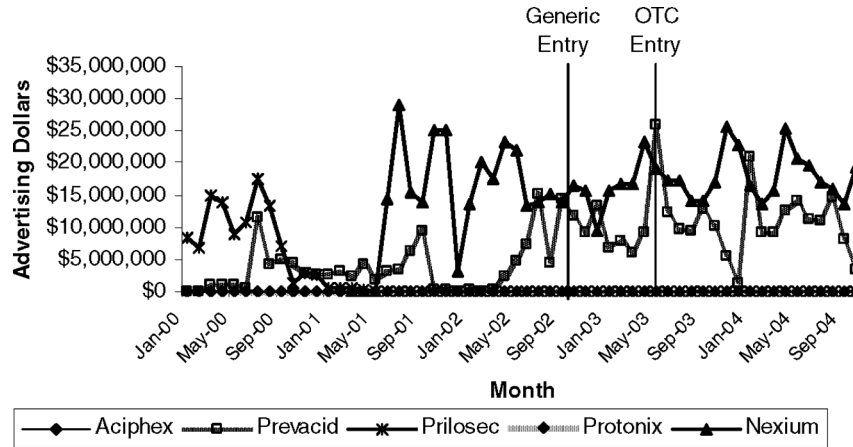


TABLE 1. Interrupted Time Series Analyses of PPI Level DTC Advertising.

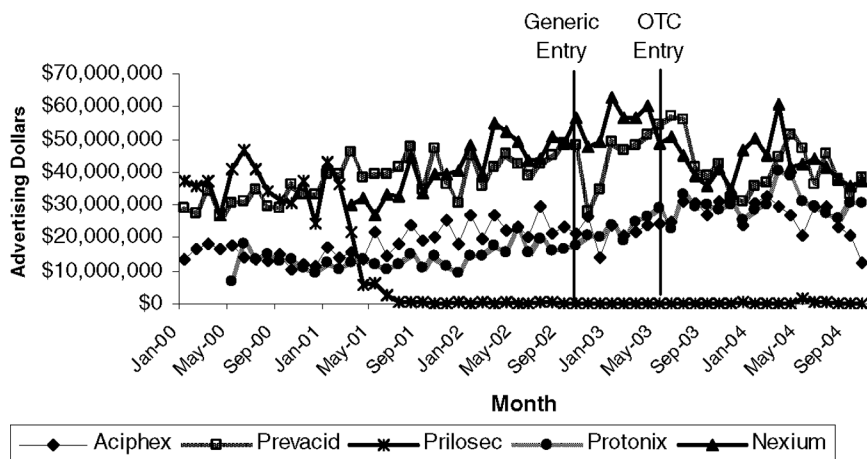
|               | Prevacid                        | Aciphex                 | Protonix                | Nexium                          |
|---------------|---------------------------------|-------------------------|-------------------------|---------------------------------|
| Intercept     | 796,703.62<br>(1,326,347.64)    | -1,755.97<br>(1,828.37) | -61.97<br>(43.07)       | 8,611,075.78<br>(6,935,354.08)  |
| Month         | 176,521.86*<br>(87,887.94)      | 150.49<br>(154.97)      | 4.04<br>(2.76)          | 550,797.16<br>(457,968.45)      |
| Generic entry | 1,905,720.44<br>(3,035,968.04)  | -3,298.95<br>(3,471.38) | -214.26<br>(227.17)     | -4,186,514.36<br>(4,168,089.10) |
| Generic month | 193,242.56<br>(540,006.65)      | -158.90<br>(154.15)     | 35.42<br>(51.45)        | -303,135.83<br>(769,488.09)     |
| OTC entry     | -1,347,067.42<br>(5,252,351.18) | 22.50<br>(26.96)        | -3,368.90<br>(2,231.66) | 731,431.22<br>(5,106,663.78)    |
| OTC month     | -475,106.58<br>(687,493.88)     | 8.41<br>(9.20)          | 620.20<br>(352.26)      | -289,946.87<br>(697,961.38)     |

\* $p < 0.05$ 

Standard error in parenthesis

Given the significance of exogenous market factors on the decision to advertise, we next ran the fixed effects regression models of various promotional advertisements on predicted prescription volume. Table 3 presents results of the fixed effects panel estimation of promotional voice on prescription volume. Because promotional voice is a ratio

FIGURE 7. Monthly Physician-Directed Advertising.

TABLE 2. Interrupted Time-Series Analyses of PPI Level Physician Advertising.<sup>†</sup>

|               | Prevacid                           | Aciphex                            | Protonix                           | Nexium                             |
|---------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| Intercept     | 28,967,975.17***<br>(1,375,080.39) | 12,157,332.39***<br>(1,169,781.03) | 10,566,037.78***<br>(1,734,602.83) | 28,634,858.55***<br>(2,148,702.90) |
| Month         | 515,960.87<br>(74,369.81)          | 359,610.34***<br>(57,154.52)       | 210,656.18*<br>(92,737.69)         | 1,284,942.39***<br>(191,805.49)    |
| Generic entry | -11,355,962.91<br>(11,059,916.23)  | -6,431,390.79<br>(4,354,811.20)    | 1,604,713.93<br>(2,191,391.24)     | 2,666,336.37<br>(9,850,139.54)     |
| Generic month | 1,483,058.70<br>(1,809,318.16)     | 735,699.24<br>(610,063.24)         | 978,979.31*<br>(458,437.04)        | -2,307,075.93<br>(1,370,515.46)    |
| OTC entry     | -16,056,247.26<br>(8,972,307.16)   | 3,940,401.73<br>(3,383,566.29)     | 96,749.00<br>(3,312,295.55)        | -2,669,918.09<br>(7,677,021.55)    |
| OTC month     | -1,933,667.71<br>(1,916,154.80)    | -1,932,238.81**<br>(716,718.80)    | -1,165,453.39*<br>(502,119.16)     | 793,998.56<br>(1,477,266.51)       |

<sup>†</sup>Physician advertising is the sum of detailing, samples, and journal advertising.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

Standard error in parenthesis

variable whereby 1 equals 100% of PPI promotional voice and 0 represents 0% of PPI promotional voice, for convenience we chose to interpret coefficients on the basis of a 1% increase in promotional voice for each variable. Furthermore, to aid in interpretation, we also ran the model using advertising dollars as the independent variable for each type of promotion to facilitate ease in interpretation of results (data not shown).

TABLE 3. Fixed Effects Panel Estimation of Prescription Volume Conditioned on Promotional Voice.

|                        | Full Model Estimation |                              | DTC/Physician Estimation |                              |
|------------------------|-----------------------|------------------------------|--------------------------|------------------------------|
|                        | b                     | 95% Confidence Interval      | b                        | 95% Confidence Interval      |
| Intercept              | 205,338.84            | (−140,865.87, 551,543.55)    | −16,607.85               | (−288,611.57, 255,395.86)    |
| Time                   | 16,891.71***          | (9,918.25, 23,865.17)        | 19,765.64***             | (13,412.44, 26,118.84)       |
| Generic entry          | −166,532.54           | (−342,890.88, 9,825.80)      | −204,673.18*             | (−373,638.33, −35,708.03)    |
| OTC entry              | −216,689.57*          | (−409,197.93, −24,181.20)    | −248,237.23*             | (−445,535.94, −50,938.52)    |
| DTC advertising        | −155,655.91           | (−422,290.45, 110,978.64)    | 6,728.74                 | (−310,358.64, 323,816.12)    |
| Physician advertising† |                       |                              | 4,366,237.60***          | (3,571,049.06, 5,161,426.13) |
| Detailing              | −1,520,198.40*        | (−2,942,833.67, −97,563.12)  | —                        | —                            |
| Samples                | 4,650,951.26***       | (3,752,154.23, 5,549,748.30) | —                        | —                            |
| Journal                | 654,688.59*           | (150,370.53, 1,159,006.65)   | —                        | —                            |

†Physician advertising is the sum of detailing, samples, and journal advertising.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

The results from Table 3 suggest nonsignificance between DTC promotional voice and prescription volume among individual PPI medications. This contrasts to significance of the coefficient for sample voice which suggests an increase of approximately 46,510 prescriptions for each 1% increase in promotional voice. Using advertising spending in dollars as the dependent variable, for each additional dollar spent on samples 0.035 additional prescriptions were dispensed. Interestingly, there was evidence of a decline in prescription volume attributable to physician detailing, furthering our concern of multicollinearity among physician-directed types of promotion.

Given the potential for multicollinearity in the models described above, we also ran fixed effects regression models dividing the type



of promotion into physician-directed media (journal, detailing, and sample media) and DTC media. This reduced model again showed nonsignificance between DTC promotional voice and prescription volume. However, the coefficient for physician-directed advertising was statistically significant. A 1% increase in physician-directed promotional voice was associated with an increase of 43,662 additional PPI prescriptions dispensed in the reduced model. Using advertising spending in dollars as the dependent variable, for each additional dollar spent on physician advertising 0.037 additional prescriptions were dispensed. Interpretation of the coefficient "Time" suggests an increase in the number of individual PPI medications dispensed over time. The coefficients "Generic Entry" and "OTC Entry" suggest a decline in the number of prescriptions dispensed during the time periods associated with generic and OTC entry into the PPI market, respectively.

### DISCUSSION AND CONCLUSION

Examining the relationship between share of promotional spending and share of prescription volume in the PPI market revealed a relatively strong association ( $r^2 \geq 0.8$ ). This is consistent with analyses conducted by Jones and Schroer, where SOM was shown to routinely follow changes in SOV (15, 20). These authors contend that the two values cannot be drastically different or market share can no longer be maintained. In other words, any attempt to diminish advertising once advertising has been initiated can significantly reduce a firm's share of the market. Our analysis of the relationship between SOV and SOM in the PPI market is consistent with this, although the strength of the relationship over time was influenced by other market dynamics. By plotting the changes of SOV and SOM over time for each individual drug, we are able to visually observe these relationships.

The influence of market dynamics (e.g., new market entrant, generic entrant, OTC entrant) on the relationship between SOV and SOM appears to have a near-term effect and then stabilize over time. For example, the PPI market experienced such changes between 2001 and 2003, causing a weaker linear correlation between SOV and SOM, as evidenced by the drop in  $r^2$  from the year prior in 2000 when the SOV-SOM relationship was strongest ( $r^2 > 0.9$ ). The transient effects these changes had on market dynamics stabilized by 2004, as evidenced by an  $r^2$  value of 0.84, at which time market leaders Prevacid, Nexium, and

Protonix established their market share. During the transitional period, as Prilosec neared patent expiration and Nexium was introduced to the market, promotional strategies changed, and an inverse relationship between SOV and SOM appeared for Prilosec and Nexium. This phenomenon can most likely be attributed to AstraZeneca's (parent company of both Prilosec and Nexium) use of a market strategy described by Jones (20). Under this theory, AstraZeneca milked Prilosec—an established brand with a large market share in 2000—for profit by ceasing promotional spending and allowing its market share to slip. Contrarily, in an effort to increase market share, AstraZeneca launched Nexium with aggressive promotional spending, making it the highest advertised drug in the class within a year (more than doubling the dollar amount spent on Aciphex and Protonix).

The decision to advertise, or more importantly where and how much to advertise, is influenced by time on the market and subsequent exogenous factors such as generic and OTC entry. For example, high advertising expenditures early in a product's life cycle can be illustrated by market entry of Nexium and Protonix. Generic and OTC entry primarily influenced physician-directed advertising rather than DTC advertising. Our regression model demonstrated that generic and OTC penetration of omeprazole and Prilosec OTC, respectively, had an influence on the way marketers budgeted their promotional spending. Physician-directed advertising significantly increased for Protonix after generic omeprazole was introduced and significantly decreased for both Aciphex and Protonix after Prilosec OTC was introduced. The decrease in physician-directed advertising after OTC availability seems logical because physicians would likely have less influence over drug selection when patients could purchase the OTC product without a doctor's prescription. One possible reason that we did not observe a significant change with all the PPI drugs could be the different internal market beliefs by manufacturers of single-source PPI drugs. One company may think that its PPI sales will drop because generic Prilosec exists, while another will believe that Prilosec is the only drug that will lose sales to its generic equivalent. Those opposing beliefs could drive decisions about promotional budget. Another exogenous factor that may have influenced a manufacturer's promotional spending on its PPI drug is the coincidental release of new products at the same time as generic Prilosec and OTC. After reviewing the product portfolios of the companies studied, we did not find new drug entries with high revenue potential that would have shifted the promotional budget enough to alter our results.

In our fixed panel estimation, we separated the different types of promotional venues to see which type of advertising had the biggest impact on prescription volume. Using both SOV and prescription volume, our results suggested that an increase of 1% in physician-directed advertising voice was associated with an additional 43,662 prescriptions, while an increase in consumer-directed advertising had a lower impact on prescription volume. In dollar terms, this meant that an additional \$27 spent on physician-directed advertising led to one additional prescription. Although we were unable to confirm the relative ROI for various promotional media reported by Neslin, our analysis was consistent with Neslin in that DTC advertising appears to have a relatively low ROI compared to physician-directed media (21). However, we caution interpretation of media-specific coefficients. Given the significance of correlations between detailing and sampling, separating physician-directed advertising sources gave illogical coefficient estimates for detailing. Given these findings, pooling detailing, sampling, and journal advertising into a physician-directed advertising variable seemed more appropriate. In addition, we realize that consumers may be exposed to journal advertisements and providers may be exposed to DTC advertisements. Our classification of DTC advertising and physician-directed advertising should be interpreted with these possibilities in mind.

In relation to most other studies of pharmaceutical promotion in the literature, this study differs in that we look at SOV and SOM. The use of SOM accounts for distribution of prescription volume within the market but not the overall size of the market. Unlike physician survey data, SOM reflects actual prescribing and utilization behavior, which is a more direct way of looking at advertising effect because the relationship between physicians' attitudes and actual prescribing behavior can be significantly different (6). However, because we are looking at market trends, our analysis may be subject to the ecological fallacy. Interpretation of results should not extend to the individual prescribing relationship between providers and patients.

Our results also should be interpreted on the basis of a number of additional limitations. We did not assume a lag in advertising (i.e., advertising now affects sales in the future) or model any type of cumulative effect of advertising. Prior research which has attempted to control for the effect of previous advertising has suggested that this problem is minimal (17). We therefore chose to treat advertising as a simple flow variable. We are unable to control for the effects of marketing mix on prescription volume. This question is better suited for behavioral research that follows patients from the point of advertising exposure,

to the doctor's office, and to the pharmacy. Generalizability is limited to the PPI market. The results of this study may not be directly extrapolated to other therapeutic drug markets. The PPI market was chosen because of the similarity in efficacy between the different drug brands. Because of this, we were comfortable in assuming that clinical efficacy had a weak influence on prescribing behavior and could focus primarily on marketing strategies. Past studies that looked into the relationship between promotional efforts and practice behavior have also used therapeutic markets where the difference in efficacy between the drugs is small, such as the nonsedating prescription antihistamines and the statins (22). The PPI market is also unique in regard to DTC advertising because PPIs have a favorable safety profile and the disease state is easy for patients to understand and diagnose. Other drug markets that do not share the same characteristics may not see the same benefits with DTC advertising. Although price can affect prescription demand, we were unable to include this variable in our models because we did not have an accurate measure of patient out-of-pocket cost (rather than average wholesale price) which we believed would have the greatest influence on demand. One of the greatest limitations of our study is the direction of causality between promotion and prescription sales. Although it appears that greater promotion is positively associated with greater market share, there is also the possibility that PPI medications with greater market share promote more aggressively. Despite this limitation, we show clear evidence of an association between advertising and sales in our analyses.

This case study of the PPI market illustrates that the relationship between brand promotions and prescription volume is complex. Marketing managers, when budgeting for their promotional expenditures, may want to consider their brand's share of voice and share of market. Our observations suggest that increasing SOV is associated with gains in prescribing volume and market share. We also found that DTC advertising, despite being the fastest growing advertising expenditure, was not associated with changing PPI market share. More work is needed to understand the interrelatedness of different types of promotional media on market share.

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