Do pharmaceutical prices respond to potential patient out-of-pocket expenses?

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Abstract

Despite the importance of patient insurance in the market for prescription pharmaceuticals, little is known about the impact of patient reimbursement on the pricing behavior of pharmaceutical firms. This paper examines the link between potential patient out-of-pocket expenses and pharmaceutical pricing using a unique policy experiment from Germany.[1] Starting in 1989, a maximum reimbursement for a given medicine replaced a flat prescription fee. This change in reimbursement exposes the patient to the price of a prescribed product. Using a product level panel dataset covering several therapeutic categories before and after the policy change, I find that producers significantly decrease prices after the change in potential patient out-of-pocket expenses. Price declines are most pronounced for brand name products. Moreover, branded products that face more generic competitors reduce prices more.

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[1] Throughout the paper the term Germany refers to the states comprising the Federal Republic of Germany before reunification.

1. Introduction

As governments worldwide try to curb their health care costs, policy debates increasingly focus on the pricing behavior of pharmaceutical firms. Most countries constrain pharmaceutical firms through direct price regulation. Only a few countries, such as the United States and Germany, allow for product level price competition and rely on indirect means to reduce pharmaceutical expenditures. The supporters of price controls justify regulation with the moral hazard problem in prescribing, as physicians might not internalize the cost of a prescription to the patient or the patient's insurance provider. They argue that insurance coverage of prescription pharmaceuticals reduces the sensitivity of physicians and patients to prices. Yet, little is known whether and how patient out-of-pocket expenses affect the pricing behavior of pharmaceutical firms. This paper investigates this relation.

Several studies provide insights on whether insurance impacts physician and patient behavior and thus demand for medical services. Hellerstein (1998) investigates the physician's prescription decision between brands and generics, motivated by the puzzle that in 1989, less than 30% of prescriptions for multi-source drugs specified the generic version even though "generics are generally priced 30-60% lower than their trade-name counterparts (p. 108)."[2] She finds that the patient's insurance plan does not affect the physician's choice between a brand name and a generic product. However, HMO-affiliated physicians have a higher propensity to prescribe generics irrespective of a patient's insurance plan. This pattern could stem from the cost containment measures imposed on physicians by HMOs. Moreover, studies based on data from the Rand Health Insurance Experiment document that insurance impacts demand for health services. The experiment randomly assigned different cost-sharing plans to individuals and found that the total expenditure (to all parties) on prescription pharmaceuticals is greater for patients with higher insurance coverage. According to the study, the participants' "expenditures on drugs averaged $65 (in 1991 dollars), ranging from $82 on the free care plan to $46 on the 95 percent

[2] Multi-source drugs are those that are no longer protected by a patent and are available in brand name as well as generic versions.

coinsurance plan (Newhouse et.al., p. 165)."

Given the impact of patient reimbursement on physician and patient behavior, my goal is to explore whether potential patient out-of-pocket expenses also affects the pricing behavior of pharmaceutical firms. I use a unique policy experiment from Germany. In 1989, Germany implemented reference pricing, a cost containment scheme that imposes a maximum reimbursable price to a patient for a given product.[3] Producers are free to set their prices, but if the retail price exceeds the reference price (RP), the consumer pays the difference. Previously, patients paid only a fixed prescription fee regardless of the prescribed medicine. This change in patient reimbursement directly exposes a patient to the price of a medication. The change in insurance reimbursement modifies the demand conditions in the market and thus alters the markup that pharmaceutical firms charge over marginal cost. I evaluate the relationship between patient out-of-pocket expenses and pharmaceutical prices using a detailed product level data set that spans years before and after the change in insurance and covers several therapeutic groups. My identification relies on the comparison of prices before and after the reform. When data permits, I additionally exploit the lag in the implementation of the reform within a therapeutic group. I then compare the differences in the intertemporal price response of products that compete in a similar environment, but face different timing in the changes in patient reimbursement. Finally, I investigate whether changes in pricing behavior of pharmaceutical firms can be explained by differences in the competitive pressures firms face.

Germany provides an excellent setting to study the link between patient out-of-pocket expenses and the pricing by pharmaceutical firms. Unlike the US market with many insurance providers, the German statutory health insurance covers over ninety percent of the population and always provides coverage for prescription drugs. This setting enables me to address the question without detailed patient level data documenting their health insurance plan. Additionally, since most people have the same insurance coverage there is no selection problem, where people who expect higher medical expenses opt

[3]British Columbia, Denmark, the Netherlands, and New Zealand also introduced reference pricing.

for a more generous insurance plan. Reliance on country level data could pose a problem if prices differed across various regions and purchasing outlets as in the United States. German retail pharmacies are the only place permitted to dispense drugs for outpatient consumers and there is no price variation across them. The government controls the wholesaler's and retailer's margins, and the prices of the pharmaceuticals dispensed by pharmacies are uniform by law.

My results suggest that, at least in this case, the pricing behavior of pharmaceutical firms is very sensitive to potential patient out-of-pocket expenses. This finding is robust to different identification strategies and therapeutic markets. The estimates of price adjustment to exogenous change in insurance reimbursement range from 10 to 26%. Brand name products experience the biggest price decline. The price responses by pharmaceutical firms are partially explained with variation in their exposure to competition. The drop in prices is sharper for those brand name products that face more generic competition. Policy implications and generalization of these results are discussed in the conclusion of the paper.

The next section presents institutional background on the German pharmaceutical market and the reference pricing scheme. Section 3 provides theoretical motivation on how changes in patient out-of-pocket expenses might affect the pricing of pharmaceutical products. Section 4 looks at the data and descriptive statistics. Section 5 introduces the empirical strategy and discusses the estimation results. Section 6 concludes.

2. Institutional Background on the German pharmaceutical market

In Germany, the retail pharmacies dispense all outpatient care prescription drugs. These retail pharmacies are the last stage in the distribution of pharmaceuticals from the manufacturer to the patient. Pharmaceutical manufacturers sell their products to the wholesaler. Manufacturers are free to set their prices without government approval before and after the implementation of reference pricing. However, producers need government approval to launch a new product and must obtain a permit to produce it. Imported drugs must be licensed and can only be handled by a licensed importer. Moreover, a

manufacturer must sell the product for the same price in a given time period to all wholesalers. The wholesalers then sell the product to retail pharmacies that deliver it to the patient. The government controls the wholesaler's and retailer's margins. Thus, by law retail pharmacy prices are uniform across the country. [4]

Insurance plays an important role in the transaction between a patient and the retail pharmacist. Over ninety percent of the population is covered by statutory health insurance that always includes coverage for prescription pharmaceuticals. Prior to 1989, patients paid only a fixed prescription fee when purchasing a pharmaceutical product regardless of the retail price. The 1989 reference pricing scheme imposes the maximum reimbursable amount (i.e. reference price) for a given product. If the retail price exceeds the maximum reimbursement, the patient bears the excess cost. Otherwise, the patient does not need to copay. The consumer continues to pay a DM3 prescription fee only for the products not subject to a reference price.[5] The retail pharmacist is reimbursed directly by the insurance based on the prescription obtained from the patient. Unlike in the United States, the pharmacist is not allowed to substitute to a generic product unless the doctor *explicitly* permits it on the prescription pad. The dispensed product must match the strength of the active ingredient, the size, and the dosage of the physician's prescription (Sitzius, pp. 245). I describe how reference prices might affect a physician's prescribing behavior in detail in section 3.

The Federal Commission of Physicians and the Statutory Health Insurance Committee determine reference prices in two stages. In the first stage, they jointly specify the therapeutic groups that should be under the reference price system. Thereafter, the insurance committee selects the level of the reference price for the most common package size in a given active ingredient or therapeutic group. The reference

[4] The hospital market is completely separate from the retail pharmacy market. Hospitals provide pharmaceuticals only for inpatient care. They purchase either from the wholesaler or directly from the manufacturer, in which case they often receive discounts and rebates. For all these reasons, I do not include them in my analysis.

[5] In 1993, the prescription fee was extended to all products and it depended on the price of a package: DM3 if retail price is less than DM30, DM5 if retail price is between DM30 and DM50, and DM7 if retail price exceeds DM50. Since 1994, prescription fee depends on package size: DM3 for small package, DM5 for medium package, DM7 for large package.

prices for other package sizes are then adjusted to accommodate differences in package size and doses (Sullivan, pp. 72). The committee usually sets the reference price below the price of the most expensive brand, but above the prices of the generics. For example, for the case of glibenclamide in 1990, the reference price for a package containing 30 3.5 mg pills was DM9.93, while a brand cost DM12.45 and the generics ranged from DM6.50 upwards. Reference prices are reviewed on an annual basis. Although the scheme was introduced in 1989, its implementation continued throughout the early 1990s. For example, in oral antidiabetic group only the products containing the active ingredient glibenclamide became subject to reference prices in 1989, while some other products were not covered until 1994. All antiulcerants (H2 antagonists), on the other hand, became subject to reference pricing in 1992. Overall, 50% of the sales on the German pharmaceutical market were covered by the reference pricing scheme by July 1993. This significantly falls short of the health ministry's plan to cover 70 to 80% of prescription sales by 1992 (Sullivan, pp. 72-3). By 1996, reference pricing extended to 75% of the market (ABPI 1996).

Overall, the existence of a single insurance scheme covering most of the population, the retail pharmacies as the only outlet for the outpatient pharmaceutical products, the exogenous change in patient reimbursement, and the uniformity of prices across the pharmacies make Germany a good setting to study the impact of the patient out-of-pocket expenses on the pharmaceutical pricing.

3. Theory Motivation

The impact of patient insurance reimbursement on the pricing behavior by pharmaceutical firms can be motivated in a model of demand for pharmaceutical products. Changes in potential patient out-of-pocket expenses affect the demand conditions prevailing on the market and might alter the markup that pharmaceutical firms charge over marginal cost.

Let us first consider the decision to consume a pharmaceutical product. Hellerstein (1998) discusses the agency and moral hazard problem in prescribing in detail. The physician acts as an agent for the patient and prescribes the product probably considering her own cost of prescribing and a

patient's utility. Based on the prescription, the patient obtains the prescribed medicine from a retail pharmacy as described in section 2 of the paper. A doctor writing a prescription for a patient with a particular illness faces a choice among several alternative treatments (active ingredients) in a given therapeutic group. Additionally, several companies can produce a given active ingredient after patent expiration or under a licensing agreement, providing an option between brands and generics. A pharmaceutical product can thus be viewed as a bundle of characteristics that affects patient well being such as efficacy, safety, reliability, brand name, and price. If a doctor acts as a perfect agent for the patient, the doctor prescribes the product that yields the highest well being for the patient. This choice might be altered if it is costly for a doctor to gather information about product prices or other characteristics.

Potential patient out-of-pocket expenses might affect the doctor's prescription if the doctor considers the patient's well being in prescribing. When patients only perceive a constant prescription fee for all products, the price of a product does not determine the choice of product relative to other characteristics such as efficacy and safety unless the doctor is liable for the reimbursement cost of her prescriptions. The new reimbursement rules, however, expose the patient to the price p_i of product i if i's price exceeds the maximum reimbursement level p_r. The perceived price that enters the valuation problem is $p_i - p_r$ if $p_i > p_r$ and 0 otherwise. In the setting of this paper, a physician likely considers the product's price in her prescribing decision. Physicians are required by law to inform the patient whether the price of the prescribed product exceeds the reimbursable level, and physicians can obtain price quotes and reference prices in Rote Liste. Rote Liste includes pharmacological information such as dosage, side effects, retail price, and the reference price of pharmaceutical products. It is the most important reference source for physicians prescribing pharmaceuticals (Sitzius, pp. 247). Physicians can then prescribe a product whose price does not exceed the reference price rather than a more expensive product if the quality or reliability of the two products does not differ substantively (i.e. cross-price elasticities are high). This might particularly affect the pricing of brands relative to generics. If brands

face generic competition and their efficacy and reliability do not differ much, the producers of brands might need to decrease their prices to protect their market share. Therefore, one would expect a differential response for brands and generics to reimbursement change. The price adjustment also might differ with the level of competition. Products exposed to more competition might be more likely to lower their price than those without many alternatives. I thus explicitly control for competition when I estimate the price responses to changes in patient reimbursement in section 5. Finally, in the current case, doctors are required to inform the patient if the price of the prescribed product exceeds the reimbursed level. As a result, patients and doctors might become better informed about prices of pharmaceutical products. This might increase additionally the price sensitivity of patient and doctors after the reform.

4. Data and Descriptive Results

The analysis relies on data on oral antidiabetics and antiulcerants (in particular, H2 antagonists) from IMS Health.[6] The two therapeutic groups are used worldwide to treat widespread illnesses: type II diabetes (oral antidiabetics) and peptic ulcers (antiulcerants). In addition, both therapeutic groups provide a choice of various active ingredients and the choice between brands and generics. The two therapeutic groups differ in that the products in oral antidiabetics have faced generic competition for a while, while generic products only recently entered the antiulcerant market. The data spans eleven years from 1986 to 1996 and covers the area comprising the Federal Republic of Germany before reunification. The original IMS Health database provides quarterly time series information on the value and volume of retail pharmacy sales for each presentation of a given drug produced by a given manufacturer. In each time period, I aggregate over various presentations of a given drug produced by a given manufacturer and define that as a product.[7] An observation is then a product-quarter. Since the reference prices are quoted

[6] This data source has been used in the studies of the US pharmaceutical market such as Ellison et. al. (1997), Scott-Morton (1997), and Stern (1996).

[7] For example, drug named x produced by manufacturer y is sold in packages containing 80 75 milligram (mg) tablets and packages containing 40 150 mg tablets. In each time period, I aggregate the volume (in mg) and revenue data over these two presentations to obtain the volume and value sold of drug named x produced by manufacturer y.

on the retail level, I perform the analysis with retail prices.[8] For each product, I convert the volume of sales to the number of average daily doses sold. I obtain that number by dividing the total quantity sold (in mg) by the average daily dose (in mg) for a specific active ingredient contained in the product.[9] This standardization enables price and quantity comparisons across products with different active ingredients that belong to the same therapeutic group. As is common in this literature (Stern (1996), Ellison et. al (1997), Scott-Morton (1997)) the price is obtained by dividing the value of sales by the volume sold.[10] Since the volume is measured in the number of daily doses sold, prices thus always refer to the price per daily dose. All prices are expressed in 1990 (4th quarter) DM using a price deflator from the Datastream International Database. The data from IMS Health also contains information on a product's active ingredient, manufacturer, launch date, and whether a product is a brand or a generic.[11] Data on reference prices and dates of their implementation are obtained from various issues of Rote Liste. They are also expressed per daily dose. Summary statistics are provided in Table 1.

The rest of this section illustrates a drop in prices of oral antidiabetics and antiulcerants after the imposition of maximum insurance reimbursement. The fundamental finding that remains robust to all specifications in this paper is evident here: producers significantly reduce their prices after the changes in patient out-of-pocket expenses. Figures 1a and 1b plot the average price of brand name and generic oral antidiabetics affected by reference pricing since 1989 and 1994, respectively. Figures 1a and b display a pronounced drop in the average price of brands that coincides with the introduction of the new insurance scheme in 1989 and 1994, correspondingly. The average price of the generics does not change

[8] In the original data, sales are reported at the ex-manufacturer's, wholesaler's, and retailer's levels. The government regulates the wholesaler's and retailer's margins, which do not change during the time of my data.

[9] If the average patient requires 2 75mg tablets twice per day, the average daily dose is 300mg. If a firm sells 80 75mg tablets of a product, this equals 20 daily doses sold. Average patient daily doses are obtained from Martindale.

[10] Given the disaggregated nature of data and the lack of coupons or rebates, the use of sales revenue per daily dose rather than the actual price is not problematic. Even if I had actual price rather than sales data, I would need to transform it to a measure of price per daily dose to make meaningful comparisons across products.

[11] Brand name products include products marketed by the original firm that patented the active ingredient, their parallel imports, and any brand name product sold by another firm under the terms of a license agreement with the originator. This also includes products that are marketed by the distributor, a company that does not manufacture the product and markets them under the same trade name as the originator.

as much. Figure 1c plots the same information for antiulcerants that received RP in 1992. The average price of brands has been declining over time in general, but does so faster after 1991 when generic products enter the market. There is a sharper drop in prices in 1992. The average price of generics also follows the same pattern. Although the decreases in average prices coincide with the implementation of changes in insurance reimbursement, other time varying factors such as the number of generics could affect the prices in the two markets. Given the recent introduction of generic products this poses a particular concern for antiulcerants. Moreover, since 1993 doctors are liable financially if the total cost of their prescriptions exceeds a certain budget. In my estimation I control for this change in various ways. Moreover, since the change in 1993 may also lower the prices of pharmaceutical products, it might bias the results that consider changes in patient out-of-pocket expenses in 1994 against finding any impact. In my analysis in section 5, I develop several empirical strategies to control for all these factors in identifying the impact of patient reimbursement on firm pricing.

5. Empirical Analysis

5.1 Empirical Implementation

The preliminary evidence in the previous section is consistent with producers reacting to changes in potential patient out-of-pocket expenses. This section proposes several approaches to identify the effect of patient reimbursement on the pricing behavior of pharmaceutical firms. Since I observe product level market outcomes before and after the change in patient out-of-pocket expenses, I first focus my analysis on the variation of prices over time. I can consider the relationship between patient out-of-pocket expenses and pharmaceutical pricing by exploiting the intertemporal variation in prices before and after the imposition of reference prices. I employ the following semi-logarithmic specification:

$$\ln(p_{it}) = \alpha + \beta_1 post_t + \beta_2 (brand_i * post_t) + m_i + time + \varepsilon_{it} \tag{1}$$

where p_{it} is the retail price of a product i at time t, $post_t$ is an indicator whether period t is covered by reference pricing, and $brand_i$ is an indicator whether product i has a brand name, and the interaction between $brand_i$ and $post_t$ denotes a brand sold after the imposition of reference prices. m_i is a product

fixed effect and *time* is a control for aggregate time-variant shocks (either a time trend or year indicators).[12] ε_{it} could represent a measurement error in prices or unobserved factors that affect prices.

With the approach of equation (1), I can capture the key institutional features in the pharmaceutical industry. First, the relevant market consists of products in a therapeutic group that are used for treatment of a particular disease. I thus look separately at the market for oral antidiabetics and antiulcerants. Second, within a therapeutic group, there are several possible therapeutic alternatives (i.e. active ingredients) that differ in the therapeutic value. Since inclusion of product fixed effects in (1) controls for product-specific attributes (such as active ingredient) that affect prices, product indicators also capture the differences in therapeutic value of active ingredients in products. Third, several companies might produce the same active ingredient either after patent expiration or under a licensing agreement. I therefore distinguish between generics and brands. Obviously, brand status does not vary within a product. Hence, I cannot separately identify the effect that a brand name or any other product time-invariant characteristic has on prices. However, I can identify whether prices of brands react differently from generics to the change in insurance reimbursement.

Within the framework of equation (1), absent any uncontrolled factors affecting prices and varying before and after RP, the coefficient β_1 on the post indicator depicts the impact of changes in patient out-of-pocket expenses on the pricing of firms producing generic products. The interaction between the brand and the post indicator allows the effects of the reimbursement policy to differ for brand-name products. If the coefficient β_2 is negative, the brand prices decline by more after the reimbursement change than the prices of generics.

The estimates that rely on the variation of prices before and after the reimbursement change to identify the impact of patient out-of-pocket expenses on pricing might be biased by intertemporal variation unrelated to changes in RP such as changes in technology, regulation, or demand. Thus, when

[12] Note that since all antiulcerants receive RP at the same time, I need to exclude two base years when I estimate (1) with year indicators. I discuss this in detail in section 5.2.2.

data permits (as is the case for oral antidiabetics), I rely on differences in the intertemporal changes across products that vary in their exposure to reference prices. That is, I compare the pricing of products affected by reference prices (the treatment group), to products subject to similar technology, regulatory, and demand shocks as the treatment group, but not subject to reference pricing (the control group). Consider the following semi-logarithmic regression specification:

(2) $$\ln(p_{it}) = \alpha + \delta_1 rp_{it} + \delta_2 (brand_i * rp_{it}) + m_i + t_t + \varepsilon_{it}$$

where rp_{it} is an indicator that is one if product i at time t is covered by reference pricing. The interaction between $brand_i$ and rp_{it} denotes a brand product i covered by reference prices at time t. t_t is a year indicator. Other notation follows that of (1).

Within equation (2), year indicators control for factors that change concurrently with the change in patient out-of-pocket expenses and affect both products with and without reference prices. Product fixed effects control for the time-invariant product specific characteristics. The coefficient on the rp_{it} δ_1, is the estimate of the impact of the changes in patient-out-of pocket expenses on generics. The coefficient on the interaction of the reference price indicator rp_{it} and brand indicator δ_2, is the estimate of the impact of patient reimbursement on the pricing of brands. This framework identifies the effect of patient out-of-pocket expenses on pharmaceutical prices using the average change in prices (before and after the reform) for products subject to reference prices relative to the concurrent change in prices for products in the control group. Thus the identification of the patient out-of-pocket expenses on pharmaceutical prices requires that no unobserved time shocks occur that impact the pricing of products with and without reference prices differentially at the time of reference prices imposition.

Finally, my data set is a product-level panel. In my estimation, I compute robust standard errors adjusted for clustering on product level. These standard errors are robust to the presence of general forms of heteroscedasticity. They also account for general forms of serial correlation within products over time.

5.2 Empirical Results

5.2.1 Oral Antidiabetics

I first focus the discussion of results on oral antidiabetics. The first active ingredient was introduced in the 1940s in this therapeutic category. Thus, oral antidiabetics present a relatively stable and established market during my sample that is unlikely to incur significant changes in technology and the competitive environment concurrently with reference price changes.

Because of the gradual implementation of new insurance rules for oral antidiabetics, I can estimate the impact of patient out-of-pocket expenses relying on both variation over time and relative to a control group as in (2). I exploit the fact that some oral antidiabetics do not face RP until 1994, or do not face RP during my sample period. I use them as control groups for products that obtain RP during my sample. The question obviously arises whether this comparison is legitimate, i.e. whether the differences in the timing of RP are uncorrelated with other unobserved factors associated with intertemporal variation in prices. To begin with, anecdotal evidence suggests bureaucratic lags delayed some of the implementation of RPs (Sullivan, pp. 72-3). Second, I check whether the timing of the imposition of reference prices was associated with the differences in price trends across the control and treatment group prior to insurance changes. Figures 1a and b show the average prices of branded and generic products that become subject to reference prices in 1989 and 1994, respectively. The trends in prices across the two groups do not seem significantly different prior to the implementation of the reforms. Moreover, I test that the differences in trends in prices across products that become subject to RP at different times are not statistically different. Using data covering 3 years (12 quarters) prior to the respective insurance changes, I regress prices on quarter-year indicators and the quarter-year indicators interacted with an indicator whether a product is in the treatment group. If the treatment group follows the same time trend, then the interaction terms should be jointly insignificant.

Table 2 reports the coefficients on the treatment*quarter-year interactions. In column 1, I test whether prices for products that obtain RP in 1989 (treatment group) trend differently than prices of products that receive RP in 94 or never receive RP during my sample (control group). All of the

interactions of treatment indicator with quarter-year indicators are statistically insignificant. In addition, an F-test suggests that the interactions are also jointly insignificantly different from zero. Column 2 repeats this exercise with the same treatment group, but uses only products that never receive reference prices as a control group. The conclusions are the same. Column 3 considers whether prices of products that receive RP in 1994 trend differently than prices of products that never receive RP during my sample. As in columns 1 and 2, all of the interactions of the treatment indicator and quarter-year indicators are statistically insignificant and the F-test indicates that the interaction of the treatment indicators with the quarter-year indicators are also jointly statistically insignificantly different from zero. Overall, this evidence suggests that both products that eventually receive reference prices and those that do not had prices that were following the same general trend through time before RP are implemented. Thus, the differences in the timing of the implementation of RP do not seem to be driven by differences in time trends across oral antidiabetic products prior to the implementation of the reform.

In table 3, I report the estimates of the effect of RP on prices based on (2), for oral antidiabetics. Column 1 does not distinguish between brands and generic products. The coefficient on the reference price indicator is the average percentage change in prices associated with changes in patient out-of-pocket expenses. The negative coefficient suggests that pharmaceutical prices drop by about 18 percent after the change in reimbursement. Figures 1a and 1b and the theoretical motivation in section 3 of the paper suggest that brands and generic products might adjust differentially to insurance changes. Column 2 of table 3 report estimates of equation (2) differentiating between generic products and brands. Brands reduce their prices significantly more than generics. The prices of generic products decline on average by 11% after the change in insurance. Although the prices of brands are on average higher than those of generics prior to changes in insurance, the brand premium declines after the reform. The prices of brands drop on average by an additional 26%. Column 3 and 4 check the robustness of the results in column 2 to alternative time controls: a linear time trend (column 3) and quarter-year indicators (column 4). These specifications yield the same conclusion. In column 5, I add the interactions of brand indicator with year

indicators to the specification in column 2. This allows for a differential trending of prices of brand name products that are subject to reference prices from those that are not. While the absolute magnitude of the coefficients declines slightly, the findings are not statistically different from the findings reported in column 2. Finally, confounding factors associated with the general trending of prices of products that receive RP but not products not subject to RP could be influencing the estimates of the impact of RP. In column 6, I allow the time variation in prices to differ across products with and without reference prices by including interactions of year indicator with an indicator whether a product eventually becomes subject to reference prices ($treatment_i$). Estimates of the effect of RP are consistent with those in earlier columns. Column 7 adds the brand name-year indicators interactions to specification in column 6 in order to allow branded and non-branded products without RP to follow different time trends. These additional controls do not substantively alter my estimates of the effect of RP.

Overall, my results suggest that prices respond sharply to increases in potential patient out-of-pocket expenses. The estimated effects are economically large and statistically significant. My estimates also confirm the anecdotal evidence that reimbursement changes affect brands and generics differently. Zweifel and Crivelli (1996) suggest that the reform produced an immediate decline in prices of innovators to the reference price level, but had little impact on generic prices, which were already below the reimbursement ceiling. Sullivan (1993), on the other hand, claims that generic producers increased prices so that the reform decreased price competition. This could, for example, occur if imposition of reference prices facilitates collusion among generic producers by providing a focal point, from which firms are less likely to deviate. I find that the prices of generic products decline, but that the decrease in price is on average much more pronounced for brands. This suggests that producers need to significantly decrease the premium for a brand name product to protect their market shares as patients actually perceive the price of a product.

5.2.2 Antiulcerants

As oral antidiabetics are a market with no major changes in competitive environment, the

estimates of the relationship between patient out-of-pocket expenses and price are not very sensitive to whether and how I control for other time varying variables. Antiulcerants, however, have undergone significant changes in their market. Generic products only enter the market in 1991, a year prior to reimbursement change, and the increased presence of generic products can impact prices independently of changes in patient out-of-pocket expenses. Hence, the estimates of the link between patient out-of-pocket expenses and pricing that do not control for generic competition might be less robust than those for oral antidiabetics. Moreover, all antiulcerants became subject to reference prices at the same time. As a result, there does not exist a potential control group that I can compare to price movements in products subject to reference prices. I thus estimate the relationship between product prices and patient out-of-pocket expenses using the before and after framework of equation (1).

Note that since all antiulcerants receive reference prices in 1992, I need to exclude two year indicators when I estimate (1) with year indicators. I always exclude the first year of the reform, which is equivalent to renaming the year indicator for the initial year of insurance change as post. The choice of the other base year determines the reference year for my estimate of the effect of patient reimbursement. If prices are trending downwards over time, excluding the year prior to the implementation of the reform (1991) likely yields the smallest estimates. The effect of patient reimbursement (the coefficient on post) is then identified solely by the variation in prices in the first year of the reform relative to the year preceding the reform. In this paper, I focus mostly on these estimates. This identification obviously relies on the assumption that no unobserved shocks that affect prices occur between these two years.

The question arises whether the estimated effects are sensitive to the excluded base year. Table 4 reports the estimates of (1) for antiulcerants using various base years. In column 1, I exclude the year prior to the implementation of the reform (1991) and the first year of the reform (1992). In column 2, I exclude the first year of the reform (1992) and 1990. Column 3, on the other hand, excludes the initial year of the sample (1986) and the first year of the reform, so that the coefficient on post is identified by the variation in prices in the first year of the reform relative to the initial year of the sample. All columns

suggest that prices decline after the imposition of maximum reimbursement. Moreover, the magnitudes of the coefficients are not very different when I compare the first year of the reform to the year preceding the reform (1991) or the year before that (1990) (column 1 and 2, respectively). However, unsurprisingly the magnitudes of the effect differ across the specifications that use a base year close to the beginning of the initial reforms (1990 or 1991) and the specification in column 3 that uses the initial year of the sample as a base year. The variation in generic competition over time could potentially account for the differences in results. It is thus important to control for the evolution of generic competition. In the next section, I explicitly incorporate the changes in competition in the analysis of patient out-of-pocket expenses and pricing of pharmaceutical products. I find that the results are not sensitive to the choice of base year once generic competition is considered.

5.3 Competition

In this section I first check whether the decline in prices of pharmaceutical products after the change in patient out-of-pocket expenses persists when I directly control for the competitive environment. I then examine whether the responses of products to changes in patient copayment vary with the differences in competition products face. I find that after controlling for generic competition, the results are not sensitive to excluded base year. Moreover, brands that face more generic competition reduce their prices by more after RP.

I control for competition by augmenting equation (1) with a variable measuring the number of generics in the active ingredient group. This measure of competition has been, for example, used by Scott-Morton (1997). Using the number of generics as a measure of competition raises some potential estimation problems. First, the number of generics might not be a good measure of competition if patients and physicians perceive generics as poor substitutes for brands and do not prescribe them. This preference for brands should produce a low market share for generic products. To overcome this problem, one could alternatively measure competition using Herfindahl index of an active ingredient grouping. A market segment with a higher Herfindahl index is more concentrated and potentially less

competitive. The Herfindahl index and the number of generics in a given active ingredient group are thus likely inversely related if generics account for a nontrivial market share. The correlation between the Herfindahl index and the number of generics is -.89 for oral antidiabetics and -.86 for antiulcerants. Hence, the results based on the Herfindahl index should and do yield similar conclusions to measuring competition with the number of generics.

Second, the number of generics facing a product in a given active ingredient group could be a function of a product's price. For example, more generics might enter a market segment with higher prices because of higher anticipated profits. Also, there might be unobserved factors that affect product prices and generic entry. Hence, to identify the effect of generic competition on price, I need variables that affect a producer's ability to enter a pharmaceutical market that do not directly affect the prices of existing products. The endogeneity problem in the case of this paper is mitigated because it takes time to acquire a production permit or an importer's license, so that the entry of generics is determined by past prices and patent expiration dates. Also, if the endogeneity issue arises because higher prices lead to greater entry of generics, this suggests a positive correlation between prices and generic competition. If we are interested in whether additional generic competition lowers prices, this form of a bias attenuates the true effect and might result in a false rejection of the hypothesis. Alternatively, if the endogeneity arises from unobserved, time-invariant characteristics associated with prices and competition, product fixed effects capture this type of heterogeneity and yield unbiased estimates of the effect of competition on prices.

The estimates of equation (1) augmented with the number of generics are reported in table 5 for antiulcerants. This table controls for the unobserved time-varying factors with year indicators and relies on the variation in prices in the initial year of the reform relative to the year preceding the reform. Appendix table 1 and 2 estimate the augmented equation (1) using two years prior to reform (1990) and the first year of the sample (1986) respectively for a base year. The question obviously arises whether specifications that use different base years yield different conclusions. After controlling for generic

competition, the findings across the specifications with different base years do not differ much, so I focus my discussion on table 5.

Columns 1-4 of table 5 report the results for all antiulcerants. A comparison of the effect of RP on columns 1 and 2 illustrates the importance of controlling for generic competition in this evolving market. Column 1 suggests that prices declined on average by 10.6 % (albeit the coefficient is not significant) after the change of RP and that brands did not change their prices differently from generics. Conditioning on the number of generics in column 2 halves the magnitude of the estimated coefficient on the post indicator to 5.2%. A similar pattern is obtained in columns 5 and 6 using only products with the active ingredient subject to generic competition since 1991. Overall, conditional on the number of generic products, the 1992 change in reimbursement is not associated with a statistically significant change in product prices. Moreover, the negative coefficient on the number of generics in column 2 and 6 suggests that in general, additional generic competition is associated with lower prices.

Obviously, it is difficult to pinpoint the impact of the 1992 RP change even after controlling for generic competition given that generic products entered the market in 1991. The impact of generic competition on prices will naturally be confounded with the price level in the base year. However, some products also experience a large reduction in the assigned reference price in 1994. By then, generic competition existed before and after the copayment change. In columns 9-12, I focus on the 1994 RP change using data for 1992 to 1996. The post indicator is thus one if the time period is covered by the 1994 RP change and zero otherwise. Column 9 suggests a decline in the price of generics and an additional decline in the price of brands after the reimbursement change. Conditional on the number of generics, the price of a generic product actually increases on average after the change in copayment, while the increase in the potential patient out-of-pocket expenses has a small negative impact on the pricing of brands (column 10).

Given the importance of generic products in the antiulcerant market, I next check whether generic competition influences the price response of products to changes in patient out-of-pocket

expenses. If products lower their prices because they effectively face more price competition from generics after the changes in patient out-of-pocket expenses, the coefficient on the interaction between the number of generics and the post indicator should be negative. The results for antiulcerants in table 5 support this hypothesis. Columns 3, 7, and 11 allow the number of generics to affect prices differently before and after the copayment change. In columns 7 and 11, the coefficient on the interaction of post and the number of generics is negative.[13] This suggests that everything else equal, the additional generic competition lowers product prices more after the change in reimbursement. The importance of generic competition is even more pronounced for brands: the coefficient on the interaction of post indicator, brand, and the number of generics is always negative (columns 4, 8, 12). Moreover, a comparison of these results with the results based on a different base year reported in Appendix tables 1 and 2 suggests that these results are not sensitive to the choice of the base year. The signs and the magnitudes of the coefficient on the interaction of number of generics and post and the interaction of brand, post, and number of generics are very similar. Thus, much of the sensitivity to base years in table 4 appears to be attributable to price variation from variation in generic competition.

Table 6 repeats the exercise reported in column 4, 8, and 12 of table 5 using the Herfindahl index as a measure of competition rather than the number of generics. A higher Herfindahl index suggests greater market concentration and thus potentially less competition. The results suggest that brand name products in more concentrated markets reduce their prices by less, which is in line with the results based on the number of generics.

Finally, I consider the effect of generic competition on the pricing for oral antidiabetics. I augment equation (2) with the number of generics in a market segment and allow the number of generics to have a differential impact for products with and without reference prices. As previously mentioned, unlike antiulcerants that experience significant entry of new generic products, oral antidiabetics are a relatively stable market that does not face much new generic entry. Therefore, it is not surprising that the

[13] In column 3, the additional generic competition lowers prices, but this effect is not significantly different before

results for oral antidiabetics are not sensitive to controlling for generic competition. Column 1 of table 7 suggests that controlling for generic competition does not affect our findings about the relationship between patient out-of-pocket expenses and pharmaceutical pricing. The coefficients in column 1 are nearly identical to the coefficients in column 5 of table 3. When I allow the impact of RP on pricing of brands to vary with the number of generics in column 2, I find (as will antiulcerants) a larger decline in the prices of brands facing more generic competition. The coefficient on the interaction of the indicator for brand name products subject to reference prices and number of generics is negative. This suggests that after the changes in patient out-of-pocket expenses, brands are no longer able to attain as high of a brand premium as when all products are subject to the same prescription fee. Column 3 uses Herfindahl index as a measure of competition and I find results similar to what I found by measuring competition with number of generics.

In sum, the results in this section suggest that generic competition plays an important role in the response to reference prices. Products that face more generic competition drop their prices by more. This response is especially pronounced for brands: brands that face more generic competition lower their prices by more. Given the large price response to changes in patient out-of-pocket expenses found in this paper, I also check whether the quantity of products sold responds to changes in patient reimbursement. Table 8 reports estimates of (2) and (1) with log quantities of product sold as a dependent variable. The results for oral antidiabetics (column 1-2) are estimated using equation (2) (i.e. with a control group), while the results for antiulcerants rely on before and after analysis as in equation (1). The results in column 1 and 3 suggest that the quantity of products sold is, on average, unaffected. However, this hides a differential quantity response between brand name products and generics. Columns 2 (oral antidiabetics) and 4 and 5 (antiulcerants) distinguish between generics and brands. While the quantity sold for generics on average stays the same (oral antidiabetics) or increases (antiulcerants), the quantity sold of brands on average declines after changes in patient out-of-pocket expenses. However, the

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and after the RP change.

coefficients for oral antidiabetics are imprecisely estimated. These results seems to suggest that the brand name products lost some market share as a result of reference prices and that the producers of brand name products have an incentive to lower prices to shield their market share.

6. Conclusion

This paper examines a unique episode of changes in potential patient out-of-pocket expenses to assess the link between patient out-of-pocket expenses and pricing behavior by pharmaceutical firms. I find that, at least in the current case, producers significantly reduce prices as the change in patient copayment directly exposes patients to prices. Depending on the therapeutic group and specification, the estimates of price reductions due to changes in insurance reimbursement range from 10 to 26%.

Generic competition seems to play an important role in this process. The changes in reimbursement mostly affect price competition between brands and generics within the same active ingredient group. Brands reduce their prices on average by 21 to 26% more than generics, and the price drop is bigger for brands containing an active ingredient facing more generic competition. This corroborates the findings by Ellison et. al. (1997) that the relevant competition in the pharmaceutical market occurs between generics and the brand name version of the same active ingredient rather than across products that are therapeutics substitutes, i.e. products with different active ingredients, but belonging to the same therapeutic group. Their model of pharmaceutical demand yields high estimates of cross-price elasticities among generics and brands with the same active ingredient and low estimates of cross-price elasticities between products with different active ingredients. The lack of competition between therapeutic substitutes is also found by Scott-Morton (1997). She investigates how the OBRA legislation affects the pricing by pharmaceutical firms in the US market. Scott-Morton finds the legislation does not substantively alter the pricing of patented products because of relatively weak competition from their therapeutic substitutes.

Another potential reason in the current case why changes in potential patient out-of-pocket expenses have a large impact on pharmaceutical is that patients and physicians might become better

informed about prices after the change in insurance reimbursement. As discussed in the text, doctors were required by law to discuss reference prices with patients. This likely improves information about pharmaceutical prices. Thus, the evidence in this paper is also consistent with pharmaceutical prices responding to better patient and doctor information about pharmaceutical prices. However, the additional out-of-pocket expenses faced by patients under the new reimbursement rules also generate a new incentive to value this information on prices that did not exist before.

My results strongly suggest that patients and doctors are sensitive to patient out-of-pocket expenses for prescription pharmaceuticals. Recent studies of pharmaceutical demand abstract from insurance coverage. A more explicit treatment of patient insurance in these empirical models might be a fruitful area for future research.

Most importantly, this paper shows that changes in potential patient out-of-pocket expenses at least in the present case spillover to the pharmaceutical producers. This channel should not be ignored when discussing the implications of expanding health insurance coverage. For example, recent debates in the United States about whether Medicare should cover outpatient prescription pharmaceuticals often conclude with demands for the direct price regulation of pharmaceuticals. Public interest in these debates in not surprising given that pharmaceuticals account for 30 percent of out-of pocket expenditures for health services in the United States in 1992, and the elderly account for 35 percent of total drug consumption (Schweitzer 1997). A carefully designed insurance reimbursement scheme for outpatient pharmaceuticals might provide an alternative to direct price regulation. However, lower prices might dissuade pharmaceutical firms from cross subsidizing research intensive activities as the producers might be less likely recoup their R&D investment. Clearly, future research should identify this tradeoff between lower pharmaceutical prices and R&D investment.

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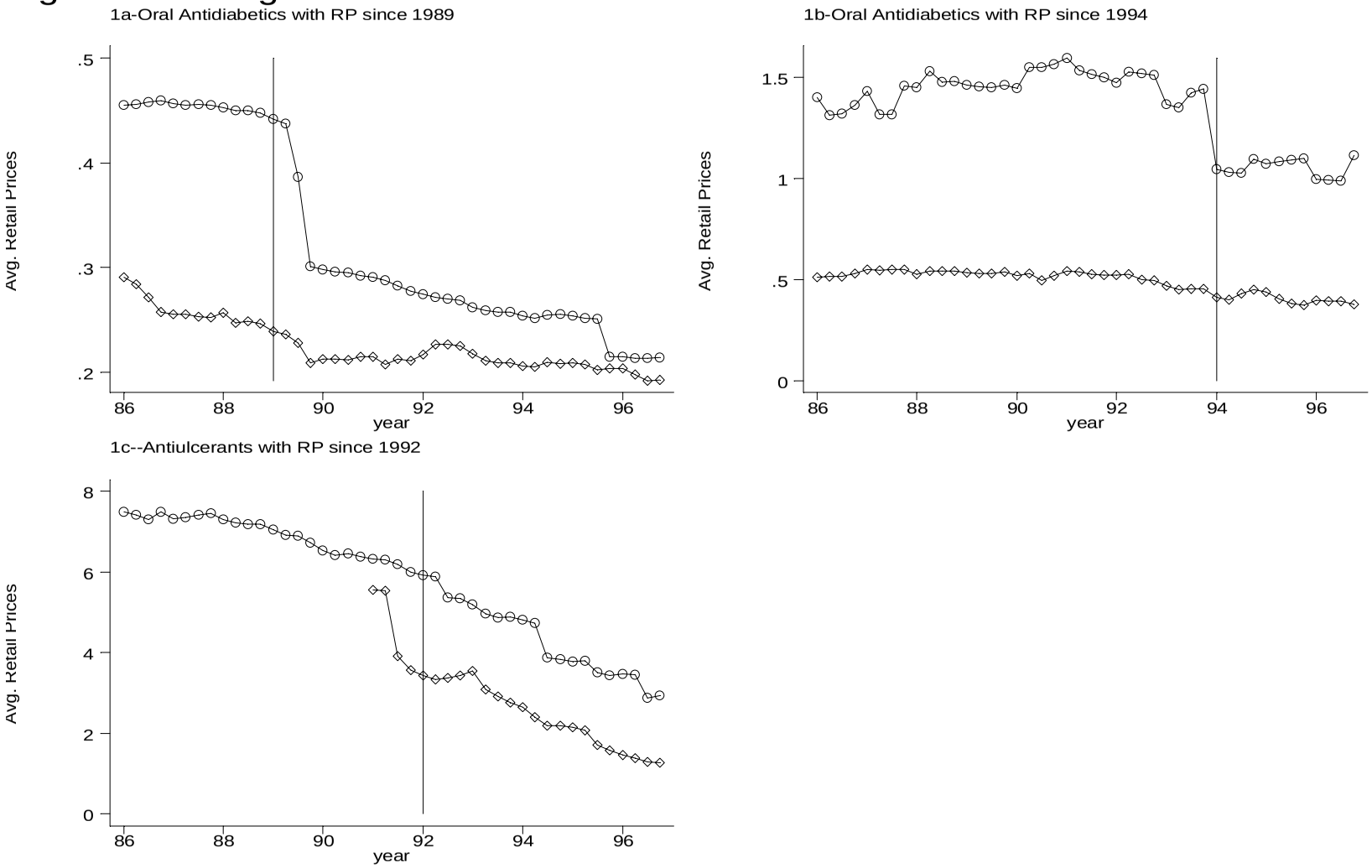
Figure 1-Average Price of Brands and Generics with RP



circle—brands, diamond—generics

Note: The vertical line depicts the year insurance changed for a given product.
Source: IMS Health, Rote Liste, author's own calculations.

Table 1--Summary Statistics

Variable	N	Mean	S.D.	Min	Max
Oral Antidiabetics					
Price of Average Daily Dose	2051	0.49	0.45	0.07	2.26
Share of Brands	2051	0.24	0.43	0	1
Number of Generics per Active Ingredient	374	6.53	9.65	0	32
Antiulcerants					
Price of Average Daily Dose	1347	4.10	2.22	0.72	8.37
Share of Brands	1347	0.58	0.49	0	1
Number of Generics per Active Ingredient	193	2.95	7.28	0	29

Note: Prices in 1990 DM. Source: IMS Health, CPI is from Datastream. N is the number of quarter-products. N is the number of quarter-active ingredients in the case of the number of generics per active ingredient.

Table 2--Price Trends Prior to Reference Prices

	(1)	(2)	(3)
Treatment group	RP89	RP89	RP94
Comparison group	no RP, RP94	no RP	no RP
Treatment*quarter_-11	.012	.012	-.002
	(.012)	(.012)	(.005)
Treatment*quarter_-10	.016	.005	-.013
	(.013)	(.018)	(.013)
Treatment*quarter_-9	.013	.006	-.008
	(.012)	(.015)	(.015)
Treatment*quarter_-8	.002	-.012	-.005
	(.013)	(.020)	(.021)
Treatment*quarter_-7	.004	-.015	-.007
	(.016)	(.038)	(.030)
Treatment*quarter_-6	.001	.000	.003
	(.013)	(.016)	(.021)
Treatment*quarter_-5	-.005	-.006	.006
	(.013)	(.017)	(.023)
Treatment*quarter_-4	-.028	-.028	.036
	(.021)	(.024)	(.025)
Treatment*quarter_-3	-.019	-.022	.021
	(.022)	(.024)	(.027)
Treatment*quarter_-2	-.018	-.018	.032
	(.025)	(.028)	(.026)
Treatment*quarter_-1	-.028	-.024	.032
	(.026)	(.028)	(.026)
F-test of joint insignificance (p-value)	(.114)	(.484)	(.270)
Product indicators	yes	yes	yes
N	535	348	459

Note: Robust standard errors adjusted for clustering on product level are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. The regression also include 11 unreported quarter indicators. The omitted category is the quarter 12 quarters prior to treatment.

Table 3--Patient Out-of-Pocket Expenses and Pricing of Oral Antidiabetics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Products subject to reference price (rp_{it})	-.183 **	-.112 **	-.086 *	-.112 **	-.123 **	-.115 **	-.125 **
	(.055)	(.056)	(.045)	(.056)	(.062)	(.056)	(.063)
Branded product subject to reference price ($brand_i$*rp_{it})		-.260 **	-.280 **	-.260 **	-.217 *	-.259 **	-.222 **
		(.128)	(.128)	(.129)	(.113)	(.128)	(.112)
Product indicators	yes	yes	yes	yes	yes	yes	yes
Year indicators	yes	yes	no	no	yes	yes	yes
Year indicators*branded indicator	no	no	no	no	yes	no	yes
Year indicators*treatment indicator	no	no	no	no	no	yes	yes
Quarter-year indicators	no	no	no	yes	no	no	no
Annual time trend	no	no	yes	no	no	no	no

Note: Robust standard errors adjusted for clustering on product level are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. 1986 is the omitted year indicator. N is 2051.

Table 4--Patient Out-of-Pocket Expenses and Pricing of Antiulcerants

	(1)	(2)	(3)
Post	-.121 **	-.161 **	-.267 **
	(.017)	(.023)	(.029)
Year indicators	yes	yes	yes
Excluded Years	91, 92	90,92	86,92
Product Indicators	yes	yes	yes

Note: Standard errors are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. N is 1347.

Table 5--Patient Out-of-Pocket Expenses, Competition, and Pricing of Antiulcerants

	RP in 1992 (all products 1986-1996)				RP in 1992 (1986-1996)				RP in 1994 (1992-1996)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	-.106	-.052	-.069	-.571 **	-.098	-.025	.174	-.364 **	-.099 **	.120 **	1.160 **	.980 **
	(.065)	(.055)	(.096)	(.081)	(.061)	(.042)	(.110)	(.083)	(.028)	(.027)	(.263)	(.269)
brand*post	-.020	-.046	-.035	.503 **	-.074	.006	-.033	.662 **	-.149 **	-.141 **	-.148 **	.354 **
	(.080)	(.070)	(.085)	(.084)	(.076)	(.070)	(.085)	(.108)	(.060)	(.059)	(.060)	(.314)
Number of generics (ngen)		-.011 **	-.013 **	-.064 **		-.025 **	-.013 *	-.064 **		-.033 **	-.016 **	-.018 **
		(.003)	(.005)	(.005)		(.003)	(.007)	(.005)		(.003)	(.004)	(.006)
ngen*post			.002	.058 **			-.021 **	.036 **			-.050 **	-.042 **
			(.006)	(.009)			(.008)	(.009)			(.012)	(.013)
ngen*brand				.056 **				.059 **				.005
				(.005)				(.005)				(.006)
ngen*post*brand				-.061 **				-.070 **				-.022
				(.009)				(.010)				(.015)
Product Indicators	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year Indicators	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Omitted Year Indicators	91, 92	91, 92	91, 92	91, 92	91, 92	91, 92	91, 92	91, 92	93,94	93,94	93,94	93,94
N	1347	1347	1347	1347	882	882	882	882	646	646	646	646

Note: Standard errors are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. Columns 1-4 are estimated using all antiulcerants. Columns 5-12 are estimated using only products with generic competitors since 1991. Columns 1-8 consider the effect of RP change in 1992 using data from 1986 to 1996. Columns 9-12 consider the impact of additional change in RP using data from 1992 to 1996.

Table 6--Patient Out-of-pocket Expenses, Herfindahl Index, and Pricing of Antiulcerants

	(1)	(2)	(3)
post	.079	-.444 **	.084
	(.110)	(.155)	(.248)
brand*post	-.304 **	-.682 **	-2.159 **
	(.119)	(.213)	(.605)
Herfindahl Index (herf)	1.493 **	1.493 **	5.242 **
	(.552)	(.552)	(1.327)
Herf*post	-.019	3.869 **	-1.963
	(.701)	(1.230)	(3.167)
Herf*brand	-1.393 **	-1.166 **	.321
	(.560)	(.561)	(1.128)
Herf*post*brand	.320	5.472 **	27.599 **
	(.703)	(1.794)	(7.611)
Product Indicators	yes	yes	yes
Year Indicators	yes	yes	yes
Omitted Year Indicators	91, 92	91, 92	93,94
N	1347	882	646

Note: Standard errors are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. Column 1 is estimated using all antiulcerants. Columns 2 is estimated using only products that had generic competitors since 1991. Columns 1 and 2 consider the effect of RP change in 1992 using data from 1986 to 1996. Column 3 considers the impact of additional change in RP using data from 1992 to 1996.

Table 7--Patient Out-of-pocket Expenses, Competition, and Pricing of Oral Antidiabetics

	(1)	(2)	(3)
Products subject to reference prices	-.134 **	-.758 **	.151
	(.069)	(.179)	(.124)
Branded products subject to reference prices	-.217 *	.425	-.652 **
	(.112)	(.236)	(.150)
Number of generics (ngen)	.010	-.009	
	(.013)	(.011)	
Products s.t. reference prices*ngen		.036 **	
		(.008)	
Ngen*branded		-.002	
		(.012)	
Branded products s.t. reference prices*ngen		-.020 **	
		(.010)	
Herfindahl Index (herf)			.150
			(.172)
Products s.t. reference prices*herf			-.811 **
			(.264)
Herf*branded			-.682
			(.778)
Branded products s.t. reference prices*herf			1.061 **
			(.426)
Year indicators	yes	yes	yes
Year indicators*branded	yes	yes	yes
Year indicators*ngen	no	yes	no
Year indicators*herf	no	no	yes
Product indicators	yes	yes	yes

Note: Robust standard errors adjusted for clustering on product level are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. N is 2051.

Table 8--Patient Out-of-Pocket Expenses and Quantity Sold
(dependent variable is log quantity sold)

	Oral Antidiabetics		Antiulcerants		
	(1)	(2)	(3)	(4)	(5)
Products subject to reference price	-.086	.049	.064	1.585 **	1.614 **
	(.198)	(.203)	(.162)	(.173)	(.176)
Brands subject to reference price		-.496		-2.010 **	-2.327 **
		(.390)		(.245)	(.272)
Year indicators	yes	yes	yes	yes	yes
Product indicators	yes	yes	yes	yes	yes
N	2051	2051	1347	1347	882

Note: Quantity is measured in number of daily doses sold. Robust standard errors clustered on product are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. Column 5 only includes products subject to generic competition since 1991. The omitted year indicators in columns 3-5 are 1991 and 1992.

Appendix Table 1--Patient Out-of-Pocket Expenses and Pricing of Antiulcerants
(a robustness check)

	RP in 1992 (all products 1986-1996)				RP in 1992 (1986-1996)				RP in 1994 (1992-1996)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	-.142 **	-.054	-.064	-.582 **	-.133 **	.063 *	.204 **	-.372 **	-.199 **	.170 **	1.134 **	.953 **
	(.066)	(.056)	(.083)	(.079)	(.062)	(.038)	(.082)	(.083)	(.037)	(.033)	(.252)	(.259)
brand*post	-.020	-.046	-.035	.503 **	-.074	.006	-.033	.662 **	-.149 **	-.141 **	-.148 **	.354
	(.080)	(.070)	(.085)	(.084)	(.076)	(.070)	(.085)	(.108)	(.060)	(.059)	(.060)	(.314)
Number of generics (ngen)		-.011 **	-.013 **	-.064 **		-.025 **	-.013 *	-.064 **		-.033 **	-.016 **	-.018 **
		(.003)	(.005)	(.005)		(.003)	(.007)	(.005)		(.003)	(.004)	(.006)
ngen*post			.002	.058 **			-.021 **	.036 **			-.050 **	-.042 **
			(.006)	(.009)			(.008)	(.009)			(.012)	(.013)
ngen*brand				.056 **				.059 **				.005
				(.005)				(.005)				(.006)
ngen*post*brand				-.061 **				-.070 **				-.022
				(.009)				(.010)				(.015)
Product Indicators	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year Indicators	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Omitted Year Indicators	90, 92	90, 92	90, 92	90, 92	90, 92	90, 92	90, 92	90, 92	92,94	92,94	92,94	92,94
N	1347	1347	1347	1347	882	882	882	882	646	646	646	646

Note: Standard errors are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. Columns 1-4 are estimated using all antiulcerants. Columns 5-12 are estimated using only products with generic competitors since 1991. Columns 1-8 consider the effect of RP change in 1992 using data from 1986 to 1996. Columns 9-12 consider the impact of additional change in RP using data from 1992 to 1996.

Appendix Table 2--Patient Out-of-Pocket Expenses and Pricing of Antiulcerants
(another robustness check)

	RP in 1992 (all products 1986-1996)				RP in 1992 (1986-1996)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
post	-.247 **	-.143 **	-.154 *	-.671 **	-.245 **	-.048	.092	-.510 **
	(.073)	(.062)	(.084)	(.080)	(.073)	(.056)	(.093)	(.092)
brand*post	-.020	-.046	-.035	.503 **	-.074	.006	-.033	.653 **
	(.080)	(.070)	(.085)	(.084)	(.076)	(.070)	(.085)	(.109)
Number of generics (ngen)		-.011 **	-.013 **	-.064 **		-.025 **	-.013 *	-.064 **
		(.003)	(.005)	(.005)		(.003)	(.007)	(.005)
ngen*post			.002	.058 **			-.021 **	.040 **
			(.006)	(.009)			(.008)	(.009)
ngen*brand				.056 **				.059 **
				(.005)				(.005)
ngen*post*brand				-.061 **				-.070 **
				(.009)				(.010)
Product Indicators	yes	yes	yes	yes	yes	yes	yes	yes
Year Indicators	yes	yes	yes	yes	yes	yes	yes	yes
Omitted Year Indicators	86, 92	86, 92	86, 92	86, 92	86, 92	86, 92	86, 92	86, 92
N	1347	1347	1347	1347	882	882	882	882

Note: Standard errors are in parenthesis. ** and * indicate significance at a 5% and 10% level, respectively. Columns 1-4 are estimated using all antiulcerants. Columns 5-8 are estimated using only products with generic competitors since 1991. Columns 1-8 consider the effect of RP in 1992 using data from 1986 to 1996.