Payments, promotion, and the purple pill

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Abstract

I estimate pharmaceutical demand using unique panel data that include rich variation in copayments, actual patient out-of-pocket spending, and controls for promotional spending. In the data, the copayments vary across time, across 85 insurance groups, and across drugs in the same therapeutic class in the same group in a given month. I find that it is important to use copayment rather than price when estimating pharmaceutical demand. Furthermore, I find that it is important to control for the effects of promotional spending when estimating copayment elasticities - failure to do so decreases the copayment elasticity by nearly 50 percent.

Keywords: copayment, formulary, marketing, pharmaceuticals.

JEL: D43, I11, I18, L65, M3.

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1 Introduction

Drug spending by private insurers increased by 18.5 percent in 2002, according to pharmaceutical benefits manager Express Scripts. In the first quarter of 2003, however, spending growth slowed. "Companies that raised co-payments that consumers face for certain costly drugs experienced a greater moderation in spending" (Freudenheim 2003). High prescription drug co-payments may be used to increase the portion of drug costs paid by patients and to induce patients to choose cheaper alternatives (e.g., cheaper branded drugs, generic drugs, over-the-counter-drugs, dietary changes). Many employers are adopting tiered benefit structures in which higher copayments are charged for non-preferred drugs. States such as Florida and Michigan have implemented preferred drug lists for Medicaid (Pérez-Peńa 2003) and cost control measures are likely for Medicare (Gleckman and Barrett 2003).

While insurers are increasing copayments, drug manufacturers are increasing promotional spending. Since 1994, spending on direct-to-consumer advertising (DTCA) of pharmaceuticals has increased nearly ten-fold (Rosenthal, Berndt, Donohue, Epstein and Frank 2003) and the pharmaceutical industry's sales force has more than doubled (Hensley 2003).

Many payers blame pharmaceutical marketing for the increase in drug costs. "Are drug company ads driving up health-care costs? You bet. Not everyone with heartburn needs the purple pill," according to the executive director of health-care initiatives at General Motors. GM spent $55 million

on Prilosec in 2001 (Burton 2002).

Using unique panel data I examine the impact of prescription copayments and marketing on drug utilization. The data include copayment variation over time, across 85 insurance groups, and across drugs in the same therapeutic class within an insurance group in a given month. I exploit this variation to measure the impact of a copayment change relative to the minimum copayment in the class. Furthermore, I find that it is important to control for the effects of marketing in copayment analysis. Using monthly promotional data to control for marketing increases the copayment elasticity by nearly 50 percent.

I find that the copayment elasticity of demand for anti-ulcer drugs is -0.3 when all drugs change copayments in the same amount, but -0.9 when a drug's copayment increases while the minimum for its rivals is unchanged. When not controlling for marketing, the latter estimate is less elastic (-0.6). Substituting copayment data for price data generally increases the elasticity of marketing.

In the long run physician details and free drug samples increase demand for drugs – and provide a public good for rivals – by increasing awareness of diseases and the available class of drugs. In the short run, however, free samples actually hurt that drug's sales by cannibalizing purchased products. Direct-to-consumer and medical journal advertising also increase drug demand.

In section 2 I review related literature on pharmaceutical demand; in sec-

tion 3 I provide background information on anti-ulcer drugs and advertising in the pharmaceutical industry; in section 4 I describe the data; in section 5 I describe the variation that I use to identify the model; in section 6 I describe the econometric model; in section 7 I describe the results; and in section 8 I conclude.

2 Related Literature

Several studies examine strategic pricing by pharmaceutical manufacturers. Grabowski and Vernon (1992) and Lu and Comanor (1998) find that the profit-maximizing price for a drug depends on the extent of its therapeutic advance over rivals and on where it is in its life cycle. Similarly, Ekelund and Persson (2003) find that in Sweden introductory prices depend on the degree of therapeutic innovation, although they find that in the regulated Swedish real market prices fall substantially over time for all classes. In the United States, copayments can be dramatically different from prices, so the aforementioned studies have important implications for third party payers such as private insurers and the government, but limited direct impact on insured consumers.

The best-known study of consumer responsiveness to changes in medical care copayments is the RAND Health Insurance Study from the 1970s. Manning, Newhouse, Duan, Keeler and Leibowitz (1987) estimated that copayment elasticity for medical care was approximately -0.2. Likewise, in

a study of Russian drug utilization, Street, Jones and Furuta (1999) found that the price elasticity of demand was between -0.2 and -0.44. Using data on cephalosporin prescriptions in the late 1980s, Ellison, Cockburn, Griliches and Hausman (1997) found large elasticities for generic drugs as well as some significant elasticities for therapeutically-equivalent branded drugs. Esposito (2002) found that the copayment elasticity of demand for cholesterol-lowering statins was -0.04 to -0.45. Huskamp, Deverka, Epstein, Epstein, McGuigan and Frank (2003) found that when a health plan moves to a three-tier formulary and increases copayments, some enrollees stop filling prescriptions. Furthermore, studies found that increasing pharmaceutical copayments through tiered formularies resulted in lower costs to insurers (Motheral and Fairman 2001; Joyce, Escarce, Solomon and Goldman 2002; Rector, Finch, Danzon, Pauly and Manda 2003).

The aforementioned studies of price and copayment elasticity of demand did not include marketing data. I find that including marketing increases the copayment elasticity by nearly 50 percent. This finding is consistent with Berndt, Bui, Reiley and Urban (1995). When they included market factors, the price elasticity of demand for anti-ulcer drugs was estimated to be -0.69. When they did not include such factors, it was half that. Unfortunately, Berndt et al. (1995) did not have access to copayment data so they used price data. According to a recent study by Rosenthal et al. (2003), "we believe the price variable is measured with error, and has no close relationship to patient copayments."

Other studies have used marketing and price data, but not copayment data. Leffler (1981) and Hurwitz and Caves (1988) examined whether prescription drug advertising was persuasive or informative. Recent studies analyzed the effectiveness of advertising in increasing pharmaceutical sales (Rizzo 1999; Neslin 2001; Azoulay 2002; Ching 2002; Iizuka and Jin 2002; Rosenthal et al. 2003).

One marketing study that did use copayment data was Wosińska (2002) who analyzed direct-to-consumer advertising and formulary status for cholesterol-lowering drugs used by patients enrolled in Blue Shield of California insurance plans. She found that DTCA increases total therapeutic class sales but only increases brand sales if that brand has preferred status on the insurance formulary. Furthermore, she found that DTCA has a significantly smaller impact than detailing (on the order of five times). My research differs from Wosińska (2002) in time frame, therapeutic category, methodology, and in the richness of the variation in the copayment data. I have copayment variation over time, across 85 insurance groups, and across drugs in the same therapeutic class within an insurance group in a given month. This unique panel data create an advantage in identifying the impact of a copayment change and allows me to estimate the impact of a relative copayment change (with rival copayments held constant).

3 Background

Demand for health care differs from the demand for other products in that the consumer is typically not be the sole decision maker because of the influence of the physician. In recent years, however, there has been a rise in "consumerism" as patients have faced higher copayments and have acquired more information about their health care options. According to a telephone survey of 1601 adults, 32 percent of Americans have talked to a physician about an advertised medication (Prevention Magazine 2001). According to an Internet survey of 639 patients and 289 pharmacists, one in four patients taking a prescription anti-ulcer medication each month asks her doctor or pharmacist about other options due to concerns about high copayments. About 80 percent of drug switches were motivated by patients who asked a physician or pharmacist about alternatives. This implies that patients are the primary decision-makers, but the study might be biased upward if people who are active in responding to an Internet survey also play a more active role in their medical care. Nevertheless it is reasonable to believe that physicians might allow patients much latitude in the choice of PPIs. "For price-sensitive patients, co-pay levels may sway drug-prescribing decisions, given that many physicians view these products as interchangeable," said Chris Droukas associate vice president of Market Measures/Cozint which conducted the study (Pallarito 2003).

Not only are patients more informed about available therapies, but in

recent years physicians have become more informed about relative prices for drugs. Lundin (2000) found that physicians in Sweden were less likely to prescribe branded drugs for patients who faced large out-of-pocket costs. Hellerstein (1998) found that American physicians that are contacted by pharmaceutical manufacturers and those that are affiliated with managed care have a greater awareness of drug prices. On the other hand, physician responsiveness to copayment changes is muted, because when they find a product that works for a patient they are reluctant to switch to a different product (Crawford and Shum 2003).

Pharmaceutical firms attempt to raise awareness of their products' attributes and inspire brand loyalty through promotional spending to physicians and patients. In 2000, pharmaceutical manufacturers spent $7.9 billion on free drug samples, $4 billion on visits by pharmaceutical representatives to providers' offices ("detailing"), $2.5 billion on DTCA (predominantly television, but also print, radio, and billboards), $0.8 billion on hospital detailing, and $0.5 billion on medical journal advertising (National Institute for Health Care Management Foundation 2001).

In this study, I examine the demand for PPIs. The PPI market includes Prilosec (the "purple pill") and Prevacid, which were both in the top ten in world drug sales in 2002 (IMS Health 2003). Furthermore, anti-ulcer drugs were the leading therapeutic class in global pharmaceutical sales in 2002. PPIs directly inhibit the action of the proton acid pump in the gastric lining of the stomach. They are considered an advance in acid control over older

treatments such as H_2 receptor antagonists which act indirectly by inhibiting gastric acid through blocking histamine receptors on acid-secreting cells in the stomach lining. Prilosec was launched in October 1989, Prevacid in May 1995, Aciphex in September 1999, and Protonix in April 2000. Prilosec's manufacturer AstraZeneca launched Nexium in March 2001 and hoped to switch consumers to this new product that had better bioavailability for patients and a longer patent life for its manufacturer. Nexium is not included in my insurance data, but is included in my marketing data. Prilosec faced generic competition beginning in December 2002.

4 Data

I primarily use two sources of data: drug insurance data from a pharmaceutical benefits manager and drug marketing data from an independent consulting company.

The insurance data consist of monthly observations of four brands of PPIs in 85 pharmaceutical insurance groups covering approximately 3 million people from May 2000 to May 2002. An observation is a drug-group-month and there are 8500 observations. The pharmaceutical insurance data were provided by AdvancePCS, a pharmaceutical benefits manager with data on the prescription drug claims of one quarter of the population of the United States for the most recent 25 months. AdvancePCS reports that its own analyses show that its data closely match United States Census Bureau estimates of

the distribution of the U.S. population based on age, sex, and geographic region. For this study sample, AdvancePCS included pharmaceutical groups in which individuals did not have a front-end deductible or back-end stop loss. Mail-order claims are excluded.

If a brand has zero sales in an insurance group in a month then units and copayment are not observed. In this case, I assign zero units and a copayment based on the copayment for that brand in that group from another month. The data set includes the date of the copayment change so I know when the copayment is the same between two months. I drop groups in which I cannot assign a copayment to a brand because the brand has no sales in the period leading up to the next copayment change. I also drop groups that have no sales of any brand in a month in the sample and two groups with enrollments below 1000. Hence, the group with the smallest enrollment has 3466 members. The mean group enrollment is 37,287. At the midpoint of the sample (May 2001), I have 123 groups covering 3.89 million members in the original sample and 85 groups covering 3.36 million members in the reduced sample.

I analyze the following drugs and dosage strengths: Aciphex 20MG tablet, Prevacid 30MG capsule, Prilosec 40MG capsule, and Protonix 40MG tablet. There are alternative dosage strengths but the aforementioned strengths account for at least 82 percent of each brand's sales in any month in the data.[1]

[1]In my data, Aciphex 20MG tablets accounted for 100 percent of Aciphex sales in any month, Prevacid 30MG capsules accounted for at least 82 percent of Prevacid sales in any month, Prilosec 40MG capsules accounted for at least 90 percent of Prilosec sales in any

Because Aciphex, Prevacid, and Prilosec are capsules and Protonix is a tablet with enteric coating, it is uncommon for consumers to try to save money by purchasing a stronger dose and splitting pills.

Eleven of the groups change copayments for the PPIs twice, 29 of the groups change once, and 45 of the groups do not change in the sample period. Copayment changes are typically made on January 1 of 2001 or 2002. Nine changes are made on a day other than January 1.

The marketing data consist of monthly observations on promotional spending for PPIs between January 1990 and May 2002. An observation is a drug-month. Verispan, an independent consulting company that collects data on the pharmaceutical industry, provided the marketing data. Detail dollars are calculated based on the average cost of a sales call by a pharmaceutical representative to a provider including the fixed costs of salary and transportation but not variable costs such as samples. If a PPI is discussed during the sales call, then it is considered a detail for that PPI. Sample dollars are calculated based on the average wholesale price of the samples.

DTCA dollars include spending on newspapers, magazines, radio, television, and billboards. Prevacid and Prilosec have sufficient spending on DTCA to appear in the Verispan audit. Medical journal advertising is calculated in thousands of dollars. I used total units (new or refill) dispensed in retail pharmacies to compare my pharmaceutical insurance data to aggregate

month, and Protonix 40MG tablet accounted for at least 99 percent of Protonix sales in any month.

national data on utilization by insured and uninsured people.

In table 1 I compare market shares for the insurance data to the national average. Market shares are the four-brand average using the major dosage strengths in the insurance data and all dosage strengths in the national data. The insurance data closely match the national data. Market shares differ by fewer than three percentage points in the first, middle, and last months.

[Insert Table 1 about here.]

In table 2 I provide the mean copayments for the first, middle, and last periods of the 85 insurance groups. The average copayment for each drug is between \$12.36 and \$14.48 in May 2000 and between \$16.01 and \$18.32 in May 2002. The minimum copayment is \$0 and the maximum copayment is \$40. I do not have national data on copayments, but \$15 is typical in the industry (Martinez 2002).

[Insert Table 2 about here.]

Finally, I use data from the U.S. Bureau of Labor Statistics on the seasonally-adjusted consumer price index for all urban consumers in order to adjust copayments and promotional spending for inflation.

5 Identification

In the insurance data, copayments vary over time, across insurance groups, and across drugs. The copayment variation over time comes from 29 in-

surance groups that change copayments once and 11 insurance groups that change twice. Furthermore, copayments vary across insurance groups in a given month. Finally, copayments vary across drugs, even in the same therapeutic class in the same month in the same insurance group. The promotional variables vary over time and across drugs.

Figures 1 and 2 illustrate the type of variation that I use to identify copayment and marketing elasticities. Figure 1 illustrates the first and second products to market: Prilosec and Prevacid, and Figure 2 illustrates the third and fourth products to market: Aciphex and Protonix. Market shares for the four products sum to one.

I sum all previous marketing for each brand since 1990 and illustrate the shares for Prilosec and Prevacid in Figure 1A. In May 2000, Prilosec accounted for about 60 percent of cumulative national marketing for PPIs. This is not surprising because Prilosec was introduced more than five years before the second entrant. As rival products enter the market, the initial spending by Prilosec declines in proportion to total spending for all brands.[2]

Figure 1B illustrates the utilization shares for the largest insurance group.[3] In May 2000 Prilosec accounted for about 60 percent of the prescriptions in this insurance group. Copayments are $0 for all PPIs throughout the 25 months.

[2]This is analogous to a fixed cost spread over greater quantity resulting in a decrease in average cost.

[3]At the midpoint of the data (May 2001), enrollment in this insurance group was more than one quarter of a million people.

Notice in Figures 1A and 1B that marketing share and utilization share track: as Prevacid's share of marketing increases relative to Prilosec so too does its share of utilization in the insurance group. This increased utilization share for Prevacid only occurs when copayments for the two drugs are similar. For the insurance group in Figure 1C, Prevacid is unable to capture Prilosec's market share when its copayments are twice that of Prilosec's.

[Insert Figure 1 about here.]

In Figure 2 I repeat the previous plots for the third and fourth entrants: Aciphex and Protonix. Figure 2A illustrates the cumulative marketing shares for Aciphex and Protonix. Protonix is introduced in April 2000, so its May 2000 cumulative marketing share is near zero.

Figure 2B illustrates the utilization share in the largest insurance group. As in Figure 1B, the copayments are $0 for all PPIs in this insurance group. Notice that when all copayments are equal, cumulative marketing share (Figure 2A) and utilization share (Figure 2B) track.

The most interesting plot is Figure 2C which illustrates the utilization shares in the insurance group that has the largest decrease in copayment. (It is the same insurance group that is illustrated in Figure 1C.) Protonix is introduced in April 2000 so its unit share is near zero in May 2000. Notice that the drug with the lower copayment gains utilization share. Protonix is initially $10 cheaper and attains a utilization share equal to Aciphex by April 2001. In April 2001, Protonix becomes $15 cheaper than Aciphex

and overtakes Aciphex in utilization share. In January 2002 Aciphex and Protonix reverse copayments so that Aciphex is $15 cheaper than Protonix and Aciphex overtakes Protonix in utilization share.

[Insert Figure 2 about here.]

Figures 1 and 2 indicate that marketing drives a drug's utilization share when copayments are equal, but when copayments differ the cheaper drug increases in utilization share. In the model below I test that hypothesis.

6 Model

I assume that the physician and patient jointly determine demand for a drug. An insured person's demand for a drug is a function of the drug's copayment, the copayments for other drugs in the therapeutic class, characteristics of the drug, characteristics of the pharmaceutical insurance group, and promotional activity directed at consumers and physicians.

I assume that people may respond to increases in copayments by decreasing utilization, but few respond by changing insurance groups. I believe that this is a reasonable assumption given my data and the structure of health insurance. On average, insurance groups that increased copayments for the PPIs experienced a smaller decline in enrollment than those that did not increase copayments. Consider the structure of employer-provided health insurance. Employees are typically allowed to change insurance groups only

in the autumn (with implementation January 1). People are only allowed to change insurance groups once per year in order to decrease the costs of paperwork and to mitigate the adverse selection problem. At the time in which an employee chooses an insurance group, she might not be informed of the formulary status of the PPI that she is taking or plans to take. Furthermore, even if the consumer is fully informed, the consumer has a limited number of options and the copayment for a PPI may not be the most important factor in her choice of insurance groups. Finally, while employees may have a choice of insurance groups, they may not have a choice of drug benefits. For example, at Duke University employees may choose one of three insurers, but the drug benefit is "carved out" so that all employees have the same drug benefit (http://www.hr.duke.edu/).

The insurer determines drug copayments. According to Verispan, in May 2002 the average wholesale price for Prilosec 40MG in a 30-unit package was $198.65. In my insurance data, in May 2002 the average copayment for Prilosec 40MG in a 30-unit package was approximately $16 with a minimum copayment of $0 and a maximum copayment of $40 (see table 2).

The impact of promotional activity is cumulative. Following Berndt et al. (1995), the stock of promotional activity S_{dt} for drug d at time t is

$$S_{dt} = (1-\delta)S_{d(t-1)} + F_{dt} = \sum_{\tau=0}^{t}(1-\delta)^{\tau}F_{d(t-\tau)} \tag{1}$$

where F_{dt} is the flow of new promotional activity and δ is the monthly depre-

ciation rate. I assume that the depreciation rate for marketing directed at providers (i.e. details, samples, and medical journal advertisements) was different from the depreciation rate for marketing directed at consumers (DTCA). A depreciation rate of $\delta = 0.02$ for providers and $\delta = 0.1$ for consumers fit the data best. In contrast, Berndt et al. (1995) used $\delta = 0$.

I use fixed effects to control for characteristics of the drug and the pharmaceutical insurance group that are time invariant but not observable in the data. I estimate a semi-log demand model.[4] The dependent variable is the natural log of units of drug d per 100,000 members in insurance group i in month t ($\ln(y_{dit})$). The explanatory variables are as follows: copayment adjusted by the consumer price index (CPI) (c_{dit}); minimum copayment in a group's therapeutic class (m_{it})[5]; a vector of the stock of promotional spending (details multiplied by free samples[6], DTCA, and medical journal advertising) (S_{dt}); a vector of the stock of promotional spending multiplied by a dummy variable that equals 1 if a drug is in a higher formulary tier than its rivals ($c_{dit} > m_{it}$); a vector of the stock of promotional spending for all other drugs (S_{-dt}); the lagged flow of national sampling[7] ($s_{d(t-1)}$); a quadratic time trend;

[4]Six percent of the observations for the dependent variable are zero and fewer than one percent are between zero and one. Following Pakes and Griliches (1984), when $y_{dit} < 1$ I assigned $\ln(y_{dit}) = 0$ and assigned a dummy variable. I did not take logs of the independent variables because a high portion of them are zeros.

[5]Using a weighted average of rivals' copayments in a given insurance group gave the same results as minimum copayment.

[6]Pharmaceutical representatives typically detail physicians and provide free samples simultaneously. The Pearson correlation coefficient between the flow of details and the flow of samples is 75%. Furthermore, the correlation between the stocks of those variables is 90%. To account for this correlation I interact the terms rather than including them individually.

[7]I test the hypothesis by Joseph and Mantrala (2003) that free samples may decrease

a drug fixed effect (γ_d); and an insurance group fixed effect (γ_i). Variables are adjusted for the consumer price index (CPI) where appropriate.

$$\begin{aligned} \ln(y_{dit}) &= \beta_0 + \beta_1 c_{dit} + \beta_2 m_{it} + \beta_3 S_{dt} + \beta_4 h_{dit} S_{dt} + \beta_5 S_{-dt} \\ &\quad + \beta_6 s_{d(t-1)} + \beta_7 t + \beta_8 t^2 + \gamma_d + \gamma_i \end{aligned} \tag{2}$$

In order to calculate copayment elasticities, I totally differentiate equation 3, hold constant all variables other than copayment and minimum copayment, and solve for $(1/y)dy/dc$.

$$\frac{1}{y}\frac{dy}{dc} = \beta_1 + \beta_2 \frac{dm}{dc} \tag{3}$$

The copayment elasticity of demand is as follows:

$$\eta = \frac{c}{y}\frac{dy}{dc} = c(\beta_1 + \beta_2 \frac{dm}{dc}) \tag{4}$$

If the copayment changes but the minimum copayment does not then $\eta = \beta_1 c$. If the copayment and minimum copayment changes are equal – for example because all of the copayments for a therapeutic class change by the same amount – then $\eta = c(\beta_1 + \beta_2)$.

sales in the short run by substituting for purchased drugs.

7 Results

The estimation results are reported in Table 3. I find that an increase in copayment decreases utilization, but this decrease in utilization is dampened if the minimum copayment for the therapeutic class also increases. At an average copayment of $14.57 and constant minimum copayment for the class, the copayment elasticity is -0.9. This is more elastic than the finding of -0.69 for price elasticity by Berndt et al. (1995). This makes sense, given that consumers should be more responsive to copayments than prices since copayments are a more accurate measure of the cost to insured patients. Furthermore, the latest over-the-counter products might be closer substitutes today than in the past.

When the minimum copayment changes with the copayment, as in the case when all copayments in a class rise equally, then the copayment elasticity is -0.3. This implies that consumers are more willing to adopt substitutes within a therapeutic class, than to adopt substitutes outside the class (e.g., over-the-counter drugs, dietary changes).

There are several interesting results regarding details and samples. First, the stock of detailing multiplied by the stock of samples has a positive impact on own-brand sales. Second, the impact of detailing and samples is somewhat smaller but still significant if a drug is in a higher formulary tier (higher copayment) than its rivals. Third, detailing appears to provide a public good for rivals perhaps because it raises provider awareness of diseases that

can be treated by this class of drugs. Fourth, I test the hypothesis by Joseph and Mantrala (2003) that samples can have an adverse impact on sales in the short run. I find that this is indeed true. While free samples raise consumer and provider awareness of products and have a positive long run impact on sales, they cannibalize short run sales.[8]

The elasticity of demand for the stock of details multiplied by samples is 0.5 when a drug is in the lowest formulary tier (lowest copayment) in its class and 0.3 when it is not. A one percent increase in national drug demand would require an additional $2 million spent on both details and free samples.[9]

The elasticity of demand for the stock of DTCA is 0.2. This effect does not appear sensitive to whether the product is in a higher formulary tier. Of the marketing expenditures, the DTCA elasticity was closest to zero. Berndt et al. (1995), Neslin (2001), and Wosińska (2002) all found that DTCA had the smallest impact of the marketing methods.[10] The fact that this elasticity is close to zero may be due to the lack of experience of pharmaceutical marketers. The prevalence of DTCA is rather recent because the FDA loosened restrictions on pharmaceutical marketing in 1997. Alternatively, DTCA may be applied intensively and effectively in local markets, but I may not capture that impact because my marketing data are national. Overall the model fits the data well with an R-squared of 0.86.

[8]When a sales representative stops selling in an area, sales often increase the following month, but decrease later, according to a pharmaceutical district sales manager.

[9]Samples are valued at list price which may overstate the true cost to the manufacturer.

[10]Berndt et al. (1995) found that the DTCA elasticity of demand was 0.01 and Neslin (2001) found that the return on investment for DTCA was $0.19 plus or minus $0.52.

When I exclude marketing variables, the copayment elasticity is -0.6 which is consistent with Berndt et al. (1995) who find that the price elasticity estimate is more inelastic when marketing variables are omitted. When price[11] is used en lieu of copayment, it is not significant, although a share-weighted average of rivals' prices is significant. When nominal rather than real values are used, there is little change. When marketing is treated as a flow ($\delta = 1$), DTCA and lagged samples are not statistically significant. When the marketing stock is not depreciated ($\delta = 0$), medical journal advertising appears to only benefit drug sales if that drug has the lower copayment in its class and lagged samples actually increase demand.

[Insert Table 3 about here.]

In order for a change in copayment (with minimum copayment constant) and a change in the stock of marketing to be offsetting in terms of drug utilization, the following relationship must hold:

$$\frac{\frac{dS}{S}}{\frac{dc}{c}} = -\frac{\eta_c}{\eta_s} \tag{5}$$

Equation 5 says that the ratio of marketing to copayments must equal the negative of the inverse of their elasticities. Pharmaceutical manufac-

[11] I use wholesale acquisition cost (WAC) which is preferable to list price because it includes discounts and chargebacks. WAC does not, however, include rebates given to insurers and it does not reflect the price actually paid by insured patients. In fact, the Pearson correlation coefficient between WAC and copayment is close to zero. This is consistent with Rosenthal et al. (2003) who wrote that "the observed prices are measured with error and are probably not closely correlated with the desired consumer out of pocket price."

turers and insurers can use this information to offset strategies enacted by one another. My results imply that if a drug's copayment increases by one percent with the minimum copayment held constant, then the drug's manufacturer can offset the impact on utilization by increasing the stock of details multiplied by samples by 1.7 percent, all else being equal.

Likewise, the insurer might adjust copayments to offset marketing. The insurer can offset a one percent increase in the stock of details multiplied by samples by increasing the copayment of that drug by 0.6 percent. On its face, this seems to be a simple task as a 1 percent increase in the average copayment is quite small (less than $1) whereas a one percent increase in the stock of marketing is quite large (millions of dollars nationally or thousands locally). If marketing is a public good, however, then an increase in marketing for one drug will increase the demand for another drug within that class. Hence, in order to offset the impact of marketing, the insurer will have to increase copayments for all of the drugs in the class. As I demonstrated above, consumers are less responsive to increases in copayments when all of the drugs in a class rise.

My estimates are based on a study of branded drugs that are relatively close substitutes and have copayments in the range of $0 to $40. Demand may be more inelastic for a class of drugs in which the products are not regarded as very close substitutes. Demand may be more elastic for copayments greater than $40.

It is commonly assumed that higher copayments and marketing expendi-

tures are socially harmful. This may be true if high copayments dissuade poor or myopic people from using a drug that would provide substantial benefits and if marketing is primarily persuasive rather than informative. In combination, however, high copayments and high marketing can actually lead to a more socially desirable equilibrium in which more people are informed of diseases and treatments, and people who benefit most from the treatments are the ones willing to pay the high copayment.

8 Conclusion

Understanding how consumers respond to changes in prescription drug prices and marketing is important for insurers, drug manufacturers, and policy makers. I estimate pharmaceutical demand using unique panel data that include rich variation in copayments, actual patient out-of-pocket spending, and controls for promotional spending. In the data, the copayments vary across time, across 85 insurance groups, and also across drugs in the same therapeutic class in the same group in a given month. I find that the copayment elasticity of demand for anti-ulcer drugs is -0.3 when all drugs change copayments in the same amount, but -0.9 when a drug's copayment increases while the minimum for its rivals is unchanged. When not controlling for marketing, the latter estimate is less elastic (-0.6). Substituting copayment data for price data generally increases the elasticity of marketing.

In the long run physician details and free drug samples increase demand

for drugs – and provide a public good for rivals – by increasing awareness of diseases and the available class of drugs. In the short run, however, free samples actually hurt that drug's sales by cannibalizing purchased products. Advertisements in medical journals increase drug demand, and direct-to-consumer advertising has a small but significant impact on demand.

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Table 1: Summary statistics for the first, middle, and last periods of the insurance data with comparisons to the national average for the four brands.

Month	Variable Description	National Mean	Insurance Data Mean	Insurance Data Std Dev
May-00	Aciphex market share	0.05	0.06	0.05
	Prevacid market share	0.40	0.40	0.19
	Prilosec market share	0.55	0.54	0.19
	Protonix market share	0.00	0.00	0.00
May-01	Aciphex market share	0.09	0.07	0.04
	Prevacid market share	0.38	0.37	0.20
	Prilosec market share	0.47	0.47	0.22
	Protonix market share	0.07	0.10	0.07
May-02	Aciphex market share	0.09	0.11	0.06
	Prevacid market share	0.32	0.36	0.19
	Prilosec market share	0.35	0.37	0.21
	Protonix market share	0.15	0.17	0.14

Table 2: Average copayments for Proton Pump Inhibitors in 85 insurance groups in the first, middle, and last periods of the insurance data.

		PBM	
Month	Variable Description	Mean	Std Dev
May-00	Aciphex copayment ($)	14.48	10.10
	Prevacid copayment ($)	13.62	9.86
	Prilosec copayment ($)	13.22	9.19
	Protonix copayment ($)	12.36	8.80
May-01	Aciphex copayment ($)	16.59	10.82
	Prevacid copayment ($)	15.74	10.77
	Prilosec copayment ($)	14.34	9.13
	Protonix copayment ($)	13.71	9.02
May-02	Aciphex copayment ($)	16.65	10.88
	Prevacid copayment ($)	18.32	11.69
	Prilosec copayment ($)	16.01	10.62
	Protonix copayment ($)	17.56	11.28

Table 3: Results: Log of units per 100,000 Enrollees.

Explanatory Variable	Coefficient	SE
Intercept	-45.398^{**}	14.723
Copayment	-0.063^{**}	0.007
Minimum copayment	0.041^{**}	0.009
Stock details*stock samples	0.042^{**}	0.014
Stock details*stock samples*high tier	-0.019^{**}	0.004
Stock DTCA	0.927^{**}	0.197
Stock DTCA*high tier	-0.217	0.168
Stock medical journal ads	0.596^{**}	0.169
Stock med journal ads*high tier	0.465^{**}	0.102
Rivals' stock details*stock samples	0.264^{**}	0.033
Rivals' stock DTCA	-0.275^{**}	0.090
Rivals' stock medical journal ads	-1.022^{**}	0.149
Lagged samples	-3.070^{**}	1.086
Month	0.726^{**}	0.207
Month^2	-0.003^{**}	0.001
Drug fixed effect	included	
Insurance group fixed effect	included	
Monthly mktng depr (prov, cons)	0.02,0.1	
R^2	0.86	

* Significant at 0.01

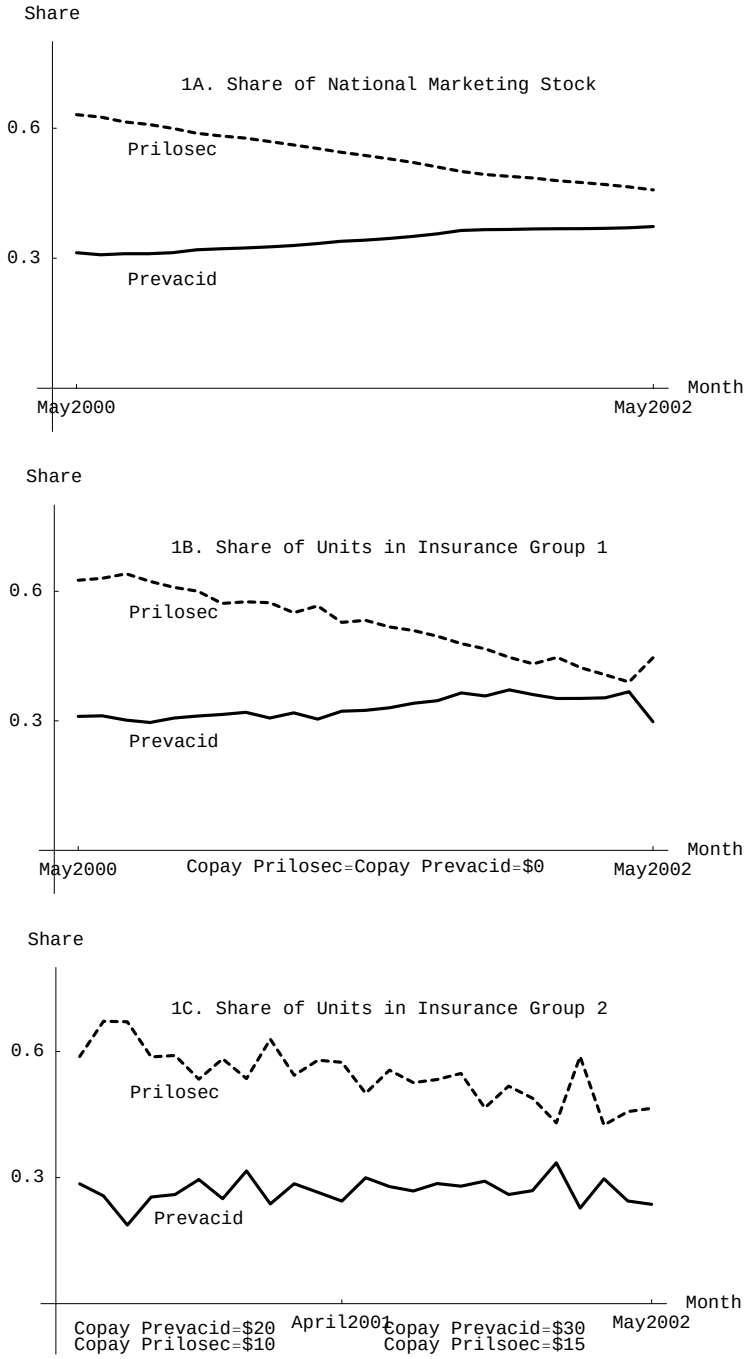

Figure 1: When copayments are equal (1B), utilization share closely tracks the national cumulative marketing share (1A), but when Prilosec is cheaper than Prevacid, Prilosec is able to retain utilization share (1C) despite decreased marketing share (1A).

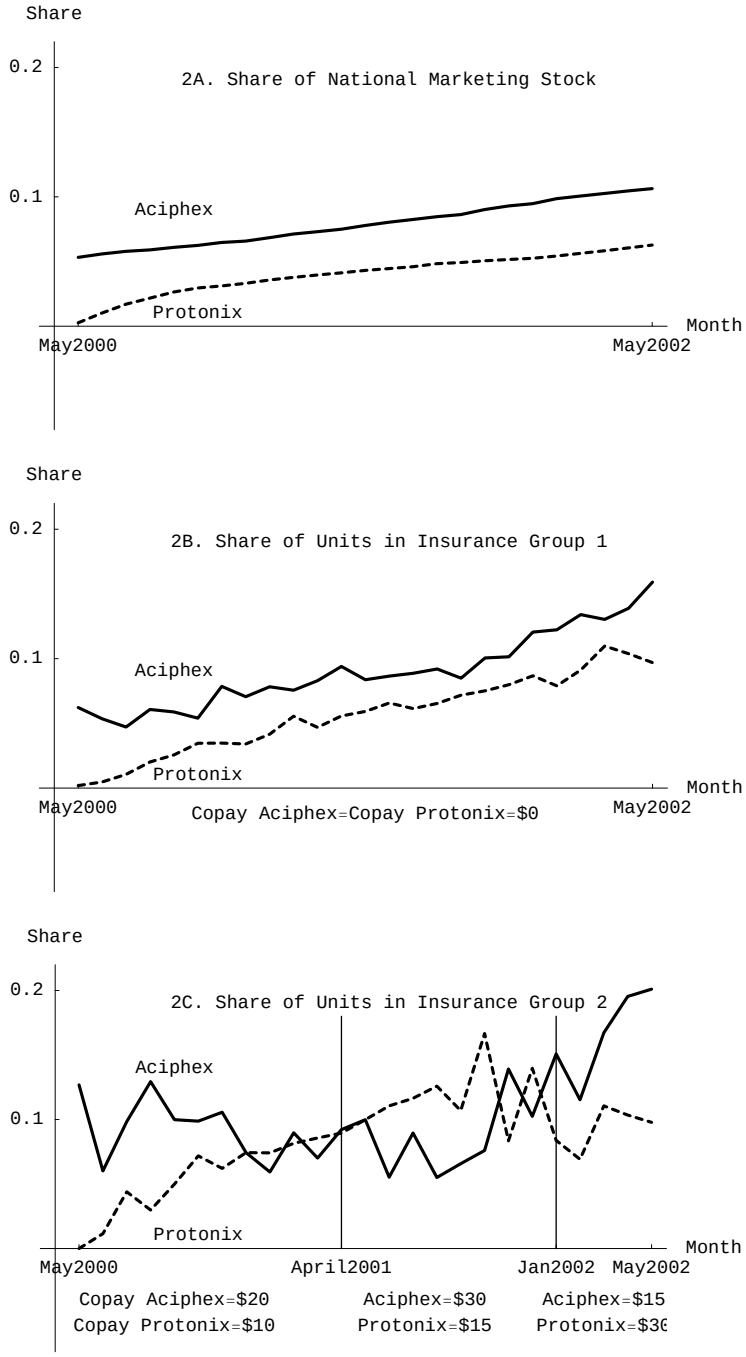

Figure 2: When copayments are equal (2B), utilization share closely tracks the cumulative national marketing share (2A), but when copayments differ then the brand with the lower copayment gains utilization share (2C).