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24-05

June, 2024

DISCUSSION PAPERS

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The effect of higher out-of-pocket payments on drug prices and demand

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June 12, 2024

Abstract

Health care markets often lack a market force because the presence of health insurance undermines price signals. Patients have little incentive to shop for low-priced alternatives because they do not bear the full cost of their health care consumption. In turn, producers lack incentives to compete on prices. To improve efficiency in the pharmaceutical market, Switzerland introduced out-of-pocket price differentiation. As of July 1st 2011, substitutable pharmaceuticals with prices above a predefined threshold were subject to 20% coinsurance instead of the regular 10% coinsurance rate. Using comprehensive price data from public sources and patient drug use data from two Swiss health insurers, we analyze the price and demand response of this policy. Our analysis reveals an average pharmaceutical firm price reduction of 11%, with a more pronounced response from generic producers than from firms producing brand-name drugs. Regarding demand, we exploit a natural experiment in which one health insurer failed to timely implement the 20% coinsurance policy, resulting in quasi-random exposure to higher coinsurance. For patients affected by the policy, we find that the likelihood of purchasing a 20% coinsurance drug decreases by 4.3 and 1.3 percentage points for generic and brand-name drugs, respectively. These demand response estimates constitute lower bounds, as without the anticipatory behavior of producers, the demand response would likely have been more pronounced. Hence, our results indicate that the policy's effectiveness is based on the interaction between price-sensitive demand and profit-maximizing firms. Overall, our findings suggest that the (re)introduction of market-like mechanisms, such as price signals, can be effective in improving health care market efficiency.

Keywords: Patient cost sharing; pharmaceutical pricing; patient demand; price signals; regulated competition; natural experiment.
JEL: I11, I18, D12, D22.

1 Introduction

Health insurance reduces financial risks for patients but also undermines the allocation function of prices. Patients with insurance coverage do not pay the full price of their health care consumption out-of-pocket. Consequently, their incentive to shop for lower-priced alternatives is low, implying that health care providers and producers of health care goods have little incentive to compete on prices. Consequently, health care markets often lack a price mechanism to ensure the efficient allocation of resources. This lack of a market force may also explain the price differences between homogeneous goods often observed in the health care market, such as equivalent medical supplies and devices, identical laboratory services, and pharmaceutical products. Improving price signals by introducing differential cost sharing is expected to restore price competition, influencing both supply and demand, because the supply side must account for the potential response in demand. Thus, introducing out-of-pocket price differentiation is a promising tool for enhancing efficiency in the health care market.

The pharmaceutical market seems well suited to use out-of-pocket price differentiation as an allocation instrument. First, there are therapeutically equivalent products; therefore the choice of the drug is not confounded by medical considerations. Second, patients have more control over the choice of drugs than, for instance, the choice of laboratory services. Unsurprisingly, patients purchasing pharmaceuticals have become increasingly exposed to out-of-pocket price differences in recent years. Today, most European countries apply reference price systems, within which patients must pay any difference between the drug price and its reference price out-of-pocket. Because the reference price depends on the price of cheaper alternatives, out-of-pocket expenditures are higher for patients purchasing expensive pharmaceuticals. In Medicare Part D, drugs are assigned to one of up to five tiers, across which cost sharing varies. Higher-priced drugs are usually assigned to a tier with higher cost sharing as long as cheaper alternatives are available. Similarly, in Switzerland, a higher coinsurance rate is applied to expensive drugs, whereas a lower rate is charged for low-cost drugs.

In this study, we analyze the effect of the introduction of this "two-tiered" coinsurance rate for substitutable drugs in Switzerland in 2011. Switzerland is especially interesting be-

cause pharmaceutical consumption is relatively low compared to other OECD countries, and pharmaceutical expenditures are mainly driven by high prices and the high market share of expensive drugs (Paris and Docteur, 2007). Specifically, we study the pharmaceutical firms' price and the patients' demand reactions in response to the 2011 reform. As of July 1st 2011, expensive generic and brand-name drugs became subject to 20% instead of 10% coinsurance if sufficient less expensive generic alternatives were available.[1] This policy triggered producers and consumers to respond sequentially. First, in the early spring of 2011, firms were informed whether their product is intended to be subject to 20% coinsurance starting July 2011, and were given the opportunity to reduce prices to avoid high coinsurance on their products. Second, patients could react to the higher coinsurance rate on products for which firms decided not to reduce their prices.

The implementation of the two-tiered coinsurance rate in mid 2011, which did not affect all drugs per substance, provides an ideal setup to analyze price responses. Moreover, we exploit a natural experiment − the delayed implementation of the policy by one health insurer − to identify demand responses. To analyze the effect on drug prices, we use the list of drugs covered by compulsory health insurance published monthly by the Federal Office of Public Health (FOPH). The list contains the drugs' ex-factory and retail prices and comprehensive information on drug characteristics. To estimate demand responses, we have access to detailed drug claims data from two Swiss health insurers, which covered 23.5% of the entire population in 2011.

Our results suggest that the (higher) 20% coinsurance rate promotes the substitution of expensive drugs with their cheap alternatives. Specifically, the likelihood of purchasing a drug subject to 20% coinsurance decreases by 4.3 percentage points among generics and 1.3 percentage points among brands with increased coinsurance. Patients who purchase generic drugs appear to be price sensitive. They tend to switch to cheaper generic options in response to differentiated cost sharing. In contrast, patients purchasing brand-name drugs seem to be less price sensitive. The estimated modest substitution behavior is likely a lower bound, as pharmaceutical firms anticipate patients' demand responses and lower their prices. To avoid the 20%

[1] In 2006, a similar policy was implemented but only applied to 23 brand-name drugs. In 2011, the policy was extended to generics and additional brand-name drugs (295 affected products).

coinsurance rate, pharmaceutical firms reduce their drug prices on average by 11%. The price reaction is more pronounced among firms producing generics, whose prices are reduced for roughly 84% of products. Producers of brand-name drugs are 1.8 times less likely to reduce prices.

Our study complements the existing evidence on the effects of differences in out-of-pocket payments for pharmaceuticals on prices and quantities (see e.g. Pavcnik, 2002; Brekke et al., 2011; Herr and Suppliet, 2017). In line with our results, previous studies report that exposing patients more strongly to actual price differences significantly reduces drug prices and increases the market share of cheap generic drugs (Pavcnik, 2002; Brekke et al., 2011; Kaiser et al., 2014). Moreover, consistent with our findings, Herr and Suppliet (2017) find higher price sensitivity among patients who purchase generics. Prior works focus on differentiated out-of-pocket costs in the context of reference price systems, whereas we study the impact of a differentiated coinsurance rate. Furthermore, our setting enables us to isolate the patient-driven demand response, while existing literature measures a combined response driven by both patients and providers (i.e., physicians and pharmacies).

The present analysis is further related to the research on generic substitution. This strand of literature finds that generic substitution is more likely among patients with higher out-of-pocket payments (Lundin, 2000; Dalen et al., 2011; Decollogny et al., 2011). Moreover, larger price differences between branded and generic versions promote generic substitution (Decollogny et al., 2011). Habit-persistence in physicians' prescribing behavior and patients' attachment and subjective beliefs about the quality of products might explain part of the observed price differences for homogeneous pharmaceutical products (Coscelli, 2000; Dalen et al., 2011). Additionally, Hjalmarsson et al. (2024) show that a lack of information on the availability of cheaper alternatives partly explains the low rates of generic substitution in Switzerland. We expand on the existing evidence in two regards. First, we focus not only on the substitution of brand-name drugs with their generic versions, but also on the substitution between generic options with different prices. Second, our results suggest that price signals induced by differentiated cost sharing help break habits or create awareness of the availability of more cost-effective options. In a broader context, we contribute to the literature on steering health care demand toward more

cost-effective options outside the pharmaceutical market. Ackley's results (2022) suggest that tiered cost sharing successfully lowers per-episode costs while not reducing the likelihood of seeking care. This coincides with the aim of the policy examined in this study: the substitution of more expensive drugs with cheaper drugs, without reducing the overall demanded quantities.

The remainder of this paper is organized as follows. Section 2 provides information on Switzerland's institutional background, drug pricing, and the two-tiered coinsurance policy. In Section 3, we discuss the price response of pharmaceutical firms and in Section 4, we present the demand response of patients. In particular, we describe the quantity data in 4.1 and discuss the natural experiment and our identification strategy in 4.2. In Section 4.3, we report the descriptive statistics on pre-treatment outcomes and patient characteristics, and present the results in 4.4. Finally, Section 5 provides a brief discussion and concludes the paper.

2 Institutional background

2.1 Health insurance and patient cost sharing

The Swiss health care system is based on the principles of regulated competition, as in Germany, the Netherlands, and the US marketplaces in the Affordable Care Act (ACA) (Schmid et al., 2018).[2] Health insurers and providers compete on price and quality, while regulations ensure risk solidarity, individual affordability of health plans, and equal access to health care. Health insurance is compulsory, but consumers can freely choose among more than 50 private insurers (open enrollment). Compulsory health insurance must cover the same standardized package of health care services. Regarding prescription drugs, health insurance covers the drugs listed on the so-called *specialties list*, which is compiled and published monthly by the FOPH.[3]

All health care services covered by compulsory health insurance are subject to patient cost sharing. The standard health insurance plan includes a deductible of CHF 300, but consumers can opt for a higher deductible ranging from CHF 500 to 2,500. A coinsurance rate of 10%

[2]The following description draws heavily on Schmid et al., 2018.

[3]A prerequisite for the inclusion of a drug in the specialties list is the drug's approval by Swissmedic, which is the national authorization authority for drugs.

applies to all costs exceeding the chosen deductible, up to a stop-loss amount of CHF 700. There is a single exception to the 10% coinsurance rate. If multiple drugs with the same active pharmaceutical ingredient, strength, and galenic form (referred to as *substitution group*) are listed on the specialty list, the coinsurance rate can be 20% (for details, see below). In this case, the patient pays 20% of the drug's retail price out-of-pocket. However, this higher coinsurance rate applies only if the patient has already exceeded the deductible and is still below the stop-loss amount.[4]

2.2 Drug pricing and the two-tiered coinsurance rate

As the 20% coinsurance is determined by price differences between substitutable drugs, we provide a brief overview of prescription drug pricing in Switzerland. The launch prices of new brand-name drugs are based on a combination of internal and external reference pricing. In internal reference pricing, the FOPH considers the efficacy and cost of a new drug relative to drugs that are already used in Switzerland to treat the same disease. In external reference pricing, the FOPH calculates the average ex-factory price of the new brand-name drug in several countries.[5] The ex-factory price in Switzerland is given by a combination of this internal and external reference price. In contrast, the launch prices of generics are determined by the price and market volume of the corresponding brand-name drug.[6] After the market launch, ex-factory drug prices of brand-name drugs and their generic alternatives are reviewed every third year. The price review for brand-name drugs is based on external reference pricing and, since 2015, additionally on internal reference pricing, whereas the price review for generics maintains a price spread between the generic and the corresponding brand-name drugs. Consequently, drug prices are decreasing in a step-wise manner over time.

Despite lower prices, the demand for generics in Switzerland has been relatively low compared to that in other European countries (see, e.g. Trüb, 2021). Moreover, pharmaceutical

[4]Moreover, only 15% of the drug price, not the paid 20%, counts toward the patient's stop-loss. This ensures that the patients' out-of-pocket expenses are larger, even if they reach the stop-loss.

[5]Today, this includes nine countries: Austria, Belgium, Denmark, Finland, France, Germany, Sweden, the Netherlands, and the United Kingdom.

[6]In general, the larger the market volume, the lower the generic price level. Today, for instance, if the average annual market volume of the brand-name drug was between four and eight million Swiss francs in the three years before patent expiration, the price of the generic has to be at least 30% below the brand's price.

prices were persistently high even for certain generics. To incentivize substitution with cheaper alternatives by patients and physicians, substitutable drugs became subject to 20% coinsurance in July 2011 if their retail price was at least 20% higher than the average retail price of the cheapest third in their substitution group.[7, 8,9] Consequently, a substitution group must comprise at least three drugs to be involved in this regulation. Moreover, as prices per unit vary with package size, the best-selling package size within the substitution group, the so-called *modal package*, is used to determine the average price of the cheapest third. Multiplying this average price by 1.2 gives the substitution group's threshold, which is published by the FOPH roughly two months before its implementation.[10] This gives pharmaceutical firms time to respond with a price reduction to avoid 20% coinsurance.[11,12] The timeline in Figure 1 provides an overview of the policy implementation in 2011, which is the focus of this study. In the next section, we analyze whether and how firms respond.

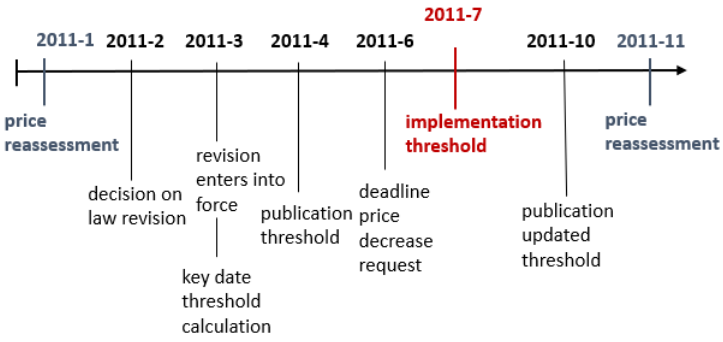

Figure 1: The 20% coinsurance implementation in 2011. *Notes:* The graph shows the periodic price reassessments and the implementation of the two-tiered coinsurance rate in 2011. The decision to adopt the policy occurred in February 2011 and it was enacted in March 2011. The Federal Office of Public Health published the thresholds in April 2011, which allowed firms to file a price decrease request until June 2011. If a firm decided not to decrease the price for drugs above the substitution group-specific threshold, these drugs became subject to 20% coinsurance as of July 1st, 2011.

[7]Note that we refer to a particular brand-name drug of a specific active ingredient and its generic versions with the same strength and galenic form as substitution group.

[8]The retail price is given by the ex-factory price plus two distribution margins, which are specified in a FOPH bylaw (see Table A.1 in the Appendix)

[9]In 2006, a similar policy was implemented but applied only to a subset of brand-name drugs. Drugs affected by the policy in 2006 are excluded from our analyses of demand effects and separately shown in our price analyses.

[10]Since 2017, the calculation of the threshold is based on the ex-factory price, and the threshold is set 10% above the average price of the cheapest third.

[11]Between 2011 and 2017, firms had to reduce the price of the modal package only; since 2017, they must reduce the price of the modal package and all other package sizes by the same percentage to avoid 20% coinsurance.

[12]Note that firms producing brand-name drugs have the possibility to avoid the 20% coinsurance for 24 months. If they reduce the price to the generic price level after patent expiration, the coinsurance rate remains at 10% even if the price is above the calculated threshold. We refer to these drugs as exempted drugs.

3 Price response of pharmaceutical firms

3.1 The market for substitutable drugs

To analyze the price reactions of firms in response to the policy, we use monthly data on pharmaceutical prices provided by the FOPH (Federal Office of Public Health, 2009-2020). This publicly available specialty list contains information on all the pharmaceutical products covered by compulsory health insurance. A pharmaceutical product is defined as a drug produced by a particular producer with a specific active ingredient, galenic form, strength, and package size. The list includes a unique product identifier (*Swissmedic number*). For each product, we also observe the monthly ex-factory and retail prices, whether it is a brand-name drug or a generic version, and whether it is subject to 20% coinsurance in a specific month. Upon request, the FOPH provided additional data to determine the threshold, particularly the information on the modal package size.

In July 2011, the specialty list consisted of $8,641$ products with $1,383$ distinct active pharmaceutical ingredients and $3,150$ substitution groups. Among these $3,150$ substitution groups, for 242 (or 8%) existed at least three substitutes. These 242 substitution groups corresponded to 19% in terms of prescription drug costs and 37% in terms of covered products.[13] Hence, the 20% coinsurance regulation targeted frequently used, off-patent prescription drugs with a relatively large number of available substitutes. Henceforth, we focus on the substitution groups targeted by the policy, that is, those for which at least three clinically proven substitutes existed on the Swiss market in June 2011.

As Table 1 shows, in June 2011, 269 products (or 9%) had a price above their substitution group-specific threshold, and were thus threatened with a higher coinsurance rate after the policy implementation.[14] These products are referred to as the *affected* drugs. Low-cost alternatives with prices below the threshold for the 20% coinsurance rate, hereafter referred to as the *unaffected* drugs, accounted for approximately 40% of the products within the targeted

[13] To calculate shares in terms of drug costs, we use the health insurance claims data described in Section 4.1.

[14] Table 1 does not show descriptive statistics on non-modal packages, exempted drugs and drugs already subject to 20% coinsurance due to an earlier reform as those products were not concerned by the policy change in July 2011. Table A.2 in the Appendix provides a complete overview.

substitution groups. Although the share of affected products was only 9%, the pre-reform market share of these products in terms of claimed packages was 20%.[15] Hence, affected products were frequently purchased before the policy. The pre-reform market share of below-threshold alternatives was 48%.

Table 1: Pre-reform prices of (un-)affected drugs

	Affected	Unaffected
No. of products	269	1221
Share of products	0.09	0.40
Mean retail price	95.22	58.03
Mean ex-factory price	70.11	38.77
Share of generics	0.65	0.92

Notes: The table shows frequencies and average pre-reform prices of affected and unaffected drugs. The group of affected (unaffected) drugs consists of modal packages with a price above (below) the substitution group-specific threshold for the 20% coinsurance rate before the implementation of the policy. The pre-reform retail and ex-factory prices represent per-package prices (in CHF) in June 2011.

Considerable price differences are observed within each substitution group. Table 1 indicates that the pre-reform average ex-factory price per package of affected drugs is roughly 1.8-times the average price of unaffected drugs. A comparison with the corresponding retail prices reveals that pharmacists and physicians have an incentive to dispense more expensive drugs (affected) because the average markup is CHF 25.11 which is considerably larger than the CHF 19.26 for below-threshold alternatives (unaffected). Moreover, generic products are less likely to be affected by the policy than brand-name products.

3.2 Measuring pharmaceutical firms' price responses

The 2011 policy change provides an ideal setup for analyzing the price responses of pharmaceutical firms. This policy may create an incentive for firms to reduce the prices of the affected products. By contrast, firms have no incentive to respond with a price change for unaffected products.[16] Moreover, there was no periodic price reassessment in July 2011, or any other event that might have led to price adjustments apart from the policy (see the timeline in Fig-

[15]To calculate the pre-reform market shares, we use the number of claimed packages within the 12 months preceding the policy change. The information on claimed packages is retrieved from the health insurance claims data described in Section 4.1.

[16]Pharmaceutical firms also have no incentive to reduce prices for exempted drugs within the 24-months period and non-modal package sizes. For brevity, we focus on affected and unaffected modal packages in the main part and refer to the Appendix for a complete analysis on all groups differently affected by the policy.

ure 1). Pharmaceutical firms generally seem reluctant to voluntarily reduce prices; in addition, price increases are almost never approved. Hence, it is very unlikely that firms change prices around July 1st, 2011 for any other reason than the incentives attributable to the policy. Indeed, Figure 2 shows that prices evolved horizontally without any price changes in 2011 except for July. Therefore, we apply simple before-after comparisons of pre- (June 2011) and post-reform (July 2011) prices to measure firms' price responses to the policy. We use the price evolution of unaffected drugs as a robustness check. If the policy causes the price response in the affected products, we should not find any reaction among the unaffected drugs.[17]

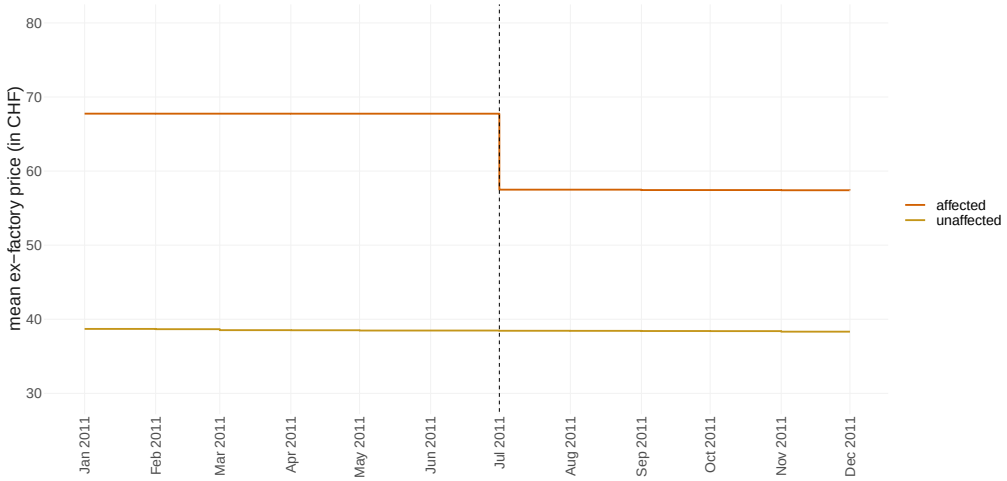

Figure 2: Evolution of average ex-factory price (per package). *Notes:* The graph depicts the evolution of average ex-factory prices (per package, in CHF) for the year 2011. The "unaffected" group consists of modal packages with prices below the substitution group-specific threshold. While the "affected" group consists of all drugs that would newly be subject to 20% coinsurance as of July 1st if the pharmaceutical firms do not reduce their prices. To prevent variations in average prices due to compositional changes, we exclude drugs that enter or exit the market throughout 2011.

The results in Table 2 show that pharmaceutical firms reduce the ex-factory prices of their affected products on average by CHF 10.42 (or 10.68%), which translates into an average decrease in retail prices of CHF 12.42 (or 9.86%). Whereas firms decide to reduce prices for more than 70% of the affected drugs, they do not lower prices for the unaffected drugs.[18] This finding suggests that the threat of a higher coinsurance rate provides strong incentives for firms

[17] As the FOPH rarely approves requests for price increases, firms cannot increase the price of their low-cost drugs to the threshold.

[18] As Table A.3 in the Appendix demonstrates, there is likewise no price change for below-threshold drugs with non-modal package size and exempted drugs. Interestingly, some firms also reduced the price of non-modal package-sized drugs with corresponding affected modal packages, which could indicate that some firms did not fully understand the policy. Moreover, firms reduced prices only for 13% of drugs that were subject to 20% coinsurance pre-reform. Consequently, the decrease in average price for these drugs is negligible.

to reduce their prices.[19] However, firms' responses are not homogeneous. Table 2 indicates that the prices of most of the affected generics are reduced. By contrast, pharmaceutical firms are much more reluctant to lower the price of their brand-name products. In fact, the probability of a price change for the affected brand-name drugs is 36 percentage points lower than that for the affected generic drugs.

Table 2: Price reductions, July 2011

	Affected	Unaffected
Δ Retail price (in CHF)	-12.42	-0.04
Δ-% Retail price	-9.86%	-0.05%
Δ Ex-factory price (in CHF)	-10.42	-0.03
Δ-% Ex-factory price	-10.68%	-0.07%
Products with price decrease	191 (71.00%)	6 (0.49%)
Generics	147 (83.52%)	2 (0.18%)
Brand-name	44 (47.31%)	4 (4.17%)

Notes: Prices per package. Price reduction from June 2011 to July 2011. To calculate the share of generic (brand-name) products with a price decrease, the baseline is the respective numbers of affected or unaffected generic (brand-name) products.

Among the firms that respond with a price decrease, the majority (76%) lower their price by just enough to avoid 20% coinsurance. Hence, the post-reform prices of the affected drugs bunch at the price threshold (see Figure 3). However, some firms reduce their prices more than expected. The main reason for this is the nonlinear structure of retail markups. Due to these nonlinearities, firms cannot set ex-factory prices to exactly meet the retail price threshold for some products (14%).[20] A further explanation for lowering prices more than required, is that some firms simultaneously reduce the prices of products with the same active ingredient but different strengths.

Our results are in line with those of previous studies (see, e.g. Pavcnik, 2002; Brekke et al., 2011; Kaiser et al., 2014; Herr and Suppliet, 2017). Similarly, these studies find that pharmaceutical firms' price-setting behavior is sensitive to patients' out-of-pocket payments. Moreover, results reported by Kaiser et al. (2014) and Herr and Suppliet (2017) also indicate a stronger price reduction for generics. Back-of-the-envelope calculations suggest that price re-

[19] Analyzing price responses to updated thresholds in January 2012, reveals that most firms sticks to their pricing strategy.

[20] As we describe in Section 2.2, the threshold was calculated on retail prices until 2017, but pharmaceutical firms can only set their ex-factory price. As the retail markup increases stepwise with the ex-factory price, a decrease in the ex-factory price can lead to a greater reduction in the retail price.

ductions induced by the policy result in yearly savings in CHF 19.4 Mio. or 2.1% of spending on targeted drugs.[21]

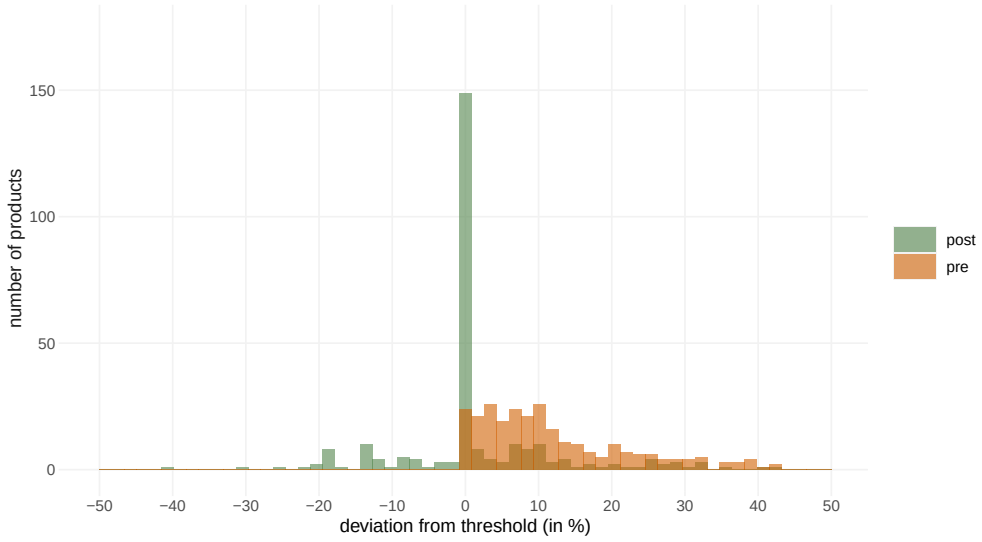

Figure 3: Pre- and post-reform deviations from the 20% coinsurance threshold (affected products). *Notes:* The pre-reform deviations from the 20% coinsurance price threshold are calculated using June 2011 prices, whereas post-reform deviations are based on prices in July 2011. In this graph, the sample is restricted to affected products.

In summary, most firms decide to decrease the prices of their products to avoid a higher 20% coinsurance rate. Hence, firms seem to fear loss of demand if their patients face higher out-of-pocket costs. Moreover, the results suggest that brand-name producers expect their patients to be less price sensitive. In the next section, we investigate whether the heterogeneous behavior of firms can be justified by patients' responses to increased cost sharing.

[21]The yearly savings are calculated as follows: (# claimed packages July 2010 to June 2011) $\times$ (Δ prices in July 2011). The information on claimed packages is based on health insurance claims data described in Section 4.1. Using the CSS market share of 16% in 2011, we project annual savings for all patients in Switzerland.

4 Patient demand response

4.1 Health insurance claims data

We use health insurance claims data to analyze the response of patients to differentiated cost sharing. Specifically, we have access to the claims data of two large Swiss health insurers, which together covered 23.5% of the entire population in 2011. The data consist of all adults who were continuously insured from 2010 to 2012 by the same insurance company. For these individuals, we observe the canton of residence, sex, age in 5-year brackets, chosen deductible, and annual expenditures for pharmaceuticals. In addition, we have detailed information on each drug purchase. We observe the Swissmedic number, date of purchase, health care provider, and provider type (physician[22], pharmacy, or hospital), number of packages, overall costs, costs covered by health insurance, and the patient's cost sharing (deductible and coinsurance payments).

4.2 Price differences: A natural experiment

Obtaining credible estimates of the price sensitivity of the demand for prescription drugs requires an exogenous variation in prices. To this end, we exploit a computer bug that occurred during processing of claims in one of the two data-providing health insurers. While SWICA charged the 20% coinsurance rate as of July 2011, CSS did not correctly implement the increased coinsurance rate until August 28, 2012. For this reason, patients with CSS (quasi-randomly) paid less out-of-pocket than patients with SWICA for the same drugs for roughly one year.

This price difference is illustrated in Figure 4, which shows the average share of claims for which a higher coinsurance rate was charged among all claims for 20% coinsurance drugs. In the SWICA data, we observe a jump in this share from zero before the reform to approximately 50% in the 12 months following policy implementation. Recall that patients with health care

[22]Some Swiss cantons allow physicians to directly dispense drugs to their patients instead of writing a prescription (see, e.g. Rischatsch et al., 2013; Kaiser and Schmid, 2016; Burkhard et al., 2019; Müller et al., 2023, for further information).

expenditures below the deductible or above the stop-loss are not subject to a coinsurance rate. Consequently, the 20% coinsurance rate does not apply to all claims, even if it is implemented correctly.

In contrast, at CSS, the 20% coinsurance rate was only charged for 8% of the claims in the 12 months following policy implementation. The non-zero share is most likely due to the delay between the drug purchase and the insurer's claim processing. Hence, if a drug was purchased between July 2011 and June 2012, but the corresponding claim was processed after the bug was fixed in August 2012, the 20% coinsurance was charged. However, the probability of being charged a higher coinsurance rate when purchasing a 20% coinsurance drug is 42 percentage points higher for SWICA patients. Overall, owing to this difference in the implementation of the 20% coinsurance, patients with SWICA and CSS faced different out-of-pocket prices for the same drugs.

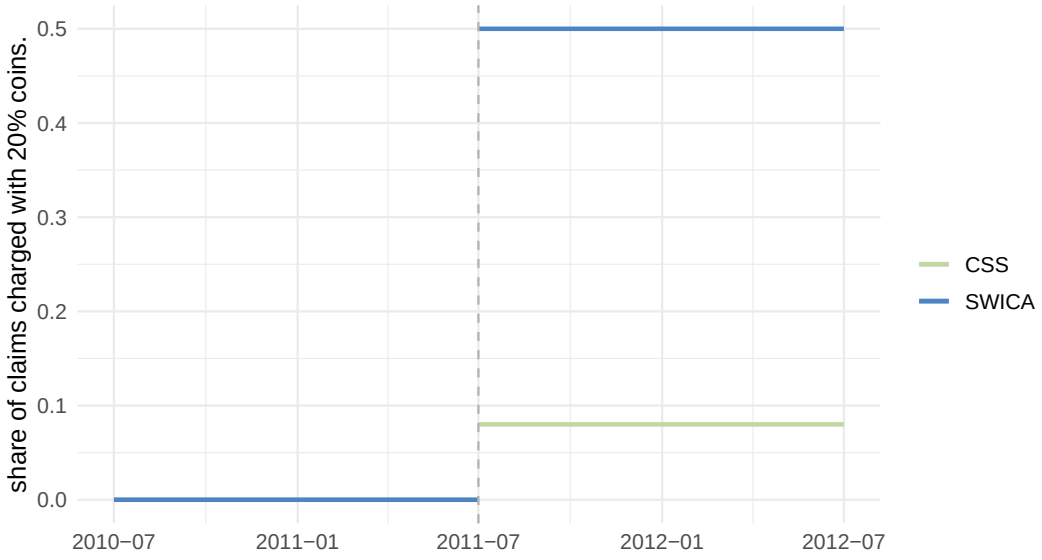

Figure 4: Share of 20% coinsurance drug claims for which 20% was actually charged. *Notes:* The figure shows the average share of claims for which the higher coinsurance rate was actually charged among all claims for 20% coinsurance drugs, separately for SWICA and CSS patients. The average shares are calculated within the 12 months before and after the policy change, which represents the observational period for analyzing the demand responses.

The non-simultaneous implementation of a higher coinsurance rate constitutes an ideal setup for identifying patients' demand responses in a difference-in-differences framework (see, e.g. Cunningham, 2021, for details on the method). We use the 12 months before the policy

change as the pre-treatment period and the 12 months afterward as the post-treatment period to account for seasonality in health care within a year. Patients of SWICA are referred to as the treatment group, whereas those of CSS represent the control group. We assume that in the absence of the policy change, the probability of buying a 20% coinsurance drug would have evolved similarly for SWICA and CSS patients. Under this common trend assumption, we estimate the policy's effect on the likelihood of purchasing a 20% coinsurance drug. The specified standard difference-in-differences model is

$$y_{it} = \beta_0 + \beta_1 post_{it} + \beta_2 swica_i + \gamma(post_{it} \times swica_i) + \varepsilon_{it}, \tag{1}$$

where y_{it} equals one if patient i purchases a drug in claim t that becomes subject to 20% coinsurance after July 2011; $post_{it}$ indicates whether it belongs to the post-reform period; and $swica_i$ equals one for SWICA patients. The causal effect of interest is captured by parameter γ. To account for potential imbalances in the observable background characteristics and pre-treatment outcomes, we apply entropy-balancing weighting based on Hainmueller (2012).[23]

A special feature of our setting, compared with previous studies (see, e.g. Pavcnik, 2002; Brekke et al., 2011; Herr and Suppliet, 2017; Kaiser et al., 2014), is that it allows us to isolate the patient-driven demand effect. The provider-driven effect, induced by the prescription behavior of physicians and product availability at pharmacies, is eliminated because this effect should apply to patients of both health insurers to the same extent.[24] In the next section, we describe the data restrictions, provide summary statistics, and discuss the validity of the identifying assumptions.

4.3 Sample selection and descriptive statistics

In what follows, we focus on the 65 substitution groups in which at least one product switches from 10% pre-reform to 20% coinsurance after the policy change. In addition, we must consider that the CSS informed some of their patients about the possibility of using generics in-

[23]This approach reweighs control observations such that the treatment and control groups become balanced in a defined set of covariates.

[24]Providers were very likely unaware that one of the health insurer did not charge the increased coinsurance rate until August 2012.

stead of brand-name drugs (for details, see Hjalmarsson et al., 2024). To eliminate the effect of this information, we exclude the eight substitution groups that were part of the information campaign. Furthermore, we do not observe any drug claims for ten substitution groups. Additionally, to ensure comparability, we exclude five small substitution groups for which we have observations from only one health insurer. However, this corresponds to only 0.2% of patients. This leaves us with 42 substitution groups for our analysis.

Regarding patients, we focus on those for whom the policy generated an incentive to change their behavior. To do so, we restrict our sample to patients who purchased a 20% coinsurance drug at least once before the policy change, when these drugs still had a coinsurance rate of 10%. None of the other patients were targeted by the policy; hence, we exclude them from the analysis. In addition, we require these patients to make at least one purchase after the policy change. This ensures that we observe the same patients before and after the policy change because patients only observed in the first period are not informative for our analysis.

In Table 3, we provide the pre-reform descriptive statistics for the estimation sample for the control and the treatment groups separately. We observe total $48,093$ patients across 42 distinct substitution groups. The control group is approximately 2.5 times larger than the treatment group, which reflects the difference in size between the two health insurers. The two groups are similar in terms of pre-reform outcomes and background characteristics. For both groups, we observe almost the same purchase frequency, drug costs, and share of 20% coinsurance drugs.[25] The number of pre-reform claims is approximately four in both groups, suggesting that the population considered consists primarily of chronically ill patients.

Although the two groups appear to be similar, Table 3 reveals some statistically significant differences. The patients in the control group are more likely to be female, older, and to choose a low-deductible plan than the treated patients.[26] Thus, the two insurers' risk pools seem to differ slightly, which may result from patient (self-)selection into different insurers. To account for observable differences, we use entropy-balancing weighting to control for imbalances between

[25]The high share of 20% coinsurance drugs can be explained by our sample selection (only patients who at least once consumed a 20% coinsurance drug in the 12 months before the policy change).

[26]In the early 2000s, CSS offered health plans with a CHF 500 deductible that strictly dominated those with a CHF 300 deductible. Therefore, many patients chose the CHF 500 deductible, and the resulting pattern partially persisted for many years.

Table 3: Pre-treatment covariate balance between the treated and control patients

	Control group (CSS)	**Treatment group (SWICA)**	**Diff.**	**S.E.**	**p-val.**
Pre-reform outcomes					
Share claimed 20% coins. drugs	0.949	0.944	-0.005	0.002	0.005
Purchase freq. (days)	158	165	7.240	1.304	0.000
Substitution group-spec. drug costs	164	158	-5.405	2.090	0.010
Number of claims	3.758	3.640	-0.118	0.036	0.001
Yearly costs 2010					
Yearly drug costs	2212	2173	-38.918	39.238	0.321
Background characteristics					
Female	0.590	0.582	-0.008	0.005	0.103
Age group					
40-	0.096	0.111	0.015	0.003	0.000
41-50	0.116	0.127	0.011	0.003	0.000
51-60	0.172	0.188	0.016	0.004	0.000
61-70	0.239	0.229	-0.010	0.004	0.016
71-80	0.247	0.222	-0.025	0.004	0.000
80+	0.130	0.123	-0.008	0.003	0.019
Deductible					
300	0.714	0.758	0.044	0.004	0.000
500	0.222	0.165	-0.057	0.004	0.000
500+	0.064	0.077	0.013	0.003	0.000
Observations	321,847	133,281			
No. of clients	33,809	14,284			
No. of substitution group	42	42			

Notes: Pre-reform outcomes are calculated for the 12 months preceding the policy implementation (July 2010 to June 2011).

the treatment and control groups. Crucially, for our identification strategy, this self-selection is independent of the differential price change caused by the billing error.

4.4 Demand effect estimates

Figure 5 depicts the results of estimating the patients' demand response which corresponds to γ in Equation (1). To estimate the demand response, we use OLS with entropy-balancing weights.[27] Recall that we measure demand by the probability of buying a given drug. We provide the overall and seperate estimates for brand-name and generic drugs. Overall, we find a statistically significant reduction of 1.5 percentage points in the probability of buying a 20% coinsurance drug. The point estimate for brand-name drugs is close to the overall effect. The probability of buying a high-priced generic drug declines by approximately 4.3 percentage points (5.7%) in response to the policy.[28]

[27]We provide estimates without weighting in Table A.4 in the Appendix. Note that we use heteroscedasticity-robust standard errors for all specifications.

[28]Recall that most generic producers reduce the prices to avoid the higher coinsurance rate. In contrast, brand-name producers tend not to reduce their prices. Thus, the majority of 20% coinsurance drugs in our estimation sample are brand-name drugs. The overall effect is thus driven by the brand-name drugs.

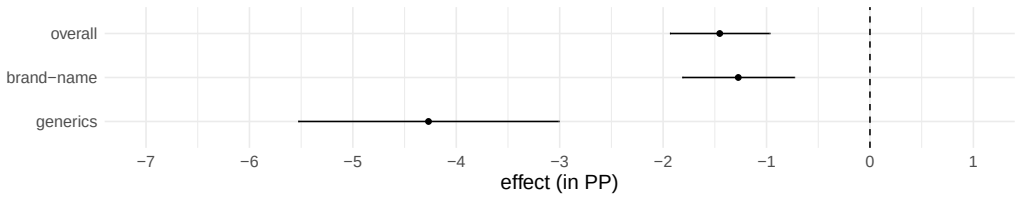

Figure 5: Demand reactions to the policy. *Notes:* The figure visualizes the effect of the properly implemented policy on the probability to purchase drugs with increased coinsurance ($\hat{\gamma}$), measured in percentage points (PP). The figure shows the overall and separate effect estimated for generics and brands with 20% coinsurance. The effect for generics is identified using only claims for generic drugs assuming that patients do not switch from generics to brand-name drugs in response to the policy. Similarly, for the brand effect, we assume that patients either stick with the 20% coinsurance brand-name drug or switch to generics with 10% coinsurance. We abstract from the possibility that they switch from a 20% coinsurance brand-name drug to a 20% coinsurance generic drug.

When interpreting the estimated effect sizes, it is important to consider that, on average, only approximately 50% of claims for 20% coinsurance drugs are effectively charged with the higher coinsurance rate. The estimated effects do not account for this because the treatment indicator (*swica*) only captures the possibility of being charged 20%, not the actually charged coinsurance (100% if still under the deductible or 0% if beyond the stop-loss). Therefore, we may consider the estimated effect as a reduced form effect for a constant 20% coinsurance, similar to the logic of instrumental variables. If we follow that logic, we may scale up the "reduced form" effect by the "first stage" (the 42 percentage point differential in the probability of being charged the 20% coinsurance shown in Figure 4). Using this approach, the higher coinsurance rate is estimated to reduce demand by approximately 3.6 percentage points overall, and even by 10 percentage points among generics subject to 20% coinsurance.

In summary, we find a considerably large demand response for generic drugs and a smaller demand response for brand-name drugs. These findings indicate that patients purchasing brand-name drugs are less price sensitive than patients purchasing generic drugs. This is in line with earlier findings by Herr and Suppliet (2017) and implies that substitution primarily occurs between different generics and not between brand-name and generic drugs.

5 Discussion and conclusion

Health insurance reduces patients' exposure to the true prices of health care services and goods. Consequently, they have little incentive to choose cheaper alternatives, which could lead to

higher health care costs. The introduction of differences in out-of-pocket prices could improve the efficiency of the health care market. In this study, we analyze the case of higher out-of-pocket payments for expensive drugs in Switzerland. A higher 20% coinsurance should provide a financial incentive for patients to select cheaper drugs that are subject to 10% coinsurance only. Among patients affected by the policy, we found a small demand response for brand-name drugs and a larger response for generic drugs. Hence, patients who purchase generic drugs seem price sensitive and tend to substitute generic drugs if they face differences in out-of-pocket prices. In contrast, patients who purchase brand-name drugs tend to be less price sensitive.

While the estimated substitution seems modest, it would be inaccurate to consider the policy ineffective. Our study highlights that producers anticipate the demand response by reducing their prices. Overall, the policy induced an average price reduction of 11%, which translated into yearly savings of roughly CHF 19.4 Mio. Without this anticipatory behavior, the demand response would likely have been more pronounced, suggesting that our demand response estimates are lower bounds. Although the policy also aimed to foster the substitution of brand-name drugs and expensive generics with cheaper alternatives, its true effectiveness is based on the interplay between price sensitive demand and profit-maximizing firms. Our results indicate that the (re)introduction of market-like mechanisms such as price signals can be effective in enhancing health care market efficiency. Consequently, our results provide information regarding the demand and supply of medical goods and services in a broader context.

Although the estimated price and demand reactions have a causal interpretation, it is important to note that these findings are not informative about the price elasticity of drug demand. First, the demand response estimates are based on drugs without price changes. If producers consider customers' price sensitivity, their decisions to change prices are endogenous. Second, our analysis primarily involves patients with chronic conditions whose price sensitivity may differ significantly from those with newly diagnosed chronic conditions or individuals selecting a medication for the first time. Hence, although our estimates are helpful for understanding how the price mechanism works in the health care market, they do not provide a comprehensive view of the overall price elasticity of drug demand.

Moreover, our study adopts a short-term perspective. The policy could have long-term effects on drug supply in Switzerland, for instance, through market entry and exit decisions and the pricing strategy of newly launched products. It remains uncertain whether the 20% coinsurance policy will lead to sustained price reductions without affecting long-term drug availability. However, it is not possible to answer this question with the data at hand; and hence, it is beyond the scope of the present study. Nevertheless, answering this question is important from an overall welfare perspective and is left for future research.

Although many developed countries have introduced measures to improve market efficiency in the health care sector, there is still great potential for improvement. Our findings suggest that improving price signals is one way of achieving this goal. Hence, our study contributes to the ongoing discussion on how to optimally design cost sharing for health care to further improve future market efficiency.

Acknowledgements

We would like to thank Caroline Chuard, Linn Hjalmarsson, and Nicolas Schreiner for their valuable comments from the beginning of the research project. We are deeply indepted to Maria Trottmann and Swica for preparing and providing the data. We are grateful to seminar and conference participants in Bern (Switzerland), Oslo (Norway), and Opatija (Croatia), in particular Rita Santos and Melissa Newham, for their comments on earlier versions of this paper.

Bibliography

Ackley, Calvin A., "Tiered cost sharing and health care demand," *Journal of Health Economics*, 2022, *85*, 102663.

Brekke, Kurt R., Tor Helge Holmas, and Odd Rune Straume, "Reference pricing, competition, and pharmaceutical expenditures: Theory and evidence from a natural experiment," *Journal of Public Economics*, 2011, *95* (7), 624–638.

Burkhard, Daniel, Christian P. R. Schmid, and Kaspar Wüthrich, "Financial incentives and physician prescription behavior: Evidence from dispensing regulations," *Health Economics*, 2019, *28* (9), 1114–1129.

Coscelli, Andrea, "The importance of doctors' and patients' preferences in the prescription decision," *The Journal of Industrial Economics*, 2000, *48* (3), 349–369.

Cunningham, Scott, "Difference-in-differences," in "Causal inference: The mixtape," Yale University Press, 2021, chapter 9, pp. 406–509.

Dalen, Dag Morten, Kari Furu, Marilena Locatelli, and Steinar Strøm, "Generic substitution: Micro evidence from register data in Norway," *The European Journal of Health Economics*, February 2011, *12* (1), 49–59.

Decollogny, Anne, Yves Eggli, Patricia Halfon, and Thomas M. Lufkin, "Determinants of generic drug substitution in Switzerland," *BMC Health Services Research*, 2011, *11* (1), 17.

Federal Office of Public Health, FOPH , "Spezialitaetenliste," 2009-2020. https://www.xn–spezialittenliste-yqb.ch/ (accessed March 10, 2022).

Hainmueller, Jens, "Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies," *Political Analysis*, 2012, *20* (1), 25–46.

Herr, Annika and Moritz Suppliet, "Tiered co-payments, pricing, and demand in reference price markets for pharmaceuticals," *Journal of Health Economics*, 2017, *56*, 19–29.

Hjalmarsson, Linn, Christian P.R. Schmid, and Nicolas Schreiner, "A prescription for knowledge: Patient information and generic substitution," Working Paper, CSS Institute, Lucerne 2024.

Kaiser, Boris and Christian Schmid, "Does physician dispensing increase drug expenditures? Empirical evidence from Switzerland," *Health Economics*, 2016, *25* (1), 71–90.

Kaiser, Ulrich, Susan J. Mendez, Thomas Rønde, and Hannes Ullrich, "Regulation of pharmaceutical prices: Evidence from a reference price reform in Denmark," *Journal of Health Economics*, 2014, *36*, 174–187.

Lundin, Douglas, "Moral hazard in physician prescription behavior," *Journal of Health Economics*, 2000, *19* (5), 639–662.

Müller, Tobias, Christian Schmid, and Michael Gerfin, "Rents for pills: Financial incentives and physician behavior," *Journal of Health Economics*, 2023, *87*, 102711.

Paris, Valérie and Elizabeth Docteur, "Pharmaceutical pricing and reimbursement policies in Switzerland," OECD Health Working Papers 27 2007. Series: OECD Health Working Papers Volume: 27.

Pavcnik, Nina, "Do pharmaceutical prices respond to potential patient out-of-pocket expenses?," *The RAND Journal of Economics*, 2002, *33* (3), 469.

Rischatsch, Maurus, Maria Trottmann, and Peter Zweifel, "Generic substitution, financial interests, and imperfect agency," *International Journal of Health Care Finance and Economics*, 2013, *13* (2), 115–138.

Schmid, Christian P.R., Konstantin Beck, and Lukas Kauer, "Health plan payment in Switzerland," in "Risk adjustment, risk sharing and premium regulation in health insurance markets," Elsevier, 2018, pp. 453–489.

Trüb, Mirjam, "Auslandpreisvergleich von patentabgelaufenen Originalmedikamenten und wirkstoffgleichen Generika: Das Referenzpreissystem kennt kaum taugliche Alternativen.," Technical Report PUE-214-27, Preisüberwachung PUE, Bern August 2021.

Appendix

A. Tables

Table A.1: Distribution markups

Ex-factory price, CHF	Markup, percent price dependent	Markup, CHF per package	Retail price, CHF excl. VAT
0.05 - 4.99	12.0%	4.00	4.06 - 9.59
5.00 - 10.99	12.0%	8.00	13.60 - 20.31
11.00 - 14.99	12.0%	12.00	24.32 - 28.79
15.00 - 879.99	12.0%	16.00	32.80 - 1001.59
880.00 - 2569.99	7.0%	60.00	1001.60 - 2809.89
$>$ 2570.00	0.0%	240.00	$>$ 2810.00

Notes: The retail price of prescription drugs in Switzerland consists of the ex-factory price and two distribution markups. The Federal Office of Public Health determines the ex-factory price and specifies the distribution markups in a bylaw (the Table here is based on art. 35a KLV). Note that these distribution markups have not changed since 2009.

Table A.2: Descriptives of pre-reform prices

	Above	Below	Not modal (modal above)	Not modal	Exempted	Coins. 20 before
Panel A: Specialty list, before July 2011						
No. of products	269	1221	309	1206	58	23
Share of products	0.09	0.40	0.10	0.39	0.02	0.01
Mean retail price	95.22	58.03	35.79	30.29	72.62	87.04
Mean ex-factory price	70.11	38.77	20.73	16.99	50.52	62.47
Share of generics	0.65	0.92	0.71	0.94	0.00	0.00
Panel B: Insurance claims data, before July 2011						
Market share (packages)	0.20	0.48	0.06	0.18	0.06	0.02
Market share (revenue)	0.25	0.47	0.04	0.10	0.11	0.04
Mean retail price	49.28	39.52	30.80	25.25	68.28	66.24
Mean ex-factory price	31.68	24.62	16.88	13.63	46.65	43.91

Notes: Prices in the pre-reform period, 2011-06. Prices per package. Market shares and average prices in Panel B are based on pre-reform health insurance claims in the period from 2010-07 to 2011-06.

Table A.3: Descriptives of post-reform prices and price reductions

	Above	Below	Not modal (modal above)	Not modal	Exempted	Coins. 20 before
Δ Retail price (in CHF)	-12.42	-0.04	-0.99	-0.01	0.00	-0.40
Δ% Retail price	-9.86%	-0.05%	-3.24%	-0.03%	0.00%	-1.21%
Δ Ex-factory price (in CHF)	-10.42	-0.03	-0.61	-0.01	0.00	-0.19
Δ% Ex-factory price	-10.68%	-0.07%	-3.84%	-0.03%	0.00%	-0.86%
Products with price decrease	71.00%	0.49%	14.24%	0.25%	0.00%	13.04%

Notes: Prices per package. Price reduction from June 2011 to July 2011.

Table A.4: Demand effects of the policy

	Panel A: Weighted			*Panel B:* Unweighted		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Constant	0.9089	0.7493	0.9080	0.9260	0.7954	0.9229
	(0.0009)	(0.0026)	(0.0010)	(0.0007)	(0.0021)	(0.0008)
post	-0.0707	-0.1174	-0.0679	-0.0716	-0.1333	-0.0685
	(0.0014)	(0.0037)	(0.0016)	(0.0012)	(0.0032)	(0.0014)
swica	-7.62×10^{-14}	-0.0033	2.21×10^{-5}	-0.0171	-0.0493	-0.0149
	(0.0015)	(0.0044)	(0.0017)	(0.0014)	(0.0042)	(0.0016)
post × swica	-0.0145	-0.0427	-0.0127	-0.0136	-0.0268	-0.0121
	(0.0025)	(0.0064)	(0.0028)	(0.0024)	(0.0062)	(0.0027)
Observations	378,990	104,067	295,883	378,990	104,067	295,883

Notes: Heteroskedasticity-robust standard-errors in parentheses. The probability to buy a 20% coinsurance drug is the dependent variable. Panel (A) presents the coefficients estimates from Model (1) defined in Section 4.3 applying entropy-balancing weighting. Panel B shows the unweighted estimation results. The first column in each panel (Columns (1) and (4)), shows the overall effect. Whereas the second column in each panel ((2) and (5)), presents the effect of the policy on generics and the last column in each panel ((3) and (6)), the effect on brands with increased coinsurance rate.

B. Figures

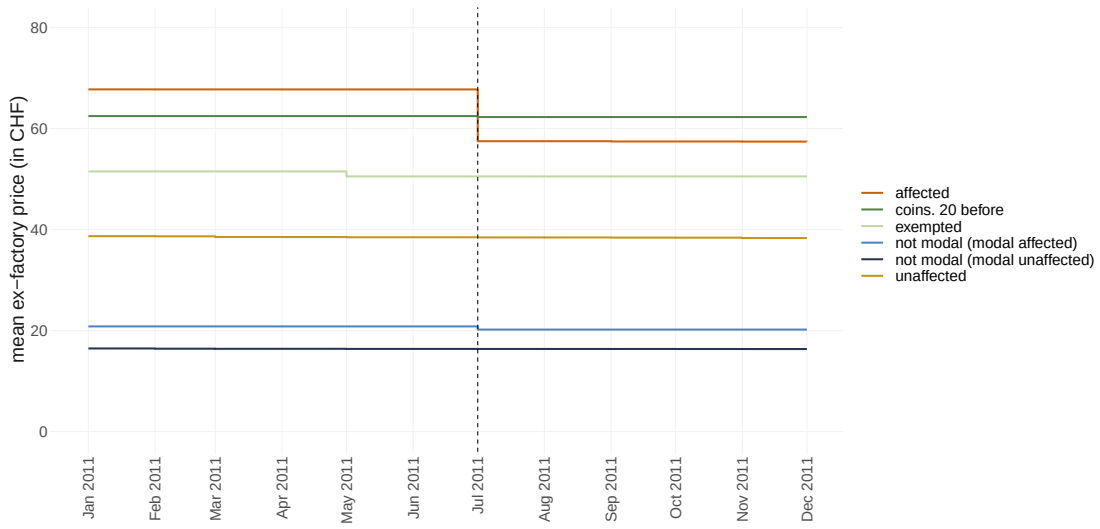

Figure B.1: Evolution of average ex-factory price (per package). *Notes:* The figure shows the evolution of average ex-factory prices (per package, in CHF) for 2011 by subgroups of drugs differently affected by the policy change in July 2011. The "affected" group consists of all modal packages that would be newly subject to 20% coinsurance as of July 1st if the firms do not reduce their prices. The "unaffected" group consists of modal packages with prices below the substitution group-specific threshold. The corresponding non-modal package sizes of those two groups are represented in the subgroup "not modal (modal affected)" and "not modal (modal unaffected)" respectively. The group "coins 20 before" represents products which were already subject to 20% coinsurance before July 2011. Finally, if the price of a a brand-name drug was reduced to the generic price level at patent expiry, these drugs are "exempted" from the policy for 24 months. To prevent variations in average prices due to compositional changes, we excluded drugs that entered or exited the market throughout 2011.