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PHARMACEUTICAL PRICES AND POLITICAL ACTIVITY

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ABSTRACT

Drug prices have been a conspicuous political issue in much of recent history, but no more so than during health care reform debates in 1993 and 1994. This paper investigates possible effects of political activity on pharmaceutical prices, with a particular focus on the health care reform period. It evaluates the extent to which pharmaceutical companies slowed the rates at which they increased prices in an attempt to preempt government intervention. To do so, we characterize companies based on their vulnerability to future price regulation. We then consider patterns in price movements across companies. The results suggest that companies whose drugs had longer patent lives and who had recently increased contributions to their corporate Political Action Committees (PACs) slowed price increases during 1992 and 1994 more than their competitors. It is difficult to distinguish pricing differences across companies in 1993, perhaps because most companies had pledged to keep price increases below the rate of inflation.

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1. INTRODUCTION

Pharmaceutical prices have been a prominent political issue over the past two decades, surfacing everywhere from the Catastrophic Health Insurance Bill to proposals for Medicare coverage of drugs. Legislative efforts to curb drug prices have been implemented on a small scale, and, during health care reform discussions, debated but not implemented on a much larger scale. Our purpose is to look for effects of legal changes and political climates on pharmaceutical prices during much of this period. Using two different data sets, we find little, if any, effect of legal changes or other events on prices. We do find evidence of self-regulation by the pharmaceutical companies during the early years of the Clinton Administration, suggesting they preemptively lowered prices or price increases under the threat of regulation. Specifically, by comparing pricing strategies across firms which differ in their vulnerability to price regulation, we find evidence that more vulnerable firms slowed their price increases during the period in which regulation seemed most likely.

Economic models deal extensively with firms' responses to the legal environment in which they operate (*i.e.* past government actions) as well as their customers' and competitors' actions. This paper addresses the hypothesis that firms' decisions are also affected by pressure from the general public and policy makers, in other words, by the threat of future government action. Economists have proposed several theories to explain government involvement in firms' decisions. Public interest theories of industrial policy predict that the government will intervene to correct market failures. If government intervention is costly, however, the role the government plays in solving different market failures may vary based on the costs of intervention (or "political transaction costs"). In other words, in circumstances where the costs of government intervention are high and the costs of private action are low, there is room for private exchange (see Noll, 1989 and the references he cites).

Whether government regulation of drug prices would have solved a market failure is a complicated, controversial question on which this paper remains agnostic. Other theories of government regulation do not start from the premise that the government is solving market failures, but rather emphasize the roles that competing interest groups play in convincing policy

makers to allocate rents to their members (Stigler, 1971). Within this paradigm, however, competing interest groups may still privately decide to enact changes to redistribute rents instead of leaving decisions to policy makers. They will do so if the private steps are much less expensive than potential policy changes. For instance, the drug companies may have lowered vaccine prices slightly in 1993 in order to diffuse the strength with which children's rights activists opposed high prices if doing so avoided costly government intervention. Private responses are likely if they sufficiently diffuse the poignancy of the competing interest group's issue. One could even imagine a type of political "contestability," where the persistent threat of government intervention constantly distorts firm behavior.

This paper seeks to provide an empirical example of a case in which firms perceived that taking costly steps on their own was preferable to likely government intervention. Little empirical evidence of such actions yet exists. A related paper by Erfle and McMillan (1990) considers oil prices during the price shocks in the late 1970's, comparing prices charged by large, domestic oil producers to prices of small and foreign companies. They hypothesize that the big, domestic firms are better able to influence government and public perceptions about policy. They show that the large, domestic producers were more likely to adjust their prices for home heating oil relative to the prices for oil sold to electric utilities when evening television programs were providing heavy coverage of the oil price shock. Pricing during less politically sensitive times was more homogenous. Both Erfle and McMillan (1990) and our paper identify politically motivated pricing by comparing decisions across firms, although the approaches are complementary. While they segment firms as being more and less able to influence the government, this paper compares pricing by firms more and less willing to sacrifice current profits to avert future regulation.[1,2] Olmstead and Rhode (1985) describe a situation where oil companies appeared to lower prices in the summer of 1920 in the face of potential government

[1] The context studied in this paper is also slightly cleaner than Erfle and McMillan's because the period when political sensitivity was high was a function of a number of economy-wide factors that influenced the rise and fall of the health care reform debate. Erfle and McMillan have to address the fact that television news coverage may not be an exogenous measure of political awareness of oil prices if coverage is influenced by the level of or changes in oil prices.

[2] Both willingness and ability to influence government action should be important in determining which firms act, but an implicit assumption of our approach is that variations in the abilities of brandname manufacturers, all fairly large and visible, to influence government actions are minimal.

involvement, but conclude that the hypothesis is "nearly impossible to test" (p. 1050). In more recent work, Stango (2000) reports that bigger, more politically visible, credit card issuers were more likely to lower interest rates following threatened legislation to cap rates. He also shows that announced rate reductions led to positive stock price responses for both the announcing firm and its competitors.

The literature on firms' environmental activities also has examples of private responses to threatened regulation.[3] For example, Pargal and Wheeler (1996) showed that Indonesian plants were less likely to pollute in areas where the local townspeople were more likely to impose high costs on polluters (for instance, they cite examples where local farmers burned a factory that was polluting irrigation channels). They describe such public reactions as a system of informal regulation that develops when formal government regulation is non-existent or poorly enforced. Our paper is similar to Pargal and Wheeler's though it considers a different sort of firm response (slower price increases as opposed to pollution abatement) and considers private actions in a country with an extensive regulatory and legislative apparatus through which competing interest groups mediate conflict.[4]

Our results also speak indirectly to the nature of corporations' political power by providing a new piece of evidence on the way in which firms can set the political agenda. Previous empirical work has considered the impact of corporate lobbying and campaign contributions on political decisions. Studies have both sought patterns in campaign contributions (*e.g.* across industries) and also considered the relationship between campaign contributions and votes in Congress.[5] By considering whether firms make decisions in response to the *threat* of policies, our results address the extent to which firms can keep issues from coming to vote in the

[3] Examples include Kennedy, Laplante and Maxwell (1994), Konar and Cohen (1997) and Maxwell, Lyon and Hackett (2000).

[4] Several studies on the deterrent effects of antitrust enforcement are also closely related to this paper. For instance, Block, Nold and Sidak (1981) find a negative relationship between various proxies for the threat of antitrust enforcement and markups in the bread industry.

[5] See, for example, Esty and Caves (1983), Masters and Keim (1985) and Grier, Munger and Roberts (1994).

first place.[6] That would imply that by only considering actual votes, previous studies might have yielded biased assessments of corporations' impact on political outcomes.

For the core of our paper—the analysis of self-regulating behavior during the period of greatest threat of regulation—we construct three measures which reflect cross-sectional differences in firm political sensitivity or vulnerability: recent past corporate contributions to political action committees, percentage of sales of drugs purchased disproportionately by the elderly, and number of on-patent drug-years ahead of each firm. We analyze whether these measures are associated with slower price growth during the early 1990s. We perform this analysis twice, using a data set containing average wholesale prices of 106 of the largest revenue prescription drugs sold in the U.S. during the period, as well as a set containing wholesale transactions prices of antibiotics. Despite the very different characteristics and origins of the data sets, our results are broadly consistent. Although the magnitudes of the effects we find are small, our measures of political sensitivity are correlated with slower price growth in both data sets.

In addition to our focus on firm behavior during the early 1990's, when major health care reform seemed likely, we take a broader view and present descriptive evidence on trends in pharmaceutical pricing over an eleven year period from 1985 to 1996. We find mostly patterns of small steady increases or decreases over this period with little evidence of the effects of political events on pricing. In fact, this event study of prices shows an effect only of health care reform debates.

Pharmaceutical prices have attracted considerable research interest, in addition to the attention they have received in public forums and the press. For instance, the systematic new product introductions (both generic and new branded) provide interesting test cases for theories of market dynamics (see *e.g.*, Caves, Whinston and Hurwitz, 1991, and Ellison and Ellison, 1999) and price indices (see *e.g.*, Griliches and Cockburn, 1994). The industry is also heavily regulated along several dimensions, and a number of existing studies evaluate the effects changes

[6] Since health care reform legislation failed for a number of reasons (see Johnson and Broder, 1996), the particular case we consider is not a good example of this part of the process. Other regulatory changes are more piecemeal and, therefore, more prone to the effects we describe.

in specific regulations have had on drug pricing (see *e.g.*, Masson and Steiner, 1985, Grabowski and Vernon, 1992 and Scott Morton, 1997). Those studies consider enacted legislation and address neither the genesis of the regulatory changes nor the effects drug companies' actions may have had on the legislative outcome.

This paper proceeds by providing a chronology culled from the contemporary press of events, perceptions, and debates relevant to pharmaceutical pricing since the mid-1980s. Section 3 describes the pricing data we use. Section 4 presents overall time series patterns in pharmaceutical pricing, and considers evidence of changes in price trends around the events identified by the chronology in Section 2. Section 5 considers the period of debate of health care reform in more detail, and presents cross-sectional evidence, based on firm differences in political sensitivity, of the effects of those debates. Section 6 concludes.

2. CHRONOLOGY

The time period we consider begins in October 1985, a year after the Drug Price Competition and Patent-term Restoration Act of 1984 (commonly referred to as the Waxman-Hatch Act) was passed. This lifted substantial barriers to generic entry into many therapeutic categories.[7] The mid to late 1980's brought various congressional proposals to expand Medicare coverage to include prescription drugs (*The Washington Post*, 1987b, 1988), as well as public scrutiny of prescription drug prices (*The Washington Post*, 1987a). Starting in July of 1988, however, public scrutiny shifted as a scandal involving several manufacturers of generic drugs broke (*The Washington Post*, 1989). The scandal involved allegations of Food and Drug Administration (FDA) favoritism in granting approval of generic drugs. It resulted in fines and jail sentences for some FDA officials, as well as the tabling of any congressional proposals involving mandated generic substitution. In fact it was reported that "as the current crisis continues to hold the public spotlight, many health officials fear that one of the most effective ways to hold down medical costs for the consumer may now be in serious jeopardy (*The Washington Post*, 1989)."

[7] Note that provisions similar to those in Waxman-Hatch had already been in place for antibiotics for decades (see Hellerstein (1995)), one reason why generic entry into antibiotics had historically been so substantial.

Public confidence was gradually restored in generic manufacturers and the FDA as the scandal faded from public view, bringing branded manufacturers under scrutiny again. Concerns over prices prompted Merck & Co. to announce voluntary price restraints (amounting to a pledge not to raise prices faster than inflation) in 1990 and to publicly scold its competitors for large price increases in 1991. Merck's CEO Roy Vagelos says "`It is clear that the U.S. public and our congressmen and senators are focusing on health-care costs…. People are really concerned… and drug prices are such an obvious target' (*The Wall Street Journal*, 1991)." (Several other leading manufacturers joined Merck's voluntary price restraints a few years later in the midst of the debate on health care reform.)

Also in 1990 Congress became concerned over Medicaid drug costs. Medicaid, unlike Medicare, did (and does) provide prescription pharmaceutical coverage, and a proposal requiring that Medicaid only provide coverage for the least expensive drug (*i.e.* generic, when available) was defeated. Instead, a plan by which each drug company must charge Medicaid the lower of its "best" wholesale price or approximately 15% off its current inflation-indexed average manufacturer's price[8] was passed and slated to go into effect in January of 1991 (*The Los Angeles Times*, 1990, *The Washington Post*, 1990).

There was some speculation in the industry that such a provision would cause firms to eliminate deep discounts given to some wholesale customers (such as hospitals and HMOs). Such action would have two effects, decreasing wholesale price dispersion and also raising the average wholesale price.

> Best-price is working brilliantly for its proponents. By forcing drugmakers to extend discounts to Medicaid for no additional business, it makes price cutting far more expensive. The manufacturers' response is simple: On many drugs, no buyer gets a discount deeper than Medicaid's 15.7%. The losers are the most powerful buyers like HMOs and hospitals, which frequently received discounts of 40%, 50%, or more (*Fortune*, 1993b).

During much of this period, there was a vague public discussion of the need for health care reform—Harris Wofford won an interim Senate election in Pennsylvania on a health care

[8] The average manufacturer's price is the average price charged by wholesalers for products distributed to the retail class of trade (U.S. Congress, Office of Technology Assessment (1993)).

reform platform—but the discussion heated up considerably during the 1992 Presidential campaign.[9] In September of 1992, then-candidate Clinton gave a speech at Merck discussing the need for reform but offering few specifics. The speech was generally well received by the industry. After Hillary Rodham Clinton was appointed the head of the Health Care Task Force in January of 1993 and leaks about the Task Force's attitude toward drug prices surfaced later in the spring of 1993, prospects for the pharmaceutical industry dimmed significantly.

> As part of a plan to transform the cost and delivery of health care, the Clinton Administration has launched a scalding attack on drugmakers, fanning public outrage over their high prices. The presidential task force, headed by Hillary Rodham Clinton, has threatened to shackle the industry with price controls and other onerous regulations (*Fortune,* 1993a).

The prospects of the industry are reflected in a huge decrease, over 40% by one measure[10], in the market-adjusted value of a portfolio of pharmaceutical stocks over the year during which the health care reform plan was being formulated. The most precipitous decline occurs in the spring months, after leaks about price controls.

In March of 1993 several pharmaceutical companies announced voluntary price restraint, essentially keeping price increases at the rate of inflation (*The San Francisco Chronicle,* 1993). The Task Force disbanded at the end of May, and in September of 1993, the President's Health Security Plan was first leaked and then officially unveiled before Congress. The plan did not include price controls for pharmaceuticals. Instead it proposed to control costs of pharmaceuticals by giving the purchasers more "buying clout."

> Under reform, with the addition of prescription drug coverage, Medicare will become the world's largest purchaser of drugs. And the Medicare program will use its negotiating power to get discounts from the pharmaceutical companies. In addition, with competing health plans trying to become more efficient, more and more buyers will use the same successful negotiating techniques (*The President's Health Security Plan,* 1993).

[9] Much of the chronology and discussion of health care reform in the Clinton Administration is based on *The System* by Johnson and Broder.

[10] See Ellison and Mullin (2001).

October of 1993 marked the high point for the political prospects of health care reform (Johnson and Broder (1996)). The demise of the Clinton Plan was gradual, beginning soon after its official unveiling, continuing with announcements of various business and consumer interest groups that they would oppose it,[11] and culminating with the official tabling of the legislation in September of 1994.

From the fall of 1992 through the fall of 1994, Congress was occupied first with the election and then with hearings on health care reform. Not surprisingly, there were no substantial legal changes enacted at the federal level involving pharmaceuticals during this period.[12]

3. PRICING DATA

For our analyses we use two main pricing data sets. One is a set of 106 of the largest revenue prescription drugs sold in the U.S. during this period. These drugs span many different therapeutic classes and were all produced by "branded" manufacturers, those engaging in efforts to discover, patent, and sell novel pharmaceutical products. These are also the manufacturers receiving the most political scrutiny and pressure during health care reform discussions. These data contain monthly prices from 1989 to 1996, but do not contain information on sales or revenues. The second is a set of (virtually) all prescription antibiotics sold in the U.S. from 1990 to 1996 and one large subclass of antibiotics from 1985 to 1990. These data have the obvious drawback of only covering one therapeutic class, but they do contain revenue information as well as information on sales by "generic" manufacturers and sales of other small revenue drugs. The other main difference between the two data sets is that the former contains Average Wholesale Prices (AWP), as reported by the manufacturers, and the latter contains averaged transactions prices, as collected from both manufacturer and wholesale purchaser by IMS, a market research firm. More detail on the structure and sources of these data sets is included in the appendix.

[11] For example, The Business Roundtable announced opposition to the plan in February.

[12] Ellison and Mullin (2001) provide a more complete argument that the health care reform debates were by far the most important event affecting pharmaceutical companies during this period.

Note that both of these data sets contain measures of wholesale prices, arguably the level of most interest in this market. Much of the public debate, centering on the actions of the drug manufacturers, is focused on the wholesale level. Government policies regarding drug reimbursement also are concerned with wholesale prices.

Our use of two separate data sets is an important feature of our study. Previous studies using AWP have been questioned because AWP tends to significantly overstate transactions prices, a more reliable measure of actual firm behavior.[13] The reliability of IMS transactions prices has also been questioned because they do not reflect rebates given by the manufacturer. While we cannot construct a perfect data set, we do have the unusual advantage that we can carry out our analyses twice, once on each data set. In fact, we find that our general results are robust to our choice of data set, bolstering confidence in our interpretations.

Our pricing data are summarized in Table 1, which presents average price growth rates, *Price Change* = $((p_t - p_{t-1})/p_{t-1})$. For the top 106 data set, p is AWP for month t. We have monthly data on prices for 925 National Drug Codes (NDCs) for 106 top-selling drugs.[14] The price series begin in January 1989, so the first price change is in February 1989. The data continue through December 1996. For the antibiotics data set, p is aggregated transactions prices at the drug level for month t. This data set is separated into four categories. First, data on cephalosporins, a subclass of antibiotics based on its mechanism of action, is presented for months November 1985 to August 1996.[15] Cephalosporins are further separated into those produced by branded manufacturers and those produced by generic manufacturers.[16] Then for

[13] It could be argued that AWP may, in fact, be the measure we are most interested in because it is reported and published and so tends to receive a lot of public scrutiny. Also, since most of our analysis uses price changes rather than price levels, changes in AWP may be reflective of changes in transactions prices, even if the levels are systematically too high.

[14] NDCs provide unique identifiers for every strength, dosage form, and package size of every drug.

[15] Cephalosporins, constituting approximately 40% of antibiotic sales during this period, is the only subclass for which we have data back to 1985. We will, therefore, use cephalosporin data to examine time series evidence over a longer period. Section 5, which examines cross-sectional evidence of political pressure focusing on health care reform discussions of the early 1990's, will exploit a fuller set of antibiotics, all of those products made by branded manufacturers.

[16] We defined a branded manufacturer as one that has engaged in R&D effort and introduced at least one novel, patented pharmaceutical product, even though they may also produce "generic" versions of some drugs. The summary statistics in

the period October 1990 to August 1996, we present summary statistics for all antibiotics, again separated by branded and generic manufacturers.

For the top 106 drugs the average monthly growth rate was .4% per month, though the standard deviation suggests there was significant variation over time and across NDCs. Both average growth rates and standard deviations are much smaller for the antibiotics data sets. These facts are not unexpected given the density in product space of antibiotics relative to other classes of drugs (thus making price increases more difficult) and the relative homogeneity of products within a class relative to across classes. Note, also, that the (branded) antibiotics are, on average, older than the top 106 drugs, with a much larger average time since patent expiration (and smaller average time before). We also computed the between firm standard deviation of prices by year to examine how variations in pricing strategies have evolved over time. We found that 1993 was the year with the lowest standard deviation, consistent with firms entering into price pledges in response to the threat of potential regulation.

4. OVERALL TRENDS

We first examine broad time series patterns in pharmaceutical company pricing and research and development spending decisions to look for effects of the various events mentioned in the chronology. Figure 1 plots an eleven-year monthly price index of all cephalosporins.[17] This aggregate index exhibits a modest average annual growth rate (AAGR) of 1.1%, as well as consistency through the political vicissitudes of the past eleven years. The only notable deviation from a broad linear trend occurs over the most recent few years. As public concern over rising drug prices waxes and wanes, cephalosporin prices, at least, steer a fairly steady course of small price increases until approximately 1994, when prices level off and then drop.[18]

Table 1 do not weight by revenue, explaining why the average price increase was higher for generic than for branded cephalosporins.

[17] As mentioned in the data section, cephalosporins are the only class of drugs for which we have data back to 1985. Over the period of overlap, we compared the price indexes for cephalosporins with those from other groups of antibiotics, and general trends were similar.

[18] This recent slowdown of price growth exists in an aggregate index of all antibiotics, but it is less pronounced.

Consider the events in the chronology in more detail. The Medicaid best price provision, taking effect in January 1991, has no obvious impact on prices of cephalosporins, despite speculation in the popular press about how average wholesale prices will go up. (There is a run-up in price in the four months leading up to January 1991 of about 2%, but this increase is not out of line with other fluctuations around the general trend.)[19]

Examining pricing differences between branded and generic[20] manufacturers gives us another lens through which to analyze events mentioned in the chronology. In particular, we would expect some of those events to have had differential impacts on branded and generic manufacturers. Figure 2 shows the branded-generic split. The generic index is rebased at approximately 50% of the branded index, reflecting that fact that existing generics in October of 1985 were pricing on average at half of the branded price for the corresponding chemical compound. The branded index exhibits price increases over the entire period, although at a slower rate starting around 1993. The generic index is falling over our entire period, with an increasing rate of price decline in recent years roughly paralleling the branded slow down. [21]

The first event of note is the generic drug scandal. If the scandal served to shift down demand for generic drugs, further differentiate branded and generic versions, temporarily relieve political pressure on branded manufacturers, or all three, we would expect a further widening of the branded-generic price difference during this period. We do, in fact, see a small but perceptible increase in the rate at which generics are decreasing prices around mid-1988. The

[19] Scott Morton (1997) provides a detailed discussion of the 1991 Medicaid reimbursement change and analysis of its effect on drug prices. Using average wholesale prices of cardiovascular drugs, she finds an increase in price at the time of Medicaid best price.

[20] For this figure only, we defined a branded manufacturer as the innovator for the particular drug and a generic manufacturer as anyone else who produced it. Other definitions yielded very small generic sales through much of this period.

[21] These broad aggregate patterns are a fairly good representation of pricing patterns on the drug level. Although there is significant variation around these norms, prices of individual branded drugs often increase over time, and prices of individual generics often decrease over time.

branded index appears unaffected. Note, however, that cephalosporins had relatively little generic penetration at this time: generic sales were about a third of branded sales in mid-1988.

Health care reform might also have different impacts on branded and generic manufacturers. Political pressure was clearly focused on branded manufacturers, and it was the branded manufacturers who voluntarily restrained prices.[22] We do, however, see a slightly more marked price decrease among generic manufacturers than among branded manufacturers. Generic antibiotics, however, have a slightly different regulatory history from generic drugs in other therapeutic classes and may not be representative of the class overall. For one, branded manufacturers produce a substantial fraction of generic antibiotics, unlike other therapeutic classes.

Figure 3 presents the last piece of graphical evidence of pharmaceutical price changes: plots of annual changes in the CPI and PPI for pharmaceutical products, as well as the average annual price change across drugs in our top 106 data set. For comparison purposes, we also include the overall CPI. The slowdown in price growth in the early 1990's is much more pronounced than in the antibiotics plots, and it is instructive to consider why. First, it is well known that the Bureau of Labor Statistics (BLS) over-samples older drugs and higher revenue drugs when constructing the CPI and PPI (see Griliches and Cockburn (1994) and Berndt, Griliches, and Rosett (1993), for example). Since these drugs tend to have faster price growth, this typically leads to an upward bias in the official indexes. In our case, however, a pronounced *slowdown* in the official indexes, relative to the antibiotics index, suggests that the drugs oversampled by BLS, the older, higher revenue drugs, actually had *slower* price growth during this period. To the extent that the drugs over-sampled by the BLS tended to be more visible and high-profile, this observation is consistent with our notion that political sensitivity led to price moderation.[23] Second, we would expect the same pattern for the top 106 data set since it is composed entirely of high revenue drugs.

[22] Such political pressure could have had an indirect effect on generic manufacturers through changes in the competitive environment, but one would expect those effects to be smaller than any direct effect.

[23] The different pricing patterns we observe are not due to peculiarities in cephalosporin pricing. The cephalosporin PPI exhibits the same pronounced slowdown as the pharmaceutical PPI and CPI, in contrast to the more subtle slowdown in

To further investigate the possible effects of health care reform discussions, we consider one specific mechanism through which prices could have been moderated: voluntary price restraints. Table 2 summarizes price increases for all of the manufacturers in our data sets that had pledged to voluntarily restrain prices.[24] For the top 106 data set, we report the average price increase for each company, unweighted by sales across drugs, for the period 1990-1992 (roughly, the pre-pledge period) and 1993-1996 (roughly, the post-pledge period). All of the companies lowered their price increases precipitously during the post-pledge period, although many of the increases exceeded the inflation rate of 2.8%.[25] Notably, of the five companies for which we found no evidence that they had pledged to lower their prices, two of the companies (Amgen and Burroughs Wellcome) had higher price increases in the post-pledge period than in the pre-pledge period. While hardly a conclusive test, this could suggest that the lower price increases were not related to general trends that affected the whole industry and that the pledges restrained pricing. For the antibiotic data set, we calculated average annual growth rates (AAGRs) of the price indexes for each firm. AAGRs for the pre-pledge period range from -14.2% to 7.5%, five exceeding the inflation rate of 4.0%. During the post-pledge period, only one firm exceeded the inflation rate and seven of the seventeen lowered antibiotic prices during that period. All but four of the firms had slower price growth (or sharper decline) in the post-pledge period.

Generally, the results in Table 2 suggest that firms abided by their pledges and decreased prices or lowered their rate of price increases in response to the threat of health care reform. To the extent that one firm's price reduction could defray the probability of regulation for all firms in the industry, unilateral price reductions may not have been successful. While the DOJ declared the industry's attempt to coordinate pledges illegal, the industry-wide push to have firms

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our broader cephalosporin index.

[24] This list was constructed using newspaper accounts of firms who joined the pledge, a March 14, 1996 Federal Trade Commission document concerning an investigation of the pledge as a means of price fixing and correspondence with the Pharmaceutical Research and Manufacturers of America (PhRMA).

[25] Note that we cannot formally test the drug companies' pledges because we only have data on a subset of each company's products.

adhere to their pledges appeared at least somewhat successful in overcoming the collective action problem.

The last overall trend we consider is firm-level investment in research and development (R&D). Figure 4 plots the weighted-average ratio of R&D to sales for the 15 companies in our sample for which we could get both R&D and sales data for the entire eleven-year period from 1986-1996.[26] The graph demonstrates that the deceleration in R&D expenditure growth during health care reform exceeded the sales slowdown. This could suggest that the companies foresaw some chance that prices for new drugs would be regulated in the future, so they had less of an incentive to invest in drug development.

5. CROSS-SECTIONAL EVIDENCE

Time series evidence from the last section suggested a slowdown in price increases coincident with health care reform discussions. In particular, firms which entered into a politically-motivated pledge to keep price increases at the rate of inflation seemed to increase their prices at a slower rate (or decrease them) after entering into the pledge. Other explanations, such as the changing structure of the market for pharmaceuticals, for instance, cannot be ruled out based on the time series evidence alone. This section investigates the extent to which cross-sectional differences in firms could provide additional evidence that they were reacting to political pressures during health care reform discussions. Ironically, the price pledge, which seemed important in detecting time series evidence, will complicate our search for cross-sectional evidence, because such a collective action masks the differences in firms' incentives to act unilaterally.

Broadly speaking, our empirical strategy is to measure the political sensitivity of firms—

[26] The R&D and sales data are from Compustat. Data for G.D. Searle and Sandoz were unavailable. Data for 6 companies were only available for part of the time period, and we exclude those companies from the figure so that year-to-year changes do not reflect compositional changes. When we include them, the dip in R&D/Sales growth in 1994 is more dramatic and the change in 1996 is positive even though none of the composition changes occur during either of those two years.

for instance based on how much they have to lose from enacted health care reform legislation—and then evaluate whether increased sensitivity is associated with slower price increases. We first lay out our methods of measuring cross-sectional differences in firms' political sensitivity.

Measuring Political Sensitivity

To develop estimates of a company's sensitivity to the political climate, we appeal to Glazer and McMillan (1992) who propose a theoretical model of a monopolist facing future regulation. They demonstrate that the firm's incentives to reduce its prices in the face of potential regulation are a function of both the effect such an action has on the probability of regulation and the cost of sacrificing short run profits to avert regulation – the firm's discount factor.[27] Based on this theoretical framework, we develop the following *firm-level* measures of the expected costs of future regulation:

Measure 1: A revenue-weighted average of the length of time remaining on a firm's patents,

Measure 2: The percent of a firm's revenues derived from sales to the elderly, and

Measure 3: The growth in a firm's contribution to its corporate Political Action Committee (PAC) in 1993.

Measure 1 is intended to proxy for the firm's discount factor, under the assumption that a firm with less time remaining on important patents would be less willing to take costly steps in the short run to preempt future regulation. Measure 2 captures the fact that firms with more drugs used by the elderly faced a higher probability of facing regulation in the near term since Medicare reimbursements would have provided a ready vehicle through which the government could affect

[27] Baron (1997) develops a common agency model where two firms attempt to influence government decisions (in his case Kodak and Fujifilm are both trying to influence the Japanese and American governments). Though Baron's setting is somewhat different from Glazer and McMillan's (for instance, he has firms making direct expenditures to influence the government rather than using prices), the characterization of multiple firms taking actions to influence the government is appropriate to the pharmaceutical industry. A number of Baron's comparative static results are similar to those in Glazer and McMillan. For instance, he shows that a firm will spend more to influence the government if its payoff from doing so is higher.

drug prices. For instance, the most overt regulation of drug prices called for in the Clinton reform package was the proposal to prohibit Medicare reimbursement for new drugs deemed to be priced "too high." To the extent that the elderly are a more cohesive and powerful political faction than other drug consumers, Measure 2 could also capture a firm's incentive to influence potential regulation.[28] Measure 3 describes a firm's overtly political actions under the assumption that they proxy for its sensitivity to political pressure.

The variables we use to capture each of the three political sensitivity measures are described in Table 3. *Co. Patent Duration* is the sales-weighted average of the time left on a company's patents as of 1993. In 1993, the average company in our sample had almost six years left on its typical patent, though there is a fair amount of variation across companies. *Co. Elder Drugs* measures the sales-weighted fraction of a company's drugs in therapeutic classes that are consumed primarily by the elderly. On average, companies sell 36 percent of their drugs in elder categories. *Co. PAC Growth* is a measure of the increase in the amount each company's corporate PAC disbursed between 1991/2 and 1993. It is based on information reported to the Federal Election Commission and is not applicable for three companies. Neither Bayer nor Hoechst-Roussel had a corporate PAC during the time period considered, Zeneca's PAC was not organized until the middle of 1993.

The assumptions and data used to construct *Co. Patent Duration*, *Co. Elder Drugs* and *Co. PAC Growth* are described in the Appendix. While each of the three measures is based on a different hypothesis about political sensitivity and captures different attributes of the companies, patterns and correlations across the measures are nonetheless instructive. Table 3 provides the value of each political sensitivity variable for all of the companies in our data set, and also indicates whether the variable is above (H) or below (L) the median value of that variable. Interestingly, the values of *Co. Patent Duration* and *Co. PAC Growth* are quite positively correlated. The correlation coefficient for the values is 0.80 and the coefficient for the dummy variables indicating whether or not the value is above the median is 0.39. By contrast, *Co. PAC*

[28] Maxwell, Lyon and Hacket (2000) develop a model where firms facing consumers with low political organizing costs would lower prices more to preempt regulation.

Growth is negatively correlated with *Co. Elder Drugs* ($\rho = -0.38$). If *Co. PAC Growth* reflects the extent to which a company took political action in response to the impending threat of regulation and *Co. Patent Duration* and *Co. Elder Drugs* attempt to proxy for the different reasons a company would be sensitive, this suggests that *Co. Patent Duration* is a better measure.[29]

Corporate PAC contributions, reflected in *Co. PAC Growth*, is only one of many ways in which companies spend money attempting to influence political outcomes. For instance, individual company employees can contribute to PACs and directly to political candidates. If the individuals are executives, contributions may be implicitly tied to preferences on policies that affect the company. Unfortunately, it is extremely difficult to track such donations. The Center for Responsive Politics (see Makinson and Goldstein, 1994), provides aggregate statistics on the percent of contributions each industry makes through corporate PACs as a fraction of total contributions. According to their calculations, 76 percent of pharmaceutical manufacturers' contributions were through corporate PACs. We, therefore, feel that our measure captures the bulk of the political contributions.

Empirical Specification

The cross-sectional empirical results we present below can be interpreted with respect to the following semi-reduced form pricing equation:

$$p_{itj} = \theta_{itj} mc_{itj} \tag{1}$$

where p_{ijt} is the price charged by firm j for drug i during month t and mc_{ijt} is marginal cost.[30] We want to allow political pressure in addition to market conditions to affect a firm's pricing

[29] We also collected data on the ratio of R&D to sales by company. This is negatively correlated with *Co. Patent Duration*, perhaps indicating that firms with few remaining good patents are spending more (relative to sales) on developing new drugs.

[30] This estimation strategy is very similar to the one used by Caves et al. (1991) to estimate the effect of generic entry on drug prices. The strategy does not attempt to identify all determinants of drug prices. Instead it relies on comparisons across firms facing different potential regulatory costs.

decisions, so we will model θ_{ijt} as a multiplicative function of the demand elasticity for drug *i* at time *t* and the political pressure faced by firm *j* at time *t*.[31] Because we do not observe marginal costs, we decompose mc_{ijt} into a month-specific term and a drug-specific term. Taking logs and rewriting, this pricing equation becomes:

$$\ln(p_{itj}) = \beta X_{ijt} + \gamma Y_{ijt} + \ln(mc_t) + \ln(mc_{ij}) \quad (2)$$

where X_{ijt} is a vector of variables affecting the elasticity of demand for the drug and Y_{jt} is a vector of variables measuring the political pressure faced by the firm. We make the further simplifying assumption that changes in the log of industry-wide marginal costs are linear within *k* different time periods (note that this also accounts for industry-wide changes in elasticity not captured by the variables in X_{ijt}) and that there are no systematic, drug-specific changes in costs beyond the industry trend. Then, differencing equation (2) and allowing for a random error, we get:

$$\ln(p_{ijt} / p_{ij(t-1)}) = \alpha_k + \beta \Delta X_{ijt} + \gamma \Delta Y_{jt} + \varepsilon_{ijt} \quad (3)$$

To estimate equation (3) we use data on the time until each drug goes off patent or the time since it was off patent and therapeutic category dummies as variables which could relate to changes in the demand elasticity (ΔX_{ijt}).[32] We construct ΔY_{jt} by interacting our cross-sectional measures of firm sensitivity with dummy variables for periods over which the salience of political pressure varied. Finally, we estimate α_k with period-specific dummy variables.

Our null hypothesis is that the components of γ will be equal to zero for all periods. The alternative hypothesis—roughly that political pressure will affect drug pricing—merits elaboration. First of all, during periods when political pressure is particularly salient, we expect the corresponding rows of γ to be negative, suggesting that firms that are more sensitive will have slower price increases. Since health care reform falls in the middle of our data set, we also have periods before and after the period of intense political pressure. If there is some baseline level of political pressure during the entire time period and if the companies we identify as politically

[31] Note that we are modeling political pressure at the company level and not the drug level and not capturing, for instance, the fact that drugs sold to a specific class of customers (*e.g.*, the elderly) may be subject to more political pressure.

[32] Caves et al. (1991) show that prices for drugs off patent have slower inflation (especially as they face more competition from generics) and that drug prices accelerate for the several years before a patent expires. Similarly, different therapeutic categories will face different changes in market structures over time, suggesting that changes in demand elasticities may differ by therapeutic category.

sensitive restrain their price increases as a result, the components of γ may always be negative. We would expect, however, that the coefficients during health care reform would be *more* negative. After health care reform, the coefficients could be positive if firms try to make up for the fact that they restrained pricing when political pressure was high, although there may be some base level of political pressure that prevents this kind of catch up.

Results

We start by examining the data set of the top 106 drugs, and Table 4 begins to address the central hypothesis evaluated in this paper by comparing price changes across companies. To calculate the figures reported in each column, we first divided the companies into two categories: those with political-sensitivity values above the median and those below the median. We then calculate the average price change by year within each group. (We first averaged across NDCs for a given drug-month and then took the average for each year over drug-months. The test statistics are calculated using every drug-month as an observation. This avoids weighting drugs with many distinct NDCs too heavily, and avoids overstating the number of independent observations reflected in the data.) The rows of the table reflect the difference between the average monthly price change for companies with low values and the average for companies with high values in a given year. If more politically-sensitive companies raise their prices slower, the difference should be positive.

When *Co. Patent Duration* is used to split the data, all of the differences are positive, though a one-tailed t-test of the equality of the means is only rejected at the 90 percent confidence level or greater in 1994 and 1995. In the other two columns, only one difference is statistically significant, 1989 for *Co. PAC Growth*, though both columns show positive price differences that are nearly statistically significant in 1994.

In all three columns, cross-company differences are small in 1993, exactly when the likelihood of future drug price regulation was highest. (The difference between the two types of companies' pricing is either smallest or second smallest in 1993.) This, we believe, reflects the

fact that many of the companies in the database were involved in the pledge to keep their price increases below the rate of inflation. Though a handful of companies had made pledges before 1993 (Merck did as early as 1990), the industry-wide push may have peaked with PMA's request to the Justice Department to grant antitrust exemption. Before 1993, few general patterns hold across all three columns.

The pattern in Table 4 is consistent with the idea that staving off industry-wide regulation is a public good. We are trying to take advantage of the fact that companies' individual incentives to take costly steps to defer regulation varied, but ideally, as came close to happening in 1993, all companies should participate. The fact that the difference between low and high companies becomes positive again in 1994 suggests that the Justice Department's refusal to uphold the companies' request for antitrust exemption freed companies with less concern about regulation to raise their prices, while the more sensitive companies still kept them low. (Health care reform legislation did not die until September 1994.)

To the extent the positive values in 1994 reflect politically-motivated price reductions, price changes in 1995 and 1996 can provide some clue as to whether companies tried to make up for slower price increases when the threat of imminent regulation disappeared. If this were the case, we would expect large negative values, as we see when the companies are divided based on their PAC contributions or sales of Elder Drugs. In the first column, however, the price changes are still lower for politically sensitive companies.

While the simple differences in Table 4 are instructive, they do not control for other factors known to affect drug prices. For instance, Caves et al. (1991) show that there are persistent price and advertising reactions to imminent patent removal and recent patent loss. Perhaps the ages of different companies' drugs relative to their patent expiration dates (the very variation *Co. Patent Duration* seeks to take advantage of) affects their relative price changes. Since *Co. Patent Duration* is based in 1993, such an effect may be greatest then. In order to control for such possibilities, we estimated versions of equation (3) and report the results in Table 5.

Like Table 4, Table 5 reports results based on all three measures of political sensitivity, again using just the top 106 data set. In each regression, we include period fixed effects and interact the period dummies with the political sensitivity variable listed at the head of the column. (In other words, for column 1, the coefficient reported in the *Political Sens*Period1* row is based on the variable *Co. Patent Duration*Period1* but in column 3 it is based on *Co. Elder Drugs*Period1*.) We report two sets of results for each sensitivity measure: one including therapeutic category specific effects for each period, and one without those fixed effects. We consider five time periods. The first time period covers 1989 and 1990. The second covers January 1991 through October 1992, the last month in which there was uncertainty about the next party in the White House and the composition of Congress. A third spans November 1992 to September 1993, the month in which the DOJ rejected the companies' request for antitrust exemption. A fourth covers October 1993 through September 1994, the end of health care reform legislation; and a fifth includes October 1994 through December 1996.

The regression results demonstrate the same general patterns as Table 4. The coefficient on *Political Sens*Period3* is small for both *Co. Patent Duration* and *Co. PAC Growth*, suggesting that there was little cross-company variation in drug pricing during the period when the companies' pledges to keep drug price inflation low were salient. The Period3 coefficients for *Co. Elder Drugs* are both negative, and the coefficient is statistically significant without therapeutic category fixed-effects. The coefficients in Period1 and Period2 illustrate no general patterns and are only significant in two of the specifications. Unlike in Table 4, the interaction terms with Period3 and Period4 break 1993 into the periods before and after the DOJ requested the PMA request. (The end of Period3 is September 1993, and Period4 picks up the end of 1993 and ends in September 1994.) The negative coefficient for *Political Sens*Period4* is consistently negative in all six columns and statistically significant in columns 2 and 6. This suggests that while the threat of regulation still loomed but after the companies' plan to adhere to voluntary price reductions had been rejected, the patterns predicted by political economic stories of pricing emerge. For both *Co. Patent Duration* and *Co. PAC Growth* the interaction terms continue to be negative and statistically significant in Period5.

It is difficult to use the results in Table 5 to assess how much of the aggregate price dip depicted in Figure 3 and discussed in Section 4 can be explained by political motivations. While we identify politically-motivated pricing by comparing pricing strategies of more and less sensitive companies, it is conceivable that even the least sensitive companies lowered their prices somewhat in response to the threat of regulation. With that caveat in mind, the results reported for the interaction terms for Period4[33] each suggests that a one standard deviation increase in political sensitivity is associated with roughly a two to five-hundredths of a percentage point change in monthly inflation. By comparison, the average monthly price increase fell by about three tenths of a percentage point between 1989-1991 and 1993-94. Taking these magnitudes as lower bounds on the extent to which political motivations affected pricing decisions, they only explain ten to fifteen percent of the drop in inflation. Clearly many factors were at work (see, *e.g.* Ellison, 1998) of which politics is just one.

The control variables included in Table 5 are generally significant and their signs are roughly consistent with past work. For instance, the variable *Time since Patent Exp.* is negative suggesting that price increases slow progressively as the time since the patent expiration increases. To the extent there are more generic entrants over time, this result is consistent with Caves et al. (1991). Similarly, the negative coefficient on *Time to Patent Exp.* is consistent with the positive coefficient that they find on variables measuring the time since the drug was introduced. Also, the coefficients on the period effects show the largest drops in drug price inflation in 1993 and 1994.

Co. PAC Growth is used here as a measure of political sensitivity, but the results in columns 5 and 6 also address the complementarity between overt political strategies and politically-motivated pricing decisions. The coefficients on *Co. PAC Growth*Period3* and *Co. PAC Growth*Period4* could be insignificantly different from zero, for instance, if PAC contributions and pricing strategies are substitutes. For instance, if demand elasticites are very different across different companies' drugs, the same price reduction (which could have roughly

[33] The numbers reported in Table 5 are the coefficients times 10^4.

the same political impact) could have very different costs. If price changes are costly for a given firm, it could substitute into PAC contributions.

Several additional issues can be addressed by limiting the data set to antibiotic drugs, for which we have information on volume sales. We use the information on volume sales to weight price changes for different presentations by their sales. For instance, since most price pledges were vague about how increases would be weighted, it is possible that the companies increased prices for high volume presentations and decreased them for low volume. Also, by considering a specific sub-class of products, we can control for changes in demand elasticity or cost that were unique to that class.

The results we obtain for the antibiotics, reported in Table 6, are broadly consistent with those for the top 106 drugs, albeit somewhat less strong. *Co. PAC Growth* is the only measure of political sensitivity that yields significant results, but those results are consistent with our findings for the top 106 drugs. Higher levels of *Co. PAC Growth* are associated with statistically significantly lower levels of price growth in all periods except Period3. In Period3 we cannot distinguish the effect from zero. In other words, results from the antibiotics data set support the main finding, that politically sensitive firms exhibit slower price growth around health care reform discussions, except during Period3, when collective action could be masking firm differences. In addition, the coefficients on control variables and period dummies in the antibiotics regressions are less precisely estimated than in the regressions using the top 106 drugs, but the significant ones are roughly consistent across the two data sets.

Given the very different characteristics of the two data sets, the consistency in results is striking and encouraging. It is instructive, however, to consider the differences in the two sets of results more carefully. Upon initial consideration, one might have expected more precisely estimated coefficients from the antibiotics data set, where the set of drugs was more homogeneous. For our purposes, however, what may be more important is that the antibiotics data set contains many small revenue drugs that would not have been very politically visible. Although our analysis implicitly assumes that political sensitivity varies only by firm and not by

drug within firm, it may be that firms recognize that distorting their prices on their more visible drugs is a more efficient way to deter regulation. Therefore, it may not be surprising that we obtained stronger results for the top 106 drugs, given that it is a data set comprised entirely of high revenue, politically visible drugs.

6. Conclusions

The results presented here suggest that there was a political component to pharmaceutical pricing during the health care reform debates, explaining approximately fifteen percent of the total reduction in price inflation observed in 1993-4. Probably the most profound recent development in the prescription pharmaceutical market is the increase in the volume of drugs sold through mail order outlets (and the concomitant fall in the percent of drugs sold through retail outlets, including pharmacies, mass merchandisers and food stores) and the increase in retail sales paid for by a third party.[34] The most often-cited explanation for slower drug price inflation in the early 1990s is the pressure that cost-conscious managed care plans are putting on pharmaceutical companies. While we cannot explicitly rule out other explanations for price reductions, and no doubt many of them were also affecting prices, they only explain our results if companies' sensitivity to the additional factors was correlated with the political sensitivity measures we are using.

Note that our results do not speak to the welfare implications of any politically motivated price reductions. It may be tempting to conclude that when firms voluntarily lower prices, efficiency increases. However, lower prices may reduce R&D below socially optimal levels, favoring current drug consumers at the cost of the future sick. To the extent politics put downward pressure on prices in 1993-4, there is little evidence that the most affected companies have subsequently tried to make up with accelerated price increases. This suggests that the reallocation of rents to current consumers has not been temporary.

[34] Berndt et al. (1998) report that 57% of pharmaceutical sales took place through retail outlets in 1996 compared to 64% in 1990 while mail order sales have increased from 5% to 9% of the market (the hospital and HMO shares have remained relatively constant). Over the same time period, the percent of retail sales paid for by third parties (other than Medicaid) has risen from 28% to 57%.

The health care reform debates provide a relatively distinct shock (with exogenous boundaries) to the political pressure faced by the drug companies, and a number of steps taken by the companies suggest that they took the threat seriously. For that reason, the situation provides a weak test of political pricing. The fact that political effects seem to play a relatively minor role in explaining recent price movements may suggest that they are of limited importance. However, several factors, most notably the industry-wide push to moderate price inflation, complicate the assessment of political pricing in this context.

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Table 1: Summary Statistics, Pricing Data

Data Set	Variable	Varies by	Mean	Standard Deviation	Number of Obs.
Top 106 Drugs (2/89-12/96)	*Price Change* [percent]	NDC-Month	.37	1.64	58875
	Time to Patent Exp. [years]	Drug-Month	5.40	4.99	8643
	Time Since Patent Exp. [years]	Drug-Month	.57	1.40	8643
Antibiotics—Branded Cephalosporins (10/85-8/96)	*Price Change* [percent]	NDC-Month	.024	1.21	64624
Antibiotics—Generic Cephalosporins (10/85-8/96)	*Price Change* [percent]	NDC-Month	.033	1.09	83022
Antibiotics—Branded (10/90-8/96)	*Price Change* [percent]	Drug-Month	.002	.085	13101
	Time to Patent Exp. [years]	Drug-Month	.53	1.31	13101
	Time Since Patent Exp. [years]	Drug-Month	2.41	1.93	13101
Antibiotics—Generic (10/90-8/96)	*Price Change* [percent]	Drug-Month	.004	.153	16320

Table 2: Pre- and Post-Pledge Price Growth by Company*

	Top 106 Drugs		Antibiotics	
Company	AAGR 1990-92 (pre-pledge period)	AAGR 1993-1996 (post pledges)	AAGR 1990-92 (pre-pledge period)	AAGR 1993-1996 (post pledges)
Abbott Labs	9.4	5.5	3.6	2.4
Bristol-Myers Squibb	7.9	3.1	3.3	0.1
Ciba-Geigy	—	—	-6.5	-2.3
DuPont Merck	—	—	7.5	-27.9
Eli Lilly	6.6	1.5	6.4	0.7
G.D. Searle	9.2	5.3	-14.2	1.0
Genentech	1.0	0	—	—
Glaxo	8.3	3.5	7.5	-0.5
Hoechst-Roussel	9.8	4.4	-0.9	-2.1
Hoffmann-La Roche	7.3	4.5	1.3	-1.3
Johnson & Johnson	7.8	3.3	-0.1	2.8
Knoll	—	—	6.3	4.5
Marion Merrell Dow	5.0	3.4	—	—
Merck	5.9	2.8	-0.3	2.6
Pfizer	4.5	2.6	4.1	-3.6
SmithKline Beecham	6.5	2.9	2.8	1.3
Syntex	6.1	3.9	—	—
Upjohn	7.3	3.5	2.3	1.4
Warner-Lambert	12.5	4.7	2.0	-10.5
Wyeth-Ayerst	8.6	5.2	2.3	1.1
Zeneca	6.1	3.1	—	—

* Note that dashes indicate that the relevant data set contained very small or no sales of drugs by the company.

Table 3: Company-Specific Political Sensitivity Measures

Company	*Co. Patent Duration* (years)	*Co. Elder Drugs* (percent)	*Co. PAC Growth* (percent change)
Abbott Labs	10.0 (H)	34 (H)	18 (H)
Amgen	20.0 (H)	0 (L)	396 (H)
Bayer	8.7 (H)	13 (L)	NA
Bristol-Myers Squibb	4.4 (L)	66 (H)	-7 (L)
Burroughs Wellcome	5.4 (H)	0 (L)	-44 (L)
Eli Lilly	5.5 (H)	17 (L)	-30 (L)
G.D. Searle	3.7 (L)	51 (H)	69 (H)
Genentech	3.8 (L)	54 (H)	-32 (L)
Glaxo	4.9 (H)	11 (L)	86 (H)
Hoechst-Roussel	2.1 (L)	32 (H)	NA
Hoffmann-La Roche	8.7 (H)	0 (L)	46 (H)
Johnson & Johnson	11.2 (H)	0 (L)	181 (H)
Marion Merrell Dow	0.4 (L)	65 (H)	8 (L)
Merck	7.1 (H)	58 (H)	48 (H)
Pfizer	6.4 (H)	61 (H)	48 (H)
SmithKline Beecham	8.3 (H)	17 (L)	18 (H)
Sandoz	4.2 (L)	21 (L)	130 (H)
Schering-Plough	4.3 (L)	15 (L)	8 (L)
Syntex	1.5 (L)	100 (H)	9 (L)
Upjohn	0.8 (L)	34 (H)	-50 (L)
Warner-Lambert	1.8 (L)	66 (H)	-4 (L)
Wyeth-Ayerst	2.1 (L)	30 (L)	-11 (L)
Zeneca	6.6 (H)	81 (H)	NA
MEAN	5.7	36	44
STD DEVIATION	4.3	29	101

Table 4: Difference between Average Price Changes for Less Sensitive and More Sensitive Companies*

Year	*Co. Patent Duration* $\overline{\Delta p}_L - \overline{\Delta p}_H$	*Co. Elder Drugs* $\overline{\Delta p}_L - \overline{\Delta p}_H$	*Co. PAC Growth* $\overline{\Delta p}_L - \overline{\Delta p}_H$
1989	8.0	14.6	**34.7**
	(0.5)	(0.9)	**(2.0)**
1990	12.4	8.4	-7.4
	(0.9)	(0.6)	(-0.5)
1991	10.4	-3.7	7.7
	(0.8)	(-0.3)	(.6)
1992	2.2	7.5	11.5
	(0.2)	(0.8)	(1.1)
1993	1.0	-2.2	5.4
	(0.2)	(-.4)	(0.8)
1994	**10.4**	8.8	9.3
	(1.5)	(1.3)	(1.2)
1995	**19.8**	-4.5	-10.4
	(1.4)	(-0.3)	(-.7)
1996	7.7	-0.6	-2.9
	(1.2)	(-0.1)	(-0.4)

* Note that the reported numbers are the estimated coefficients times 10^2. t-statistics in parentheses.

Table 5: Regression Results[*]

Dependent Variable: $ln(p_t) - ln(p_{t-1})$

Political Sens. Proxy:	*Co. Patent Duration*		*Co. Elder Drugs*		*Co. PAC Growth*	
	(1)	(2)	(3)	(4)	(5)	(6)
Period2	-24.5		-22.6		-15.5	
(1/91-10/92)	(5.5)		(5.4)		(3.6)	
Period3	-48.2		-33.8		-36.4	
(11/92-9/93)	(5.8)		(5.2)		(3.5)	
Period4	-47.6		-39.7		-38.4	
(10/93-9/94)	(5.2)		(4.9)		(3.4)	
Period5	-42.7		-35.8		-37.0	
(10/94-12/96)	(5.0)		(5.3)		(3.5)	
*Political Sens*Period1*	-2.9	-1.4	-14.6	10.8	-9.2	-4.4
	(.8)	(1.2)	(8.8)	(14.2)	(3.0)	(6.6)
*Political Sens*Period2*	-1.2	-1.3	1.8	20.9	-5.6	-6.8
	(.5)	(.7)	(6.2)	(9.0)	(1.8)	(3.8)
*Political Sens*Period3*	.18	1.3	-12.3	-10.7	.28	-.8
	(.50)	(.8)	(5.5)	(7.8)	(1.9)	(3.9)
*Political Sens*Period4*	-.72	-1.6	-8.2	-2.1	-1.1	-5.4
	(.39)	(.5)	(4.6)	(5.6)	(1.6)	(2.7)
*Political Sens*Period5*	-1.2	-.75	-12.8	-13.7	.23	3.5
	(.3)	(.31)	(5.5)	(5.2)	(.36)	(5.4)
Time to Patent Exp.	-.69	-.62	-1.4	-.87	-1.0	-.82
	(.22)	(.31)	(.2)	(.28)	(.2)	(.30)
Time since Patent Exp.	-1.7	-1.7	-2.3	-1.7	-2.0	-1.8
	(.3)	(.8)	(.4)	(.8)	(.3)	(1.1)
Fixed-Effect Estimated	None	Ther.Cat.* Period	None	Ther.Cat.* Period	None	Ther.Cat.* Period
R^2	.007	.015	.007	.012	.007	.015
Number Observations	58875	58875	58875	58875	52454	52454

[*] Note that the reported numbers are the estimated coefficients times 10^4.

Period1 (2/89-12/90) is omitted from each specification. Robust standard errors in parentheses.

Table 6: Regression Results—Antibiotics*

Dependent Variable: $ln(p_t) - ln(p_{t-1})$

Political Sens. Proxy:	*Co. Patent Duration*	*Co. Elder Drugs*	*Co. PAC Growth*
	(1)	(2)	(3)
Period2	-70.7	-29.5	-36.3
(1/91-10/92)	(35.1)	(20.3)	(14.1)
Period3	-67.2	-39.9	-39.2
(11/92-9/93)	(36.4)	(21.0)	(14.7)
Period4	-71.5	-32.3	-35.9
(10/93-9/94)	(36.1)	(20.9)	(14.7)
Period5	-89.3	-27.7	-40.1
(10/94-12/96)	(35.1)	(20.3)	(14.5)
*Political Sens*Period1*	-5.1	.1	-1.4
	(5.2)	(.5)	(.4)
*Political Sens*Period2*	.6	-.1	-.3
	(1.8)	(.2)	(.1)
*Political Sens*Period3*	-.7	.1	-.1
	(2.2)	(.2)	(.1)
*Political Sens*Period4*	.3	-.1	-.2
	(2.0)	(.2)	(.1)
*Political Sens*Period5*	1.8	-.5	-.2
	(1.4)	(.1)	(.1)
Time to Patent Exp.	-.03	-.05	.2
	(.15)	(.1)	(.2)
Time since Patent Exp.	-.4	-.5	-.4
	(.1)	(.1)	(.2)
R^2	.0028	.0035	.0045
Number Observations	13101	13101	11064

* Note that the reported numbers are the estimated coefficients times 10^4.

Period1 (1/89-12/90) is omitted from each specification. Robust standard errors in parentheses.

APPENDIX

Following is a more detailed description of some of the data sets and variables used in this paper.

Prices

The first pricing data set, with the top 106 largest revenue drugs, was derived from the ReadyPrice database, a compendium of the information found in the annual publication and monthly supplements to the *Red Book*. Both ReadyPrice and the *Red Book* are published by Micromedix. ReadyPrice contains average wholesale prices (AWP) for a number of drugs, of which we have selected 106 to analyze in this paper. Our data set covers only those NDCs that were available in the beginning of 1997, and the pricing histories for each NDC are not consistent. Only 52 percent of the NDCs for which we have data in 1997 are covered in 1989. Information on historical pricing is unavailable because the NDC was introduced mid-way through the time period we study, or because Ready Price discontinued coverage of the NDC.

One concern with the ReadyPrice series is that it does not contain information on sales or revenue figures by NDC. We are unable to identify those NDCs that are used by many customers and those which are comparatively rare. (It is not entirely clear that we *should* weight more heavily drugs or dosage-forms used by more people. Dosage-forms used by more people are seen by more people, but it is not clear that this is the relevant metric of political exposure.) The difference between the standard deviation within a drug-month and between drug-months suggests that the bulk of the variation is between drug-months, though price changes are not uniform across NDCs within a drug. We report results based both on average price changes across drugs (Table 4) and using each NDC as a separate observation (Table 5).

The second pricing data set, covering antibiotics, comes in two pieces, one covering 1985 to 1991 and the second covering 1990 to 1996. The first piece, collected by IMS America, contains wholesale quantities and revenues of all prescription cephalosporins (a subclass of antibiotics) sold in the U.S. from October 1985 to December 1991. These data are monthly and come at the NDC level, but we aggregate up to the drug level by computing a Divisia price index for each drug. Figures 1 and 2 are Divisia price indexes of many drugs. See Ellison (1998) for a more comprehensive discussion both of this data set and the calculation of the Divisia indexes.

Co. Patent Duration

Co. Patent Duration measures the sales-weighted average patent life remaining on each company's drug portfolio as of 1993. Table A1 details the drugs, sales figures and patent expiration dates used to construct the variable. Finding sales information for a number of drugs for comparable markets (*e.g.* U.S. and not international, consistent weights on distribution outlets) is not easy. We use the annual lists of the top 100 drugs by US sales published every spring in *Med Ad News*. Because we want to describe a company's perspective in 1993, we use information on drug sales in 1993, 1994 and 1995, under the assumption that companies could accurately forecast drug sales for existing and new products through 1995. The three lists together cover 140 drugs. Each list contains information on the current years' sales as well as the previous years', so a number of the gaps in sales figures could be filled. For instance, when a drug showed up on the 1994 list that had not been on the 1993 list, the 1994 list almost always contained information on 1993 sales. If sales figures for a given year were still missing, we extrapolated from recent growth rates, or included zero sales for drugs

brought to market after the year for which we had no data. We calculate each drug's total sales over the three-year period, though we discount 1994 and 1995 sales by factors of .9 and .8 respectively because, as of 1993, the sales were both in the future and uncertain.

The patent expiration years in Table A1 are those reported in *Med Ad News* or *Scripps*. The commercially-relevant expiration date is not always identifiable in the FDA's Approved Drug Products with Therapeutic Equivalence Evaluations (also referred to as the Orange Book), though the expiration dates in the Orange Book coincide with the commercial sources (plus or minus two years) about 90 percent of the time. We calculate the number of years each drug has remaining on patent and then take the sales-weighted average across each company's products.

Since we only consider drugs that made the top 100 lists in 1993-1995, we do not have a complete view of each company's patent profile. The distortions this introduces, however, are most likely minimal. First, drug sales are skewed heavily towards the most popular drugs. (For instance, 1993 US sales for Zantac, the top selling drug according to *Med Ad*, were 70 times larger than sales for the one-hundredth largest drug.) Also, for 20 of the 23 companies in our study, the largest drug not making the *Med Ad* lists would comprise less than five percent of total sales. Of course, if companies have a number of small drugs that do not make the list, and if those drugs are very different from the ones on the list (in terms of remaining patent years), the political sensitivity measures are less accurate. We do not think this is the case, though, since comparing the drugs we have on our list to the drugs mentioned by companies in their annual reports and 10K's suggests we have covered the bulk of the important ones.[1]

Co. Elder Drugs

Co. Elder Drugs measures the percent of each company's revenue from drugs in therapeutic classes that are predominantly used by the elderly. The drugs considered for each company and the sales weights used are identical to those described above and summarized in Table A1 of the Appendix. Elderly therapeutic classes are identified from Berndt et al. (1998) who report usage patterns between the elderly and non-elderly based on information from surveys of physicians on drugs prescribed to patients of different ages. All cardiac drugs, antineoplastic agents, cholesterol reducers, antidiabetics, arthritis treatments, glaucoma treatments, antiemetics, diuretics, clot dissolvers, and one drug (Parlodel) used to treat patients with Parkinson's disease were considered elderly.

Co. PAC Growth

Co. PAC Growth measures the increase in the annual disbursements made by each company's corporate PAC between the 1991/2 election cycle and calendar year 1993. Information on PAC disbursements for the 1991/2 election cycle is from Makinson and Goldstein (1994). The PACs of two companies, Amgen and Wyeth-Ayerst, were not covered by Makinson and Goldstein (1994), so we used information assembled by ICPSR. Data on PAC disbursements for companies covered by both Makinson and Goldstein and ICPSR were very similar. Information on PAC disbursements for the calendar year 1993 was obtained directly from company filings with the Federal Election

[1] We also estimated results omitting companies for whom the smallest drug in *Med Ad* was bigger than five percent of total sales. They were very similar to those reported.

Committee, downloaded from the Federal Election Commission's web site (www.fec.gov). Online information only extends back to 1993. Note that Makinson and Goldstein (1994) only covers donations to Congressional candidates, so even though 1991/2 coincided with the presidential election cycle, the PAC contributions we consider are roughly comparable across time periods.

Time to/since Patent Exp.

The patent expiration years listed in Table A1 were also used to construct the last two variables in Table 1, *Time to Patent Expiration* and *Time since Patent Expiration*. The first variable is equal to zero in years after a drug's patent has expired and equal to the number of years until the patent expires for drugs that are still on patent. The second variable is equal to zero for drugs that still have patent coverage and equal to the number of years since the patent expired for off-patent drugs. Due to the different regulatory treatment of antibiotics, patent expirations are not available from the same sources. For the second data set, therefore, we simply use the year in which generics entered as the year of commercially-relevant patent expiration.

Table A1: Drug Sales & Patent Information by Company

Company	Product	Patent Expiration (year)	Sales (wtd '93-'95 $millions)	Percent Co. Sales	Price in Data Set?
Abbott Labs	Abbokinase		367	13%	No
	Biaxin	2005	1,059	37%	
	Depakote	2008	578	20%	
	Hytrin	1997	827	29%	
Amgen	Epogen	2013	2,007	56%	
	Neupogen	2013	1,582	44%	
Bayer	Adalat	1991	292	13%	
	Cipro	2003	1,884	87%	
Bristol-Myers Squibb	BuSpar	2000	651	10%	
	Capoten	1996	1,484	23%	
	Cefzil		549	9%	No
	Duricef	1994	479	7%	
	Isovue	1998	853	13%	
	Paraplatin	2004	391	6%	
	Pravachol	2000	925	14%	
	Taxol	1997	688	11%	
	VePesid	1993	416	6%	
Boehringer Ingelheim	Atrovent	1998	610	100%	No
Burroughs Wellcome	Imuran	1993	211	12%	
	Retrovir	2005	406	23%	
	Zovirax	1997	1,150	65%	
Ciba	Estraderm	2001	278	12%	No
	Lopressor	1990	671	30%	No
	Tegretol	1986	344	15%	No
	Transderm-Nitro	2001	235	11%	No
	Voltaren	1993	703	32%	No
Dupont-Merck	Coumadin		748	100%	No
Eli Lilly	Axid	2002	964	13%	
	Ceclor	1992	982	13%	
	Dobutrex	1993	472	6%	
	Humatrope		181	2%	No
	Humulin	1995	1,241	17%	
	lorabid		339	5%	No
	Prozac	2001	3,115	42%	
	Vancocin	1990	186	2%	
Fisons	Intal	1993	403	100%	No
G.D. Searle	Ambien	2006	206	14%	No
	Calan	1992	812	56%	
	Daypro	1997	439	30%	No
Genentech	Activase	2000	707	54%	
	Protropin	1992	610	46%	
Generic	Cefaclor		619		No
Generic	Tamoxifen		200		No
Glaxo	Beconase	1994	370	4%	
	Boclovent	1999	90	1%	

	Ceftin	2000	847	9%	
	Fortaz	1999	201	2%	
	Imitrex	2006	510	5%	
	Serevent	2008	110	1%	
	Ventolin	1989	523	6%	
	Zantac	1997	5,668	61%	
	Zofran	2005	983	11%	
Hoechst-Roussel	Carafate	1986	465	25%	No
	Claforan	1998	273	15%	
	DiaBeta	1994	476	26%	
	Lasix	1990	115	6%	
	Trental	1997	503	27%	
Hoffmann-La Roche	Accutane	2001	401	15%	
	Klonopin	1999	620	23%	
	Rocephin	2005	1,074	39%	
	Versed	1999	634	23%	
Johnson & Johnson (Janssen)	Duragesic		242	6%	No
	Hismanal	1999	552	14%	
	Nizoral	1999	325	8%	
	Propulsid	2007	411	10%	No
	Risperdal	2007	300	7%	
(Ortho Biotech)	Procrit	2012	641	16%	
(Ortho Pharmaceutical)	Ortho-Novum	2003	1,125	28%	
(Ortho-McNeil)	Floxin		410	10%	No
Knoll	Synthroid		629	100%	No
Marion Merrell Dow	Cardizem	1992	2,135	65%	
	Seldane	1994	1,170	35%	
Merck	Mevacor	2001	2,778	22%	
	Pepcid	2000	1,578	13%	
	Prilosec	2001	2,303	18%	
	Primaxin	2002	395	3%	
	Prinivil	2001	610	5%	
	Proscar	2005	310	2%	
	Recombivax HB		587	5%	No
	Timoptic	1997	445	4%	
	Vasotec	2000	2,459	20%	
	Zocor	2000	1,041	8%	
Pfizer	Cardura	2000	266	3%	
	Diflucan	2004	889	11%	
	Feldene	1992	124	1%	
	Glucotrol	1994	698	8%	
	Norvasc	2007	803	10%	
	Procardia	1994	3,149	38%	
	Unasyn	1999	366	4%	
	Zithromax	2005	311	4%	
	Zoloft	2005	1,708	21%	
Rhone-Poulenc	Azmacort		429	71%	No
	Lovenox	2012	172	29%	No

Sandoz	Clozaril	1994	497	23%	
	Lamisil	2006	90	4%	
	Lescol	2011	116	5%	No
	Lotensin	2003	224	10%	
	Parlodel	1990	226	10%	
	Sandimmune	1995	1,033	47%	
Sanofi Winthrop Pharm	Omnipaque	1998	1,309	100%	No
Schering-Plough	Claritin	2004	880	21%	
	Eulexin	2001	274	6%	
	Intron A	2002	238	6%	
	K-dur		306	7%	No
	Lotrisone		146	3%	No
	Nitro-dur		356	8%	No
	Proventil	1989	1,101	26%	
	Vancenase	1994	332	8%	No
	Vanceril	1994	646	15%	
SmithKline Beecham	Amoxil	1989	157	3%	
	Augmentin	2002	1,400	27%	
	Engerix-b	2004	628	12%	
	Kytril	2006	170	3%	No
	Paxil	2008	847	16%	
	Relafen	2002	867	17%	
	Tagamet	1994	1,131	22%	
Syntex	Anaprox	1993	384	22%	
	Naprosyn	1993	691	40%	
	Toradol	1997	657	38%	
Upjohn	Cleocin	1990	149	6%	
	Micronase	1994	772	34%	
	Provera	1995	570	25%	
	Xanax	1993	811	35%	
Warner-Lambert	Accupril	2002	288	20%	
	Dilantin	1993	484	34%	
	Lopid	1993	670	46%	
Wyeth-Ayerst	Ativan	1994	416	8%	
	Effexor		376	7%	No
	Lodine	1997	650	12%	
	Oruvail		229	4%	No
	Premarin	1990	1,864	34%	
	Triphasil	1990	374	7%	
(Lederle)	Lupron	1996	945	17%	
	Minocin	1990	143	3%	
	Suprax		468	9%	No
Zeneca	Diprivan	1997	488	19%	
	Nolvadex	2002	634	24%	
	Tenormin	1991	398	15%	
	Zestril	2001	922	35%	
	Zoladex	2005	181	7%	

Figure 1
Cephalosporins

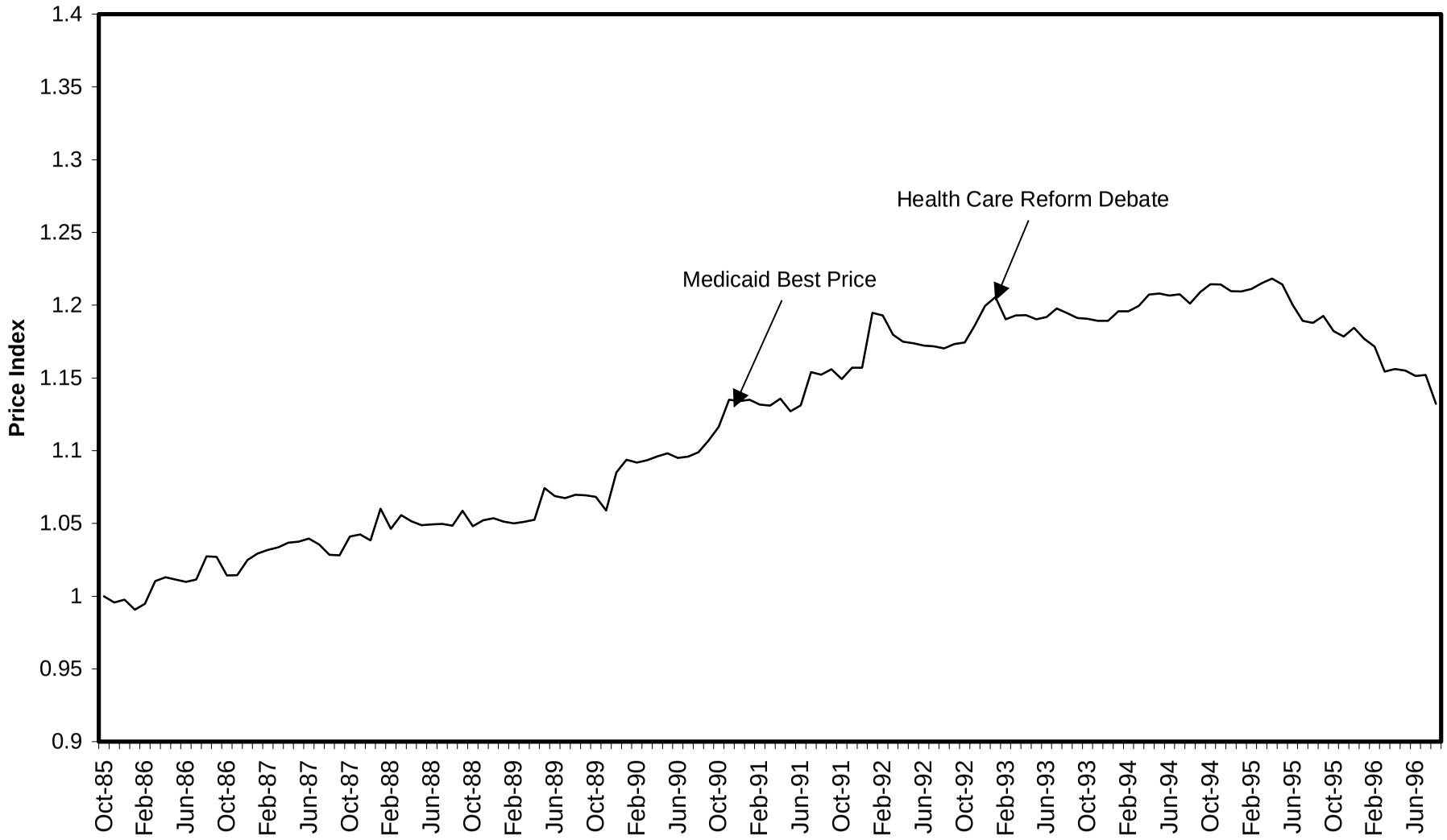

Figure 2
Cephalosporins-Branded versus Generics

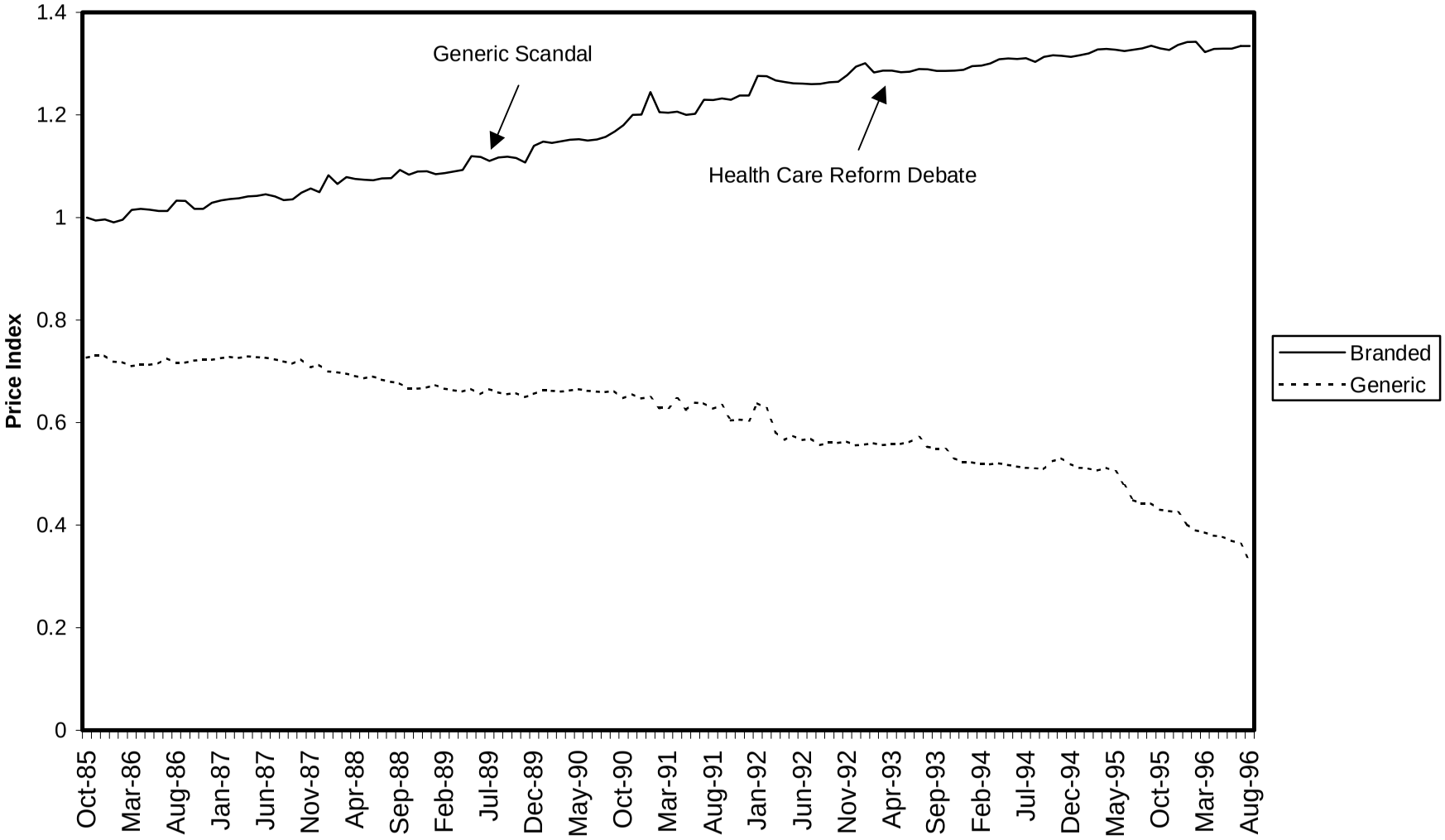

Figure 3
Changes in Prices or Indexes, December to December

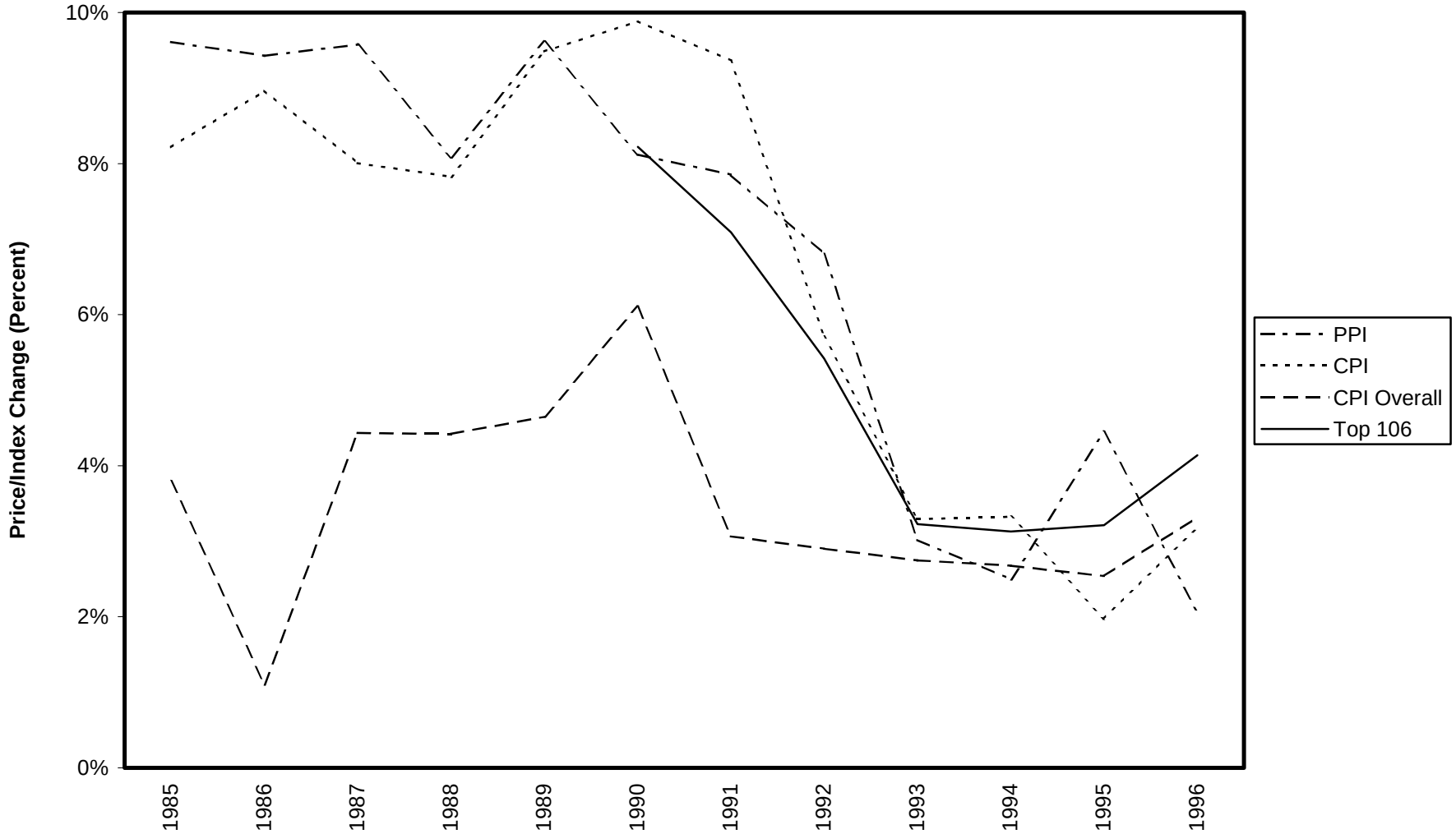

Figure 4
R&D Expenditure as a Percent of Sales by Sample Companies