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Abstract

Co-payments are a common instrument of health insurers to lower their pharmaceutical expenses and to share costs with consumers, the patients. Tiered drug co-payments, e.g. lower co-payments for generic drugs, incentivize patients to buy certain products and, hence, steer drug consumption patterns. Since 2007, the German Statutory Health Insurance follows an innovative and unique regulation by differentiating drug co-payments by the drug's price relative to its reference price. Co-payment exemption thresholds have been introduced in 185 out of 281 therapeutic clusters since 2007. We answer how effective this co-payment exemption policy is in order to reduce overall prices for pharmaceutical products. We analyze prices of all drugs marketed in reference price clusters and being subject to the policy in Germany using quarterly data from January 2007 to October 2010 published by the Federal Association of Statutory Health Insurance Funds in Germany. We find empirical evidence of differentiated price setting strategies by different firm types ranging from price decreases of -8% to increases of +1.3% (innovators) following the introduction of co-payment exemption threshold. We refer to the latter case as the "co-payment paradox". Furthermore, prices of generic and branded generic firms and reference prices tend to converge. The results are robust when we estimate static and dynamic linear panel data models and control for the heterogeneity of active ingredient's clusters, autocorrelation, and heteroscedasticity. Our competition proxies (no. of firms and ratio products/firm in the same market) suggest a significant negative impact of competition on prices and, thereby, question whether more competition may be an alternative way to lower pharmaceutical prices.

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1 Introduction

In 2009, in the US, about 10% of the national health expenditures were spent on pharmaceuticals [CMS, 2011] while the German Statutory Health Insurances (SHI) spent 19% of its budget on drugs [BPI, 2011]. Health care politics faces several challenges due to the design of the pharmaceutical market: Patients ask for the best medication while paying at most a small fraction of the prices directly due to almost full coverage by health insurances (inelastic demand). Firms seek to make profits while facing high fixed costs for research and development (brand-name drugs) or market protection via patents (generics).

Usual means to control expenses for off-patent drugs are reference price systems and co-payment schemes [Kanavos et al., 2008]. Both instruments let patients freely choose their medication and, in addition, guide them to cost-efficient drug use. In 2006, the German SHI came up with an innovative instrument to lower drug prices within the reference price scheme: since then, for some active clusters, patients are exempted from co-payments if the firm sets a price 30% or more below the reference price. Thus, this regulation leads price sensitive patients to choose cheaper drugs and introduces more competition into the market.

This paper gives first insights on the question how much the introduction of a co-payment exemption for low-priced drugs reduces prices in the respective therapeutic clusters. We analyze prices of all drugs marketed in reference price clusters in Germany using quarterly data from January 2007 to October 2010 published by the Federal Association of Statutory Health Insurance Funds (FASHI) in Germany. In the data, we further observe product level information (by presentation = "Pharmazentralnummer (PZN)") which means that each drug is differentiated by active ingredient, package size, dosage form, reference prices, exemption levels, etc. We estimate a price equation whose specification stems from theoretic considerations and find empirical evidence of differentiated price setting strategies. The estimated price effect of the policy ranges from -8% to +1.3%. We refer to increasing prices by innovators after the introduction of a co-payment exemption threshold as the "co-payment paradox". Furthermore, prices and reference prices for generics and branded generics tend to converge. The results are robust when we estimate different linear panel data models and control for the heterogeneity of active ingredient's clusters, autocorrelation, and heteroscedasticity. Our competition proxy [# of firms and ratio (products/firm) in the same market] suggests a significant negative impact of competition on prices and, thereby, questions whether more competition may be an alternative way to lower pharmaceutical prices.

Following Germany, in most of the European health care systems reference programs have been introduced until today, thus most of the literature is European based. The first study on reference prices in Germany dates back to Pavcnik [2002]. She investigates data from IMS Health on oral anti-diabetics and antiulcerants for the period 1986 to 1996. Her findings show price reductions of 10% to 26% and a higher price reduction for branded products after the introduction of a reference price.[1]

Augurzky et al. [2009] utilize a long panel data set on German prescription

[1] In contrast, researchers like Frank and Salkever [1992] or Grabowski and Vernon [1992] find that branded products (originators) are increasing prices when they face competition by generic drugs (so-called "generic paradox").

drugs from 1994 to 2005 to investigate the effect of changes in reference prices. They find significant time trends for drugs without reference prices and a 0.29% change of prices when reference prices change by 1%. Moreover, he finds that the introduction of a reference price decreases mean prices by 7% with a large variance. Stargardt [2010] uses micro data of patients of a German sickness fund to investigate the impact of introducing reference prices for statins in 2005. His difference-in-difference estimation is based on patent's characteristics and focuses on substitutional behavior between statins. He estimates savings of € 94 million to € 108 million due to the introduction of reference prices.

For Denmark, Kaiser et al. [2010] evaluated a reform of the reference price scheme in 2005. Building on a nested logit demand model they find a list price decrease by 26% on average and a decrease in patients' co-payments by 7.5%. Additionally, they estimate welfare effects. Their results differ by the type of drugs and effects are stronger for initially high priced drugs. Kaiser et al. [2010] suggest to set reference prices at the lowest price of the sample in order to make demand more elastic and thereby enhance competition. Using a firm entry model, Moreno-Torres et al. [2009] suggest that reference price schemes might hamper entry of generic competitors.

The literature about co-payments and cost-sharing is mostly U.S. based due to the high insurance coverage in Europe. Chandra et al. [2010] provides a recent survey of the relevant literature and an analysis of Medicare supplemental plan members who were facing a co-payment raise. Her results for elderly people are very similar to the results of the RAND Health Insurance Experiment for younger people.[2] Our study is similar to more quasi-experimental studies about co-payment changes or tier co-payment schemes, e.g. by Landsman et al. [2005] or Gaynor et al. [2007]. For Europe, Skipper [2010] takes advantage of a quasi-natural experiment which increased co-payments for Danish patients in 2000. He shows that stockpiling for insulin occurred, a drug that treats a chronic disease, and he estimates a price elasticity of -0.18 to -0.35 for penicillin, a treatment for non-chronic illnesses. Furthermore, he finds that low income individuals are more price sensitive. His results are in line with Simonsen et al. [2010] who studied the kinked drug reimbursement schemes in Denmark. Miraldo [2009], Mestre-Ferrandiz [2003], and Puig-Junoy [2004] analyze co-payments within a theoretic framework. A study that focuses explicitly on competition is provided by Ganslandt and Maskus [2004] who estimate price changes due to the introduction of parallel imports from the European Union. They use instrumental variables for market entry and measure competition by the number of firms in the relevant market. Their results suggest that parallel imports decrease manufacturer prices by 12% to 19%.

In the following Section 2, the German market for pharmaceuticals is briefly described before a theoretical model will be presented in Section 3 which mirrors pricing strategies of the firms within one therapeutic alternative given demand and the explained regulation. Section 4 presents the estimation strategy and explains the data used. Section 5 discusses the estimation results in light of the theoretical hypotheses while Section 6 concludes.

[2]The RAND Health Insurance Experiment is a basis for many studies about co-payment incentives, e.g. Manning et al. [1987] survey literature using the experiment.

2 The market for pharmaceuticals: Regulating supply and demand

This study analyzes the German pharmaceutical market between January 2007 and October 2010. To understand underlying principles we start with a short description of the German market structure for this period. In 2010, the German Statutory Health Insurance (SHI) covered 69.5 million people or almost 85% of the population[3] and was the largest insurer [BMG, 2011a]. Around 10% of the population are privately insured, e.g. civil servants and freelance professionals, who do not face drug co-payments the way as the members of the SHI do. Thus, we focus on the SHI in our research.

In general, patients must visit a physician to get a prescription for most of the drugs reimbursed by the insurer. Physicians have to treat patients with all necessary, efficient and best treatments available [§12 SGB V]. Thus, we here assume them to act as the patients perfect agent when prescribing drugs. Pharmacies hand out prescription drugs and collect patient's co-payment. All German pharmacies charge the same price for the same prescription drug. Pharmacists forward the co-payments to the SHI and receive as reimbursement a fixed fee plus a percentage share of the drug's price directly from the health insurance. In general, pharmacists hand out the product specified on the prescription. This is particular true for on-patent drugs. If the physician allows substitution or names the active ingredient on the prescription instead of the brand name, pharmacists can substitute drugs. The pharmacist either hands out the product which is available under a rebate contract between the producer and the patient's health insurance (compare Subsection 2.3). Or, if there is no rebate contract in place, the pharmacists hands out the indicated drug or one of the three cheapest drugs available.[4] From 2007 to 2011, the only way for a patient to receive a specific drug consisted of asking the physician for a specified prescription.

Furthermore, drugs' prices coverage by the SHI is limited e.g. by a reference price (Subsection 2.1) and cost sharing through co-payments (Subsection 2.2). For an overview of different other regulatory instruments see Kanavos et al. [2008].

2.1 Reference Prices in Detail

Germany was the first country that introduced reference prices in 1989 by clustering active ingredients as one therapeutic market and setting a maximum reimbursable price per cluster. Thus, reference prices do not directly intervene into price setting decisions of firms. Consequently, firms can price above the reference price while then the patients have to pay the difference.

Originally only applied to generic substitutes, the reference price clusters can include pharmacological equivalent products since 1992 and therapeutic equivalent active ingredients since 1993.[5] In the period of interest (2007 to

[3] Several exceptions, for example high income or self-employment, allow people to switch to a private insurer. Insurance status and topics such as selection bias are beyond the scope of this paper.

[4] Detailed rules regarding drug substitution can be found in § 129, Abs. 1, SGB V.

[5] Generic and originator drugs of different active ingredients are defined as groups of perfect substitutes. The definition of one reimbursable price is based on the assumption of perfect

2010), on- and off-patent drugs can be included in one reference group as long as the on-patent product does not add any additional benefit ("me-too drugs"). Furthermore, innovative drugs can be grouped to so-called "jumbo groups" [§ 35 SGB V)].

Reference prices are set in two steps. First, the *Federal Joint Committee*[6] defines bundles of therapeutic substitutes on the basis of active ingredients. In a second step, the FASHI calculates reference prices for each package size, dosage, etc. and publishes decisions about reference prices on its webpage. Firms can, if they want, adjust their prices to the (new) reimbursement level. Still, firms are free in setting prices.

2.2 Co-Payments

In Germany, cost sharing of pharmaceuticals is applied by the SHI since 1923 when patients had to cover 10%-20% of the medication's costs. Traditionally, and unlike in the US[7] drug co-payments plays a minor role in Germany. Since January 2004 patients pay 10% of the drug's price but with a maximum of 10 euro. The co-payment must not exceed the pharmacy's selling price and, thus, shows the following form

$$co-payment_i = \begin{array}{ll} p_i & if \quad p \leq €5 \\ €5 & if \quad 5 < p_i \leq 50 \\ 0.1 \cdot p_i & if \quad 50 < p_i \leq 100 \\ €10 & if \quad p_i > 100 \end{array}$$

In graph 1, we illustrate the function of co-payments in Germany. In other countries, like the U.S., tiered co-payment schemes are a common instrument since the early 1990ies. Tiered co-payments steer consumption to preferred (by the insurer) drugs. In Germany, the co-payment depends on prices and does not differ between generic and branded drugs.

However, as an additional instrument to lower prices the SHI introduced a co-payment exemption threshold for selected clusters of reference priced drugs. While there are detailed descriptions and rules of how a reference price is set in Germany, there is only scarce information about the process of choosing applicable clusters. Two legal requirements have to be fulfilled by a reference price cluster to permit the introduction of a co-payment exemption threshold [§ 31, Abs. 3, SGB V]

1. the list price of a drug is at least 30% below its reference price, and
2. the statutory health insurance expects savings from imposing an exemption threshold.

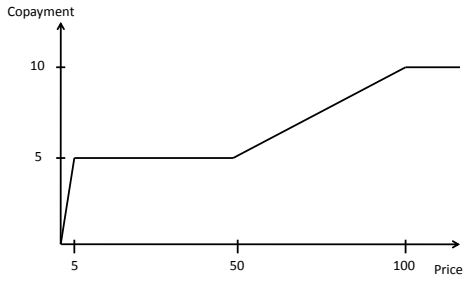
Yet, there is no detailed information available about the internal selection process of the relevant clusters. According to personal discussions with managers

substitutability [Zweifel and Crivelli, 1996].

[6] From 2007 to 2011, the Federal Joint Committee consisted of five representatives of the national health insurances, another five representatives of doctors, dentists, and hospitals, and three non-party members. (Gemeinsamer Bundesausschuss: `http://www.g-ba.de/fordetails`.)

[7] Compare Austvoll-Dahlgren et al. [2008] for an overview.

Figure 1: Illustration of co-payments in Germany since 2004



of the FASHI the choice depends heavily on assumptions about the patients' substitutional behavior, the budget effects of canceled co-payments, and characteristics of the therapeutic market such as chronic indications, etc. Regarding the latter they consult pharmacists and drug experts before introducing co-payment exemptions thresholds for a reference price cluster.

2.3 Rebate Contracts

Rebates for pharmaceuticals can be negotiated between manufacturers and statutory health insurances since 2005 which started extensively in 2007. In early 2010, 185 insurers had rebate contracts for over 2.5 million drugs with 141 pharmaceutical companies. Altogether, 47.5% of all prescriptions were covered by rebate contracts [KBV, 2011]. The information on prices and quantities negotiated in the context of such contracts are not publicly available. However, price competition among rebated products is fierce since especially exclusive contracts with big health insurances promise high sales. We cannot account for rebate contracts but assume the SHI to act as a perfect agent to minimize costs and offer a variety of (rebated) products to their insures. We discuss missing information on rebate contracts in chapter 5.

3 A Theoretical Model

Our theoretical model illustrates the market for drugs with reference prices, co-payments and co-payment exemptions before we estimate the price equation in chapter 5. The model is based on Brekke et al. [2009], Miraldo [2009], and Frank and Salkever [1992]. Consider n firms offering each one drug in the same therapeutic market, which means that all products $[x_1, ..., x_n]$ within that market cure the same specific disease (e.g. insulin). In our framework, all drugs are classified into one therapeutic group facing each the reference price $\hat{p}$, which is set by a third party payer (health insurance).

3.1 Timing of the Game

1. The reference price $\hat{p}$ and the co-payment exemption threshold p^* are set by the responsible authorities.

2. Firms choose the profit maximizing price given a product's attributes (quality, efficacy) and the reference price / co-payment exemption threshold.

3. Patients (or doctors or health insurance, who act as perfect agents) buy one product out of a portfolio of therapeutically equivalent prescription drugs and pay the respective co-payment.

In our data, the market is dynamic in the sense that the reference prices and co-payment exemption thresholds are adjusted regularly reflecting price changes in the market. Here, we discuss a simple static framework but our empirical model will reflect the adjustments.

3.2 Patient's choice

Patients are free in choosing a drug out of the n therapeutic alternatives[8] (non-perfect substitutes) and face different co-payments depending on the drug's price. Moreover, in this model products with a price below a limit price, p^* are exempted from co-payments.[9]

In particular, a patient faces the following co-payment c_i for drug i

$$c_i = \begin{cases} \min[p_i, \max[\underline{c}, \min[\bar{c}, \alpha\hat{p}]]] + (p_i - \hat{p}) & \text{if} \quad p_i > \hat{p} \\ \min[p_i, \max[\underline{c}, \min[\bar{c}, \alpha p_i]]] & \text{if} \quad \hat{p} \geq p_i > p^* \\ 0 & \text{if} \quad p_i \leq p^* \end{cases} \tag{1}$$

where $\hat{p}$ is the reference price and p_i is the drug's price. The threshold price for exemption from co-payment is p^* and α is the co-payment share of each patient. In Germany the patient pays at least p_i for $p_i \leq 5$ and at most $\bar{c} = €10$ for $100 \leq p_i \leq \hat{p}$, as indicated in section 2. If the patient chooses a drug with $p_i > \hat{p}$, he must additionally cover the difference to the reference price.

In a very general form, the demand function $D(.)$ can be derived from the utility functions of the $k = 1, \ldots, l$ patients $U_k[p, p^*, \hat{p}, \alpha, q_i, n, m/n]$, where p is a vector $p = [p_1, p_2, ..., p_n]$ of the prices, q is a vector of perceived quality or pharmacokinetic efficacy or quality, n is the number of drugs in the cluster, and

[8] In fact, until 2010 patients were not free in choosing a specific drug because the pharmacy had to hand out drugs for which the health insurance has a rebate contract. However, there were three institutional settings in place that introduced the same incentives as the individual decision to choose a certain drug: (1) patients could ask their physician to prescribe a specific drug; (2) for active ingredients/products without rebate contract the pharmacy had to hand out one of the three cheapest products; (3) health insurances act as perfect agents for their patients and choose the optimal price-product combination.

[9] We ignore those therapeutic clusters unaffected by the new policy in the following since we are interested in the price effect of those exemptions.

m is the number of firms producing the n drugs. Thus m/n mirrors concentration of firms within the cluster. Cross product substitution for product i is given by $\frac{\partial D_i}{\partial c_i} < 0$; $\frac{\partial D_i}{\partial c_j} > 0$ and conversely with respect to quality $\frac{\partial D_i}{\partial q_i} > 0$; $\frac{\partial D_i}{\partial q_j} < 0$, where $j \neq i$ and $j = 1, 2, ..., i-1, i+1, ..., n$. In our simple framework we define that the utility of consuming one drug i increases with increasing n and m/n since more options to choose substitutes (with e.g. less side-effects) from different firms gives direct benefits to the patients. In line with Brekke et al. [2009], we assume drugs not to be perfect substitutes due to their heterogeneous pharmacokinetic quality and efficacy. The latter assumption enriches our framework to have non-zero demand for high priced products.

Utility is assumed to be linear in all parameters. Since q_i is assumed to be exogenous given and constant over time, we abstract from these parameters in our theoretical model. We account in our estimation for those unobserved factors exploiting the panel structure of the data. The number of firms m depends on the maximum market size, duration of possible patent protections, and profits. A low ratio of firms per offered products m/n reflects concentration in the sense that one cluster can be dominated by few firms. Then, choice is restricted for the patients which reduces their personal utility.

3.3 Stage 2: Firms set prices

Firms are free in setting prices. They are assumed to maximize profits given demand D, the reference price $\hat{p}$, and the threshold price below which patients are exempted from co-payments p^*. We focus on three stylized firms producing one drug each and together defining one therapeutic cluster. Firm A produces a branded drug ("innovator"), firm B offers a branded generic and firm C offers a generic drug. In several countries the reference price is defined as an average of prices in the cluster. In Germany, at least one third of prices must be below the reference price (§ 35, SGB V).[10] In our model, the reference price is set between the highest and the second highest of the three prices. This means usually that $p_a > \hat{p} > p_b \geq p_c$. We assume that marginal costs are zero but fixed costs occur for firms A (marketing and R&D) and B (marketing), which are sunk but which increase quality and other unobserved factors making at least some patients willing to pay more than for the "no-name" generic.

A: Firm A offers a branded or more efficacious product which allows the firm to set a price above the reference price. Firm A maximizes its profits by solving

$$\frac{\partial \Pi_a}{\partial p_a} = D_a[c_a, c_b, c_c; q_a, q_b, q_c; n, m/n] - p_a \frac{\partial D_a(.)}{\partial c_a} = 0 \tag{2}$$

B: Firm B offers a branded generic and maximizes profits by solving

$$\frac{\partial \Pi_b}{\partial p_b} = D_b[c_a, c_b, c_c; q_a, q_b, q_c; n, m/n] - \alpha p_b \frac{\partial D_b}{\partial c_b} = 0 \tag{3}$$

Firm B sets a price, p_b, between the reference price and the price where patients are exempted from any co-payment: $p^* < p_b \leq \hat{p}$. We argue that firm B cannot sell at the exemption threshold because the firm has higher fixed costs due to marketing activity. Instead, firm B has the incentive to set $p_b = \hat{p}$ because the co-insurance rate paid by the consumer, α, is usually small and

[10] Puig-Junoy [2010b] explains different RP setting strategies in Europe.

the co-payment is limited to $\bar{c}$ as long as $p_b \leq \hat{p}$. This means that the demand elasticity is low just below the reference price while it is steep just above the reference price, especially for high priced drugs.

C: Firm C sets a price below p_b to increase its market share given the low efficacy or low perceived quality of the drug. Now, at p^*, the drug is exempted from co-payments. Additionally, since firms receive the list price from the third party payer, there is no incentive for the firm to set a price below the exemption-level p^*. Thus, firm C will meet the threshold $p_c = p^*$ which results into $c_c = 0$.

Since the price elasticity of demand increases with increasing prices, price changes would imply higher demand changes (Δ) for firm A than for firm B than for firm C if prices were continuous: $\triangle_A > \Delta_B > \Delta_C$. Since in several countries there is a maximum co-payment per package, the co-payment function is kinked as is the demand function. Thus, it depends on the price level whether firm A or C face higher losses if co-payments increase. In addition, for given co-payments and prices, firm A (C) faces lowest (highest) demand.

What incentives does a possible co-payment exemption introduce for the firms? Assume that the introduction of a co-payment exemption threshold makes C lowering the price from $\hat{p}$ to p^*. Since demand reacts to co-payments some consumers will switch from firm A or firm B to firm C. More from B than from A, though. Facing this loss in demand, firm A and B decrease their prices. Furthermore, some firms will leave the market (cluster) due to increasing pressure. More innovative and brand firms will leave than enter, while pure generic firms will still enter unless the price equals marginal costs. Then, demand for each individual firm increases again and, following traditional demand theory, all three firms have the incentive to subsequently increase prices (probably less for firm C).

However, in the meantime, the reference price may be adjusted to the new price structure in the market and be lowered to $\tilde{p}$ which in turn lowers the exemption threshold. This would have a direct effect for the branded drug A, since the patient additionally pays the absolute difference to the new reference price $\hat{p} - \tilde{p}$. The adjustment would also affect the branded generic B, which now faces the highest loss in demand since it now is above the reference price. B would reduce its price to meet $\tilde{p}$ again. Finally, firm C would have to decrease its price further to still offer an exempted product.

To conclude, the optimal strategy of firms depends heavily on the assumptions on demand elasticity and thereby on consumers willingness to disburse a higher co-payment for a higher quality or efficacy. In our empirical analysis we will split the market into different groups to disentangle the reactions of the different players in the cluster with respect to the introduction of a co-payment exemption threshold. The hypotheses from this model we test can be summarized as

1. Reference prices will decrease due to the average decrease of prices after the introduction of the co-payment exemption threshold.

2. Both types of generic producers will reduce prices on average. However, the reference price decreases more such that prices converge to the reference price from below.

3. The effect on innovative firms depends on the specific demand structure of the cluster and the new reference price and is not unambiguous.

In the following section we present our data and estimation strategy to test above derived hypothesis.

4 Estimation Strategy and Data

4.1 Data

We observe quarterly price data on product level of all drugs belonging to any reference price cluster from January 2007 to October 2010. Prices and reference prices are pharmacy's selling prices inclusive VAT and including the pharmacist's reimbursement of a fixed fee (€ 8.10) plus 3% of the selling price. All products have a unique identification number (PZN) by active ingredient, package size, strength, form of administration, and reference price cluster. Although we observe information about "over-the-counter" (OTC) for which patients do not need prescriptions and pay the full price in the pharmacy we focus on prescription drugs. The Federal Association of Statutory Health Insurance Funds in Germany (FASHI) provides publicly available information on reference prices.[11] We augment the data with product specific co-payment exemption thresholds, where applicable. The FASHI provides this data since May 2006.[12]

We observe product level data over 16 quarters. In the full sample, out of 35,629 products 12,252 drugs entered the market and 9,128 exited the market. By the end of 2010, the data covered 71.7% of all drug packages sold and 36.6% of all pharmaceutical expenses in Germany [ProGenerika, 2010]. We classified the 364 companies according to their web page into six classes: generic firms, branded generic firms, innovative firms, trading firms, importing firms, and herbal drug firms. Table 1 specifies the classification we chose after analyzing the firms' webpages and Table 7 in the Appendix relates each firm we observe in our data to a specific classification.

Table 1: Firm Classification

Firm Classification	**Definition of the Classification**
generic	Firms marketing mainly generic products, not investing heavily into R&D, and not advertising broadly, e.g. AbZ Pharma
branded generic	Firms marketing mainly generic products, not investing heavily into R&D, and advertising their non-prescription drugs, e.g. Ratiopharm
innovative	Firms investing in research & development of new molecules, e.g. Pfizer
trading	Firms mainly trading with drugs and marketing some of their products
importing	Firms importing drugs and branding their products with their name, e.g. KohlPharma
herbal	Firms producing mainly non-prescription products such as health supplements and food supplements

Classifications chosen after analyzing the firms' webpages.

[11] In cooperation with the German Drug Regulatory Authorities the German Institute for Medical Documentation and Information (DIMDI) is a central information platform for pharmaceutical products in Germany and updates its database of reference prices quarterly: `http://www.dimdi.de/static/en/amg/fbag/index.htm`.

[12] `http://www.gkv-spitzenverband.de/Beschluesse_zuzahlungsbefr_Arznei.gkvnet`.

Table 2: Mean of selected variables of final sample by firm class and before/after the introduction of co-payment exemption thresholds (Treatment)

	Treated?	Products (#)	Price (€)	Reference Price (€)	Difference P-RP (% of price)	Products in Cluster (#)
Generics	no	15,623	47.62	67.47	-24.93	36.2
	yes	10,543	36.74	42.99	-12.74	26.3
Branded Generics	no	4,437	49.82	64.8	-18.1	33.84
	yes	4,634	31.29	35.05	-9.83	20.12
Innovative	no	3,531	73.56	87.29	-8.93	34.77
	yes	2,591	67.67	62.4	28.32	23.02
Import	no	4,763	63.62	69.34	-5.58	33.59
	yes	3,338	46.32	46.27	9.84	31.3
Total	no	28,591	54	69.62	-18.58	35.28
	yes	21,360	40.8	44.09	-3.5	25.43

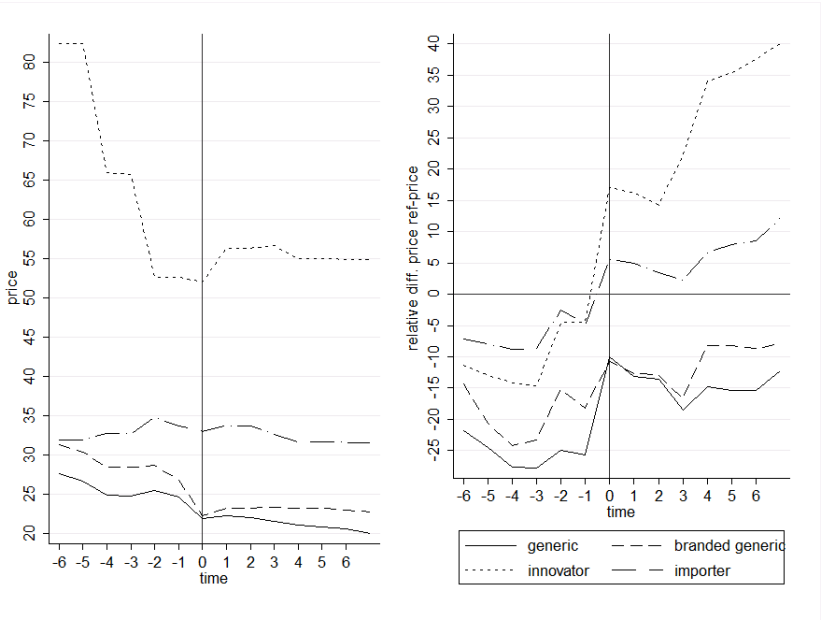
Data Source: Federal Association of Statutory Health Insurance Funds (FASHI). Own Calculations. Subsample of German drugs assigned to any reference price cluster, Jan 2007 to Oct 2010

In order to reveal effects of a possible co-payment exemption we reduce our sample to those clusters in which co-payment exemption thresholds have been introduced in April 2007 or later. The selection leaves us a sub-sample of 49,951 out of 468,234 observations.

Table 2 provides a descriptive overview of our sub-sample. Most products are offered by firms classified as generic firms. Mean prices in € are similar for generic and for branded generic firms while importers tend to set higher prices and innovators seem to focus on high-priced products. Within the sub-sample, Glimepirid, an oral anti-diabetic drug, marketed by several generic firms is the product-package-strength combination with the lowest price of € 9,67 (Teva) from 2008 to 2010; while the highest price with € 3,342.27 falls on Erypo®, an anti anemic syringe from Janssen-Cilag, in 2007. Furthermore, on average, prices are lower after the introduction of a co-payment exemption threshold (yes compared to no). Since reference prices are adjusted regularly and often simultaneously to the introduction of co-payment exemption thresholds it is hard to disentangle the effects descriptively. Generic and branded generic firms tend to sell below the reference price, however, the difference tends to be smaller after the treatment while, on average, innovative and importing firms set prices above reference prices.

Figure 2 provides an overview of pricing behavior around the the introduction of a co-payment exemption threshold in period 0. The left graph illustrates decreasing prices before the introduction of the treatment for generic, branded generic, and innovative firms while importing firms tend to increase their prices slightly. After the treatment, mean prices are fairly constant for most groups although generic firms tend to decrease prices and innovative firms slightly increase their prices. The graph on the right illustrates how firms set prices with respect to the respective reference price. For all types of firms prices are converging towards the reference price before the treatment. The trend slows down for generic and branded generic firms. Innovators and importing firms on average set prices above the cluster's reference price. Regarding our sub-sample, Flouxetin KSK, an antidepressant, only costs a fraction of the reference price

Figure 2: Prices (mean) and *(price-reference price)/price*-ratio around the introduction of a co-payment exemption for low priced drugs (time=0) by firm classification.



Source: FASHI.

(the price is 82% below the reference price in 2008) while *AstraZeneca* markets *Crestor*® 511% above the reference price in 2010.

4.2 Estimation Strategy

To evaluate the policy, we exploit the panel structure of our data to quantify the impact of a possible co-payment exemption and, additionally, estimate effects of competition. Following the ideas of our theoretical model above, we set up the following price equation for each drug i at quarter t

$$\begin{aligned} \ln p_{i,h,c,t} \quad = \quad & \beta_0 + \beta_1 \ln rp_{i,t} + \beta_2 \textstyle\sum_{f=1}^{4} copay_{f,h,t} \\ & + \beta_3 n_{c,t} + \beta_4 [\tfrac{n}{m}]_{c,t} + \beta_5 \triangle rp_{h,t} \\ & + \textstyle\sum_{g=3}^{16} \beta_{3+g} t_{g,t} + \gamma_i + \epsilon_{i,t}. \end{aligned} \tag{4}$$

where $p_{i,h,c,t}$ are prices of product $i = 1, ..., I$, marketed by firm $f = 1, 2, 3, 4$, in reference price cluster $h = 1, ..., H$, in the competitive environment $c = 1, ..., C$, and at time $t = 1, ..., 16$, n is the number of products within one competitive cluster and m the number of competing firms. The factor of highest interest in Equation (4) is the dummy capturing the introduction of a co-payment exemption threshold $copay_{f,h,t}$, which is =1 from the quarter on the threshold is set for the specific reference price cluster h, and zero before. Thus, we conduct a before-after-difference estimation. The parameter β_2 is estimated separately

for each type of producer, $f = 1, 2, 3, 4$ which enables us to distinguish different reactions of the different firm types.

Since we are also interested in competitive effects in the drug market, we include the number of competing products in competitive group c, $n_{c,t}$ (with $c = 1, ..., C$ per active cluster, quarter, presentation, and package size), and the ratio of products per firm, $[\frac{n}{m}]_{c,t}$. As prices and reference prices are autocorrelated we include lagged prices, $p_{i,t-1}$ and lagged reference prices, $rp_{i,t-1}$, in model (3).

In some cases, reference price adjustments coincide with the introduction or adjustment of co-payment exemption levels. Thus, the binary variable $\triangle rp_{h,t}$ captures the effect of a price adjustment in the first period after the change of the reference price. Time dummy variables, t_g, for $g = 3, ..., 16$, control for unobserved quarter specific shocks common to all drugs. The parameter γ_i captures all product specific effects that are constant over time (like quality, efficacy or the firm's management strategy) and $\epsilon_{i,t}$ is a time and product specific random error.

Firms classified as trading or herbal firms are not considered in our regressions because of the small number of observations (39 and 4 drugs, respectively). However, the competition variables still consider products from trading or herbal firms as competitors.

The data is first order autocorrelated as we reject the null hypothesis of the Lagrange-Multiplier test for serial correlation. Therefore, we set up an estimation strategy to control for autocorrelation by first-differences. In the following analysis we present three different models: (1) a first-difference estimation with heteroscedastic robust standard errors, (2) a linear fixed effects model with an AR(1) disturbance, and (3) a first-difference estimation with heteroscedastic robust standard errors where we use instrumental variables for the first lag of prices and reference prices.

By definition, the inclusion of lagged regressors of first order in a first-difference estimation gives us inconsistent results. Due to differentiating, $p_{i,t-1}$ and $rp_{i,t-1}$ are correlated with the error term, $\varepsilon_{i,t}$. Thus, to identify our model, we use the following instrumental variables in model (3): the ratio (and squared ratio) of reference prices and prices, $[\frac{rp}{p}]$, and the mean price of competing products, *meanpother*. All instrumental variables are significant in the first-stage (see Tables 5 and 6 in the Appendix) and do not reject the F-test of excluded instruments. The identifying assumption for all instrumental variables is $Cov(Z, \varepsilon) = 0 \, \forall \, i$ and is tested by the overidentification test of all instruments. We reject the Hansen J statistic with a p-value of 0.25.

To identify our key parameter we assume the decision to implement a co-payment exemption level to be exogenous. Co-payment exemption levels are introduced by the FASHI following an unknown procedure. In addition, the introduction of co-payment exemption levels for a whole reference price cluster depends on the potential to decrease prices in that respective cluster where this potential is identified by the health insurances during an inexplicit process. A single firm has probably only limited influence on the decision. The number of products and the ratio of firms per product in a specific therapeutic cluster might be endogenous. For interpretational purposes, we assume the market structure to be exogenous or we interpret the market structure not to be a causal driver for prices but to be correlated with prices.

5 Results

In Table 3 we summarize the results of the empirical models described above. Column (1) and column (2) present results of a first-difference model and a fixed effects estimation that controls for an AR(1) error term, both without lagged covariates. Finally, column (3) summarizes the results of a first-difference model with instrumental variables for two lagged dependent variables. In all models we control for time specific effects and for heteroscedasticity robust standard errors.

Our preferred first-differences specification (3) accounts for first order autocorrelation and uses instrumental variables for the first lag of prices and first lag of reference prices. All significant coefficients show the expected signs.

We observe negative price effects due to the introduction of co-payment exemption thresholds for products from generic (-1.6%), branded generic (-8%), and importing firms (-3.6%). Our results indicate that consumers are price sensitive in co-payments. Firms have to lower their prices to attract patients to buy their products.

However, innovative firms increase their prices by +1.3% after the introduction of a co-payment exemption level, thus we can speak of a "co-payment paradox". Some products might provide a higher quality unobserved to the researcher that allows the firms to set a higher price than the competitors. Even regulators do not consider these quality or perceived quality differences. After the introduction of a co-payment exemption threshold some high quality firms might market their products in a lower pricing area than before or exit. Therefore, the supply of exclusive high-priced products becomes smaller and allows the remaining firms to set higher prices than before the treatment.

If the cluster-specific reference price decreases by 1% the prices decrease by 0.21% on average. In our model, reference prices are correlated highly with the prices (highest paramter estimate). Lagged prices and lagged reference prices show positive and significant but small coefficients. Sometimes, co-payment exemptions thresholds are introduced simultaneously with (downward) reference price adjustments. We disentangle the two effects by including a dummy variable which is equal to one in periods in which reference prices are adjusted. Dummy variables for quarters 3 to 16 control for time specific influences in all models and indicate a negative price trend over all periods.

The study of Augurzky et al. [2009] uses similar price data and estimates an (ex-factory) price increase of 0.29% when reference prices increase by 1% which is close to our estimate. Stargardt [2011] uses data from one German health insurance (2004 to 2006) and finds that patients are not price sensitive because they may not have enough information about the co-payment scheme or are already exempted from co-payments, as for example a large part of the chronically ill patients. Our results contrast his findings as we find that firms decrease their prices due to price sensitive consumer. Our results are, however, in line with Pavcnik [2002] who finds substantial decreases in prices after a potential rise of the patient's payments.

The competition measures show that, on average, the price decreases by 0.1% when the cluster grows by one product. Additionally, the ratio "products per firm" indicates that one more product per firm in the market (less competition) decreases prices by 1%. To check for robustness, we used other measures of competition, e.g. the number of products by brand, which confirmed the

Table 3: Estimation Results

	FD (1)	AR (2)	FD, Inst (3)
Price (ln)	Coeff.	Coeff.	Coeff.
	(std.err.)	(std.err.)	(std.err.)
Price_{t-1}(ln)			0.068***
			(0.015)
Reference Price_{t-1}(ln)			0.065***
			(0.006)
Reference Price (ln)	0.210***	0.324***	0.209***
	(0.009)	(0.003)	(0.009)
Co-payment exemption	-0.016***	0.017***	-0.016***
(generic firms)	(0.003)	(0.002)	(0.003)
Co-payment exemption	-0.081***	-0.048***	-0.080***
(branded generic firms)	(0.006)	(0.003)	(0.006)
Co-payment exemption	0.014***	0.036***	0.013***
(innovative firms)	(0.005)	(0.003)	(0.005)
Co-payment exemption	-0.035***	-0.018***	-0.036***
(importing firms)	(0.005)	(0.003)	(0.005)
Number of Products (n)	-0.001***	-0.001***	0.010***
	(0.000)	(0.000)	(0.000)
Product/Firm (n/m)	0.008***	0.022***	0.010***
	(0.003)	(0.003)	(0.004)
Constant	-0.037***	2.188***	-0.005***
	(0.003)	(0.004)	(0.000)
RP adjustment	yes	yes	yes
Quarter Dummies	yes	yes	yes
N	45,529	45,579	41,129
R^2_{adj}	0.203	0.216	0.225
F	119.94	769.57	107.733

Data Source: FASHI, Own Calculations. Standard errors in parentheses. Significance level: *** indicates $< .01$, ** indicates $< .05$, * indicates $< .1$; "Co-payment exemption" means: =1 after after the introduction of a co-payment exemption threshold in a reference price cluster. FD: First-Difference-Estimation, Inst: with instruments for lagged values

impact of competition. Other studies are pointing in the same direction: in Stargardt [2011] an additional firm in the active ingredients cluster reduces the price per package by about 0.031% per quarter; Reiffen and Ward [2005] estimate a structural model and present a generic wholesale price decline of about 30% following the entry of 1 to 10 firms; for anti-invectives, Wiggins and Maness [2004] present a price decrease of 52% as the number of sellers increases from between 6 and 15 to more than 40; and for Sweden, Ganslandt and Maskus [2004] present a reduction in manufacturer's price of 12-19% if the number of firms increases by one in generic markets. Still, to draw conclusions we have to make strong assumptions about the exogeneity of the market structure. We will leave this issue for future research.

5.1 Robustness

In our final sample we excluded firms classified as trading and herbal. Including both firm types does not change the above results and indicates a price increase of 1.7% and 4.7% for these groups, respectively.

Additionally, our general results are robust to changes in the sample size. When including all clusters in which a co-payment threshold had been implemented (365,696 obs) already in January 2007 (or later) the precision of our model and general statements do not change.

6 Discussion

Our results suggest differentiated pricing patterns of different firm types. Generic, branded generic, and importing firms decrease their prices due to the introduction of a co-payment exemption threshold between -1.6% and -8%. However, this is not true for all firms: innovators tend to increase prices by about 1.3% on average. Some firms tend to not participate in the Bertrand pricing game and increase prices after the introduction of a co-payment exemption threshold, which we interpret as a "co-payment paradox". Additionally, some firms even set prices above reference prices although they priced below the reference price before.

A first reason for the limited price reaction of generic drugs is that co-payments for products with a price below the reference price are limited to 10%, max €10. Thus, the maximum amount a patient can save is €10. Second, we do not take into account rebate contracts between health insurances and pharmaceutical companies. In general, health insurances negotiate rebate contracts for selected drugs if they can contract lower prices. Then, insurers often offer co-payment exemptions for these selected low priced drugs to their insured. This implies that list prices (which we observe) must be higher than the prices health insurances really pay for the drugs under rebate contracts. Controlling for rebate contracts would increase the negative price effect of co-payment exemptions for non-contracted low-priced drugs. Thus, we may underestimate the effect of potential co-payment exemptions.

Grabowski and Vernon [1992] and Frank and Salkever [1992] suggest that prices of branded drugs react positively (if significant) to generic competition, the "generics paradox". Our results are similar in the way that we find firms increasing prices due to this policy which was meant to decrease prices. The

product with the highest price to reference price ratio is *Crestor*® marketed by *AstraZeneca* in 2010 with plus 511%. Economic theory would suggest zero demand when cheaper substitutes are available. Setting prices above the exemption level or even above the reference price could be interpreted as a sign for market power, e.g. due to higher but unobserved quality. Differences in observed quality and trust in so-called experience and credence goods may drive patients to pay more for their preferred brand. For instance, Brekke et al. [2007] discuss the eventual health problems patients face when they consume a less suitable drug because it is exempted from co-payments.

To analyze welfare effects of the policy one would need information on sales to observe substitutional behavior due to a possible co-payment exemption. For an analysis of the full costs it is not sufficient to observe drugs prices and quantities only: data on physician's or hospital's visits and follow-up costs should be taken into account.

Our study evaluates the price effect of the introduction of a co-payment exemption threshold in a given regulatory health care system. However, the question arises how effective the co-payment exemption is compared to other instruments. Puig-Junoy [2010a] points out that from an economic perspective it is not necessary to intervene in markets for generic drugs. Therefore, to rationalize a regulation like reference prices or co-payment exemptions, these have to prove to be more efficient than the economically optimal solution: strict generic substitution. Indeed, e.g. Italy, the Netherlands and Poland set the maximal reimbursable price equal to the lowest price in the reference price cluster [Puig-Junoy, 2010a]. Furthermore, some countries do not regulate generic markets more than with a strict generic substitution policy, e.g. Norway.[13]

In Germany, the reference price is not set equal to the minimum price. Therefore, our analysis reveals potential for price reduction in clusters where co-payment exemption thresholds were introduced. The policy of reducing prices seems to work for firms that produce generic or branded generic drugs and trading firms. However, a pure generic substitution policy does not need such a regulatory environment as reference prices and can be more efficient by saving resources.

Moreover, policy makers should pay attention to innovators that do not decrease prices after the introduction of a co-payment exemption threshold. Drugs are selected for reference price clusters when they have the same or very similar quality in curing a specific disease. Also products of innovative firms are classified by the health insurance as having the same quality as all other drugs in the cluster. Here, we cannot speak of an innovation but more of an imitation, a so called me-too drug. Reference prices can be an instrument to put me-too drugs under price pressure. However, innovations with a superior quality have to pay off to reward pharmaceutical innovation.

7 Conclusion

In this study we utilize data on German drug prices, reference prices, and co-payment exemption thresholds of the years 2007 to 2010 to evaluate the effect of co-payment exemptions for low priced drugs. A first-difference model with instrumental variables for lagged values of the price and reference price reveals

[13] For an overview of alternative regulations see Kanavos et al. [2008].

that different firm types react differently to this policy. Firms producing generics or branded generics or importing drugs decrease prices after the introduction of a possible co-payment exemption. Firms that invest in R&D (innovators) tend to increase prices of their products, thus we call our finding for this group the "co-payment paradox". Furthermore, competition seems to have a significant negative effect on prices. However, the limitation of our data allows us only limited conclusions. To estimate welfare effects and underlying substitutional behavior of patients or health insurances we would need data on drugs' sales. A structural demand and supply system would reveal more information about the behavior of firms, patients, and health insurances.

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Table 4: Publication date of reference prices and co-payment exemption thresholds (CET)

Coming into effect	RP published by DIMDI	RP published by FASHI	CET published by FASHI
01.01.2007	Prices from 01.01.2007	Prices from 05.10.2006 Decision from 23.10.2006	Prices from 15.10.2006 Decision from 23.10.2006
01.04.2007	Prices from 01.04.2007		
01.07.2007	Prices from 01.07.2007	Prices from 01.01.2007 Decision from 07.05.2007	Prices from 01.01.2007 Decision from 07.05.2007
01.10.2007	Prices from 01.10.2007		
01.01.2008	Prices from 01.01.2008	Prices from 01.07.2007 Decision from 26.10.2007	Prices from 01.07.2007 Decision from 26.10.2007
01.04.2008	Prices from 01.01.2008		
01.06.2008	Prices from 01.07.2007	Decision from 07.04.2008	
01.07.2008	Prices from 01.07.2008		
01.10.2008	Prices from 01.10.2008		
01.01.2009	Prices from 01.01.2009	Prices from 01.07.2008 Decision from 03.11.2008	Prices from 01.07.2008 Decision from 03.11.2008
01.04.2009	Prices from 01.04.2009		
01.07.2009	Prices from 01.07.2009		
01.10.2009	Prices from 01.10.2009		
01.11.2009	Prices from 01.04.2009	Prices from 01.04.2009 Decision from 26.08.2009	
01.01.2010	Prices from 01.01.2010		
01.04.2010	Prices from 01.04.2010	Prices from 01.04.2009 Decision from 01.02.2009	Prices from 01.04.2009 Decision from 01.02.2009
01.07.2010	Prices from 01.07.2010		
01.09.2010	Prices from 01.07.2009	Prices from 01.07.2009 Decision from 29.06.2010	
01.10.2010	Prices from 01.10.2010		
01.11.2010	Prices from 01.04.2010	Prices from 01.04.2010 Decision from 27.08.2010	
01.01.2011	Prices from 01.01.2011	Prices from 01.10.2010 Decision from 01.10.2010	Prices from 01.10.2010 Decision from 01.10.2010

Appendix

Table 5: First-stage regression of LD.lnrefprice, Table 3, Model FD, Inst (3)

Reference Price$_{t-1}$ (ln)	Coeff. (std.err.)	
Price (ln)	0.006	***
	-0.002	
Co-payment exemption (generic firms)	0.002	***
	0.001	
Co-payment exemption (branded generic firms)	-0.001	
	0.002	
Co-payment exemption (innovative firms)	0.010	***
	0.002	
Co-payment exemption (import firms)	-0.001	
	0.002	
Competitive Products	0.000	*
	0.000	
Product/Firm (ratio)	-0.009	***
	0.002	
RP/P$_{t-1}$	0.840	***
	0.029	
[RP/P]$^2_{t-1}$	-0.103	***
	0.009	
Mean Price of Competitors$_{t-1}$	0.411	***
	0.015	
Constant	-0.012	***
	0.000	
N	41,129	
Centered R^2	0.732	
Angrist-Pischke multivariate F test of excluded instruments:	3,257.06	

Standard errors in parentheses. Significance level: *** indicates $< .01$, ** indicates $< .05$, * indicates $< .1$.

Table 6: First-stage regression of LD.lnprice, Table 3, Model FD, Inst (3)

$Price_{t-1}$ (ln)	Coeff. (std.err.)	
Reference Price (ln)	0.007	***
	0.002	
Co-payment exemption (generic firms)	0.001	
	0.001	
Co-payment exemption (branded generic firms)	-0.005	**
	0.002	
Co-payment exemption (innovative firms)	0.010	***
	0.002	
Co-payment exemption (import firms)	-0.004	
	0.002	
Competitive Products	0.000	
	0.000	
Product/Firm (ratio)	-0.008	***
	0.002	
RP/P_{t-1}	-0.583	***
	0.029	
$[RP/P]^2_{t-1}$	0.128	***
	0.009	
Mean Price of $Competitors_{t-1}$	0.417	***
	0.015	
Constant	-0.012	***
	0.000	
N	41,129	
Centered R^2	0.3089	
Angrist-Pischke multivariate F test of excluded instruments:	580.69	

Standard errors in parentheses. Significance level: *** indicates $< .01$, ** indicates $< .05$, * indicates $< .1$.

Table 7: Firm Classification

Firm's Type	Firm's Name
generic	1 A Pharma GmbH,AAA-Pharma GmbH, ACCEDO Arzneimittel GmbH, ALIUD PHARMA GmbH, ALMUS Deutschland GmbH, APOCARE Pharma GmbH, AWD.pharma GmbH & Co. KG, AbZ-Pharma GmbH, Alhopharm Arzneimittel GmbH, Alpharma-Isis GmbH & Co. KG, Apothekamed S.A., Apotheke in der Droote, Aristo Pharma GmbH, Aurobindo Pharma, Axea Pharma GmbH, AxiCorp GmbH, BOLDER Arzneimittel GmbH & Co. KG, Basics GmbH, Bendalis GmbH, Berco - Arzneimittel Gottfried Herzberg, Billix Pharma GmbH, Blanco Pharma GmbH, Bluefish pharmaceuticals AB, Byk Tosse Arzneimittel GmbH, C.P.M. ContractPharma GmbH & Co. KG, CONCEPT HEIDELBERG GmbH, CT Arzneimittel GmbH, Cefak KG., Combustin Pharmaz. Präparate GmbH, Cordes Pharma GmbH, D.A.V.I.D. Pharma GmbH, DENK PHARMA GmbH & Co. KG, DOLORGIET GmbH & Co. KG, Dermapharm AG, Desitin Arzneimittel GmbH, Desma Healthcare, Dexcel Pharma GmbH, Docpharma bvba, Dr. K. Hollborn & Söhne GmbH & Co.KG, Dr. Loges + Co., Dr. Ritsert Pharma GmbH & Co KG, Dr. Robert Winzer Pharma GmbH, Drossapharm AG, Duopharma Biotech Bhd., Engelhard Arzneimittel GmbH & Co KG, Ethinerics Pharmaceutical GmbH, Euro OTC Pharma GmbH,FLEXOPHARM GmbH & Co. KG, Febena Pharma GmbH, GALENpharma GmbH, GIB Pharma GmbH, Grnwalder Gesundheitsprodukte GmbH, HAEMATO PHARM AG, Heumann Pharma GmbH & Co. Generica KG, Heunet Pharma GmbH, Hofmann Pharma GmbH & Co. KG, Holsten Pharma GmbH, Hormosan Pharma GmbH, INRESA Arzneimittel GmbH, InfectoPharm Arzneimittel und Consilium, Institut für industrielle Pharmazie For, JULPHAR Pharma GmbH, Juta Pharma GmbH, Key Pharmaceuticals Pty Ltd., Kohne Pharma GmbH, LIBRA-PHARM Gesellschaft fr pharmazeut, LINDEN ARZNEIMITTEL-VERTRIEB-GmbH, Lindopharm GmbH, Lionpharm Regulatory Consulting GmbH, LšNpharma GmbH, MIP-Holding GmbH, MR Pharma GmbH, Mylan dura GmbH, Optopan Pharma GmbH, Pelpharma Handels GmbH, People's Pharma B.V., Pharma Funcke GmbH, Pharma Stulln GmbH, Pharma Wernigerode GmbH, Pharmapol Arzneimittelvertrieb-GmbH, Pharvita GmbH, Profusio Gesundheits GmbH Deutschland, Pädia Arzneimittel GmbH, QUISISANA PHARMA AG, Ranbaxy Laboratories Limited, Ravensberg GmbH Chemische Fabrik, Retorta GmbH, Rodleben Pharma GmbH, Rottapharm Madaus GmbH, RubiePharm Arzneimittel GmbH, Rudolf Lohmann GmbH KG, Ruhrpharm AG, S & K Pharma Schumann und Kohl GmbH, Sophien-Arzneimittel GmbH, Spreewald-Pharma GmbH, Steiner & Co. Deutsche Arzneimittelgesellschaft, Strathmann GmbH & Co. KG, Sdmedica GmbH Chem. Pharm. Fabrik, TAD Pharma GmbH, TEVA GmbH, Uropharm AG, VERON PHARMA Vertriebs GmbH, Versandapotheke DocMorris N.V., Vipharm GmbH, WERO-MEDICAL Werner Michallik GmbH & Co, Winthrop Arzneimittel GmbH, ZYO PHARMA TRADE GmbH & Co. KG, ZytoJen GmbH Jena, acis Arzneimittel GmbH, axcount Generika AG, axios PHARMA GmbH, betapharm Arzneimittel GmbH, biomo pharma GmbH, bittermedizin Arzneimittel-Vertriebs-GmbH, bluepharma GmbH & Co.KG, corax pharma GmbH, esparma GmbH, gepepharm GmbH, medac Gesellschaft für klinische Spezial.,medphano Arzneimittel GmbH, mibe GmbH Arzneimittel, neuraxpharm Arzneimittel GmbH, norispharm GmbH, onkovis GmbH, pharma service Grünewald GmbH, propharmed GmbH, r.p.pharma.gmbh, ribosepharm division Hikma Pharma GmbH
branded generic	Actavis Deutschland GmbH & Co. KG, Amgen GmbH, Apotheker Walter Bouhon GmbH, Astrid Twardy GmbH, Chauvin ankerpharm GmbH, HEXAL AG, Hemopharm GmbH, MEDICE Arzneimittel Pütter GmbH & Co. KG, Merck Selbstmedikation GmbH, Merckle GmbH, Procter & Gamble Germany GmbH & Co Oper, SANOL GmbH, STADA Arzneimittel AG, Sandoz International GmbH, Sandoz Pharmaceuticals GmbH, TOGAL-WERK AG, Trommsdorff GmbH & Co. KG Arzneimittel, Töpfer GmbH, Wick Pharma, ratiopharm GmbH
innovative	ADL GmbH Anti-Dekubitus-Lagerungssystem, ALCON Pharma GmbH, ALLERGAN, INC., APOGEPHA Arzneimittel GmbH, APS Pharma GmbH, Abbott GmbH & Co. KG, Acino Holding AG, almirall, S.A., Amdipharm Limited, Arzneimittel ProStrakan GmbH, Astellas Pharma GmbH, AstraZeneca GmbH, Axcan Pharma Inc., B&B-Pharma GmbH, B. Braun Melsungen AG, BC Biochemie GmbH, BENSAPHARM GmbH & Co. KG, Baxter Deutschland GmbH, Bayer AG, Berlin-Chemie AG, Boehringer Ingelheim Pharma GmbH & Co., Bristol-Myers Squibb GmbH & Co. KGaA, CARINOPHARM GmbH, CNP Pharma GmbH, CYATHUS EXQUIRERE PharmaforschungsGmbH, Carl Hoernecke Chem. Fabrik GmbH & Co., Chemische Fabrik Kreussler & Co. GmbH, Chiesi GmbH, DAIICHI SANKYOÿDEUTSCHLAND GmbH, Deutsche Chefaro Pharma GmbH, Dr. August Wolff GmbH & Co. KG Arzneimittel, Dr. Falk Pharma GmbH, Dr. Felgenträger & Co. ™ko.-chem. und P, Dr. Gerhard Mann chem.-pharm. Fabrik GmbH, Dr. Kade Pharmazeutische Fabrik GmbH, Dr. R. Pfleger Chemische Fabrik GmbH, Dr. Ritsert Pharma GmbH & Co KG, Dyckerhoff Pharma GmbH & Co. KG, Eisai GmbH, Essex Pharma GmbH, FERRING Arzneimittel GmbH, Firma Krewel Meuselbach GmbH, Fresenius SE & Co. KGaA, G. Pohl-Boskamp GmbH & Co. KG, Galderma Laboratorium GmbH, GlaxoSmithKline GmbH & Co. KG, Goldshield Group Limited, Grünenthal GmbH, HENNIG ARZNEIMITTEL GmbH & Co. KG, HEYL Chemisch-pharmazeutische Fabrik, Hospira, Inc., ICHTHYOL-GESELLSCHAFT CORDES, HERMANNI, InnovaPharma, Intendis GmbH, Interpharma, Verband der forschenden ph, Janssen-Cilag GmbH, Jenapharm GmbH & Co. KG, Johnson & Johnson GmbH, Kwizda Agro GmbH, LEO Pharma GmbH, Laves Arzneimittel GmbH, Lilly Deutschland GmbH, Louis Widmer GmbH, Lundbeck GmbH, MCM Klosterfrau Vertriebsgesellschaft, MEDA Pharma GmbH & Co. KG, MSD SHARP & DOHME GMBH, MTT Pharma & Bio-technology Co.,Ltd, MaxMedic Pharma GmbH

Table 8: Firm Classification (cont'd)

Firm's Type	**Firm's Name**
innovative (cont'd)	Merck KGaA, Merck Serono GmbH, Merz GmbH & Co. KGaA, Mundipharma GmbH, NeoCorp Aktiengesellschaft, Nordmark Arzneimittel GmbH & Co. KG, Novartis Pharma GmbH, Novo Nordisk Pharma GmbH, NycomedÿGermany Holding GmbH, ORION Pharma GmbH, OmniVision GmbH, Oncosachs Pharma GmbH, Onkoworks Gesellschaft für Herstellung, Ortho-McNeil Janssen Scientific Affairs, PARI GmbH, PB Pharma GmbH, PCR Pharmaceutical Consultancy in Regis, Pentatop Pharma GmbH, Pfizer Deutschland GmbH, Pharma Medico Group, PharmaCept GmbH, Pierre Fabre Dermo-Kosmetik GmbH, RIEMSER Arzneimittel AG, Roche Deutschland Holding GmbH, Rotexmedica GmbH Arzneimittelwerk, SANUM-Kehlbeck GmbH & Co. KG, SERAG-WIESSNER KG, SERVIER Deutschland GmbH, SIGA Laboratories, SOLVAY GmbH, Sanofi-Aventis Deutschland GmbH, Sanofi-Aventis Deutschland GmbH, Sanorell Pharma GmbH & Co KG, Schwarz Pharma Deutschland GmbH, Serumwerk Bernburg AG, Shire Deutschland GmbH, Spirig Pharma AG, Stiefel Laboratorium GmbH, Synthon BV, TEOFARMA S.R.L. Takeda Pharma GmbH, Taurus Pharma GmbH, Temmler Pharma GmbH & Co. KG, Tha Pharma GmbH, UCB Pharma GmbH, URSAPHARM Arzneimittel GmbH, VARIPHARM Arzneimittel GmbH, Valeant Pharmaceuticals International, Vifor Pharma Deutschland GmbH, Warner Chilcott Deutschland GmbH, Whitehall Munch GmbH, Wyeth Pharma GmbH, Wörwag Pharma GmbH & Co.KG, ZAMBON SVIZZERA S.A., bene-Arzneimittel GmbH, cell pharma Gesellschaft für pharmazeutisch., curasan AG, laboratoires genopharm, lapharm GmbH Pharmazeutische Produkte, sigma-tau Arzneimittel GmbH
trading	ABAKUS Pharma Trading, ASCONEX Arzneimittelvertriebs GmbH, BR Pharmaceuticals Ltd, BestPhago GmbH, Biscova-Arzneimittel Vertrieb pharmazeutisch.,CathaPham GmbH, Daniel Schumacher GmbH, Dr. Friedrich Eberth Arzneimittel GmbH, Dr. Lach Pharma Consulting, Dr. Scheffler Nachf. GmbH & Co. KG, FATOL Arzneimittel Betriebsstätte der R, Fair-Med Healthcare GmbH, Fournier Pharma GmbH, ILLA Healthcare GmbH, Intermuti Pharma GmbH, MARKA AG, Meduna Arzneimittel GmbH, ONCOtrade GmbH & Co. KG, Pelikan Apotheke, Pharmafrid Arzneimittel GmbH, Pharmaplast Vertriebsgesellschaft GmbH, StegroPharm Arzneimittel GmbH, Sun Pharma Vertriebsgesellschaft GmbH, Tussin Pharma GmbH, Vitasyn GmbH Entwicklung & Vertrieb Pharma, WIEB PHARMA Vertriebs GmbH & Co. KG, cardiologix GmbH, medipolis Versandapotheke, mevita Handels GmbH
importing	ACA Müller ADAG Pharma AG, APS ALL Pharma Service GmbH, Abis-Pharma, BERAGENA Arzneimittel GmbH, CC-Pharma GmbH, EMRA-MED Arzneimittel GmbH, EurimPharm Arzneimittel GmbH, GPP Pharma Arzneimittelvertriebsgesellschaft, Vertriebs Aktiengesellschaft, MILINDA GmbH & Co. KG, MTK-PHARMA Vertriebs-GmbH, Opti- Arzneimittel GmbH, Pharma Gerke GmbH, Pharma Westen GmbH, kohlpharma GmbH
herbal	ARDEYPHARM GmbH, Bastian-Werk GmbH, Berco - Arzneimittel Gottfried Herzberg, Biokanol Pharma GmbH, Bionorica SE, Burg Apotheke, Dr. Armah-Biomedica GmbH & Co. KG, Dr. Willmar Schwabe GmbH & Co. KG, Evisco-Pharma, Farmasan Arzneimittel GmbH & Co. KG, Grünwalder Gesundheitsprodukte GmbH, HERMES ARZNEIMITTEL GmbH, Hans Karrer GmbH, Harras Pharma Curarina Arzneimittel GmbH, Hevert-Arzneimittel GmbH & Co. KG, Johannes Brger Ysatfabrik GmbH, KyraMed Biomol Naturprodukte GmbH, Köhler Pharma GmbH, MIT Gesundheit GmbH, Mamisch GmbH Prorenal, NESTMANN Pharma GmbH, PASCOE pharmazeutische Präparate GmbH, Pharmazeutische Fabrik Kattwiga GmbH, Pharma Schwörer GmbH, Protina Pharmazeutische GmbH, R.A.N. Novesia AG Arzneimittel, REPHA GmbH Biologische Arzneimittel, ROBUGEN GMBH PHARMAZEUTISCHE FABRIK, RenaCare NephroMed GmbH, SALUS Haus Dr. med. Otto Greither Nachf, SCHUCK GmbH Arzneimittelfabrik, SCHöNING Pharmazeutische Präparate GmbH, Sidroga Gesellschaft für Gesundheitsprobleme, Steigerwald Arzneimittelwerk GmbH, TRUW Arzneimittel GmbH, Verla-Pharm Arzneimittel GmbH & Co. KG, W. Spitzner Arzneimittelfabrik GmbH, Wiedemann Pharma GmbH, aar pharma GmbH & Co. KG, biosyn Arzneimittel GmbH, meta Fackler Arzneimittel GmbH, pharmakon Arzneimittel GmbH