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Author's address: Maurus Rischatsch
E-mail: maurus.rischatsch@soi.uzh.ch

Maria Trottmann
E-mail: maria.trottmann@access.uzh.ch

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Sozialökonomisches Institut
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URL: www.soi.uzh.ch
E-mail: soilib@soi.uzh.ch

Physician dispensing and the choice between generic and brand-name drugs – Do margins affect choice?*

Maurus Rischatsch† and Maria Trottmann‡

Socioeconomic Institute, University of Zurich,
Switzerland

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Abstract

Many politicians blame physician dispensing (PD) to increase health care expenditure and to undermine independence of drug prescription and income leading to a suboptimal medication. Therefore, PD is not allowed in most OECD countries. In Switzerland, PD is allowed in some regions depending on the density of pharmacies. This enables to investigate the difference in prescribing behavior between physician which gain income from prescribing a specific drug and their colleagues which prescribe the drug but do not sell it. Because the considered drugs are bioequivalent we focus on the economic consequence of PD. We analyze the prescribing behavior of Swiss physicians using cross-sectional data between 2005 and 2007 for three important agents. The results support our hypothesis that dispensing physicians have a higher probability of prescribing the drug with the (most likely) higher margin compared to non-dispensing physicians. Further, generic drugs are prescribed more often to patients with higher cost-sharing while patients' cost-sharing is less influential with PD. High-income patients face a much higher probability to receive the brand-name drug due to their lower marginal utility of income. Today's administered reimbursement prices for generics seem to be high enough to gain physicians for prescribing generics because of their high margins.

JEL-Classification: Physician dispensing, prescribing behavior, generics, brand-name drugs

Keywords: I10, I18, I19

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†Contact: Socioeconomic Institute, University of Zurich, Hottingerstrasse 10, CH-8032 Zurich, phone: +41 44 634 37 17, fax: +41 44 634 49 87, email: maurus.rischatsch@soi.uzh.ch

‡Contact: maria.trottmann@access.uzh.ch

1 Introduction

In most OECD countries, prescribing and dispensing of drugs is strictly separated between physicians and pharmacies. However, some Swiss cantons (counties/districts) are exceptional as physicians are allowed to dispense drugs directly to their patients. This system will be referred to as 'physician dispensing' (PD) in the remainder of this paper. Drawbacks of PD are that financial gains might incite physicians to prescribe too many, too expensive or even clinically inappropriate drugs. The adverse consequences for society are inefficiently high drug expenditures or lower health outcomes. The advantages of PD are easier access to drugs and increased choice among drug providers. Acknowledging the strong position of physicians as advisers in medical needs, many cantons require them to inform patients about their right to obtain their prescription and buy the drugs in a pharmacy of their choice.

This research analyzes the influence of physician dispensing on the choice between generic or brand-name drugs, which has never been done on Swiss micro-data as far as we know. The drugs chosen for analysis are bioequivalent and easy to substitute, so both versions are assumed to be equal in terms of clinical benefits. Expenditures for prescription drugs are covered by basic health insurance which is compulsory in Switzerland. The coverage only kicks in after the annual deductible is exceeded. The deductibles range from CHF 300 – 2,500 (€ 200 – 1,666) and are chosen by the patient at the beginning of the year. On top of the deductible, there is a 10 percent co-payment up to a max of CHF 700 (€ 467) per year. For certain brand-name drugs, the co-payment was increased to 20 percent during our observation period. In consequence, some patients have stronger interest in receiving cheaper drugs than others. This allows us to analyze the extent to which the prescribing physician regards the patient's interest as her own (physician agency).

For the seller, generic drugs are expected to yield higher margins than brand-name ones (cf. Liu et al. [2009]), so dispensing physicians are likely to sell more of the former. Physicians who are not dispensing do not have direct incentives to favor one drug over the other. Insurers are unlikely to influence drug choice as they are obliged to reimburse all licensed physicians according to a fee-for-service schedule which is negotiated collectively between the insurers' association and the physicians' association. Criterion for reimbursement is that the service is *efficacious, appropriate and economic* for treating the patient's illness. With this broad definition and diagnostic information generally unavailable, insurers have limited possibilities to influence physicians' decisions. However, the insurer's association monitors physicians and reclaims payments from those who show – and fail to explain – much above average cost in a given accounting period.

The remainder of this article is structured as follows. Section 2 starts of with a short review of the literature. Section 3 contains a theoretical model of physician prescription behavior and a set of testable hypotheses derived from it. The empirical strategy for hypothesis testing is explained in Section 3.2. Section 4 contains a description of the data. Results are shown in Section 5. Section 6 rounds of with summary and conclusions.

2 Literature Review

Up to our knowledge, there is no Swiss study that analyzes the effect of PD on the choice of generic versus brand-name drugs. Empirical studies of the effect of PD on total spending have not reached consistent conclusions. Hunkeler [2008] corroborates the hypothesis that PD leads to margin optimization or even margin maximization through dispensing packages and dosages with higher official margins. He finds that companies entering the market for generics provide exactly these packages first before they broaden the assortment of packages. Dummermuth [1993] compares two otherwise similar, neighboring cantons (Lucerne and Argovia) with differing laws on drug dispensing and concludes that PD leads to slightly higher drug and slightly higher total HCE in Lucerne. This finding is in line with Beck et al. [2003] whose regression analysis indicates a positive impact of PD on drug expenditures. By way of contrast, Vatter and Ruefli [2003], who control for a very comprehensive set of political and socioeconomic covariates, find a significantly negative effect of the share of dispensing physicians on average HCE. More surprisingly still, Schleiniger et al. [2007] find a significantly negative effect of physician dispensing on drug expenditure which is robust over several specifications.

Liu et al. [2009] analyze the choice between generic and brand name drugs in Taiwan where PD is the dominant dispensing system. They find that financial incentives markedly influence the decision between drug versions. For example, institutions on global budgets are more likely to prescribe generic drugs than if institutions are reimbursed fee-for-service. Moreover, cheaper drugs that yield smaller margins on average are more often replaced by generics. Papers that are methodically closely related to ours are Hellerstein [1998], Coscelli [1998] and Lundin [2000] who analyze the choice between generic versus brand-name drugs in a pharmacy based system. Hellerstein argues that the information cost of prescribing generics are likely higher than for brand-names because generics only appear after physicians collected personal experiences with the brand-name drugs. Contrary to the 'moral hazard' hypothesis, she finds that prescription is not influenced by the patients' insurance status. However, physicians who treat a large share of patients in prepaid or Health Maintenance Organization (HMO) settings are more likely to prescribe generics (conditional on insurance status). Her panel data specification also shows that a large part of the unexplained variance can be attributed to the physician. The same claim can be made from Lundin's results. However, Lundin finds evidence for moral hazard because higher patient co-payments increase the probability of generics being prescribed, while higher cost to the insurance companies do not. Conscelli proves strong brand loyalty both among physicians and patients. His policy setting, however, is special because Italian regulation forced generic and brand-name drugs, decreasing incentives to acquire information about new generic drugs.

3 Model specification and hypotheses

3.1 Theoretical model of drug choice

Because of their central role in the resource allocation in health care markets, physician behavior has spurred a very rich literature (cf. McGuire [2000] for an overview). The purpose of this section is to use existing theoretical models to derive testable hypotheses about how physician dispensing influences drug choice. The drugs for analysis are regarded as particularly unproblematic to substitute. Therefore, we assume that the clinical benefit to the patient is the same for generic and brand-name drugs. However, Hellerstein [1998] argues that the information cost of prescribing generic drugs are likely higher than for brand-name drugs because the former are less aggressively marketed and less documented by clinical evidence. In addition, generic drugs are introduced to the market only after physicians have collected personal experience with the brand-name drug. Lundin [2000] also points out that physicians might feel loyal to the producers of brand-name drugs because of R&D expenditures and its pioneering character, which further increases the cost of describing a generic. In the following, the combined cost of prescribing a generic (g) instead of a brand-name (b) drug are denoted by e_g. The cost for prescribing b is normalized to zero ($e_b = 0$).

The first model corresponds to the much cited specification of Ellis and McGuire [1986]. Physician behavior is modeled as driven by two factors, namely revenue (Π) and patient's benefit (B) from the treatment. The extend to which the physician takes the patient's benefit as his goal is denoted by the agency parameter α. For example, an α value of 0.5 implies that the physician attaches twice as much weight to revenue than to patient benefits (in monetary terms). With this in mind, the utility of physician i from prescribing drug d to patient j is defined as follows.

$$V_{ijd} = \Pi_{i,d} + \alpha B_{j,d} - e_{i,d} \quad \text{with} \quad d = g, b \tag{1}$$

As mentioned earlier, we assume that g and b are bioequivalent and therefore no difference between the patient's benefit exists. Then the physician prescribes a generic drug if

$$V_{ijg} - V_{ijb} = \Pi_{i,g} - \Pi_{i,b} - e_{i,g} > 0. \tag{2}$$

Hypothesis 1: Dispensing physicians are much more likely to prescribe the drug with the highest margin than non-dispensing ones.

Hypothesis 2: Among the non-dispensing physicians (for whom $\Pi_{i,b} = \Pi_{i,g} = 0$), the share of generics prescribed is likely very low because $e_{i,g} > 0$.

Other authors have broadened physician agency by including the patient's utility of income into the physician's consideration. For example, Bradley and Lesu [2006] have modeled physicians' utility as a function of her revenue as well as the patient's total utility, which depends on medical benefits from treatment and disposable income. In a similar spirit, De Jaegher and Jegers [2000] and Gonul et al. [2001] have argued that physicians who show consideration to their patients' finances might attract more patients than competitors who do not. For simplicity, we will assume that the patients' utility is additively separable into income (Y_j) and benefits from medical care. Let θ_j denote patients' cost-sharing rate, $(P_b - P_g)$ the price difference and $u'\{Y_j\}$ the patients' marginal utility of income. A generic drug would then be prescribed if

$$V_{ijg} - V_{ijb} = [\Pi_{i,g} - \Pi_{i,b} - e_{i,g}] + \alpha[\theta_j(P_b - P_g)u'\{Y_j\}] > 0. \quad (3)$$

Hypothesis 3: Generic drugs are prescribed more often to patients with higher cost-sharing as long as $P_b > P_g, \; \forall g$.

Hypothesis 4: Patient cost-sharing is more influential if the physician does not dispense on his own account because again $\Pi_{i,b} = \Pi_{i,g} = 0$.

Hypothesis 5: Generic drugs are prescribed less to patients with higher incomes because of their lower marginal utility of income.

Given Eq. (3), the incentive to prescribe g is very low for a non-dispensing physician who treats a high-income or low cost-sharing patient. However, physicians might also consider social cost of inefficient care. With high and rapidly increasing HCE being one of the top concerns of the Swiss population, promoting a cost-efficient practice style could create a *warm-glow* effect of doing what is good for society. Moreover, fear of tighter regulation in future or sanctions by insurers[1] might make physicians care for society's cost.

$$V_{ijg} - V_{ijb} = [\Pi_{i,g} - \Pi_{i,b} - e_{i,g}] + \alpha[\theta_j(P_b - P_g)u'\{Y_j\}] + \gamma[(1-\theta_j)(P_b - P_g)] > 0. \quad (4)$$

Hypothesis 6: Contributing to the social goal of cost-efficient health care might provide an additional motivation for prescribing the cheaper generic drug.

3.2 Econometric model specification

We analyze the prescribing behavior of physician using a dichotomous discrete choice model. The dependent variable takes on the value one if the physician prescribes g and zero otherwise. According to Ben-Akiva and Lerman [1985], we have to separate the utility physician i gets from prescribing drug $d = (b, g)$ to patient j into a deterministic and a random component, $U_{ijd} = V_{ijd} + \varepsilon_{ijd}$, where ε_{ijd} is unobserved by the researcher. Hence, the probability that physician i chooses drug g if he faces patient j is

$$P_{ijg} = Pr[U_{ijg} > U_{ijb}] = Pr[V_{ijg} + \varepsilon_{ijg} > V_{ijb} + \varepsilon_{ijb}] = Pr[\varepsilon_{ijb} - \varepsilon_{ijg} < V_{ijg} - V_{ijb}] \quad (5)$$

and $V_{ijg} - V_{ijb}$ is given by Eq. (4). It represents the probability that the random term of the utility function is smaller than the deterministic part which is observed by the researcher (cf. Train [2003]). We specify the random term $\varepsilon_{ij} = \varepsilon_{ijb} - \varepsilon_{ijg}$ to follow the logistic distribution resulting in the binary logit model specification. The choice probability is then given by

$$P_{ijg} = \frac{1}{1 + exp(V_{ijg} - V_{ijb})} \quad (6)$$

[1] The insurers' association scrutinizes physicians having inexplicably high cost compared to their peers and occasionally sues physicians.

which has a closed-form that facilitates to obtain the maximum likelihood estimates analytically and allows to derive odds-ratios which enable a convenient and intuitive interpretation. To calculate the choice probabilities, we are left with specifying the systematic component of the utility function ($v_{ij} = V_{ijg} - V_{ijb}$).

The deterministic part of the utility pertaining to the revenue component of Eq. (2) can be expressed as $(\Pi_{i,g} - \Pi_{i,b}) = \beta_1[(m_g - m_b) \cdot PD_i]$. The physician's revenue is determined by the difference between the drug margins (m) interacted with the dummy that indicates physician dispensing (PD). If the physician does not sell the drug on his own account the revenue is zero as discussed previously. Unfortunately, we can not observe the *true* margins the physicians obtain. They are the outcome of an individual bargaining process between the physician and sales representatives. According to Liu et al. [2009] the drug's margin increases with market size, competition, and reimbursement price but decreases with marginal cost. They state that the marginal cost of generics have to be less than for brand-name drugs because of at least three reasons. First, a company producing generics do not face the same mandatory expensive clinical trials as in the case of brand-name drugs. Second, the cost of marketing the drug is lower for imitative firms than for innovative firms which have to propagate information about the new agent. Third, the generic firms concentrate their activities in the local market in contrast to the innovative firms with their international scope. Offering higher discounts and therefore lower prices in some other countries could have a negative rebound-effect and leading to lower reimbursement prices if reference pricing is applied. This restricts the manufactures' offering of high discounts for brand-name drugs. Interviews with Swiss market actors as wholesalers and physicians strengthen that the bargained margin for generics is generally higher than for brand-name drugs. Hence, we assume that $m_g - m_b > 0$ and because we do not observe the exact values we just take into account that the sign of β_1 is expected to be positive which means that dispensing should increase the probability of choosing g. The information cost (e_g) corresponding to Eq. (2) can not be modeled explicitly and will be absorbed by the random term. Further, we include a dummy for general practitioners (GP) to test if they differ in their prescribing behavior from specialist.

The patients cost-sharing (θ_j) in Eq. (3) is included in the analysis using the patient-specific health insurance contract on the one hand and the drug-specific co-payment rate on the other hand. The health insurance contracts differ in the deductible level (DL) as well as the contract type. If the physician acts as a perfect agent, he would be interested in keeping the patient's out-of-pocket cost low. The higher the DL and therefore the cost-sharing, the less we would expect to observe the brand-name drug prescribed. The opposite could be the case for individuals with a low DL. The probability that the DL and the co-payment will be exceeded anyway could lead the physician to prescribe the original as no further out-of-pocket payments have to be borne by the patient which might prefer b over g. In addition, the patient's co-payment rate for the brand-name drugs for all three investigated agents was increased from 10 to 20% due to a law enacted in January 2006. To lower the HCE for pharmaceuticals all drugs that exceed the price of the lowest available drug within the same class by 20% was imposed with the higher co-payment. Hence, we can test if the cost-sharing affects the choice by including time-dummies (T). Despite the effect of the increased co-payment they might control for an exogenous time-trend. We expect a trend in favor of generics as the practitioners get more familiar to them and the experience about side-effects become better known.

Because the rebated pharmaceutical prices are administrated in Switzerland even if the prices among the generics differ the price for the original remains constant which would lead to a perfect prediction if we include them in the regression. For this reason we replace $(P_b - P_g)$ in Eq. (4) by one to take into account that the price difference between b and g is strict positive for all combinations of package size and dosage and has only an effect on the sign of the cost-sharing coefficients because it enters Eq. (4) multiplicatively. The interaction between PD and DL allows to evaluate if cost-sharing is more influential if PD is present or not.

Concerning the patients' insurance contracts (CO) we control for deviations from the basic insurance type. The patients could choose either a Health Maintenance Organization (HMO) or a family-doctor contract. Further, we include a set of dummies for additional insurance options (IO) that could explain patient attitudes. The voluntary insurance for a broader coverage of rebated services could give a hint if the patient is risk-averse or not while the accident insurance option is mostly an indication of unemployment as the accident insurance is usually covered by the employer.

The hypothesis that generics are prescribed less to patients with higher income due to their lower marginal utility of income is tested by including a dummy for high-income areas together with a set of other location indicators (LI). These are used as proxies for the type of the commune the practice is located in. Additionally, the presence of the expensive hospital insurance option could indicate that the patient is wealthy.

We complete the econometric specification by including further LIs and some other variables (R) which might effect the decision as patients' age and gender. Different political attitudes and governments could have an effect on the physicians awareness of HCE. In some Swiss cantons physician dispensing is widely accepted or even desired while in others it is very disputed. In the latter case, the political and social environment could affect the behavior of dispensing physicians trying to keep HCE low to make it more accepted. To control for these effects we add 25 canton-dummies omitting Zurich as the reference group. A dummy indicating if the prescription took place in the second-half of the year is included as well because a prescription in the second-half of the year could be affected by the knowledge that deductible and co-payment is already payed and that the patient will not have to bear the cost of the more expensive brand-name drug. To control if there is a difference between prescribing b and g for different dosage levels and package size we include the contained dosages (in mg) and the pills per package of each prescription. The deterministic utility therefore is given by

$$v_{ij} = \beta_0 + \beta_1 PD_{ij} + \beta_3 GP_i + \beta_4 DL_j + \beta_5 CO_j + \beta_6 IO_j + \beta_7 LI_j + \beta_8 T + \beta_9 R. \tag{7}$$

We discuss the results of the logistic regression using odds-ratios (ORs) along with their standard errors. The concept of ORs and how they are calculated in the presence of interaction terms can be found in Hosmer and Lemeshow [2000].

4 Data

4.1 Investigated agents and the market shares for brand-name drugs

We investigate the physician's prescribing behavior using panel data from 2005 to 2007 for the three agents omeprazole (o), amlodipine (a), and ciprofloxacin (c).[2] Omeprazole is an agent that is utilized to treat gastric and duodenal abscesses while amlodipine is a calcium channel blocker and used to treat angina. Ciprofloxacin is a chemotherapeutic agent used to treat specific bacterial infections. The reason for investigating these agents is that there are many bioequivalent generic drugs available on the Swiss market which facilitates the substitution.[3] Further, the agent omeprazole belongs to the therapy group with the highest turnover which secures many observed prescriptions in the data set. We observe 199,065 (o), 147,234 (a), and 95,745 (c) prescriptions. The data were provided by a major Swiss health insurance company covering about 15 percent of the Swiss citizens.

The market share of the brand-name drug for each agent is depicted in Figure 1. In 2006, the patient's co-payment for some brand-name drugs was increased from 10% to 20%. Affected were original drugs for which a generic drug existed for the same agent and whose sales price was 20% higher than the cheapest generic[4]. This regime switch explains the drop in market share for brand-names between 2005 and 2006 as all three brand-names are affected. In our sample, Antra MUPS® (o) had a market share of 16% in 2005 but it decreased to 7% and 6% in the following two years. The market for omeprazole generics was dominated by two drugs, Omed®[5] and Omezol-Mepha MT®, both with a market share of about one-third. Norvasc®, the brand-name drug for amlodipine lost its patent right in spring 2005 and lost its market leading position to 19% within the same year and leveled off on about 15% since then. In contrast, the generic Amlodipin-Mepha® expanded in the same period from 18% to 37% (2006) and 38% (2007). The pioneer drug for ciprofloxacin, Ciproxin®, was halved from 25% (2005) to 13% (2006, 2007).

4.2 Physician and patient descriptives

In the analyzed data we record 7,522 (o), 6,016 (a), and 7,698 (c) physicians. The share of PD varies between 34% and 44% depending on the agent. The share of GPs dominates the share of specialized practitioners and lies between 67% and 79%. The areas according to the community typology of the Swiss Statistical Office are defined as urban, suburban, high-income, touristic, industry & tertiary, rural & commuter, mixed agriculture, and pure agriculture areas. The majority of physicians have their practice in urban (47%) or suburban (25%) areas.

The 61,825 patients receiving omeprazole as well as the 58,489 patients getting ciprofloxacin reveal an average age of about 57 years whereof 40% are male. The 27,080 patients obtaining amlodipine have an average age of 70 years and a share of 46% males. Only a small number of insureds deviated from the basic insurance plan by signing an HMO (2-4%) or family-doctor (6-7%) contract. In contrast, a high

[2] ATC-code: omeprazole (A02BC01), amlodipine (C08CA01), ciprofloxacin (J01MA02). For more details about the investigated agents see *www.drugbank.ca/drugs*.

[3] Number of available generics on the Swiss market (2005–2007): omeprazole (11), amlodipine (12), ciprofloxacin (11).

[4] Art.38a KLV

[5] In 2007, the producer renamed Omed to Omeprazol Sandoz Eco for marketing reasons. Apart from that the two drugs are identical.

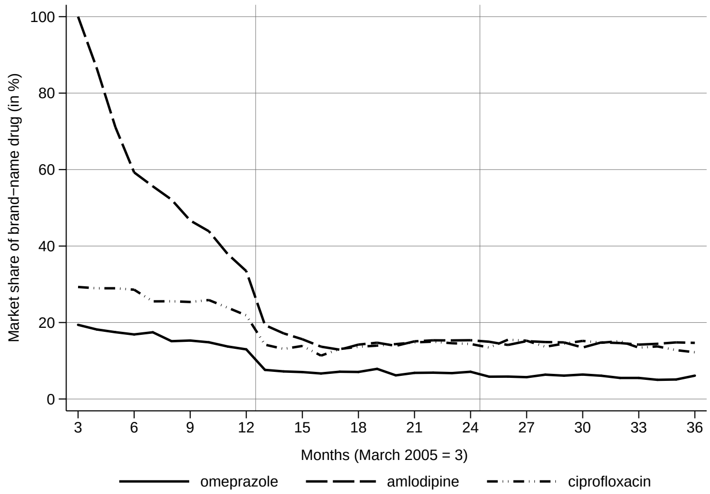

Figure 1: Market share of brand-name drug between March, 2005 and December, 2007

share of about 87-90% of the insured signed at least one of the additional voluntary insurance options which broaden the rebated services. 65-82% possess an accident coverage while 21-26% have a hospital insurance. The median deductible is lowest possible (CHF 300) for all agents.

5 Estimation results

We estimate two different model specifications for each of the three agents to test the hypotheses stated in Section 3.1. The likelihood-ratio test of random-effects against pooled regression indicates that the panel-level variance is very important in our study. The proportion of the total variance contributed by the panel-level variance component (ρ) can be used to test if an unobserved effect is present (cf. Wooldridge [2002]). For all agents and models, ρ is very high and the likelihood-ratio test of ρ being zero can be rejected with a p-value lower than 0.000. The ρ-values are 0.7 (o), 0.5 (a), and 0.6 (c). This is in line with the findings of Lundin [2000] which estimates $\rho = 0.4$, Hellerstein [1998], and Coscelli [1998].

5.1 The effect of physician's revenue

The coefficient of main interest in our study is the effect of physician dispensing on the choice between brand-name and generic drugs. In the case of omeprazole the OR pertaining to PD is 3.6 indicating that if the drug is sold by a physician the probability that the patient receives a generic drug is 3.6 times higher no matter if he is a GP or a specialist (insignificant interaction of PD and GP). Compared to specialized practitioners the likelihood of prescribing generics is twice as high for GPs. This could be a sign that GPs with a lower average income compared to their specialized colleagues are more sensitive to margin maximization due to a higher marginal utility of income. The models for amlodipine and ciprofloxacin lead to significant interactions of PD and GP. Therefore, the likelihood of prescribing g depends both on PD and GP simultaneously. The OR are then calculated as $OR = exp(\hat{\beta}_{PD} + \hat{\beta}_{GP} + \hat{\beta}_{PD \cdot GP})$, where $\hat{\beta}$ is the coefficient belonging to PD, GP, and the interaction of PD and GP. Hence, all ORs are in comparison

	Omeprazole				Amlodipine				Ciprofloxacin			
	Model A		Model B		Model A		Model B		Model A		Model B	
Physician's revenue:	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Physician dispensing (PD)	3.76***	(0.55)	3.58***	(0.29)	2.47***	(0.25)	3.27***	(0.19)	0.72***	(0.06)	1.77***	(0.12)
General practitioner (GP)	2.07***	(0.22)	2.07***	(0.21)	1.87***	(0.15)	2.00***	(0.15)	2.21***	(0.19)	3.59***	(0.28)
Interaction of PD and GP	1.01	(0.15)	–	–	1.47***	(0.16)	–	–	4.11***	(0.42)	–	–
Physician agency:												
Deductible of CHF 500[a]	1.37***	(0.04)	–	–	1.08***	(0.02)	–	–	1.00	(0.03)	–	–
Deductible of CHF 1,000	2.67***	(0.56)	–	–	0.66***	(0.10)	–	–	1.41**	(0.21)	–	–
Deductible of CHF 1,500	2.38***	(0.22)	–	–	1.34***	(0.09)	–	–	1.00	(0.05)	–	–
Deductible of CHF 2,000	2.43*	(1.15)	–	–	0.96	(0.36)	–	–	1.23	(0.29)	–	–
Deductible of CHF 2,500	2.54***	(0.56)	–	–	1.38**	(0.21)	–	–	1.13	(0.12)	–	–
Deductible (DL[b])	–	–	1.10***	(0.01)	–	–	1.02***	(0.01)	–	–	1.01**	(0.00)
Interaction of PD and DL	–	–	0.96***	(0.01)	–	–	1.00	(0.01)	–	–	0.99*	(0.01)
HMO contract[c]	2.16***	(0.27)	2.14***	(0.27)	1.88***	(0.23)	1.84***	(0.22)	1.41***	(0.16)	1.40***	(0.15)
Family-doctor contract	2.81***	(0.24)	2.69***	(0.23)	1.72***	(0.10)	1.71***	(0.10)	1.34***	(0.08)	1.33***	(0.08)
Voluntary insurance	1.17***	(0.04)	1.17***	(0.04)	1.14***	(0.04)	1.14***	(0.03)	1.00	(0.04)	1.00	(0.04)
Accident insurance	0.77***	(0.03)	0.76***	(0.03)	0.89***	(0.03)	0.89***	(0.03)	0.97	(0.03)	0.97	(0.03)
Hospital insurance	0.66***	(0.02)	0.67***	(0.02)	0.76***	(0.02)	0.77***	(0.02)	0.93**	(0.03)	0.93**	(0.03)
Suburban area[d]	1.12	(0.13)	1.13	(0.13)	1.00	(0.08)	1.01	(0.07)	0.98	(0.09)	1.01	(0.09)
High-income area	0.46***	(0.10)	0.46***	(0.10)	0.57***	(0.09)	0.59***	(0.09)	0.91	(0.17)	0.91	(0.17)
Periurban area	1.51*	(0.32)	1.53**	(0.33)	1.12	(0.14)	1.14	(0.14)	1.51**	(0.25)	1.61***	(0.26)
Touristic area	0.82	(0.22)	0.82	(0.22)	0.82	(0.14)	0.83	(0.14)	0.69*	(0.14)	0.70*	(0.14)
Industry & tertiary area	0.87	(0.14)	0.88	(0.14)	0.95	(0.10)	0.96	(0.10)	1.22	(0.16)	1.27*	(0.17)
Rural & commuter area	0.69	(0.20)	0.69	(0.20)	1.02	(0.19)	1.04	(0.18)	0.99	(0.23)	1.06	(0.25)
Mixed agriculture area	0.90	(0.24)	0.92	(0.25)	0.82	(0.14)	0.85	(0.14)	1.05	(0.24)	1.19	(0.26)
Pure agriculture area	3.25	(3.11)	3.18	(3.05)	1.01	(0.57)	1.06	(0.58)	1.03	(0.71)	1.13	(0.77)
Year 2006	3.16***	(0.08)	2.90***	(0.09)	22.50***	(0.53)	18.33***	(0.51)	3.93***	(0.12)	3.70***	(0.15)
Year 2007	3.71***	(0.10)	3.09***	(0.10)	23.76***	(0.57)	19.58***	(0.56)	3.92***	(0.12)	3.49***	(0.14)
Interaction of PD and Year 2006	–	–	1.23***	(0.07)	–	–	1.01	(0.05)	–	–	1.09	(0.07)
Interaction of PD and Year 2007	–	–	1.70***	(0.10)	–	–	0.95	(0.04)	–	–	1.23***	(0.08)

Additional 26 canton-dummies and other control variables where included in the regression (not shown here)

[a]: base category is *CHF 300.* [b]: deductible measured in CHF 100. [c]: base category is *basic insured.* [d]: base category is *urban area*

Table 1: Random-effects logistic regression of drug choice (dependent variable: generics)

to non-dispensing specialists. The likelihood to prescribe g for dispensing specialists is 2.5 times higher for amlodipine but 1.4 times lower for ciprofloxacin drugs. Non-dispensing GPs prescribe g 1.9 (a) and 2.2 (c) times more likely. The strongest preference for g are found for dispensing GPs with 7.8 (o), 6.8 (a), and 6.6 (c).

Assuming that $m_g > m_b$ (see Section 3.1) we can conclude that physician dispensing increases the likelihood of prescribing the generic drug version which might be driven by the higher margin. The estimated ORs support this for all agents whether they are GPs or not with one exception, dispensing specialized physicians in the case of ciprofloxacin.

As neither the margin nor the information cost of generics (e_g) can not be modeled explicitly the higher probability of prescribing g can arise because of Hypothesis 1 or 2 and can not be distinguished. Nevertheless, there might be other reasons why a dispensing physician would choose the cheaper generic drug. First, they have to finance their storage which binds capital and causes opportunity costs which are lower the cheaper the wholesales prices of the drug is. Second, he could be better informed about generics (in availability and prices) because he is targeted by marketing activities. Unfortunately, all these effects can not be analyzed separately in our analysis. However, the conclusion that can be drawn is that PD supports the substitution of expensive brand-names by cheaper generic drugs for different reasons. As long as physician dispensing does not result in an increase in drug use through supplier-induced demand, the presence of PD contributes to lower pharmaceutical HCE. To answer this question additional investigations are necessary whereon we will focus our future research.

5.2 The role of physician agency

Even if there is an information asymmetry about availability of different drug versions and sales prices between physicians and patients, individuals with higher DLs are interested in receiving the cheaper generic because they have to bear the full cost until deductible and co-payment is fully paid. They could therefore influence the physicians drug choice.

The ORs for the included deductible levels are often insignificant or do not take on the expected values. This might be the case because 68-74% of the patients are insured with a deductible of CHF 300 and 21-23% with CHF 500 making it difficult to estimate accurate ORs for all other levels. Until 2005, the highest deductible was CHF 1,500. Nevertheless, it is somewhat surprising that it is still the third biggest group. Hence, we focus on these three deductible levels. For CHF 500, the OR of receiving g is 1.4 (o) and 1.1 (a) while for CHF 1,500 they are 2.4 (o) and 1.3 (a). For ciprofloxacin we find only a significant OR for CHF 1,000 which is 1.4. Even if the distribution of deductible levels is skewed towards the lowest two levels these findings support Hypothesis 3 because patients with higher cost-sharing have a higher probability of getting the generic drug.

To test Hypothesis 4 which predicts that patients' cost-sharing is more influential if the physician does not dispense on his own account we interact the deductible (as continuous variable)[6] with the dummy for PD (model B). Increasing the patients deductible by CHF 100 increases the likelihood of receiving g by 5% if PD is present and 10% in the absence of PD for omeprazole. While the ORs are insignificant

[6] The deductible is included in CHF 100.

for amlodipine the effect for ciprofloxacin is significant but very small which supports Hypothesis 4. The higher cost-sharing has a lower effect towards g for dispensing physicians than for non-dispensing ones. Nevertheless, the interaction of PD and the year dummy does not support Hypothesis 4 because dispensing physicians did not react less sensitive to the change of the patients' co-payment rate for omeprazole than non-dispensing ones. However, it is unclear if the effect really represents the increase in co-payment or other exogenous effects.

Testing whatever Hypothesis 5 is true or not we focus our interest onto two variables. First, the OR for the hospital insurance indicates if a patient can afford the expensive contract option which increases the comfort in case of a hospital stay. Throughout all agents and models the ORs indicate that there is a strong preference for brand-name drugs as predicted by Hypothesis 5. The probability of facing b increases strongly by 50% and 32% for omeprazole and amlodipine, respectively, while it increases by 8% for ciprofloxacin. Second, the dummy for high-income areas can be used as a proxy for the patients' financial situation. Patients living in areas with a higher density of wealthier people receive the brand-name drug 2.2 (o) and 1.8 (a) times more likely than the urban population. This supports Hypothesis 5 that higher income and therefore lower marginal utility of income results in less forgone utility due to the higher price of the brand-name drug and the stronger preference for originals.

One might criticize that the dispensing physician does not react on the individual patient he faces with choosing between g and b because he has already decided what pharmaceuticals to have in his portfolio. Nevertheless, he could have an expectation which kind of patients he will face from past visits and store the best drug for this clientele. Further, the share of PD that is brand-loyal[7] falls with the number of prescribed packages and is between 20 and 30%. The share of brand-loyal non-dispensing physicians is always lower. This finding supports Coscelli [1998] that there is strong physicians' brand-loyalty but still most physicians prescribe not only one specific drug per agent.

Finally, the share of HMO insureds affects the likelihood of g throughout all agents. The HMO patients receive g between 1.4 and 2.2 times more likely which coincides with the findings of Hellerstein [1998].

6 Conclusions

Many politicians blame physician dispensing (PD) to increase health care expenditure for pharmaceuticals or to undermine the independence of drug prescription and prescriber's income leading to suboptimal medication. For these reasons PD is not allowed in most OECD countries. In contrast, Switzerland allows exceptions for some regions upon the availability of pharmacies within a defined range. This enables to investigate if dispensing physicians reveal different prescribing patterns compared to their colleagues which do only prescribe the drug and where it is sold subsequently by a pharmacy. The analyzed agents omeprazole, amlodipine, and ciprofloxacin are all agents with high turnovers and which are prescribed very often. Therefore, many generic substitutes entered the market after patent expiration.

[7] Brand-loyalty means that the physician prescribed only one drug to all patients.

Assuming that the unobserved margin for generics is higher than for brand-name drugs (Liu et al. [2009]) we find evidence that PD increases the likelihood of generic prescription due to financial incentives leaving the optimality of the medication unaffected because of the drugs' bioequivalence. Because of the unobservability of the actually granted margins and the information cost of generics we are not able to separate the difference in preference for generics and brand-name drugs between dispensing and non-dispensing physicians into a pure margin- and cost-effect. Dispensing physicians are targeted by sales representatives with marketing activities and are therefore better informed about availability and prices of drugs than their counterparts. Hence, e_g is lower them leading to more prescribed generics in the case of PD. Another reason than margin and information cost could lead to a preference for generics. Dispensing physicians have to finance their storage which binds capital and creates opportunity costs.

We find evidence that patients' cost-sharing has an effect on the choice between generics and brand-name drugs. The likelihood of receiving the generic drug version increases for patients with a higher deductible compared to the lowest level. The increased patients' co-payment rate for the brand-name drugs in 2006 supports the effect of cost-sharing. Moreover, cost-sharing is more influential if the physician dose not dispense on his own account. In contrast, no different choice pattern could be found due to the co-payment rate between dispensing and non-dispensing physicians.

Finally, the odds-ratios pertaining to the income proxies (high-income area and hospital insurance) support the expectation that wealthier patients have a higher probability of receiving brand-name drugs because the price difference between the two versions has a less sensitive effect for them due to their lower marginal utility of income. The administration of reimbursement prices for dispensed pharmaceuticals entails that the drug prices do not vary over time and prescriptions. This averts to answer the question if physicians in general are concerned about high pharmaceutical prices and interested in cost-efficient health care which might increase the share of non-dispensing physicians to prescribe generic drugs.

PD seems to fuel the substitution of brand-name drugs by generics because of physician's margin-maximization efforts. In the considered period generics were 30 percent cheaper than originals. However, the reimbursement prices seem to leave enough leeway for pharmaceutical companies to grant attractive margins and gaining physicians over for generics. This results in lower HCE for pharmaceuticals as long as PD does not fuel supplier-induced drug use and does not increase the prescription of economic inefficient package sizes. The findings of Schleiniger et al. [2007] of lower drug expenditure with PD would indicate that the cost-savings due to more generics is at least not overcompensated by expenditure due to supplier-induced drug use and/or economically inefficient dispensed packages. However, this problem is independent from the choice between b and g. Lowering the reimbursement price for generics to 60 percent of brand-name drugs as enacted in Switzerland in 2008 could therefore result in an ambiguous development of HCE for drugs as the substitution effect slows down. The overall effect of PD on HCE can not be answered here and is left for future research.

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