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Coordinating on lower prices: pharmaceutical pricing under political pressure

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We investigate the effects of political activity on pharmaceutical prices, focusing on the health care reform period in the early 1990s. We characterize firms based on their vulnerability to future price regulation and find that the more vulnerable firms were more likely to take various actions to forestall regulation, most notably coordinating on a specific percentage price increase during 1993. Since moderating price increases could have averted regulation, the coordination appears to be the industry's response to a collective action problem.

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. During health care reform discussions in 1993, large-scale efforts to curb drug prices were debated and seemed likely to be enacted but, in the end, were not implemented. We examine the effects of the political climate on pharmaceutical firms' actions during this period. Using two different datasets, we find evidence of the more vulnerable pharmaceutical companies distorting price increases during the early years of the Clinton Administration, possibly altering their price increases to forestall potential regulation. In addition, we find evidence that firms colluded on a specific price increase when political pressure was at its peak.

Economic models deal extensively with firms' responses to the legal environment in which they operate (i.e., past government actions). This article, however, considers the possibility that firms react to the threat of future government action and take costly steps to influence its course. Public interest theories of industrial policy predict that the government will intervene to correct market failures. If government intervention is costly (suggesting that there are high "political

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transaction costs"), the affected parties may opt to take steps on their own to avert the intervention (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 article remains agnostic. Other theories of government regulation emphasize the roles that competing interest groups play in convincing policy makers to allocate rents to their members (Stigler, 1971). Again, an interest group may perceive that effecting unilateral change to redistribute rents is less expensive than leaving decisions to policy makers.

This article 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 1970s, comparing prices charged by large, domestic oil producers to prices of small and foreign companies. They argue that the large domestic firms were better able to influence government and public perceptions about policy and show that these firms were more likely to reduce 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. While Erfle and McMillan characterize firms based on their ability to influence the government, we compare pricing by firms based on their willingness to sacrifice current profits to avert future regulation, implicitly assuming that there are negligible differences in the abilities of brand-name drug manufacturers (all fairly large and visible) to influence government actions.[1] 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 involvement, but conclude that the hypothesis is "nearly impossible to test" (p. 1050). Stango (2000) reports that bigger 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 has examples of private responses to threatened regulation,[2] and work on firms' responses to the threat of antitrust enforcement is closely related.[3]

We are unaware of any other articles on regulatory threat that have documented a collective response, though other work has empirical tests of tacit collusion in separate contexts.[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 (Esty and Caves, 1983; Masters and Keim, 1985; and Grier, Munger, and Roberts, 1994). Our results address the extent to which firms can keep issues from coming to vote in the first place.[5] Also, deviating from unconstrained profit-maximizing prices can potentially be a much larger cost to firms than either campaign contributions or lobbying.

A number of existing studies evaluate the effects that changes in specific regulations have had on pharmaceutical pricing (Masson and Steiner, 1985; Grabowski and Vernon, 1992; and Scott Morton, 1997). Those studies consider enacted legislation and address neither the genesis of the

[1] Erfle and McMillan's setting is also more complicated than ours because 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 prices. By contrast, the rise and fall of health care reform was a function of many economywide factors.

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

[3] Block, Nold, and Sidak (1981), for instance, find a negative relationship between various proxies for the threat of antitrust enforcement and markups in the bread industry.

[4] For instance, Knittel and Stango (2003) show how nonbinding price caps serve as a focal point for tacit collusion in the credit card market.

[5] Since health care reform legislation failed for a number of reasons (Johnson and Broder, 1996), the particular case we consider is not a good example of this part of the process.

regulatory changes nor the effects that drug companies' actions may have had on the legislative outcome.

This article proceeds by providing a chronology of events relevant to drug pricing through the first two years of the Clinton Administration. In Section 3 we describe the two pricing datasets we use. The first contains average wholesale prices (AWP), essentially the wholesale list price, of 106 of the largest revenue prescription drugs sold in the United States during the early 1990s, and the second contains wholesale transaction prices of antibiotics. There are fifteen antibiotics in the first dataset, so we also compare pricing patterns for the drugs in common to the two datasets.

The main empirical work is presented in Section 4. We first present overall time-series patterns in pharmaceutical pricing and R&D expenditures. These patterns are consistent with firms distorting prices to forestall regulation, although the changes could have been caused by a number of other factors. To identify the effects of political pressure, we characterize firms by their vulnerability to regulation based on two measures: the proportion of their drug portfolio that is typically sold to the elderly, and the sales-weighted average remaining patent life of their drug portfolio. We find that the more vulnerable firms, as measured by our two variables, were more likely to engage in a variety of actions to forestall potential regulation, such as increasing political contributions and coordinating on a common price increase. In addition, since we have data on two different prices, AWP and transaction prices, we can track how coordination on AWP affected actual transaction prices.

During this period, the Pharmaceutical Manufacturers Association (PMA), the industry trade group, submitted a request to the U.S. Department of Justice (DOJ) requesting exemption from the antitrust laws to enforce an agreement among member companies to hold price increases at the rate of inflation. The DOJ eventually rejected the request, so the evidence of collusion is surprising. We rely on documents submitted with the request to provide a backdrop to the companies' motivations for holding price increases down.

2. Chronology

■ The public discussion about the need for health care reform started to gain momentum around 1990, with prices of prescription drugs at the center of the discussion. Concerns over prices prompted Merck 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. Harris Wofford, who ran on a health care reform platform, was elected to a vacated Senate seat in 1991, focusing the early stages of the 1992 presidential campaign squarely on health care reform. In September 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 Clinton was appointed to be head of the Health Care Task Force in January 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. As a result, the market-adjusted value of a portfolio of pharmaceutical stocks fell sharply, over 40% by one measure (Ellison and Mullin, 2001), over the year during which the health care reform plan was being formulated. The most precipitous decline occurred in the spring of 1993, after leaks surfaced alleging that the task force would use price controls to curb price increases (Tully, 1993).

The task force disbanded at the end of May, and in September 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 the 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)

October 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 public opposition from various business and consumer groups, and culminating with the official tabling of the legislation in September 1994.[6]

3. Pricing data

■ For our analyses we use two pricing datasets. One is a set of 106 of the largest revenue prescription drugs sold in the United States during the early 1990s. 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 United States from 1990 to 1996. 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. In addition, these sales data are reported separately by type of purchaser, such as hospital or drugstore. The other main difference between the two datasets is that the former contains average wholesale prices (AWP), akin to a list price, as reported by the manufacturers, and the latter contains averaged transaction prices as collected from both manufacturers and wholesale purchasers by IMS, a market research firm. These transaction prices are typically the result of negotiated discounts off of AWP.

Our use of two separate datasets is an important feature of our study. AWPs are reported and published and tend to receive considerable public scrutiny. AWPs, therefore, are an obvious tool for firms to use if they want to change prices in a visible way. Transaction prices are not typically publicly available, so changes in them might not be as politically salient, but they are obviously important as well because they are the actual wholesale prices paid and determine the final retail price of these drugs.[7]

More detail on the structure and sources of these datasets, and on why we selected them, is included in the Appendix. Two matters bear mentioning in the text. In both datasets, we have monthly observations at the presentation level.[8] We choose to aggregate across both these levels. First, all of the analyses below will focus on price changes over six-month periods: *Price Change* $= ((p_t - p_{t-6})/p_{t-6})$, where t is either April or October and $t-6$ is the October or April six months previously. It is sensible to do this for the AWPs in the top-106 dataset because price changes are infrequent. For 91% of the observations at the monthly level, price changes are equal to zero, and the typical presentation in our data changes its price every 10 months. At the monthly level, 25% of the price changes are between December and January, so the October to April six-month change is less likely to be zero. We use six-month price changes in the antibiotic dataset for consistency with the other dataset, and because we suspect that month-to-month changes reflect changes in the composition of buyers in a given month, so aggregating up to a longer period diminishes the importance of this noise. We use April and October as endpoints so that the six-month period ending October 1993 corresponds to a period when the DOJ was reviewing the request from the pharmaceutical industry trade group to allow price coordination. For the AWP dataset, we have data on 15 six-month periods between April 1989 and October 1996. For the antibiotic dataset, we have data on 10 six-month periods between April 1991 and April 1996.

Second, we use presentation-level data for the top 106 drugs and drug-level data for the antibiotics. We aggregate up to the drug level in the antibiotics data by weighting each presentation by the quantity sold. We lack presentation-level sales data for the top-106 dataset, so any aggregating would be a strict average across presentations. Since price increases vary within a drug by

[6] Ellison and Mullin (2001) argue that the health care reform debates were by far the most important event affecting pharmaceutical companies during this period.

[7] Note that both of these datasets contain measures of wholesale prices, arguably the level of most interest in this market. Much of the public debate was focused on the wholesale level, and government policies regarding drug reimbursement were concerned with wholesale prices.

[8] A presentation identifies a unique strength, dosage form, and package size of every drug.

TABLE 1 Summary Statistics, Pricing Data

Variable	Varies by	Mean	Standard Deviation	Number of Observations
Top 106 drugs (AWP), 4/89–10/96				
Price change (percentage)	Presentation half-year	2.17	3.40	7,263
Time to patent exp. (years)	Drug half-year	5.04	4.96	1,025
Time since patent exp. (years)	Drug half-year	.64	1.44	1,025
Antibiotics (transaction prices), 10/90–4/96				
Price change (percentage)	Drug-half year	.26	11.0	1,830

Note: Price changes over half-years are measured from April to October and October to April.

presentation, averaging would mask attempts to coordinate, since companies appeared to coordinate on some but not all presentations. For the antibiotics data, price changes at the presentation-level data are already noisy because, for instance, they reflect variations in the types of customers that purchased drugs in a given month, so averaging does not create the same problem.

Table 1 presents summary statistics on price changes in the two datasets as well as on covariates that we use in our pricing equation below. For the top 106 drugs, the average six-month growth rate was over 2%, though the standard deviation of 3.4% suggests there was significant variation over time and across presentations. Average growth rates are much smaller for the antibiotics dataset, .26%, although the standard deviation is 11%, and this does not appear to be driven by the outliers.

Because there are 15 drugs that are common to both datasets, we compare the pattern of price changes on these drugs. To do this, we calculate presentation-level price changes and then form an unweighted average across presentations of the same drug.[9] The top half of Table 2 presents summary statistics on the 15-drug subsets of the two datasets, limited to the sample period for which we have prices in both datasets (October 1990 to August 1996). Notably, even when we have limited the sample to the same sets of drugs, the average monthly growth in wholesale prices is considerably faster than growth in transaction prices. Price changes in the two datasets have similar standard deviations, suggesting, not surprisingly, that the transaction prices have higher coefficients of variation.

TABLE 2 Antibiotics Prices across AWP and Transaction Price Datasets

Six-Month Price Changes		
	AWP	Transaction Prices
Mean [percentage]	1.54	.20
Standard deviation	3.42	3.63
Number of observations	154	154
Correlation between AWP & transaction price changes by channel		
	Overall	Within Drug
$\sigma_{AWP,Transaction-Federal}$	.23	.18
$\sigma_{AWP,Transaction-Clinics}$	.29	.23
$\sigma_{AWP,Transaction-HMOs}$	.32	.24
$\sigma_{AWP,Transaction-Hospitals}$	.57	.48
$\sigma_{AWP,Transaction-Drugstores}$	.72	.66
$\sigma_{AWP,Transaction-AllChannels}$	.79	.73

Note: The table reflects six-month price changes (April to October and October to April) over the period October 1990 to April 1996. Data on four of the fifteen drugs were not available in the AWP dataset for several six-month periods. The transaction price changes are not weighted by revenue.

[9] While both datasets have observations available at the presentation level, there is no correspondence between the presentation identifiers in the two datasets.

The bottom half of Table 2 reports correlations between drug price changes reflected in the two datasets. We report the overall correlation and a correlation in the variables net of the average price increase by drug. There is considerable heterogeneity in the correlations by channel: changes in the prices of drugs sold to federal facilities appear to track changes in AWP much less than changes in the prices of drugs sold to drugstores. Overall, the large difference in the means of price changes in the two data series suggests that transaction prices are not simply a fixed percentage reduction off AWP, but the correlation in the price changes suggests that AWP captures many medium-term changes in transaction prices.

4. Analysis and results

■ **Overall trends.** Aggregate time-series data on both pharmaceutical pricing and pharmaceutical R&D spending is consistent with a political pressure effect. Figure 1 plots annual changes in the Consumer Price Index (CPI) and Producer Price Index (PPI) for pharmaceutical products, as well as the average annual price change across drugs in both our top-106 and antibiotics datasets. We also include the overall CPI for comparison. The slowdown in price growth in the early 1990s is pronounced in all drug price series, and it is most dramatic between 1992 and 1993, the period of the most serious health care reform discussions.

Figure 2 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 to 1996.[10] Again, the period around health care reform is unusual. 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.

While these series are suggestive of an industry response to political pressure, they are also consistent with other, perhaps structural or demand-driven, changes in the industry. We proceed by

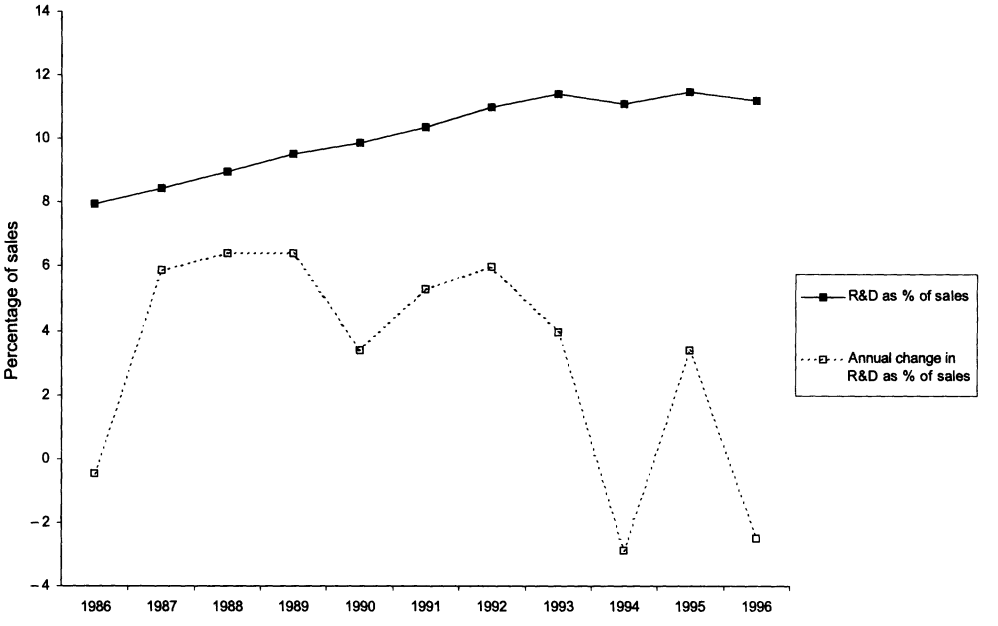
FIGURE 1

CHANGES IN PRICES OR INDEXES, DECEMBER TO DECEMBER

[10] The R&D and sales data are from Compustat. Data for G.D. Searle and Sandoz were unavailable. Data for six 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 the composition changes do not occur during either of those two years.

FIGURE 2

R&D EXPENDITURE AS A PERCENTAGE OF SALES BY SAMPLE COMPANIES



first characterizing differences in firms' vulnerability to regulation and then considering whether differences in various actions that firms took appear to be related to these cross-firm differences.

□ **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.[11] 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.

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 regulation in the near term, since Medicare reimbursements would have provided a ready vehicle through which the government could affect 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.[12]

[11] Baron (1997) develops a common-agency model where two firms attempt to influence government decisions. Though the characterization of multiple firms attempting to influence policy is appropriate to our context, some of his other modelling assumptions are not. For instance, firms make direct expenditures to influence the government rather than using prices.

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

TABLE 3 Company-Specific Political Sensitivity

	Independent Variables		Other Measures	
Company	*Firm Patent Duration* (years)	*Firm Elder Drugs* (percentage)	*Growth in Company PAC* (percentage Δ)	*Price Pledge*
Abbott Labs	10.0 (H)	34 (H)	18 (H)	3
Amgen	20.0 (H)	0 (L)	396 (H)	N
Bayer	8.7 (H)	13 (L)	NA	N
Bristol-Myers Squibb	4.4 (L)	66 (H)	−7 (L)	3
Burroughs Wellcome	5.4 (H)	0 (L)	−44 (L)	N
Eli Lilly	5.5 (H)	17 (L)	−30 (L)	3
G.D. Searle	3.7 (L)	51 (H)	69 (H)	3
Genentech	3.8 (L)	54 (H)	−32 (L)	3
Glaxo	4.9 (H)	11 (L)	86 (H)	2
Hoechst-Roussel	2.1 (L)	32 (H)	NA	3
Hoffmann-La Roche	8.7 (H)	0 (L)	46 (H)	2
Johnson & Johnson	11.2 (H)	0 (L)	181 (H)	3
Marion Merrell Dow	0.4 (L)	65 (H)	8 (L)	2
Merck	7.1 (H)	58 (H)	48 (H)	1
Pfizer	6.4 (H)	61 (H)	48 (H)	2
SmithKline Beecham	8.3 (H)	17 (L)	18 (H)	3
Sandoz	4.2 (L)	21 (L)	130 (H)	N
Schering-Plough	4.3 (L)	15 (L)	8 (L)	N
Syntex	1.5 (L)	100 (H)	9 (L)	3
Upjohn	0.8 (L)	34 (H)	−50 (L)	3
Warner-Lambert	1.8 (L)	66 (H)	−4 (L)	3
Wyeth-Ayerst	2.1 (L)	30 (L)	−11 (L)	2
Zeneca	6.6 (H)	81 (H)	NA	3
Mean	5.7	36	44	
Standard deviation	4.3	29	101	

Note: We used the following codes in the *Price Pledge* column: 1 if the company made a pledge in 1990, 2 if the company had made a pledge by March 1993, 3 if the company made a pledge at any time after March 1993, and N if we have no indication that the company pledged.

The variables we use to capture these two political sensitivity measures are presented in Table 3. *Firm 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.[13] *Firm 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% of their drugs in elder categories. Note that the correlation coefficient for the values of *Firm Patent Duration* and *Firm Elder Drugs* is approximately zero ($\rho = .01$), though the correlation coefficient for dummy variables indicating whether or not a value is above the median of the respective variable is .31. The assumptions and data used to construct *Firm Patent Duration* and *Firm Elder Drugs* are described in the Appendix.

□ **Political contributions.** Political contributions are one of the most obvious instruments available to firms seeking to influence political outcomes. The third column of Table 3 reports information on the growth in the amount each company's corporate PAC disbursed between 1991–1992 and 1993. It is based on information reported to the Federal Election Commission and is not

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

applicable for three companies. Neither Bayer nor Hoechst-Roussel had a corporate PAC during the time period considered, and Zeneca's PAC was not organized until the middle of 1993.

It would not be surprising, of course, to learn that companies had political motives when contributing to their corporate PACs, and, in particular, that more politically sensitive firms contributed more. The values of *Firm Patent Duration* and *Growth in Company PAC* are quite positively correlated. The correlation coefficient for the values is .80 and the coefficient for the dummy variables indicating whether or not a value is above the median is .39. This correlation indicates that the more politically sensitive firms, using the patent duration measure, ramped up their PAC contributions more than less sensitive firms did. By contrast, *Growth in Company PAC* is negatively correlated with *Firm Elder Drugs* ($\rho = -.38$). This could suggest that firms with high values of *Firm Patent Duration* took different steps to avert regulation than firms with high values of *Firm Elder Drugs*.

Of course, corporate PAC contributions are only one of many ways in which companies can make political contributions. 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 difficult to track such donations. According to calculations from the Center for Responsive Politics (Makinson and Goldstein, 1994), 76% of pharmaceutical manufacturers' total contributions were through corporate PACs. We, therefore, feel that our measure captures the bulk of the industry's political contributions.

□ **Joining the price pledge.** If a multifirm industry is to take actions, such as lowering prices, to avert regulation, it must overcome the incentives that individual firms face to free ride. In a highly concentrated industry, individual firms may calculate that the benefits of averting regulation for the whole industry outweigh the unilateral costs of lowering prices. It is unclear whether the pharmaceutical industry was concentrated enough for individual firms to be willing to make substantial unilateral concessions. While individual drugs can have considerable market power within a particular therapeutic category, the industry overall is not concentrated. For instance, in March 1993, the PMA claimed that "more than 20 companies' dollar sales must be included to reach a 75% share of the market" (Ferguson, 1993). The other way for firms to overcome free ridership is to act collectively in the face of potential regulation.

Recall that in 1990, Merck made a public pledge to keep drug increases at or below the rate of inflation. No other major pharmaceutical firms joined in the pledge at that time. During health care reform discussions in 1992 and 1993, Merck renewed its pledge, and this time others followed. On March 12, 1993, the PMA submitted a request for a business review letter to the DOJ asking for exemption from the antitrust laws to enforce a voluntary program among their members to maintain price increases at the rate of inflation (Ferguson, 1993). By the time the PMA submitted the request, nine companies, including Merck, had unilaterally made pledges to keep price increases at or below increases in inflation. Six of these companies are in our dataset. A March 14, 1996 Federal Trade Commission document concerning an investigation of the pledge as a means of price fixing identified an additional twelve firms that made price pledges over the course of 1993. Five of the firms in our dataset were not identified on the FTC document. The last column of Table 3 indicates which firms pledged in 1990 (only Merck, coded as 1), which firms pledged by March 1993 (coded as 2), which firms pledged after that (coded as 3), and which never pledged (coded as N).

There is no significant correlation between either whether a firm pledged or the timing of its pledge and *Firm Patent Duration*, but there is some relationship between pledge status and *Firm Elder Drugs*. Coding the firms that did not pledge as 4, we calculated the Spearman rank correlation between the pledge category listed in Table 3 and both political sensitivity variables. It is .14 for *Firm Patent Duration* and $-.32$ for *Firm Elder Drugs*, though in neither case can we reject that the variables are independent. Ignoring the differences in pledge timing, however, firms that did pledge had significantly higher values of *Firm Elder Drug* and insignificantly lower values of *Firm Patent Duration*. Given the high correlation between *Firm Patent Duration* and

Growth in Company PAC, this could suggest that firms used pledging and campaign contributions as substitutes. It could also suggest that our indications of whether firms pledged were noisy.

The PMA's request to the DOJ cited the threatened regulation and was described as a temporary measure that would be disbanded if the Clinton Administration's Managed Competition plan were adopted. Notably, the request did not specify what would happen to the policy in the event the Clinton health care package failed. In response to questioning from the DOJ about why a formal agreement was needed if firms had pledged unilaterally, the PMA cited the benefits of having a formal coordinated policy, including the ability to require independent auditing and policies for dealing with firms that deviated from the policy. On October 1, 1993, the DOJ issued a letter denying the PMA's request.

□ **Coordination in list prices.** While this episode suggests that pharmaceutical companies wanted to coordinate prices, the fact that the DOJ rejected the request would seem to suggest that no coordinated pricing actually occurred. Empirical evidence in our dataset suggests otherwise. Figure 3 plots the distribution of nonzero six-month price changes in the AWP dataset. The six-month interval ending October 1993 coincides with the period when the DOJ was reviewing the PMA request. Coordination during this interval is striking: over half (or 82/162) of the nonzero price changes were between 4.15% and 4.25%.[14] There are other mass points during other six-month periods, though none of them are as dense as the massing at 4.2% in October 1993.[15] Also, before October 1993, massing was more likely at round price increases, such as 5.0%.

Although the empirical evidence of massing at 4.2% seems clear, the choice of 4.2% is a puzzling one. The PMA's original request and most of the supporting documentation explicitly cite the CPI as the inflation rate the companies would target. We have calculated the 12-month rolling average increases in the CPI through the end of 1993, and the increase in the CPI had not been over 4.0% since July 1991. The only conceivably relevant number that is equal to 4.2% was the increase in the PPI for pharmaceuticals during 1992, cited by the president of the PMA in an address to the organization and the press announcing the PMA's request to the DOJ on March 29, 1993 (Mossinghoff, 1993).

□ **Coordination in transaction prices.** The PMA's response explicitly identified the prices that would be subject to the agreement as "net prices," so we also consider evidence of coordination in our antibiotic transaction price dataset. Histograms of price changes, similar to the ones in Figure 3, show evidence of some massing during the period around the six months when the DOJ was reviewing the PMA request, although nothing as stark as Figure 3. The first two columns of Table 4 report means and standard deviations in six-month price increases for the antibiotics, excluding those that were in the top 1% or bottom 1% of all price changes. Consistent with the evidence on the list prices, the standard deviation is lowest in the October 1993 period. We can reject that it equals the standard deviation in other periods, April 1993, the period just before October 1993, and October 1995.[16]

It is instructive to consider why the evidence of coordination is clearer for the AWPs. One possibility is that firms believed that distorting the publicly available AWPs was an effective way to diffuse political pressure, and that the eventual effect on transaction prices was not very important. It is also possible that the mechanics of collective action are complicated in a market with so many products and so many purchasers, so genuine attempts by firms to limit price increases had less success when filtered through to the transactions level.

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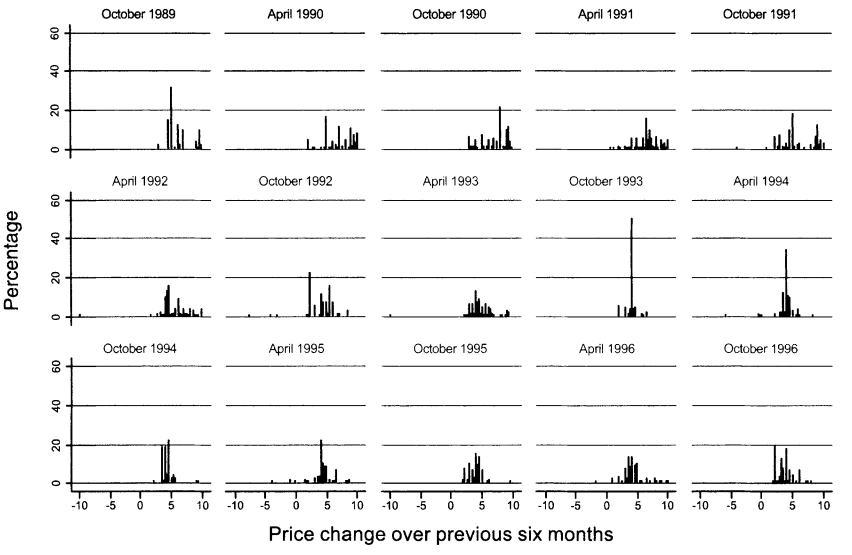
[14] For most but not all of the drugs with price changes at 4.2%, the company used this increase for all of its presentations. Each of the companies that used 4.2% had at least one drug in our dataset for which they used a different increase.

[15] Figure 3 was drawn with bins that were .1% wide and centered around .10%, .20%, etc. We censored 172 observations, though only two in October 1993, that were higher in absolute value than 10%. The mass point near 4.2% in October 1993 is the highest of all 15 six-month periods for a wide range of bin widths, although if we have bins that are wider than 2.5%, the massing in October 1993 is blurred.

[16] The third column of the table reports the p-values from F-tests of the equality of the variance in the sample period compared to the October 1993 period.

FIGURE 3

HISTOGRAMS OF NONZERO PERCENTAGE PRICE CHANGES



□ **Coordinated pricing and political sensitivity.** Just as we analyzed the relationship between a firm's political sensitivity and its other actions—making political contributions or price pledges—this subsection looks for a relationship between political sensitivity and the firm's likelihood of coordinating on price.

We specify a baseline model in which price changes absent coordination are a linear function of a set of covariates (X) plus an additive error. The set includes variables that could affect the elasticity of demand for the drug, such as time before or after patent expiration. It could also include measures of a firm's political sensitivity, since they are factors that possibly influence pricing decisions even absent coordination motives. We designate the price change implied by this model as the "latent" price change,

$$\Delta p_{ijt} = X_{ijt}\beta + \varepsilon_{ijt},$$

where Δp_{ijt} is the change in price charged by firm j for drug i over half-year t.

TABLE 4 Distribution of Antibiotic Price Changes

	Mean	Standard Deviation	p-value[a]	N
Six-month price changes to:				
October 1991	1.64	8.67	<.001	172
April 1992	1.08	8.63	<.001	170
October 1992	−.46	8.22	<.001	171
April 1993	.30	5.82	.904	177
October 1993	.10	5.76		181
April 1994	−.51	6.60	.069	183
October 1994	−.21	6.69	.046	184
April 1995	−.72	6.94	.013	185
October 1995	−.40	6.26	.266	185
April 1996	−.86	6.84	.022	185

[a] The p-value is from an F-test of the null hypothesis that the variance of price changes in the period is equal to the variance of price changes to October 1993.

In addition, suppose certain firms engaged in coordinated pricing in 1993. In particular, they would price according to the model above unless their latent price increase exceeded an agreed-upon limit, say a 4.2% increase. In that case, they would increase their prices 4.2%. We hypothesize that the more politically sensitive firms would be more likely to coordinate. Define $\alpha_{ijt} = 1$ if firm j producing drug i decides to coordinate in period t and increase prices by less than 4.2%, and $\alpha_{ijt} = 0$ if the firm does not coordinate for drug i. If $\varepsilon_{ijt} \sim N(0, \sigma^2)$, then we can define the likelihood function as follows:[17]

$$
\begin{aligned}
L = & \prod_{\Delta p_{ijt}=4.2} \left[\alpha_{ijt} \left(\Phi \left(\frac{X_{ijt}\beta - 4.2}{\sigma} \right) \right) \right] \\
& \cdot \prod_{\Delta p_{ijt}>4.2} \left[(1-\alpha_{ijt}) \left(\sigma^{-1} \phi \left(\frac{X_{ijt}\beta - \Delta p_{ijt}}{\sigma} \right) \right) \right] \\
& \cdot \prod_{\Delta p_{ijt}<4.2} \left[\left(\sigma^{-1} \phi \left(\frac{X_{ijt}\beta - \Delta p_{ijt}}{\sigma} \right) \right) \right].
\end{aligned} \tag{1}
$$

We have omitted the term in the first line that would account for a firm happening to have exactly 4.2% as its best-response price increase. Before the coordination period, there were never more than one or two observations at 4.2%. We parameterize α as a function of political sensitivity: $\alpha_{ijt} = \Pr[v^*_{jt} > 0]$, where $v^*_{jt} = \gamma Z_{jt} + \eta_{jt}$. If $\eta_{jt} \sim N(0, 1)$, then $\alpha_{ijt} = \Phi(\gamma Z_{jt})$.

The Z's are the two political sensitivity variables described above: *Firm Patent Duration* and *Firm Elder Drugs*. Covariates for the latent pricing equation, the X's, include the time until each drug goes off-patent (*Time to Patent Exp.*) and the time since it was off-patent (*Time Since Patent Exp.*), as well as political sensitivity variables in some specifications.[18]

Results from estimating equation (1) using the AWP data for the top 106 drugs are presented in Table 5. In the specifications in columns 1–3, the Δp_{ijt}'s are the six-month price changes over the coordination period (from April to October 1993). In other words, the 663 observations reflect a single time period (t), but on average about six presentations of each drug sold over this period. We rounded price changes to the nearest tenth of a percent (this is the same rounding precision reflected in Figure 3), so a price change of 4.2% effectively means the price change fell between 4.15% and 4.25%. As a robustness check, column 4 reflects price changes from April to October 1992, and we set $\alpha = 1$ when price changes during that period were between 3.15% and 5.25%. Approximately the same proportion of price changes fell in this range in 1992 as fell between 4.15% and 4.25% in 1993.[19] When we estimated specifications that pooled observations in 1992 and 1993, setting $\alpha = 1$ only for coordinated pricing during 1993, the results were very similar to those reported in columns 1–3. Adding more years of data increases the precision with which we estimate the coefficients in the pricing equation slightly and has no effect on the coordination equation.

The top half of Table 5 presents coefficient estimates from the latent pricing equation, our model of how firms would price absent political pressure to coordinate. In columns 1 and 2 we do not include the political sensitivity variables in the pricing equation. When we add the two political sensitivity variables to the pricing equation in column 3, the coefficient estimates suggest that those firms with longer average patent durations and more elderly drugs increased prices faster. Column 4, estimated on data from 1992, supports this result for the *Firm Elder Drugs* measure, though in neither column 3 nor column 4 are the coefficients on *Firm Elder Drugs* statistically significant. The coefficient on *Firm Patent Duration* is essentially zero in column 4. Since the variable was designed to reflect a company's patent portfolio in 1993, it is possible that the

[17] This specification is similar to one used by Knittel and Stango (2003).

[18] Caves, Whinston, and Hurwitz (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.

[19] In 1992, $\alpha = 1$ for 60 out of 584 observations, while in 1993, $\alpha = 1$ for 82 of the 663 observations. The results in column 4 are not sensitive to using a wider or narrower bin.

TABLE 5 Propensity to Coordinate by Firm: Top 106 Drugs

	(1)	(2)	(3)	(4)
Pricing equation				
Years to patent exp.	.012	.012	−.025	.011
	(.052)	(.052)	(.060)	(.053)
Years since patent exp.	−.274*	−.274*	−.192	−.188
	(.141)	(.141)	(.143)	(.250)
Firm Patent Duration			.151**	−.012
			(.071)	(.095)
Firm Elder Drugs			1.96	2.06
			(1.51)	(1.40)
Coordination equation				
Firm Patent Duration	−.014		.055	−.055
	(.092)		(.083)	(.138)
Firm Elder Drugs		2.41	2.83*	−3.49**
		(1.74)	(1.65)	(1.48)
σ	2.13**	2.13**	2.07**	2.30**
	(.35)	(.35)	(.33)	(.25)
Pseudo-R^2 for coordination equation	.001	.15	.17	.32
Time period analyzed	April–Oct. 1993	April–Oct. 1993	April–Oct. 1993	April–Oct. 1992
N	663	663	663	584

Note: The robust standard errors in parentheses allow for correlation within a company. Columns 1–3 define coordination as increasing prices by 4.15%–4.25%. Column 4 defines coordination as increasing prices by 3.15%–5.25%.

*Significant at 10%; **significant at 5%.

coefficient on the *Firm Patent Duration* measure in column 3 reflects in part the high correlation between the firm-level variable and the drug-level measures of time left on patent.

The bottom half of the table presents coefficient estimates from the coordination equation. The specifications in columns 1 and 2 include just *Firm Patent Duration* and just *Firm Elder Drugs*, respectively, while both variables are included in the specification in column 3. The estimates suggest that firms with longer average patent duration were no more likely to coordinate, but firms with more elder drugs were. In column 3, the coefficients on both political sensitivity variables are positive in the coordination equation, and the coefficient on *Firm Elder Drugs* is significant at the 10% level. While the power of the results is somewhat weak and the pseudo-R^2 from the coordination equations are low, perhaps suggesting that our measures of political sensitivity are noisy, the results imply that even though more politically sensitive firms had higher latent price increases, they were also more likely to coordinate.

While we would expect the latent pricing equation to be similar across years, we would expect starkly different results across years from the coordination equation, if the coordination were, in fact, a response to political pressure. This is precisely what we find. In column 4, the coefficients on the firm-level variables in the coordination equation are negative and statistically significant in the case of *Firm Elder Drugs*, suggesting that the firms with high political sensitivity were more likely to use price increases higher than 4.2% in 1992. As an additional check, we examined the correlation in the residuals across the latent pricing and coordination equations and found a very low correlation (−.03) in the average firm level residuals.[20] This contradicts the hypothesis that there is an additional factor omitted from our model that led, for instance, to higher latent price increases and a lower propensity to coordinate.

[20] In calculating the residuals from the latent pricing equation, we corrected for the truncation at 4.2% in the event of coordination using the inverse Mills ratio.

We did not estimate similar specifications on the antibiotic data, since there is not a clear focal point in the data. Instead, we divided the antibiotic sample based on whether the manufacturing firm had an above-median value of *Firm Patent Duration* and then calculated the variance in pricing during the six months ending October 1993 and the six months ending October 1992. We also divided the sample based on the manufacturing firm's value of *Firm Elder Drugs*. For both variables, the variance in 1993 was lower for the firms with above-median values of the political sensitivity variables, and the differences were both statistically significant (the p-values on the F-tests for equality were .007 and .023 for *Firm Patent Duration* and *Firm Elder Drugs*, respectively). In 1992, firms with above-median values of *Firm Patent Duration* had lower variance, but the firms with above-median values of *Firm Elder Drugs* had higher variance. These results are consistent with the hypothesis that the more politically sensitive firms were more likely to coordinate on increases in their transaction prices in 1993.

5. Conclusions

■ The results presented here suggest that there was a political component to pharmaceutical pricing during the health care reform debates. In particular, the firms we identified as more politically sensitive were more likely to engage in coordinated pricing, consistent with a pledge many firms made not to raise prices more than the rate of inflation. While these firms coordinated on the wholesale list prices of their drugs, the price distortion appears to have been dampened when filtered through to transaction prices, although the coordination seems to have had some effect. These actions are consistent with broad time-series trends indicating sharp decreases in the rate of inflation in pharmaceuticals around the time of health care reform discussions.

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 that politics put downward pressure on prices in 1993–1994, there is little evidence that the most affected companies have subsequently accelerated prices. This suggests that the reallocation of rents to current consumers was not temporary.

Our results raise, but do not answer, an interesting set of questions concerning the mechanics of coordination. The market for pharmaceuticals has multiproduct firms that face many different types of consumers. Due to a government mandate, it also has publicly available list prices, and transaction prices are the result of negotiated discounts off of the list price. It is possible, of course, that the pharmaceutical firms were mostly interested in window dressing, or the appearance of an industrywide commitment to lower prices, and were less interested in actually coordinating, a strange reversal of the normal situation that economists encounter. It is also possible that although actual coordination was the goal, the mechanics of carrying out that coordination were hard to overcome. Although the small number of drugs, fifteen, that we have in common in our two datasets would make a more substantive analysis of these questions difficult, this setting offers an appealing potential for future work.

Appendix

■ Following is a more detailed description of some of the datasets and variables used in this article.

□ **Prices.** The first pricing dataset, 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 article. Our dataset covers only those presentations that were available in the beginning of 1997, and the pricing histories for each presentation are not consistent. Only 52% of the presentations for which we have data in 1997 are covered in 1989. Information on historical pricing is unavailable because the presentation was introduced midway through the time period we study, or because ReadyPrice discontinued coverage of the presentation.

One concern with the ReadyPrice series is that it does not contain information on sales or revenue figures by presentation. We are unable to identify those presentations that are used by many customers and those that 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 for list prices.) 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 presentations within a drug. We report results using each presentation as a separate observation.

The second pricing dataset, with information on transaction prices and volume sold for antibiotics, covers October 1990 to September 1996. These data are monthly and come at the presentation level, but we aggregate up to the drug level by computing a Divisia price index for each drug. See Ellison (1998) for a more comprehensive discussion of both this dataset and the calculation of the Divisia indexes.

There are 15 drugs common to both datasets, and we present summary statistics on this subset in Table 2. The common drugs are Amoxil, Augmentin, Biaxin, Ceclor, Ceftin, Cipro, Claforan, Cleocin, Duricef, Fortaz, Minocin, Primaxin, Rocephin, Vancocin, and Zithromax.

□ **Firm patent duration.** The variable *Firm Patent Duration* measures the sales-weighted average patent life remaining on each company's drug portfolio as of 1993. To calculate this variable, we used information on sales by drug and patent lives. It is difficult to find sales information for a number of drugs in comparable markets (e.g., U.S. and not international, consistent weights on distribution outlets). We use the annual lists of the top 100 drugs by U.S. 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 year's sales as well as the previous year's, 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. For observations where sales figures were still missing, we identified several cases where the drug was not yet in the U.S. market, and for the remaining observations, we extrapolated from recent growth rates. 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.

We used the patent expiration years 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% 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 toward the most popular drugs. (For instance, 1993 U.S. sales for Zantac, the top-selling drug according to *Med Ad News*, 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 News* lists would comprise less than 5% of total sales. Of course, if companies have a number of small drugs that do not make the list, and if those drugs differ 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 10Ks suggests that we have covered the bulk of the important ones.

□ **Firm elder drugs.** *Firm 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. Elderly therapeutic classes are identified from Berndt et al. (1998), who report usage patterns between the elderly and nonelderly 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.

□ **Growth in company PAC.** *Growth in Company PAC* measures the increase in the annual disbursements made by each company's corporate PAC between the 1991–1992 election cycle and calendar year 1993. Information on PAC disbursements for the 1991–1992 election cycle is from Makinson and Goldstein (1994). The PACs of two companies, Amgen and Wyeth-Ayerst, were not covered by Makinson and Goldstein, 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 Committee, downloaded from the Federal Election Commission's website (www.fec.gov). Online information only extends back to 1993. Note that Makinson and Goldstein cover only donations to congressional candidates, so even though 1991–1992 coincided with the presidential election cycle, the PAC contributions we consider are roughly comparable across time periods.

□ **Price pledge.** We gathered information on the timing and existence of company price pledges from reports in the

trade press and from a March 14, 1996 FTC document concerning an investigation of the pledge as a means of price fixing. Numerous articles discuss Merck's pledge in 1990 (see, for example, *The Pink Sheet*, 1993b). In its request to the DOJ for antitrust exemption to oversee adherence to price pledges, the PMA states that ten companies had already made pledges but does not identify which companies fell into that category. We identified nine companies that had pledged by February 1993 (including Merck) from the trade press (see *The Pink Sheet*, 1993a), although three of the nine are not in our dataset. We identified companies as late pledgers, category 3, if they were not identified in *The Pink Sheet* (1993a) but were identified on the 1996 FTC document.

□ **Time to/since patent expiration.** To construct the last two variables in Table 1, *Time to Patent Expiration* and *Time Since Patent Expiration*, we use the patent expiration years described above. 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 dataset, therefore, we simply use the year in which generics entered as the year of commercially relevant patent expiration.

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