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THE COMPETITIVE EFFECTS OF DRUG WITHDRAWALS: THE CASE OF FEN-PHEN

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ABSTRACT

In September 1997, the anti-obesity drugs Pondimin and Redux, ingredients in the popular drug combination fen-phen, were withdrawn from the market for causing potentially fatal side effects. That event provides an opportunity for studying how consumers respond to drug withdrawals. In theory, remaining drugs in the therapeutic class could enjoy competitive benefits, or suffer negative spillovers, from the withdrawal of a competing drug. Our findings suggest that, while the withdrawal of a rival drug may impose negative spillovers in the form of higher patient quit rates, on the whole non-withdrawn drugs in the same therapeutic class enjoy competitive benefits in the form of higher utilization.

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Introduction

In the late 1990s, the drug combination fen-phen was commonly prescribed to obese patients. The name fen-phen refers to the fact that the combination consists of either fenfluramine (sold under the brand name Pondimin) or dexfenfluramine (Redux) combined with phentermine.[2] Between 1995 and 1997, 14 million prescriptions were written for either Redux or Pondimin in the U.S. (U.S. D.H.H.S., 1997); it is estimated that 6 million Americans took these drugs (Agovino, 2004). In August 1997, the *New England Journal of Medicine* published a paper linking the use of fen-phen to valvular heart disease (Connolly et al., 1997) and in September 1997 the U.S. Food and Drug Administration asked Wyeth, the distributor of Pondimin and Redux, to withdraw the two drugs from the market.[3] As of November 2004, Wyeth had paid nearly $14 billion to settle claims stemming from the adverse impacts of these drugs and has several billion more reserved for future claims; this represents the largest settlement ever by a pharmaceutical company for adverse drug reactions (Agovino, 2004).

The fen-phen debacle provides an opportunity for understanding the competitive effects of drug withdrawals and consumer responses to drug withdrawals. This paper studies the withdrawal of Pondimin and Redux and answers the following questions: Do people who previously took the withdrawn drugs switch to another drug in the therapeutic class or quit taking that class of drugs altogether? Do those taking other drugs in the same class that were not withdrawn continue to comply with their treatment

[2] The combination fen-phen, which was not approved by the FDA, was inspired by the fact that phentermine, a stimulant, helps offset the drowsiness caused by fenfluramine or dexfenfluramine.

[3] When asked by the FDA to withdraw a drug because of safety concerns, manufacturers have agreed in all cases except one: Ceiba-Geigy refused to voluntarily withdraw the antidiabetic drug phenformin in 1976. If a company refuses the FDA's request, the FDA can begin procedures to compel withdrawal, and it was through this process that phenformin was taken off the market (Meadows, 2002).

regimens or are there negative spillover effects that lead them to reduce compliance or quit? On net, does the withdrawal of a drug result in a rise in utilization of non-withdrawn drugs in the same therapeutic class? The answers to these questions have important implications for understanding the nature of competition in the pharmaceutical industry and for assessing the economic effects of drug withdrawals. The existence of spillover effects can provide important insight into how drugs compete and how product markets should be defined. In the absence of price competition, spillovers may be especially useful for defining markets; specifically, the presence of spillovers confirms that the drugs compete in the same product market.

The present study is timely, given recent developments with non-steroidal anti-inflammatory drugs (NSAIDs). In September 2004 Merck withdrew Vioxx, a Cox-2 inhibitor NSAID that was used by an estimated 20 million Americans (Agovino, 2004) for arthritis and other pain management. Subsequent concerns have been voiced over Celebrex and Bextra, the other Cox-2 inhibitors that competed with Vioxx. The frequency of past withdrawals, and the possibility of additional ones in the future (Harris, 2004), indicates a pressing need to better understand consumer responses to drug withdrawals.

To our knowledge, this is the first direct study of consumer response to drug withdrawals. Moreover, the existing literature (which does not directly examine consumer behavior) implies divergent predictions. Studies of short-run changes in the stock prices of rival firms following drug withdrawals have found evidence of both positive and negative effects (Jarrell and Peltzman 1985; Dowdell et al. 1992; Ahmed et al. 2002).

This paper extends the literature by offering a direct, longer-term test of the impacts of drug withdrawals on spillovers. In addition, the study documents *how* consumers respond to the withdrawal of a prescription drug by measuring spillover effects on new initiations of drug therapy, quit rates, continuation of therapy, and the extent of use of non-withdrawn drugs.

We use a nationally representative patient-level database from the Medical Expenditure Panel Study for 1996 through 2001. Our results suggest that, on net, drug withdrawals confer competitive benefits on remaining drugs within the same therapeutic class. While there is some evidence of negative spillovers, on net, utilization of the non-withdrawn drugs increases.

The Market for Anti-Obesity Drugs

The dramatic rise in obesity in the U.S. has increased interest in the market for anti-obesity drugs. In the last 25 years, the prevalence of obesity in the U.S. has doubled, to 30.4 percent (Hedley et al., 2004). The withdrawals of Redux and Pondimin notwithstanding, the anti-obesity drug market remains substantial, with sales totaling $317 million in 2003. With the growth in the prevalence of obesity, the U.S. market for anti-obesity drugs is expected to rise to $1.3 billion by the year 2010 (Farrigan and Pang, 2002). Anti-obesity drugs are seen within the pharmaceutical industry as the "holy grail" because of the large numbers of potential customers and because drug treatment must be continued to maintain weight loss (Mirasol, 2004).

As of 2005, there are seven drugs approved by the FDA to treat obesity. Five drugs were approved several decades ago: phentermine (sold under brand names such as Adipex and Ionamin), diethylpropion (Tenuate), phendimetrazine (Adipost, Bontril),

benzphetamine (Didrex), and mazindol (Mazanor). Two drugs have recently been approved: sibutramine (Meridia) in 1998 and orlistat (Xenical) in 1999. With the exception of orlistat, all of these drugs suppress appetite or increase satiety by modifying central nervous system neurotransmission; orlistat, in contrast, inhibits the absorption of dietary fat in the intestines (Padwal et al., 2003).

Stafford and Radley (2003) provide descriptive evidence on trends in the use of anti-obesity prescription drugs between 1991 and 2002 using proprietary data from IMS Health, a private company that collects and sells data on the pharmaceutical industry. Stafford and Radley document a dramatic rise in use between 1994 and 1997, driven by large increases in prescriptions of fenfluramine and dexfenfluramine. After those two drugs were pulled from the market in September 1997, overall anti-obesity drug use fell dramatically but began to rebound with the introduction of sibutramine in 1997 and orlistat in 1999. They estimate that 2.8 million obese Americans used anti-obesity prescription drugs in 2002. To our knowledge, the present study is the first economic analysis of consumer response to drug withdrawals and the first economic study of the anti-obesity drug market.

Previous Work

Several studies in finance have tested whether negative spillovers dominate competitive benefits by examining how non-pharmaceutical firms' share prices change in the wake of bad news about a competitor's product. Jarrell and Peltzman (1985) study drug withdrawals during 1974-1982 and find evidence of negative spillovers; specifically, the share prices of pharmaceutical companies fall an average of 1 percent in the two weeks surrounding the announcement of bad news that led to the withdrawal of a

rival drug. Examples outside of the pharmaceutical industry in which the negative spillovers of information dominated competitive benefits include: decreases in the prices of shares for airlines after a crash by a competing airline (Bosch, Eckard, and Singal, 1998) and decreases in the price of shares for nuclear energy firms after the 1979 core meltdown at the Three Mile Island nuclear power plant (Hill and Schneeweis, 1983).

In other cases, competitive benefits dominate (e.g. Dowdell, Govindaraj, and Jain, 1992). Ahmed, Gardella and Nanda (2002) find that competitors' share prices rose significantly five days after the announcements of drug withdrawals that occurred between 1966 and 1998, which is consistent with the competitors gaining market share. Finally, one study of stock prices finds no net effect of drug withdrawals on the share prices of rival pharmaceutical firms (Dranove and Olsen, 1994).

These studies of stock price changes following drug withdrawals are informative about investor beliefs (e.g. about changes in the likelihood of industry regulation) but may not reflect changes in actual drug utilization patterns. Moreover, the follow-up period of these studies (ranging from days to weeks) is too brief to assess long term trends following withdrawals. The fact that the studies come to all possible conclusions about spillovers (i.e. that they are negative, zero, positive) underscores the need for a direct study of consumer behavior following drug withdrawals.

Studies of the pharmaceutical industry most commonly focus on the impact of advertising on the sales of the drug that was advertised (Azoulay 2002; Calfee et al. 2002; Rizzo 1999; Berndt et al. 2002, 1995; Hurwitz and Caves 1988; Leffler 1981). A more recent literature finds that advertising has positive spillovers for the rest of the therapeutic class. For example, direct-to-consumer advertising (DTCA) for one drug

increases the sales of the entire class of drugs (Rosenthal et al., 2003; Iizuka and Jin, 2003).[4] DTCA appears to have spillover benefits at the intensive margin: DTCA of one drug increases compliance among users of other drugs within the same therapeutic class (Wosinska, 2003, 2004). In addition, marketing for prescription drugs has positive spillover effects for same-brand over-the-counter (OTC) versions of the drugs, although DTCA for OTC products do not appear to spill over to same brand in the prescription drug market (Ling, Berndt, and Kyle, 2002). Other research has focused on how physician prescribing behavior responds to various types of information, such as detailing and the results of clinical trials published in professional journals (Azoulay, 2002; Stern and Trajtenberg, 1998). However, to our knowledge, no previous study has examined how consumers in a pharmaceutical market respond to bad news in general, or a drug withdrawal in particular.

Conceptual Framework and Methods

In theory, the withdrawal of a drug can confer competitive benefits or impose negative spillovers on remaining drugs within the therapeutic class. Competitive benefits stem from operating in an oligopolistic market; the withdrawal of one competitor increases the residual demand, and therefore equilibrium quantity supplied, by remaining producers. Negative spillovers may arise if, for example, consumers become concerned about the safety of the entire class of drugs due to the withdrawal of one and decrease their utilization of the non-withdrawn drugs.

There are several steps involved for a patient to receive a prescription drug. First, the patient must decide to visit a physician. Second, the physician must determine

[4] DTCA appears to increase the advertised drug's market share within the class only if that brand has preferred status on the third-party payer's formulary (Wosinska, 2001).

whether to prescribe any drug, and then which drug to prescribe. Third, the patient must decide whether to fill the prescription. The methods of this paper invoke a number of simplifications. We set aside explicit consideration of the agency relationship between consumer and physician and study consumer use of drugs as an outcome; thus our results reflect consumer behavior under the average agency relationship.

We estimate five types of models: 1) *utilization*, in which the binary dependent variable equals one if the respondent is using an anti-obesity drug in that year; 2) *initiation*, in which the binary dependent variable equals one if the respondent reports using an anti-obesity drug in the current interview but did not report using one in the previous interview; 3) *continuation*, in which the binary dependent variable equals one if the respondent reported using an anti-obesity drug in both the current and previous interview; 4) *quit*, in which the binary dependent variable equals one if the respondent reported using an anti-obesity drug in the previous, but not the current interview; and 5) *compliance*, in which the dependent variable equals the natural logarithm of the number of scrips filled for all anti-obesity drugs, conditional on filling at least one. The utilization, initiation, continuation, and quit equations are estimated as logit models, and the compliance equation is estimated using OLS.

Ideally, we would be able to compare the market for anti-obesity drugs after the withdrawal of Redux and Pondimin to its counterfactual: how that market would look in the same years if the drugs had not been withdrawn. Such information is unavailable however, nor is there any satisfactory "control" group in the form of a therapeutic class with identical trends in unobserved variables but no drug withdrawals (which would permit estimation of a difference-in-differences model). Therefore, we study the impact

of prescription drug withdrawal by comparing the consumer use before withdrawal to consumer use after withdrawal, controlling for observables. A limitation of this empirical strategy is that there may be trends in unobserved variables that changed the market around the time of the drug withdrawal; in other words, there may be omitted variable bias. For example, Meridia was introduced in 1998, and there is no way to separate this effect from the influence of the withdrawals on the 1998 outcomes.[5]

Nevertheless, we believe that such bias is likely to be relatively modest. The withdrawal of Redux and Pondimin from the market was extremely well-publicized and was likely the dominant event in the market. For example, the withdrawal of fen-phen was accompanied by editorials in the *New England Journal of Medicine* and *JAMA* and prominent coverage in virtually all major U.S. newspapers (the *Los Angeles Times* won a Pulitzer Prize for its coverage of the approval and withdrawal of Redux). While our model does not control for the prices of anti-obesity drugs or advertising expenditures on such drugs, for our purposes these variables do not cause omitted variable bias. The reason is that we consider how the manufacturers of remaining drugs changed their price and advertising strategies in the wake of drug withdrawal *to be part of the overall impact of drug withdrawal* and thus these influences do not represent bias but part of what we wish to measure.

Data and Empirical Specification

This paper uses 1996-2001 data from the Medical Expenditure Panel Survey (MEPS), which is collected by the Agency for Healthcare Research and Quality (AHRQ). The MEPS database is drawn from the National Health Interview Survey (NHIS) sample,

[5] However, utilization of Meridia in 1998 was quite low in relation to Pondimin and Redux in 1997 (see Table 1). Thus the withdrawal effect likely dwarfs any introduction effects.

and each year of the MEPS data may be linked to information from the previous year's NHIS survey.

The MEPS has an overlapping panel design in which two calendar years of information are collected from each household through six interviews. The MEPS database consists of a number of files. We linked the Full Year Consolidated File to the Prescribed Medicines File for each year. The Full-Year Consolidated File is at the person-year level and includes information on health care utilization and expenditures, sociodemographic and socioeconomic characteristics, and health insurance status. The Prescribed Medicines File is an event-level file that includes information on specific drug use, the amounts paid for those drugs by patient and insurers, and the length of time that the drug was taken. We convert this event-level data into person-year data and link it to the consolidated MEPS files, which include patient-year level information on the other variables included in this analysis.

We use the Multum Lexicon File, released in Fall 2004, to identify anti-obesity drugs. Specifically, we classify as anti-obesity drugs: 1) any member of the anorexiant (appetite suppressant) therapeutic class; and 2) orlistat (Xenical), which is not an anorexiant but inhibits the absorption of fat in the intestines.

We study adults aged 18 and over because no anti-obesity drug was approved for use by adolescents during 1996-2001. The number of people in the MEPS database who had a scrip for at least one anti-obesity drug by year is listed in Table 1. The percentage of MEPS adults using anti-obesity drugs rose from 0.81 in 1996 to 0.94 in 1997 but fell thereafter in the wake of the drug withdrawals in September 1997 such that in no year during 1998-2001 is the percentage higher than 0.45, less than half its level in 1997.

We study the following five outcomes: 1) an indicator that equals one if the respondent in that year had a scrip for an anti-obesity drug; 2) an indicator that equals one if the respondent began taking an anti-obesity drug; 3) an indicator that equals one if the respondent continued taking an anti-obesity drug; 4) an indicator that equals one if the respondent quit taking an anti-obesity drug, and 5) the number of scrips filled for anti-obesity drugs conditional on use.[6]

The coefficients on year indicator variables provide information about the net effect of the drug withdrawals on remaining drugs. Specifically, we compare 1996-97 to 1998-2001. Although the drugs were withdrawn in September 1997, with news of the harmful side effects announced shortly before (Connolly et al., 1997), we classify all of that year as pre-withdrawal because MEPS asked respondents to list all drugs taken since the last interview up to the end of the year, so even interviews in October through December of 1997 may include fen-phen use from before the withdrawal.

In addition to time indicators, we control for the following variables in our regressions: indicator variables for gender, African-American, Hispanic, other race/ethnicity, married, whether the respondent has health insurance, whether the respondent's health insurance includes prescription drug coverage, age categories, urban residence, Census Region categories, income categories, and education categories.

There exist several measures of, or proxies for, the out-of-pocket price of anti-obesity drugs, each with its advantages and drawbacks. MEPS respondents list the amount they paid out of pocket for each drug, but the prices faced by those who did not

[6] Each time a patient fills a prescription, it counts as a scrip. A limitation of the data is that some pharmacies and insurance plans will allow a patient to receive a three-month supply at a time, while others limit the patient to a one-month supply, but all the MEPS records is the number of scrips.

buy drugs are not observed. We have from Medi-Span the prices of anti-obesity drugs during the period covered by MEPS, but these are national average wholesale prices and they are collinear with the year fixed effects so their inclusion would prevent us from examining the impact of the drug withdrawals in 1997.

To address patient costs while avoiding problems of multicollinearity, we use two proxies for the out-of-pocket cost of prescription drugs. The first is an indicator variable for whether the respondent lacked health insurance; uninsurance would raise the cost of a physician visit to receive a scrip. The second price proxy is an indicator for whether the respondent's health insurance includes prescription drug coverage, which would lower the cost of filling a prescription. Goldman et al. (2004) document that chronically ill patients are sensitive to the out-of-pocket cost (insurance co-payments) of prescription drugs. These indicators for health insurance coverage are also, strictly speaking, endogenous; one might worry that those who sought to consume large quantities of anti-obesity drugs would most aggressively seek out health insurance and prescription drug coverage. However, this seems unlikely to be an important factor in the decision to seek insurance coverage. Generic anti-obesity drugs are available at prices that are about equal to typical copayments for branded drugs in this class.

The FDA approved anti-obesity drugs for use in patients with a body mass index[7] (BMI) of at least 30 (i.e. the clinically obese) or for patients with a BMI between 27 and 30 if they also have at least one obesity-related comorbidity (Expert Panel on the

[7] Body mass index equals weight in kilograms divided by height in meters squared. BMI is the standard measure of fatness in epidemiology and medicine (U.S. Department of Health and Human Services, 2001); it is used to classify individuals as overweight and obese by the U. S. National Institutes of Health (NIH), the World Health Organization, and the International Obesity Task Force (Flegal et al., 1998). A BMI of 25 or higher is classified as overweight, and a BMI of 30 or higher is classified as obese.

Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 1998).[8] There are valid reasons to both include and exclude from the set of regressors the measure of whether the respondent met FDA criteria for using anti-obesity drugs. On the one hand, it is desirable to control for whether respondents met the medical criteria for using anti-obesity drugs because the prevalence of obesity was rising during the period covered by our data and we do not want that trend to cause omitted variable bias in the coefficients on year indicator variables. On the other hand, obesity status is partly determined by the use of obesity drugs, although the effectiveness of these drugs is typically described as modest and insufficient to reverse obesity.[9] One potential solution is to find valid instruments for meeting the medical criteria for anti-obesity drug use and estimate a model of instrumental variables, but such instruments are unavailable in our data.

As an alternative, we estimate models both with and without an indicator for whether the respondent meets the medical criteria for the use of anti-obesity drugs: a BMI of at least 30 (i.e. the clinically obese) or for patients with a BMI between 27 and 30 if they also have at least one of the following conditions: hypertension, cardiovascular disease, hyperlipidemia, or diabetes.[10] Since using these drugs may reduce obesity, the effect of endogeneity in this context would be to decrease the estimated impact of

[8] The risk factors and diseases that justify pharmacotherapy for those with BMI between 27 and 30 are: hypertension, dyslipidemia, coronary heart disease, Type II diabetes, and sleep apnea (Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 1998).

[9] Arbeeny (2004), Gura (2003), Farrigan and Pang (2002). Randomized clinical trials of a year or more in duration exist only for orlistat and sibutramine. A meta-analysis of these RCTs calculated that average weight loss was 2.7 kg (2.9 percent) higher among obese patients taking orlistat than among those taking placebo, and 4.3 kg (4.6 percent) higher among obese patients taking sibutramine than among those taking the placebo (Padwal et al., 2003).

[10] Sleep apnea is another comorbidity that justifies the use of anti-obesity drugs for those with a BMI between 27 and 30, but in the MEPS sleep apnea is coded within a large category of conditions. Given the choice between including a wide variety of conditions and risking many false positives, or excluding sleep apnea and risking false negatives, we elected the latter.

satisfying the medical criteria on use of the drugs, resulting in conservative estimates of the effect of this factor on the use of anti-obesity drugs.

We calculate BMI using self-reported height and weight from the NHIS for 1996-1999 and self-reported height and weight in the MEPS for 2000. The MEPS for 2001 contains BMI but self-reports of height and weight were withheld to protect respondent confidentiality. Previous research has documented substantial reporting error in self-reports of weight (e.g. Rowland, 1998); the error in reporting weight in pounds can cause substantial misclassification of individuals by clinical weight category such as obesity (Nieto-Garcia, 1990).

In order to correct for this reporting error, which has the potential to bias regression coefficients, we follow the method of Lee and Sepanski (1995) and Bound, Brown, and Mathiowetz (2002); specifically, we use the National Health and Nutrition Examination Survey III (NHANES III) as validation data. NHANES III is ideal for this purpose because it contains both self-reports and measures of actual height and weight. By regressing BMI calculated using actual values of weight and height on BMI calculated using self-reported values of weight and height in NHANES III, "transporting" the coefficients to the MEPS, and multiplying them by the self-reported values, we generate measures of BMI corrected for reporting error. The NHANES III data confirm that substantial misclassification would occur in the absence of the correction; slightly more than 24 percent of those who are truly obese report weights and heights that imply a BMI that is less than obese. (In contrast, only 2.3 percent of the non-obese report weights and heights that imply a BMI that is obese.)

The greatest number of observations is lost due to missing values in the variables that measure prescription drug coverage and whether the respondent meets the medical criteria for using anti-obesity drugs. The prescription drug coverage variable is missing for 13,025 (11.0 percent of all) observations, and the medical criteria variable is missing for 23,160 (19.5 percent of all) observations, largely due to missing data on BMI. Overall, 20 percent of MEPS observations are dropped because one or both of these variables are missing. Table 2 lists summary statistics for our sample.

Empirical Results

Tables 3-7 present the results of our regressions for utilization, initiation, continuation, quits, and number of scrips. For the sake of brevity, the tables present only the parameters of interest: the coefficients on the year indicator variables.[11] We provide the complete set of regression results for all regressors in the Appendix (Tables A3 – A7).

Extensive Margin

Any Use

Table 3 includes results from logit regressions of utilization. Each cell of the table includes the odds ratio and, below that, the t statistic in parentheses. We focus on the set of year indicator variables, in particular those after the withdrawal of Pondimin and Redux: 1998-2001. The first two regressions in the table, which differ only in whether we control for whether the respondent meets the medical criteria for anti-obesity drug use, are in considerable agreement: conditional on all observables, the utilization of anti-obesity drugs fell significantly after the withdrawal of the fen-phen drugs. The

[11] While this paper is concerned with the change in anti-obesity drug utilization following the withdrawal of Pondimin and Redux, Cawley and Rizzo (2005) more broadly describe the correlates of anti-obesity drug use.

results in column 1 of Table 3 indicate that, conditional on all observables, the average respondent was only 52 percent as likely to use an anti-obesity drug in 1998 as they had been in 1996. The probability of use remains lower for the rest of the period covered by our data: relative to 1996, use was only 50 percent as likely in 1999, 41 percent as likely in 2000, and 46 percent as likely in 2001. Utilization falls even more when one controls for whether the respondents met the medical criteria for using anti-obesity drugs (column 2 of Table 3).

These regressions reflect the use of *any* anti-obesity drug. However, to test for spillovers it is necessary to look at how utilization of *non-withdrawn* drugs changed. In the third and fourth columns of Table 3, we estimate regressions for the use of anti-obesity drugs other than Pondimin and Redux. These regressions indicate that the withdrawals of Pondimin and Redux increased the utilization of the remaining anti-obesity drugs. Column 3 of Table 3 indicates that, relative to 1996, the conditional probability of using an anti-obesity drug other than Pondimin and Redux was 100 percent higher in 1997 (as information about the harmful effects was disseminated in advance of the withdrawal), 94 percent higher in 1998, and 87 percent higher in 1999. (The increase in utilization is lower when one controls for meeting the medical criteria in column 4.) The rise in utilization of non-withdrawn drugs is consistent with the findings in Ahmed et al. (2002) and Dowdell et al. (1992) that the stock price of pharmaceutical firms increases after a drug withdrawal by a rival; presumably the higher stock price reflects increased anticipated market share due to competitive benefits.

Together, these results provide a clear story. Pondimin and Redux were the most heavily used anti-obesity drugs at the time they were withdrawn in 1997. Even though

the utilization of other anti-obesity drugs rose after they were withdrawn, utilization declined for the class as a whole.

We next study changes in patterns of utilization: initiations, continuations, and quits. A limitation of these regressions is that we are forced to exclude about half of our data, since the MEPS includes two observations for each person (each corresponding to a calendar year) and we need the first of those to determine whether the second period represents a start, continuation, or quit. All observations from 1996 must be dropped for this reason. This leads to bias in our estimates of the withdrawal on initiation, since some people who might have initiated in late 1997 may have been deterred by the news of the drug withdrawals; this makes the 1997 standard for initiations unusually low and biases against finding significantly lower initiations in 1998 or any year thereafter. Little such bias should exist for quits, since a person is counted as quitting only when they have not taken the drug for an entire year (after having taken it the previous year); thus, anyone who took anti-obesity drugs in early 1997 but quit after the drugs were withdrawn will not be counted as a quit in 1997 (because they took the drug at some point in 1997) but will be counted as a quit in 1998 if they never use the drugs during that year.

Initiation

The previous results indicated that, for the class as a whole, the probability of utilization is lower in 1998 than in 1997; this raises the question: is that due to more quits, fewer starts, or both? Table 4 presents results of logit regressions for initiation. The dependent variable equals one if the respondent had not reported any anti-obesity drug use in the previous interview, but reports such use at the current interview. The first two columns reflect initiation of any anti-obesity drug (including Pondimin and Redux

for 1996 and 1997) and the latter two columns reflect initiation of anti-obesity drugs other than Pondimin and Redux.

In the first two columns of Table 4, the coefficients on year indicator variables indicate that initiations of anti-obesity drugs fell considerably after the withdrawal of fen-phen. Column 1 indicates that, relative to 1997, the conditional probability of initiation was only 35 percent in 1998, 50 percent in 1999, and between 34 and 35 percent in 2000 and 2001.

The second two columns of Table 4 suggest that the withdrawals caused negative spillovers on the initiation of other anti-obesity drugs. In column 3, before we control for whether the respondent meets the medical criteria for use of anti-obesity drugs, the conditional probability of initiation in 2000 is 58 percent of the level in 1997. In column 4, when we control for whether the respondent meets the medical criteria, the conditional probabilities of initiation in 1998, 2000, and 2001 are between 52 and 58 percent of the level in 1997, though the 1998 coefficient is only significant at the 10 percent level.

Continuations

Results concerning the continuation of anti-obesity drug use are presented in Table 5. The dependent variable equals one if the respondent reported taking an anti-obesity drug at their last interview and also reported taking one this interview; it need not be the same anti-obesity drug, so we are measuring continuations within the class, not continuations of a specific drug. The results in the first two columns indicate that continuations fell dramatically after the drug withdrawals; continuations in 1998 and 1999 were at only 22 percent of the level in 1997. Clearly, many consumers were disconcerted by the drug withdrawals and chose not to continue taking anti-obesity drugs.

However, by 2001 the point estimate of the year effect is essentially equal to that in 1997; suggesting that continuation rates bounced back within 3-4 years.

The second two columns present results for continuations of anti-obesity drugs other than Pondimin and Redux. The point estimates suggest that continuations fell after the withdrawals, but the coefficients are not statistically significant, at least in part due to the small sample size (N=139).

Quits

The results in Table 3 indicate that, for the class as a whole, utilization fell after the withdrawal of Pondimin and Redux, suggesting that many of those who previously used those drugs did not switch to another drug in the therapeutic class, but instead stopped taking any anti-obesity drug. Table 6 presents the estimated probabilities of quits from logit regressions. The dependent variable equals one if the respondent reported anti-obesity drug use during the previous, but not during the current, interview. The indicator variable for 1997 must be excluded because there is no data for 1996 since we have no prior interview to assess quits in 1996.

The first two columns, which present results for quitting any anti-obesity drug (including Pondimin and Redux) indicate that quit rates jumped dramatically after fen-phen was withdrawn. Specifically, quitting anti-obesity drugs was roughly 350 percent more likely in 1998 and 1999 than in 1997. The fact that quits remained higher in 1999, when all quits must have been from drugs other than Pondimin and Redux, suggests that negative spillovers occurred.

The second two columns of Table 6 report results for quits of drugs other than Pondimin and Redux. The sample is small (N=140), and as a result even large point

estimates are not significant (for example, the point estimate on the 1999 indicator suggests that quits in that year were 135 percent more likely than they had been in 1997). However, the direction of the point estimates is consistent with negative spillovers throughout the class.

Intensive Margin

Number of Scrips

We next examine the intensive margin, and seek to determine whether people who continued to use anti-obesity drugs filled fewer scrips for them after Pondimin and Redux were pulled from the market. Unconditionally, the answer seems to be yes; the average number of scrips filled per year dropped from 4.9 in 1996 to 4.1 in 1997 to 3.3 in 1998; for 1999-2001 it ranges from 3.1 to 3.3.

Table 7 presents results from regressions in which the dependent variable is the natural logarithm of the number of scrips filled during the calendar year. The first two columns present results for all anti-obesity drugs, including Pondimin and Redux. They indicate that the number of scrips filled fell by roughly 22 percent between 1996 and 1997 as information was disseminated during 1997 about the damage that the drugs caused to heart valves. In 1998, 2000, and 2001, the number of scrips filled by users in a year was between 30 and 39 percent below its 1996 level.

The second two columns of Table 7 present results for number of scrips filled for any anti-obesity drug other than Pondimin or Redux. None of the coefficients on the year indicator variables is statistically significant, and the point estimates of the coefficients on year indicators for 1998-2001 are positive, which suggests that there were no negative spillovers from the drug withdrawals. Instead, those who used Pondimin and Redux may

have always had higher compliance than those who used other anti-obesity drugs. After Pondimin and Redux were withdrawn, average compliance in the market fell (as shown by the first two columns of Table 7) but average compliance among the anti-obesity drugs not withdrawn did not change (the second two columns of Table 7). We find no evidence of negative spillovers in compliance.

Taken as a whole, the results paint a clear picture. Following the removal of the fen-phen drugs, quits of non-withdrawn drugs rose, initiation of non-withdrawn drugs fell, but the overall propensity to use non-withdrawn anti-obesity drugs increased. This combination of results is only possible if there was sufficient switching by previous users of Pondimin and Redux to the non-withdrawn drugs to offset the increased quits by previous users of non-withdrawn drugs and the decreased initiation of non-withdrawn drugs. We find that the strong majority (86 percent) of those who used Pondimin and Redux in 1997 quit taking any anti-obesity drug in 1998; nonetheless, 14 percent switched to a non-withdrawn anti-obesity drug. Because Pondimin and Redux dominated the market for anti-obesity drugs prior to their withdrawal,[12] even this modest rate of switching has a large effect on the estimated propensity to use non-withdrawn anti-obesity drugs.

Generalizability

Several factors should be considered when generalizing these results to other pharmaceutical markets. First, the withdrawal of Redux and Pondimin was extremely well-publicized and this may have led to greater response by consumers than is typical. Second, one non-withdrawn drug, phentermine, was both a substitute to and a

[12] Of all MEPS respondents taking an anti-obesity drug in 1997, 53.4 percent were taking either Pondimin or Redux.

complement for the withdrawn drugs. It was a substitute because it could be prescribed in the place of Redux or Pondimin, but was also a complement in that it was the other ingredient in the drug cocktail fen-phen. The complementary nature of phentermine suggests a smaller increase in utilization after the withdrawal of Redux and Pondimin than one would predict if phentermine were exclusively a substitute for the withdrawn drugs. Markets in which remaining drugs are exclusively substitutes may exhibit greater competitive benefits and weaker negative spillovers.

Third, the change in utilization of non-withdrawn drugs likely depends in part on how close a substitute those drugs are for those that are withdrawn, in terms of their pharmacokinetic action and adverse drug events profiles. Fourth, the change in utilization of non-withdrawn drugs also depends upon their market share in relation to the withdrawn drug. If, as in the present case, market shares of the non-withdrawn drugs are modest in relation to the withdrawn drugs, then even modest switching rates from users of the withdrawn drug could increase utilization of the remaining drugs, swamping decreases in new initiations and increases in quit rates. It is unclear whether these patterns would persist for withdrawn drugs that enjoyed more modest market shares. This is an important direction for future work.

Conclusions

Our results suggest that, on net, drug withdrawals confer competitive benefits to remaining drugs within the same therapeutic class. While there is some evidence of negative spillovers in the form of lower initiations of non-withdrawn drugs after a withdrawal in the same class, utilization of the non-withdrawn drugs increases overall, the likely result of switching by previous users of the withdrawn drugs. The presence of

spillover effects suggest that anti-obesity drugs compete as a class and that nonprice attributes (in the present case, in the form of bad news about certain members of the class) have important effects on patterns of use of these drugs.

Our findings are complementary to a literature in finance that finds that competitive benefits outweigh negative spillovers after drug withdrawals in the short run (e.g. Ahmed et al., 2002; Dowdell et al. 1992); our results confirm that these effects persist over a longer horizon.

This paper does not draw conclusions on the optimality of consumers' response to drug withdrawals. One could argue that negative spillovers are justified because drug withdrawals yield information about the riskiness of the entire class of drugs. Alternatively, one could argue that spillovers reflect misguided herd behavior, but we do not take a position. Our focus is to document consumer response to one type of new information: drug withdrawals.

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Table 1: Anti-Obesity Drug Use in MEPS, 1996-2001
# of Adults and % of Adults

Anti-Obesity Drug	# Adults With Scrips for Anti-Obesity Drug, by Year					
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Fenfluramine (Pondimin) or	93	124				
Dexfenfluramine (Redux)	(.56)	(.50)				
Sibutramine (Meridia)			15	16	14	24
			(.09)	(.09)	(.08)	(.10)
Orlistat (Xenical)				17	22	23
				(.10)	(.12)	(.09)
All Others	100	173	69	49	37	57
	(.61)	(.70)	(.40)	(.28)	(.21)	(.23)
Any Anti-Obesity Drug	134	232	78	77	68	99
	(.81)	(.94)	(.45)	(.43)	(.38)	(.41)

Notes:

1) Meridia was introduced in 1998.
2) Xenical was introduced in 1999.
3) Pondimin and Redux (ingredients in the drug cocktail fen-phen) were pulled from the market in September 1997.
4) All Others includes drugs 3-7 in the Appendix
5) Respondents may have scrips for multiple anti-obesity drugs in the same year, so the number of adults with scrips for "any anti-obesity" drug is less than the sum of adults with scrips for each drug.

Table 2: Summary Statistics, MEPS Sample

Variable	N	Mean	S.D.	Min	Max
Currently Using An Anti-Obesity Drug	78992	0.0066	0.0813	0	1
Currently Using An Anti-Obesity Drug Other Than Pondimin or Redux	78817	0.0044	0.0665	0	1
Started Using An Anti-Obesity Drug	34499	0.0038	0.0617	0	1
Started Using An Anti-Obesity Drug Other Than Pondimin or Redux	34470	0.0030	0.0546	0	1
Continuing to Use An Anti-Obesity Drug	250	0.3720	0.4843	0	1
Continuing to Use An Anti-Obesity Drug Other Than Pondimin or Redux	139	0.3669	0.4837	0	1
Quit Using An Anti-Obesity Drug	250	0.6280	0.4843	0	1
Quit Using An Anti-Obesity Drug Other Than Pondimin or Redux	181	0.4862	0.5012	0	1
Number of Scrips Filled for Anti-Obesity Drugs	525	3.8457	4.0762	1	40
Number of Scrips Filled for Anti-Obesity Drugs Other Than Pondimin or Redux	350	3.0771	2.8167	1	15
Female	78992	0.5292	0.4992	0	1
Hispanic	78992	0.1751	0.3801	0	1
African-American	78992	0.1264	0.3323	0	1
Other Race	78992	0.0318	0.1754	0	1
Married	78992	0.6537	0.4758	0	1
Aged 30-49	78992	0.4390	0.4963	0	1
Aged 50-64	78992	0.2092	0.4067	0	1
Aged 65+	78992	0.1563	0.3631	0	1
Main Respondent	78992	0.6466	0.4780	0	1
Urban	78992	0.7792	0.4148	0	1
Midwest	78992	0.2218	0.4155	0	1
South	78992	0.3667	0.4819	0	1
West	78992	0.2334	0.4230	0	1
High School Graduate	78992	0.3380	0.4730	0	1
Some College	78992	0.2206	0.4147	0	1
College Graduate	78992	0.1346	0.3413	0	1
Graduate School	78992	0.0883	0.2838	0	1
Family Income 25-45k	78992	0.2413	0.4279	0	1
Family Income 45-70k	78992	0.2305	0.4211	0	1
Family Income 70k +	78992	0.2778	0.4479	0	1

Uninsured	78992	0.1144	0.3183	0	1
Has Prescription Drug Coverage	78992	0.6797	0.4666	0	1
Year: 1997	78992	0.1737	0.3788	0	1
Year: 1998	78992	0.1299	0.3362	0	1
Year: 1999	78992	0.0885	0.2840		
Year: 2000	78992	0.2052	0.4039	0	1
Year: 2001	78992	0.2788	0.4484	0	1
Meets Medical Criteria for Use of Anti-Obesity Drugs	78992	0.3019	0.4591	0	1
Obese	78992	0.2517	0.4340	0	1

Table 3: Utilization of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Year: 1997	1.184	1.166	2.001***	1.975***
	(1.36)	(1.24)	(3.19)	(3.12)
Post-Withdrawal Change				
Year: 1998	0.521***	0.493***	1.939***	1.847**
	(3.52)	(3.82)	(2.63)	(2.44)
Year: 1999	0.501***	0.464***	1.874**	1.750*
	(2.94)	(3.24)	(2.05)	(1.83)
Year: 2000	0.405***	0.349***	1.506*	1.318
	(5.02)	(5.75)	(1.65)	(1.11)
Year: 2001	0.461***	0.393***	1.717**	1.492
	(5.07)	(6.08)	(2.22)	(1.65)
Controls for Whether R Medically Qualified for Anti-Obesity Drugs?	No	Yes	No	Yes
Observations	78992	78992	78817	78817

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Initiation of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Post-Withdrawal Change				
Year: 1998	0.353***	0.343***	0.594	0.579*
	(3.77)	(3.86)	(1.64)	(1.72)
Year: 1999	0.503*	0.475**	0.843	0.799
	(1.83)	(2.00)	(0.44)	(0.58)
Year: 2000	0.342***	0.304***	0.576*	0.520**
	(3.84)	(4.28)	(1.76)	(2.11)
Year: 2001	0.349***	0.300***	0.587	0.516**
	(3.52)	(4.12)	(1.62)	(2.07)
Controls for Whether R Medically Qualified for Anti-Obesity Drugs?	No	Yes	No	Yes
Observations	34249	34249	34220	34220

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Continuations of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Post-Withdrawal Change				
Year: 1998	0.221***	0.221***	0.912	0.961
	(3.66)	(3.66)	(0.14)	(0.06)
Year: 1999	0.224**	0.221**	0.503	0.520
	(2.11)	(2.13)	(0.80)	(0.76)
Year: 2000	0.751	0.762	1.832	1.931
	(0.63)	(0.60)	(0.94)	(1.02)
Year: 2001	1.158	1.203	2.432	2.692
	(0.26)	(0.33)	(1.24)	(1.35)
Controls for Whether R Medically Qualified for Anti-Obesity Drugs?	No	Yes	No	Yes
Observations	250	250	139	139

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Quits of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Post-Withdrawal Change				
Year: 1998	4.530***	4.518***	1.277	1.190
	(3.66)	(3.66)	(0.38)	(0.27)
Year: 1999	4.458**	4.519**	2.352	2.240
	(2.11)	(2.13)	(1.02)	(0.96)
Year: 2000	1.332	1.313	0.642	0.596
	(0.63)	(0.60)	(0.71)	(0.82)
Year: 2001	0.863	0.831	0.470	0.411
	(0.26)	(0.33)	(1.07)	(1.23)
Controls for Whether R Medically Qualified for Anti-Obesity Drugs?	No	Yes	No	Yes
Observations	250	250	140	140

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Scrips of Anti-Obesity Drugs Filled

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Year: 1997	-0.217**	-0.212**	-0.037	-0.041
	(2.04)	(2.00)	(0.21)	(0.23)
Post-Withdrawal Change				
Year: 1998	-0.327**	-0.329**	0.161	0.160
	(2.20)	(2.21)	(0.83)	(0.83)
Year: 1999	-0.288	-0.289	0.210	0.209
	(1.62)	(1.63)	(1.00)	(0.99)
Year: 2000	-0.390***	-0.399***	0.107	0.112
	(2.83)	(2.89)	(0.58)	(0.60)
Year: 2001	-0.295**	-0.299**	0.180	0.182
	(2.39)	(2.42)	(1.04)	(1.05)
Controls for Whether R Medically Qualified for Anti-Obesity Drugs?	No	Yes	No	Yes
Observations	525	525	350	350

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix A: Full Regression Results

Table A3: Utilization of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Female	2.808***	2.905***	2.736***	2.778***
	(7.60)	(7.76)	(6.25)	(6.28)
Hispanic	0.806	0.713*	0.740	0.671*
	(1.14)	(1.80)	(1.32)	(1.75)
African American	0.522***	0.418***	0.534***	0.440***
	(3.18)	(4.28)	(2.71)	(3.56)
Other Race	0.310**	0.361*	0.379	0.432
	(2.21)	(1.91)	(1.62)	(1.39)
Married	0.892	0.895	1.018	1.013
	(0.91)	(0.88)	(0.11)	(0.08)
Age 30-49	1.250	1.011	1.078	0.895
	(1.24)	(0.06)	(0.38)	(0.58)
Age 50-64	0.955	0.670*	0.693	0.509***
	(0.23)	(1.91)	(1.59)	(2.92)
Age 65+	0.485**	0.360***	0.333***	0.261***
	(2.20)	(3.14)	(3.14)	(3.90)
Respondent is the Primary Interviewee	1.673***	1.571***	1.643***	1.559**
	(3.68)	(3.16)	(2.90)	(2.54)
Urban	0.865	0.928	0.988	1.050
	(0.85)	(0.44)	(0.07)	(0.27)
Midwest	1.063	0.999	0.958	0.924
	(0.28)	(0.01)	(0.18)	(0.33)
South	1.891***	1.810***	1.906***	1.850***
	(3.35)	(3.15)	(2.85)	(2.74)
West	1.287	1.317	1.313	1.344
	(1.25)	(1.38)	(1.12)	(1.24)
High School Graduate	1.723***	1.787***	1.541**	1.591**
	(2.85)	(3.03)	(1.99)	(2.12)
Some College	1.921***	2.066***	1.678**	1.799***
	(3.45)	(3.85)	(2.35)	(2.65)
College Graduate	1.720**	2.034***	1.640*	1.943**
	(2.16)	(2.81)	(1.69)	(2.26)
Graduate School	1.770**	2.170***	1.502	1.843*
	(2.15)	(2.94)	(1.20)	(1.82)
Family Income 25-45k	1.125	1.158	1.081	1.094
	(0.69)	(0.86)	(0.38)	(0.44)

Family Income 45-70k	1.150	1.204	0.993	1.028
	(0.75)	(0.99)	(0.03)	(0.12)
Family Income < 70k	1.088	1.209	0.873	0.947
	(0.43)	(0.95)	(0.58)	(0.23)
Uninsured	0.733	0.747	0.653	0.672
	(0.95)	(0.89)	(1.18)	(1.10)
Has Prescription Drug Coverage	1.571**	1.549**	1.574**	1.578**
	(2.41)	(2.33)	(1.98)	(1.99)
Year: 1997	1.184	1.166	2.001***	1.975***
	(1.36)	(1.24)	(3.19)	(3.12)
Year: 1998	0.521***	0.493***	1.939***	1.847**
	(3.52)	(3.82)	(2.63)	(2.44)
Year: 1999	0.501***	0.464***	1.874**	1.750*
	(2.94)	(3.24)	(2.05)	(1.83)
Year: 2000	0.405***	0.349***	1.506*	1.318
	(5.02)	(5.75)	(1.65)	(1.11)
Year: 2001	0.461***	0.393***	1.717**	1.492
	(5.07)	(6.08)	(2.22)	(1.65)
Meets Medical Criteria for Using Anti-Obesity Drugs		4.333***		3.625***
		(10.72)		(8.26)
Observations	78992	78992	78817	78817

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table A4: Initiation of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Female	2.909***	2.928***	2.782***	2.776***
	(4.25)	(4.17)	(3.58)	(3.53)
Hispanic	1.064	0.968	1.048	0.966
	(0.20)	(0.10)	(0.14)	(0.10)
African American	0.665	0.562	0.510	0.439*
	(1.17)	(1.59)	(1.45)	(1.73)
Other Race	0.381	0.429	0.440	0.487
	(1.29)	(1.13)	(1.08)	(0.95)
Married	1.030	1.029	1.032	1.026
	(0.12)	(0.11)	(0.12)	(0.10)
Age 30-49	1.474	1.240	1.459	1.263
	(1.37)	(0.76)	(1.25)	(0.77)
Age 50-64	1.127	0.833	0.911	0.705
	(0.32)	(0.49)	(0.22)	(0.83)
Age 65+	0.596	0.464	0.495	0.405*
	(1.10)	(1.58)	(1.34)	(1.68)
Respondent is the Primary Interviewee	2.137***	2.050**	2.813***	2.720***
	(2.67)	(2.49)	(2.80)	(2.68)
Urban	0.815	0.851	0.857	0.892
	(0.82)	(0.65)	(0.54)	(0.41)
Midwest	1.156	1.112	1.037	1.012
	(0.32)	(0.24)	(0.07)	(0.02)
South	1.734	1.683	2.088*	2.039*
	(1.52)	(1.43)	(1.91)	(1.85)
West	1.660	1.698	1.810	1.843
	(1.23)	(1.28)	(1.33)	(1.38)
High School Graduate	1.140	1.199	1.002	1.042
	(0.35)	(0.48)	(0.01)	(0.10)
Some College	1.420	1.526	1.443	1.536
	(0.86)	(1.02)	(0.83)	(0.96)
College Graduate	1.128	1.320	0.924	1.063
	(0.27)	(0.60)	(0.15)	(0.12)
Graduate School	0.838	1.018	0.879	1.046
	(0.32)	(0.03)	(0.22)	(0.08)
Family Income 25-45k	1.041	1.039	1.009	1.005
	(0.12)	(0.11)	(0.02)	(0.01)
Family Income 45-70k	1.123	1.164	0.945	0.973
	(0.33)	(0.43)	(0.14)	(0.07)

Family Income < 70k	0.764	0.834	0.713	0.770
	(0.70)	(0.47)	(0.79)	(0.62)
Uninsured	0.714	0.744	0.681	0.708
	(0.59)	(0.53)	(0.60)	(0.55)
Has Prescription Drug Coverage	1.233	1.235	1.314	1.322
	(0.50)	(0.51)	(0.58)	(0.59)
Year: 1998	0.353***	0.343***	0.594	0.579*
	(3.77)	(3.86)	(1.64)	(1.72)
Year: 1999	0.503*	0.475**	0.843	0.799
	(1.83)	(2.00)	(0.44)	(0.58)
Year: 2000	0.342***	0.304***	0.576*	0.520**
	(3.84)	(4.28)	(1.76)	(2.11)
Year: 2001	0.349***	0.300***	0.587	0.516**
	(3.52)	(4.12)	(1.62)	(2.07)
Meets Medical Criteria for Using Anti-Obesity Drugs		3.388***		2.870***
		(5.79)		(4.66)
Observations	34249	34249	34220	34220

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table A5: Continuations of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Female	0.951	0.956	1.003	1.077
	(0.12)	(0.11)	(0.01)	(0.13)
Hispanic	1.216	1.224	1.259	1.212
	(0.35)	(0.37)	(0.31)	(0.26)
African American	1.002	1.057	1.107	1.235
	(0.00)	(0.10)	(0.15)	(0.31)
Other Race	0.205	0.189	0.751	0.752
	(1.13)	(1.17)	(0.17)	(0.17)
Married	0.726	0.727	0.641	0.667
	(0.88)	(0.88)	(0.87)	(0.78)
Age 30-49	0.842	0.845	0.933	0.938
	(0.39)	(0.38)	(0.12)	(0.11)
Age 50-64	1.750	1.788	3.057	3.203
	(1.05)	(1.08)	(1.43)	(1.48)
Age 65+	4.998*	5.414*	8.866	9.301
	(1.85)	(1.92)	(1.57)	(1.61)
Respondent is the Primary Interviewee	0.841	0.813	0.599	0.545
	(0.37)	(0.44)	(0.81)	(0.93)
Urban	1.448	1.395	1.892	1.773
	(0.96)	(0.86)	(1.11)	(0.98)
Midwest	0.890	0.892	1.735	1.788
	(0.22)	(0.22)	(0.73)	(0.77)
South	0.604	0.596	0.685	0.674
	(1.08)	(1.11)	(0.61)	(0.63)
West	3.039**	2.974**	2.656	2.596
	(2.07)	(2.03)	(1.36)	(1.32)
High School Graduate	1.340	1.380	1.167	1.142
	(0.47)	(0.51)	(0.19)	(0.16)
Some College	1.113	1.123	1.559	1.459
	(0.16)	(0.18)	(0.55)	(0.47)
College Graduate	4.860**	4.957**	4.436	4.043
	(2.17)	(2.20)	(1.57)	(1.47)
Graduate School	3.289	3.394	3.318	3.030
	(1.52)	(1.56)	(1.18)	(1.09)
Family Income 25-45k	1.167	1.163	0.746	0.713
	(0.30)	(0.29)	(0.41)	(0.47)
Family Income 45-70k	1.286	1.313	0.787	0.799
	(0.48)	(0.51)	(0.32)	(0.30)
Family Income < 70k	0.779	0.784	0.493	0.507

	(0.46)	(0.45)	(0.93)	(0.89)
Uninsured	0.127**	0.124**	0.101*	0.103*
	(2.26)	(2.27)	(1.79)	(1.78)
Has Prescription Drug Coverage	0.576	0.580	0.993	1.057
	(1.16)	(1.14)	(0.01)	(0.08)
Year: 1998	0.221***	0.221***	0.912	0.961
	(3.66)	(3.66)	(0.14)	(0.06)
Year: 1999	0.224**	0.221**	0.503	0.520
	(2.11)	(2.13)	(0.80)	(0.76)
Year: 2000	0.751	0.762	1.832	1.931
	(0.63)	(0.60)	(0.94)	(1.02)
Year: 2001	1.158	1.203	2.432	2.692
	(0.26)	(0.33)	(1.24)	(1.35)
Meets Medical Criteria for Using Anti-Obesity Drugs		0.788		0.684
		(0.73)		(0.79)
Observations	250	250	139	139

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table A6: Quits of Anti-Obesity Drugs

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Female	1.051	1.046	0.964	0.883
	(0.12)	(0.11)	(0.06)	(0.22)
Hispanic	0.823	0.817	0.853	0.886
	(0.35)	(0.37)	(0.22)	(0.16)
African American	0.998	0.946	0.979	0.854
	(0.00)	(0.10)	(0.03)	(0.24)
Other Race	4.885	5.302	1.433	1.431
	(1.13)	(1.17)	(0.22)	(0.21)
Married	1.377	1.375	1.567	1.492
	(0.88)	(0.88)	(0.88)	(0.78)
Age 30-49	1.188	1.183	1.021	1.019
	(0.39)	(0.38)	(0.04)	(0.03)
Age 50-64	0.572	0.559	0.320	0.302
	(1.05)	(1.08)	(1.47)	(1.53)
Age 65+	0.200*	0.185*	0.125	0.117
	(1.85)	(1.92)	(1.50)	(1.56)
Respondent is the Primary Interviewee	1.189	1.231	1.595	1.796
	(0.37)	(0.44)	(0.74)	(0.91)
Urban	0.691	0.717	0.490	0.530
	(0.96)	(0.86)	(1.26)	(1.10)
Midwest	1.123	1.121	0.562	0.540
	(0.22)	(0.22)	(0.77)	(0.82)
South	1.654	1.679	1.333	1.371
	(1.08)	(1.11)	(0.47)	(0.51)
West	0.329**	0.336**	0.376	0.388
	(2.07)	(2.03)	(1.37)	(1.31)
High School Graduate	0.746	0.724	0.754	0.775
	(0.47)	(0.51)	(0.35)	(0.32)
Some College	0.899	0.891	0.663	0.718
	(0.16)	(0.18)	(0.51)	(0.41)
College Graduate	0.206**	0.202**	0.236	0.263
	(2.17)	(2.20)	(1.54)	(1.41)
Graduate School	0.304	0.295	0.326	0.362
	(1.52)	(1.56)	(1.11)	(1.00)
Family Income 25-45k	0.857	0.860	1.341	1.416
	(0.30)	(0.29)	(0.41)	(0.49)
Family Income 45-70k	0.778	0.762	1.143	1.121
	(0.48)	(0.51)	(0.18)	(0.15)
Family Income < 70k	1.283	1.276	1.973	1.909

	(0.46)	(0.45)	(0.91)	(0.86)
Uninsured	7.883**	8.083**	9.826*	9.753*
	(2.26)	(2.27)	(1.78)	(1.78)
Has Prescription Drug Coverage	1.736	1.723	1.049	0.974
	(1.16)	(1.14)	(0.07)	(0.04)
Year: 1998	4.530***	4.518***	1.277	1.190
	(3.66)	(3.66)	(0.38)	(0.27)
Year: 1999	4.458**	4.519**	2.352	2.240
	(2.11)	(2.13)	(1.02)	(0.96)
Year: 2000	1.332	1.313	0.642	0.596
	(0.63)	(0.60)	(0.71)	(0.82)
Year: 2001	0.863	0.831	0.470	0.411
	(0.26)	(0.33)	(1.07)	(1.23)
Meets Medical Criteria for Using Anti-Obesity Drugs		1.270		1.606
		(0.73)		(1.00)
Observations	250	250	140	140

Cells contain odds ratios and the absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table A7: Scrips of Anti-Obesity Drugs Filled

	(1) All Anti-Obesity Drugs	(2) All Anti-Obesity Drugs	(3) Non-Withdrawn Anti-Obesity Drugs	(4) Non-Withdrawn Anti-Obesity Drugs
Female	0.155	0.160	0.007	0.010
	(1.53)	(1.57)	(0.06)	(0.08)
Hispanic	-0.146	-0.153	-0.322**	-0.318**
	(1.12)	(1.17)	(2.17)	(2.13)
African American	-0.236*	-0.250*	-0.268*	-0.262*
	(1.76)	(1.85)	(1.77)	(1.69)
Other Race	-0.294	-0.277	-0.330	-0.320
	(0.86)	(0.81)	(0.94)	(0.91)
Married	0.086	0.085	0.133	0.133
	(0.96)	(0.96)	(1.28)	(1.27)
Age 30-49	-0.065	-0.070	-0.093	-0.089
	(0.59)	(0.64)	(0.75)	(0.72)
Age 50-64	-0.052	-0.061	-0.211	-0.205
	(0.40)	(0.46)	(1.42)	(1.36)
Age 65+	-0.365*	-0.377**	-0.408*	-0.400*
	(1.94)	(2.00)	(1.89)	(1.84)
Respondent is the Primary Interviewee	-0.146	-0.140	-0.131	-0.136
	(1.33)	(1.27)	(1.01)	(1.04)
Urban	-0.025	-0.016	0.074	0.070
	(0.26)	(0.17)	(0.65)	(0.60)
Midwest	-0.164	-0.163	-0.309**	-0.309**
	(1.24)	(1.23)	(2.00)	(1.98)
South	-0.259**	-0.251**	-0.334**	-0.335**
	(2.17)	(2.10)	(2.47)	(2.46)
West	-0.047	-0.038	-0.107	-0.109
	(0.36)	(0.29)	(0.70)	(0.71)
High School Graduate	-0.090	-0.086	-0.188	-0.189
	(0.64)	(0.61)	(1.20)	(1.20)
Some College	0.037	0.042	0.014	0.012
	(0.25)	(0.28)	(0.08)	(0.07)
College Graduate	0.160	0.162	0.024	0.021
	(0.98)	(0.98)	(0.13)	(0.12)
Graduate School	0.398**	0.402**	0.320	0.320
	(2.15)	(2.16)	(1.52)	(1.52)
Family Income 25-45k	-0.033	-0.034	-0.018	-0.015
	(0.26)	(0.27)	(0.12)	(0.10)
Family Income 45-70k	-0.052	-0.054	-0.086	-0.081
	(0.41)	(0.43)	(0.59)	(0.56)

Family Income < 70k	-0.096	-0.094	-0.139	-0.135
	(0.72)	(0.70)	(0.91)	(0.89)
Uninsured	-0.012	-0.010	0.088	0.090
	(0.06)	(0.05)	(0.42)	(0.42)
Has Prescription Drug Coverage	-0.038	-0.050	-0.066	-0.059
	(0.32)	(0.42)	(0.49)	(0.44)
Year: 1997	-0.217**	-0.212**	-0.037	-0.041
	(2.04)	(2.00)	(0.21)	(0.23)
Year: 1998	-0.327**	-0.329**	0.161	0.160
	(2.20)	(2.21)	(0.83)	(0.83)
Year: 1999	-0.288	-0.289	0.210	0.209
	(1.62)	(1.63)	(1.00)	(0.99)
Year: 2000	-0.390***	-0.399***	0.107	0.112
	(2.83)	(2.89)	(0.58)	(0.60)
Year: 2001	-0.295**	-0.299**	0.180	0.182
	(2.39)	(2.42)	(1.04)	(1.05)
Meets Medical Criteria for Using Anti-Obesity Drugs		0.082		-0.022
		(1.03)		(0.24)
Constant	1.430***	1.375***	1.188***	1.193***
	(5.71)	(5.38)	(3.92)	(3.90)
Observations	525	525	350	350

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%