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by

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Hospitals and the generic versus brand-name prescription decision in the outpatient sector[†]

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Abstract

Healthcare payers try to reduce costs by promoting the use of cheaper generic drugs. We show that there are strong interrelations in drug prescriptions between the inpatient and the outpatient sector using a large administrative dataset from Austria. Patients with prior hospital visits have a significantly lower probability to receive a generic drug in the outpatient sector. The size of the effect depends on both patient and doctor characteristics which can be related to differences in hospital treatment and heterogeneity in physicians' adherence to hospital choices. The spillover effects create cost ineffectiveness, in particular in healthcare systems with separate funding of inpatient and outpatient service provision.

Keywords: Prescription decision, generic drugs, physician behavior, hospitals.

JEL classification: I11.

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1 Introduction

Expenditures for medical drugs make up a substantial proportion of total healthcare costs in developed countries. As population aging poses challenges to sustainable health financing, healthcare payers try to reduce costs by promoting the use of cheaper generic drugs. While the majority of medical drugs are consumed in the outpatient sector, hospitals have a substantial impact on overall drug use. The reason is that drug choices after hospital discharge often follow the decisions made in hospitals. In this paper, we study whether and to what extent hospitals influence subsequent decisions in the outpatient sector to prescribe generic versus brand-name drugs.

In 2012 (or latest year available), OECD countries spend on average 17% of their healthcare expenditures for pharmaceuticals (OECD, 2013) making it the third biggest spending component after inpatient and outpatient care. Even if one can observe a slight decline in this percentage after 2009, medical drug consumption has shown a strong dynamic in the past. Since 2000, average spending on pharmaceuticals has risen by almost 50% in real terms (OECD, 2011, 2015). The diffusion of new drugs and the aging of populations have been identified as major factors that contributed to increased pharmaceutical expenditures. Competition from generic drugs in pharmaceutical markets is obviously a desirable policy objective in support of countries' efforts to reduce their costs of medication. The consumption of non-branded copies of drugs that contain identical active ingredients typically brings substantial savings to pharmaceutical buyers. In the U.S., for example, the first generic competitor typically enters the market at a 20 to 30% lower price than its brand-name counterpart. Subsequent entrants may provide discounts of 80% or more. Similar price drops have been found in European countries (OECD, 2009). In Austria, Heinze et al. (2015) calculate that health insurance providers could save 18% (72€ of 401€ million) of the prescription costs for antihypertensive, lipid-lowering, and hypoglycemic medicines by same-ingredient generic substitution. For this reason, promoting the use of generics has been an important measure introduced in OECD countries to reduce their pharmaceutical spending in recent years.¹

A growing body of literature has examined the choice between generic and brand-name drugs. Several studies find that doctors' and patients' preferences are important and that there is a strong brand loyalty, or state dependence, in the choice of drugs (e.g., Coscelli, 2000; Hellerstein, 1998). Additional empirical evidence suggests that economic incentives play a role. Lundin (2000) shows that doctors take their patients' costs into account. Patients with high out-of-pocket costs are less likely to have brand-name drugs prescribed than patients getting most of their costs reimbursed. Furthermore, Liu et al. (2009) and Iizuka (2012) find that in systems where physicians prescribe and dispense drugs, their

¹ Other measures included price cuts, centralized public procurement of pharmaceuticals, exclusion of drugs from reimbursement, and increases in patients' co-payments.

profit incentives affect their prescription behavior. In many countries pharmacists are allowed to substitute prescribed medicines with cheaper equivalent alternatives. Brekke et al. (2013) show in this context, that pharmacies' product margins on branded versus generic drugs have a strong effect on the generic market share.

To our knowledge, the role of hospitals has not been studied in this context. Nor have hospitals been given high priority in policies to increase market shares of generics. With respect to generic drug consumption, hospitals do not only represent a market segment on its own, but have an influence on the type of drugs that patients receive in the outpatient sector after hospital discharge. First, a patient may ask for the identical and well-tolerated medication that he or she received during inpatient treatment and/or as discharge prescription. Second, in many healthcare systems, patients receive a discharge letter or discharge summary. This letter includes information about diagnoses and inpatient treatment and recommends the physician, who is supposed to continue the patient's therapy after hospital discharge, further treatment and medication. On average, these doctors can be expected to follow the hospital doctors' recommendations in terms of suggested medication.

Pharmaceutical companies have recognized this. They stepped up their marketing activities in hospitals through rebates and free-of-charge dissemination of (brand-name) pharmaceuticals as an attempt to promote subsequent prescriptions by outpatient care physicians (Ford, 2012; Gallini et al., 2013; Vogler et al., 2013). Most European countries control prices in the outpatient sector via statutory pricing. Regulation in the inpatient sector, in contrast, only target maximum hospital list prices enabling rebates negotiated in the procurement process (Vogler et al., 2010). Additional and growing regulation in the outpatient sector restrict the activities of pharmaceutical companies (see, e.g., Francer et al., 2014), which may increase the importance of marketing activities in hospitals further. For instance, direct-to-consumer advertising for prescription drugs is banned in all developed countries except in the US and New Zealand (Humphreys, 2009).

Existing empirical evidence suggests that the interaction between the inpatient and outpatient sector is relevant. Prosser et al. (2003) interviewed 107 General Practitioners (GPs) in the UK for reasons to prescribe newly approved drugs. The pharmaceutical representative was cited most frequently, followed by hospital consultants observation of hospital prescribing. Similarly, Gallini et al. (2013) find that university hospitals have a significant influence on the pharmaceutical consumption in surrounding communities.

We find a strong impact of hospitals on the generic versus brand-name drug choice using a large administrative dataset from Austria with patient, doctor and hospital information for more than 15 million prescriptions. Patients with prior hospitalization have a significantly lower probability to receive a generic drug in the outpatient sector. The size of the effect depends on both patient and doctor characteristics such as the patients' age and income, whether the outpatient care physician holds a contract with a health

insurance fund, and whether he or she runs a primary care pharmacy.²

The remainder of the paper is organized as follows. In Section 2, we provide information on the development of generic drug use and its determinants. In Section 3, we present our research design including the institutional setting of our empirical analysis, a short description of the data, and the estimation strategy. Estimation results are presented in Section 4, and Section 5 provides a discussion of results and concludes.

2 Generic Drugs

Generic drugs are copies of original or brand-name drugs that usually become available after the corresponding patent protection expires. They contain the same active ingredient as the original product, and manufacturers have to prove their bioequivalence during approval. Chemical differences concerning inactive ingredients may exist, as well as differences in color, shape, taste and packaging.

A meta-analysis by Kesselheim et al. (2008) suggests that there are no differences in clinical outcomes between brand-name and generic cardiovascular drugs. In contrast, the perception or belief that generic drugs are less effective persists among patients (Kjoeniksen et al., 2006; Shrank et al., 2009) and physicians (Shrank et al., 2011).

In 2011 (or nearest year) OECD-19 countries reached a generic market share of 41 % in volume and 19 % in value (OECD, 2013). However, there is substantial variation among countries. Whereas generics accounted for approximately 3 quarters of the volume of pharmaceuticals in countries such as the U.S., Germany, the UK, New Zealand and Denmark, they represent less than one-quarter of the market in Italy, Switzerland, Japan and France. The share of generics in the reimbursed pharmaceutical market in Austria was 48.5 % in volumes and 41 % in values in 2014 (OECD, 2015). Notwithstanding that generics are on average cheaper than their brand-name counterparts, countries have not been successful in optimizing their cost-saving potentials. For the U.S., Aitken and Valkova (2013) identify the suboptimal use of generics, *inter alia*, as an important reason for the significant cost saving potential caused by an inappropriate use of medicines. The authors conclude that brands are still prescribed and dispensed despite the availability of therapeutically equivalent, lower-cost generics.

The reasons for the large variation in generic market shares among countries have been studied in the literature. Danzon and Furukawa (2011) argue that the cross-national differences in generic shares and prices reflect differences in the regulation/reimbursement structure. Countries such as the U.S., the U.K. or Canada have pharmacy-driven generic markets where pharmacies are legally authorized to substitute any substitutable generic unless the doctor explicitly requires the brand. The pharmacies have financial incentives to

²Outpatient care physicians are GPs or medical specialists who run their medical practice outside a hospital.

prefer cheaper generics and, as a consequence, brands play a comparatively minor role. By contrast, many other countries (Germany, France, Italy, and Austria) reflect physician-driven generic markets. In these countries, pharmacists are either not authorized or incentivized to dispense generic drugs. The physicians have little incentives to be price-sensitive and prescribe more often brands.

3 Research Design

In this section, we provide the institutional background of the Austrian healthcare system, in particular the details on drug prescription. Moreover, we include a description of our data and present the estimation strategy.

3.1 Institutional Setting

The Austrian Bismarckian-type healthcare system provides universal access to services for the whole population. With a very few exceptions (e.g., a small daily allowance per day spent in hospital), the mandatory health insurance covers all expenses for medical care including visits to general practitioners (GPs) and specialists in the ambulatory or outpatient care sector, inpatient treatment in hospitals and prescription medicines. Health insurance is offered by nine provincial health insurance funds (in German, “Gebietskrankenkassen”) that are responsible for all private employees and their dependents and represent approximately 75 % of the population.³ Expenses in the outpatient sector are funded by wage-related social security contributions of employers and employees whereas hospitalization is co-financed by social security contributions and general tax revenues from different federal levels.

There are different modes of financing the expenses for medical drugs in the inpatient and outpatient sector. The cost of medical drugs administered during hospitalization are covered by a DRG-based (diagnosis-related group) remuneration scheme. According to this scheme, hospitals are reimbursed for the costs of inpatient care according to case-based lump sums that depend on provided individual services and groups of diagnoses. This reimbursement scheme includes the costs of inpatient medication. By contrast, the health insurance funds pay the costs of every medical drug that is prescribed by outpatient care physicians. The payment of these expenses is made directly to the dispensing pharmacy that holds a contract with the health insurance fund. However, patients pay a prescription charge per medical drug to be collected by the pharmacy. In other words, patients are requested to either pay this prescription charge or the full price of the drug if

³ The remaining 16 social insurance institutions offer mandatory health insurance for particular occupational groups (farmers, civil servants, self-employed) and employees of particular (large) companies. Affiliation to a certain institution is determined by place of residence and occupation and therefore cannot be freely chosen.

it is below this deductible.⁴ With respect to the prescription of pharmaceuticals, the interface between the inpatient and outpatient sector is of particular importance. Patients, who were treated in a hospital, may receive a discharge prescription to be redeemed in a contracted pharmacy and, therefore, to be reimbursed by the health insurance fund. In contrast to other countries, pharmacists in Austria are not allowed to substitute generic drugs for branded medication.

Austria applies a positive list of medical drugs to be reimbursed in the outpatient sector. This list is called the Reimbursement Code (in German, Erstattungskodex). Depending on the degree of automaticity in the reimbursement of medication expenses by the health insurance funds, the Reimbursement Code distinguishes three different sections. “Green box” pharmaceuticals are readily reimbursed – the doctors can prescribe them without requirement of any formal approval by the health insurance funds. Prescriptions of drugs from the “yellow box” require formal authorization by a chief physician of the health insurance fund. These pharmaceuticals usually have an added therapeutical value. They are not (yet) in the green section due to security concerns (e.g. long-run clinical studies are not available) or because of their high price. Finally, the “red box” of the Reimbursement Code includes medicines for which a reimbursement policy is not established. This latter group of medicines is submitted to health technology assessment (HTA) to evaluate their cost-benefit balances, and is subsequently authorized or not on that basis (ISPOR, 2009).

The OECD states that the Austrian healthcare system provides high quality medicine and easily accessible services, however, at very high costs (Gönenc et al., 2011). It is argued that the system predominantly operates on a supply-driven basis and does not have clear mechanisms to optimize spending on a cost-benefit or cost-effectiveness basis. With respect to the costs of medication, the report criticizes that relatively few generic products are authorized, and even though physicians are required to prescribe the most economical available drugs, pharmacists are not asked to convert prescriptions to their cheapest equivalent.

3.2 Data

In the empirical analysis, we use administrative register data provided by the *Upper Austrian Health Insurance Fund*. This dataset covers the sub-population of all private sector employees (and their dependants) in the province of Upper Austria. The data include detailed individual information on medical attendance and medication in the outpatient sector. For each single drug prescription, we observe the characteristics of the patient such as sex and age, an identifier for the prescribing physician, the date of the prescription, the

⁴ The current prescription fee (2016) is 5.70 €. Low income patients with a net monthly income below 882.78 € or below 1,015.20 € (if they can prove above-average healthcare expenditures due to chronic disease) are exempted from this charge.

ATC Classification System code, and information whether it is a brand-name or generic drug. Moreover, the register contains inpatient sector information such as the number and length of a patient’s hospital stays and his or her admission diagnosis according to the ICD-10 classification system advocated by the WHO. Additional information on patient’s income can be matched from income tax data provided by the Austrian ministry of finance.

The empirical analysis covers the time period between 2008 and 2012, and we confine the sample to those active ingredients for which a brand and generic alternatives coexist. Drugs contained in the yellow and red box of the Reimbursement Code are excluded.⁵ Discharge prescriptions issued by a hospital doctor after inpatient treatment are included in the sample. One important data restriction must be noted. Since we rely on the health insurance fund’s reimbursement of medication expenses, we cannot observe prescribed drugs with a price below the prescription charge. These drugs are paid by the patients themselves and therefore not recorded in the register of the health insurance fund. Table 1 depicts the sample characteristics of the available data. We use 15.9 million prescriptions for approximately 1 million patients. The sample includes 3,025 physicians who prescribe 199 different active ingredients. 60.1 % of prescribed drugs are generic.

3.3 Empirical Strategy

In the first part of the empirical approach, the unit of observation is the individual outpatient prescription. We model the choice between the generic or brand-name version of a drug. We group the observed prescriptions to medical therapies, defined as consecutive prescriptions of the same active ingredient, and analyze whether prior hospitalization affects drug choices. A therapy starts with the first prescription of a certain active ingredient (brand-name or generic) by an outpatient care physician under the condition that the same active ingredient was not prescribed within one year before. It ends as soon as we do not observe another subsequent prescription of this ingredient for more than one year. If the time period between two consecutive prescriptions is longer than one year, a new therapy is initiated. For the first prescription that belongs to a therapy, we estimate the following equation:⁶

$$g_{ipdt} = \alpha_0 + \alpha_1 h_{ip} + \varsigma_i + \zeta_p + \rho_d + \delta_t + \nu_{ipdt} \quad (1)$$

The dependent variable is a dummy that indicates whether the outpatient prescription g_{ipdt} for active ingredient i , patient p , prescribed by doctor d at time t was a generic ($g = 1$) or a brand-name ($g = 0$) drug. The explanatory variable of interest is another dummy h_{ip}

⁵Given that prescriptions of drugs from the “yellow box” require formal authorization by a chief physician, health insurance funds can reject reimbursement on an individual level irrespective of any previous hospital stay.

⁶In an alternative specification, we include all consecutive prescriptions that belong to a therapy.

indicating whether the therapy to which g belongs was initiated in hospital ($h=1$) or not ($h=0$). The set of control variables includes fixed effects for active ingredient (ς_i), patient (ζ_p), doctor (ρ_d), and time (δ_t). The error term is denoted by ν_{ipdt} .

We define three alternative measurements for the hospital dummy. In its simplest form, h measures whether the patient visited a hospital within 3 months before the therapy started or not.⁷ In a second specification, we account for the fact that previous hospitalization may not necessarily be directly connected with the subsequent medication therapy. In other words, the reason for a previous hospital stay may have nothing to do with a subsequent pharmacotherapy. Therefore, as an alternative, we consider only hospital stays with an ICD-10 (International Statistical Classification of Diseases and Related Health Problems) classification code that is related to the ATC (Anatomical Therapeutic Chemical) code of the active ingredient. For any outpatient prescription with a given ATC code, the indicator variable 'hospital stay with matched diagnosis' is one if there is a preceding hospital stay with a corresponding ICD-10 diagnosis, and zero otherwise. Table 2 describes the assignment of an outpatient prescription to the corresponding hospital diagnoses for the generation of the indicator variable. We assign each first level ATC code the three most common corresponding ICD-10 diagnoses on the basis of discharge prescriptions. For example, a drug prescription for the active ingredient A (alimentary tract and metabolism) is assigned to ICD-10 chapters II (neoplasms), XIII (diseases of the musculoskeletal system and connective tissue), and XIX (injury, poisoning and certain other consequences of external causes). In a third variant, we exploit the fact that we can observe discharge prescriptions for a subsample of hospital patients. In this specification, we consider only hospital stays after which the patients received a drug prescription, issued by a hospital doctor, that corresponds with the continuing medical therapy in the outpatient sector.⁸

Table 3 includes descriptive statistics of the dependent and explanatory variables for the full estimation sample (column (1)), the control group (column (2)) and the three different treatment groups (columns (3)-(5)). Whereas the treatment groups vary according to the above-mentioned formulation of the hospital dummy, the control group always includes patients with no hospitalization within 3 months prior the first outpatient drug prescription. Depending on our measurement of hospital influence, the share of outpatient prescriptions that is potentially affected by prior hospital visits lies between 1.5 % and 19.2 % (see the number of observations in the table). Approximately 13 % of pharmaceuticals are prescribed by female physicians, more than 80 % by GPs, 24 % by physicians with a primary care pharmacy, and 6.5 % by physicians who do not hold a contract with a health insurance fund.

⁷In a robustness check, we show how sensitive the results are if the number of months for a previous hospital stay increases to six.

⁸Unfortunately, our data do not include information on the complete inpatient drug therapy.

Effect heterogeneity. To analyze effect heterogeneity of the hospital impact, we estimate equation (1) for different subsamples according to doctor and patient characteristics in a next step. In particular, we run separate regressions for split samples along the dimensions age and income of patients, age of doctors, and whether the physician has a primary care pharmacy. Two different channels could explain effect heterogeneity for patients: (i) different treatment of groups of patients in the hospital that translates into the outpatient sector, and (ii) outpatient physicians' adherence to hospital choices may depend on doctor and patient characteristics. A subsequent empirical analysis covers both channels. Equation (2) addresses the hospital treatment of different groups of patients.

$$g_{ipt}^h = \gamma_0 + \gamma_1 \mathbf{Y}_{pt} + \chi_i + \tau_t + \epsilon_{ipt} \quad (2)$$

The dependent dummy variable g_{ipt}^h indicates whether the hospital discharge prescription for active ingredient i that patient p receives in time t is a generic (the dummy is equal to one) or a brand-name drug. The coefficient of interest, γ_1 , measures the impact of patient characteristics \mathbf{Y}_{pt} (age and income) on the hospital prescription decision. We further control for active ingredient and time fixed effects, χ_i and τ_t respectively, and ϵ_{ipt} reflects the error term.

Finally, we address the adherence of outpatient care physicians to hospital choices for the sample of patients, for whom we observe discharge prescriptions, and analyze whether the physicians deviate from a hospital's choice of medication by estimating Equation (3):

$$a_{ipdt} = \beta_0 + \beta_1 \mathbf{X}_{dt} + \beta_2 \mathbf{Y}_{pt} + \lambda_i + \sigma_t + \mu_{ipdt} \quad (3)$$

The dependent dummy variable a_{ipdt} is equal to one, if the outpatient prescription is of the same type – generic or brand-name – as the discharge prescription from the hospital, and zero otherwise. \mathbf{X}_{dt} and \mathbf{Y}_{pt} represent characteristics of doctors and patients, respectively. λ_i and σ_t denote fixed effects for the active ingredient and time. μ_{ipdt} denotes the error term. Following this specification, we estimate whether characteristics such as the patient's age and income, the doctor's age, or whether the doctor sells drugs in his or her private pharmacy, have an influence on the correspondence of medication that a patient receives in the outpatient sector and as a discharge prescription.

Table 4 provides some insight how representative the subgroup of patients, who receive a discharge prescription, is for all hospital patients. Both groups are of similar age, and also very comparable in terms of gender participation. Outpatient expenditure for medical attendance is very similar in both groups, and those who receive a discharge prescription spend on average 128.1€ per year more for medical drugs. Even if the distribution of admission diagnoses reveals some minor differences, both groups of patients show very similar disease pictures. For example, the three most frequent diagnoses in both groups are neoplasms, diseases of the circulatory system, and diseases of the musculoskeletal

system.

Identification of hospital effect A crucial question of the empirical strategy is whether it identifies a hospital effect or rather reflects (unobservable) patient characteristics. Selection of patients into hospitals may potentially invalidate the comparison of hospitalized patients with those who did not stay in hospital. One might argue that hospital patients and those without hospital treatment receive different medicines or choose different (types) of outpatient care physicians. Both objections are met as we control for active ingredient- and doctor-fixed effects in Equation (1). Another objection is that the requirement of hospitalization indicates bad health, and therefore, it can be expected that hospital patients are sicker than those who only receive outpatient treatment. In fact, even though we control for patient-fixed effects, that cover time-invariant components of an individual's health stock such as genes or general health consciousness, (sudden) health shocks will be the most frequent cause for hospitalization.

Table 5 reveals that hospitalized patients (column (2)) differ from their non-hospitalized counterparts depicted in column (1). The most striking difference is the patients' age. Hospital patients are on average almost 14 years older than patients who were not treated in hospital within three months prior the first outpatient drug prescription. The strong presumption, that hospital patients are sicker, is supported by the fact that aggregate outpatient expenditure among this group is considerably higher. In the year, when the drug therapy started, hospitalized patients spend on average 40 % percent more for medical attendance than non-hospitalized patients (783.0 € versus 549.9 €). The difference in expenditure for medical drugs is even larger. Given their mean of 1,320.7 €, patients with hospital treatment spend 2.7 times more for medication in the same year. Similar differences between the two groups of patients can be observed for the previous year as well. Higher expenditure for outpatient healthcare services in hospitalized patients even in the year prior to hospitalization may be an expression for a worsening health condition and/or simply reflect that this group of patients is 14 years older.

The fact that hospitalized patients are *ceteris paribus* sicker than their non-hospitalized counterparts should not have an impact on the likelihood to receive a generic or brand-name prescription as long as the primary care physicians believe in the bioequivalence of both drug types. If not, they may favor sicker patients by prescribing brand-name drugs which then would be one explanation for a significant impact of hospitals.

4 Results

We present our estimation results in three steps. First, we address the selection of a proper time span in generating our hospital dummies and define a main specification for the subsequent empirical analysis. Second, we examine the influence of previous hospital stays on outpatient prescription behavior based on the three different hospital variables

defined in Section 3.3 and study effect heterogeneity with respect to patient and doctor characteristics. Third, we consider the impact of socio-economic characteristics of patients on hospital prescription behavior and analyze to what extent doctors adhere to discharge prescriptions issued after a previous hospital stay of their patients.

4.1 Hospitalization and Drug Prescription – the Time Frame

Figure 1 shows the histogram for the distribution of the number of days between a hospital discharge prescription and the first corresponding drug prescription (the same active ingredient) in the outpatient sector for all patients in our sample who received a discharge prescription at the end of their hospital stay. The graphical representation clearly indicates that the majority of first drug prescriptions by outpatient care physicians that follow a previous hospital stay occur shortly after hospital discharge. The median of the time interval is 25 days, and the 75th percentile amounts to 52 days only. Therefore, in our main specification, we define the hospital dummy to be equal to one if a previous hospital stay ended within a 3 months period before the first outpatient prescription. This implies that hospital visits that ended earlier than 3 months before the first outpatient drug prescription are coded as zero. We argue that hospital stays that are dated too far back may no longer have an influence on outpatient physicians' prescription behavior. Irrespective of this, it will be shown below that the empirical results are not sensitive to the variation in the length of this period.

4.2 Effect of hospitalization on outpatient prescriptions

First prescription. Our estimation results of the effect of previous hospitalization on the first outpatient prescription for a particular drug therapy (equation (1)) is summarized in Table 6. The dependent variable is a binary indicator for a generic versus a brand-name prescription. The table includes results for the three different measurements of hospital stays. The dummy variable 'Hospital stay' is equal to one if a patient had a hospital stay within a period of three months before the first outpatient prescription. The indicator variable 'Hospital stay with matched diagnosis' refers to the same time frame. However, the dummy is equal to one only if the ICD-10 classification code of a hospital stay medically corresponds with the ATC code of the active ingredient for the particular drug prescription. The third variant 'Hospital discharge prescription' refers to the subsample of hospital stays within the same three months period for which we observe a corresponding discharge prescription. Column (1) of Table 6 depicts the sample means for the three different hospital variables, and columns (2)-(4) include the results for different sets of control variables (fixed effects for time, active ingredient, doctor, and patient).

The coefficients show a highly significant and negative impact of hospitalization on

the probability of a generic drug prescription by physicians in the outpatient sector for the three different definitions of hospital influence and different sets of control variables. Based on the 'naive' hospital dummy definition and the specification that controls for all possible fixed effects, a previous hospital stay of a patient reduces the probability of a subsequent generic drug prescription in the outpatient sector by 6.3 percentage points, which corresponds to 10.3 % of the share of generic drugs.

These negative impacts increase to -8.7 percentage points and -23.6 percentage points for the other two variants of hospital dummies. This is first indication that the prescription behavior in hospitals generates quantitatively relevant spillovers in the outpatient sector. In line with a priori expectations, the extent of the effect increases the closer the connection between the hospital stay and the drug prescription is. Obviously, our 'naive' hospital dummy also includes hospital stays that do not have a direct relation with a subsequent drug prescription. A patient may have spent two days in hospital because of a broken leg and receives antihypertensive drugs from his or her family doctor two months later. The hospital stays with matched diagnoses identify a closer connection between hospitalization and the active ingredient of the follow-up prescription with the consequence that the hospital impact increases quantitatively. However, even in this second specification, we cannot directly control for treatment and medication during hospitalization. In the third specification 'Hospital discharge prescription', we include only hospital stays of patients who received a corresponding discharge prescription at the end of hospitalization. Whereas we do not have information on hospital medication in these cases either, we know for certain that these patients leave the hospital with a specific prescription to be redeemed in a local pharmacy. It is the most explicit indicator that the medical therapy of the patient has started in hospital. It is plausible that this specification reveals the strongest impact on doctors' prescription behavior.

Table 7 depicts that the results are not sensitive to the chosen time period within which we measure hospital stays. We rely on the simple 'Hospital stay' dummy and estimate equation (1) with varying time periods. The first row of coefficients refers to the main specification with a period length of 3 months within which we identify hospital stays. These coefficients simply replicate the corresponding results presented in Table 6. The second row of coefficients shows the impact of hospitalization on outpatient prescription decisions if we measure hospital stays within 6 instead of 3 months. The quantitative and qualitative results remain basically unchanged. Compared to the baseline specification, the significantly negative influence of hospitalization on the probability to receive a generic follow-up drug prescription decreases from 6.3 percentage points to 4.8 percentage points. A third variation in the time frame is presented in the last row of coefficients. In an alternative three months specification (II), we try to sharpen the distinction between 'treated' (previous hospital stay) and 'untreated' (no previous hospital stay) patients. The hospital dummy is again coded as one, if the patient had a previous hospital stay

within three months before the first outpatient drug prescription, and zero otherwise. However, we exclude patients from the sample who had a hospital stay within 4 to 6 months before the prescription. Again, as compared to the baseline version, the negative coefficient remains almost unchanged (-6.5 percentage points). Given these results and the fact that the majority of first prescriptions is being issued in the first couple of weeks after hospitalization, we are confident that the three months period for the identification of hospital stays is appropriate.

All prescriptions. Estimation results that do not only include the first prescriptions, but refer to all prescriptions of a therapy, are depicted in Table 8. As before, the coefficients of interest are highly significant, and the quantitative results are very similar to the results of first prescriptions only. Depending on the chosen specification, the impact of hospitals on the decisions of outpatient care physicians to prescribe a generic drug runs from -5.7 percentage points to -18.2 percentage points. Again, the lowest effect results from the 'naive' hospital dummy specification whereas the specification including only patients with discharge prescriptions provides the strongest negative impact on outpatient prescription behavior. On average, the coefficients for the whole sample of prescriptions are quantitatively slightly smaller than those for first prescriptions. There is a plausible explanation for this finding. Even if outpatient care physicians' decision to prescribe a generic drug at the start of the medical therapy is negatively affected by a patient's prior hospital visit, this influence levels off over time. The propensity to prescribe generic drugs in follow-up medication increases the further the hospital stay dates back.

4.3 Effect heterogeneity

Table 9 includes separate regressions for a series of subsamples, where we split the data according to physician and patient characteristics. We display the results for the specification that uses discharge prescriptions and estimate the hospital impact on first prescriptions. On the doctor level, we distinguish between older and younger physicians (beyond or below 50 years old), male and female doctors, doctors in urban and rural areas, general practitioners and medical specialists, contracted and non-contracted (private) physicians, and finally, physicians running a primary care pharmacy or not. With regard to patients, we differentiate between older and younger patients (beyond or below 50 years old) and between high and low income patients.⁹

The coefficients reveal interesting heterogeneity both in qualitative and quantitative terms. On the physician level, we find significantly different effects for sex and age whereas doctors with urban or rural places of their medical practice react similarly (the 95% confidence intervals overlap). The hospital effect is 2.0 percentage points stronger for

⁹High income patients have an income above the median income of their birth-year cohort in the respective calendar year.

males than for females and 1.7 percentage points stronger for younger than for older physicians.

The hospital impact for medical specialists (-18.8 percentage points) is smaller than the one for GPs (-23.6 percentage points). Medical specialists are probably more self-conscious in their prescription behavior and less influenced by the hospital than their GP counterparts. However, the question whether informal hierarchies between doctors, who work in the inpatient and outpatient sector, play a role in physicians' prescription behavior, cannot be answered unequivocally in this sort of quantitative analysis. An interesting result along this line of argumentation is revealed by the coefficients for the groups of GPs who run or do not run their own primary care pharmacy. The negative and significant hospital dummy coefficient for physicians who dispense drugs from their attached apothecary is clearly lower than the one for physicians without a pharmacy (17.6 percentage points versus 24.7 percentage points). Even if we do not have information about profit margins for generic and brand-name drugs sold in doctor-run pharmacies, the fact that these GPs are very familiar with pharmaceuticals in general, may at least help explain this phenomenon.

And finally, we find a great difference in the impact of hospitalization between contracted and non-contracted (private) doctors.¹⁰ The impact of hospitalization on outpatient prescription behavior is -14.6 percentage points for the subgroup of non-contracted physicians and runs up to -23.7 percentage points for contracted doctors. This finding allows the general interpretation that the group of non-contracted physicians decides particularly self-determined and, as a consequence, the hospital impact is lower. On the other hand, a mean of 0.35 for the proportion of generic drugs in total prescriptions (see Table 9, column (1)) for this group of doctors indicates that non-contracted physicians prescribe in general a lower share of generic drugs. Given that these doctors have no direct contractual relationship with a health insurance fund, it is plausible that they have in general less motivation or pressure to prescribe cheaper generic pharmaceuticals.¹¹ The lower impact of the hospital dummy may therefore simply reflect the similarity with hospitals (patients receive brands irrespective of previous hospital stays).

On the patient level, the results indicate some evidence that both income and age of patients matter for the hospital impact on the propensity to receive a generic or brand-

¹⁰Contracted outpatient physicians hold a direct contract with the (regional) mandatory health insurance fund. Based on a predefined catalogue of medical services and attached fees, these doctors get their services reimbursed by the health insurance funds. Patients who see a non-contracted doctor (in German, *Wahlarzt*) pay their medical attendance themselves. They can submit a request for reimbursement of treatment costs to their health fund subsequently. The insurance fund covers up to 80 % of the fee that they would have paid their contracted physicians for the same medical service.

¹¹A contracted doctor is regularly made aware by the health insurance fund of the fact that he or she may have caused substantial (above-average) medication costs. This sort of information cannot be communicated to private freelance doctors. Furthermore, there are guidelines on economic prescribing of pharmaceuticals where contract physicians are formally prompted to prescribe the most cost effective product when several therapy options are available (ISPOR, 2009).

name drug. A previous hospital stay reduces the propensity for a generic follow-up prescription by 22.7 percentage points for the oldest patients (beyond 70 years old) and by 24.8 percentage points for youngest patients (below 40 years old). The negative impact for patients in the lowest decile of the income distribution amounts to 21.6 percentage points. The figure increases to -25.4 percentage points for the highest income decile. As was mentioned above, two different channels may explain the result that the negative hospital impact increases with a patient’s income and decreases with his/her age. First, different age and income groups of patients are treated differently during hospitalization. And second, if at least some doctors are not convinced that generic drugs with the same active ingredient are (bio-) equivalent to brand-name pharmaceuticals, they may follow the hospital’s recommendation more closely and prescribe rather the younger and high income patients the brand-name versions. Similarly, a stronger socio-economic background of patients (income) could help them to carry the brand-name prescription of the hospital through. In the next step, we address these two channels, namely, treatment of different groups of patients in hospitals and the outpatient care physicians’ adherence to hospital choices.

4.4 Hospital Treatment and Outpatient Physicians’ Adherence

Estimation of equation (2) reveals the impact of patient characteristics on the probability to receive a generic discharge prescription at the end of hospitalization. Columns (1) and (2) of Table 10 depict the results for this regression. In a specification that controls for time, active ingredient, and hospital-fixed effects, we find a significant negative impact for young and high income patients. The propensity to leave the hospital with a generic discharge prescription is 0.9 percentage points lower if the patient is below 40 years old (as compared to the middle age group). The likelihood of a generic discharge prescription is for high-income patients (beyond the 90th percentile) 0.7 percentage points lower, and for low-income patients 0.5 percentage points higher than for the middle income group. The effects are statistically significant, however, their quantitative impact is moderate. The results support our previous finding that the negative hospital effect is largest for the youngest group of patients and for those with the highest net income.

For comparison reasons, columns (3) and (4) of Table 10 include the equivalent estimations for all outpatient prescriptions of patients with no previous hospital stay. In contrast to hospital medication, the propensity of old patients to receive a generic prescription in the outpatient sector is 1.7 percentage points lower for the youngest patients and 1.9 percentage points higher than in the middle age group. Moreover, high income patients receive 1.8 percentage points less likely a generic prescription from their outpatient care physician than their middle income counterparts. Patients in the lowest income group also receive less likely a generic prescription, however, the quantitative effect is minor.

Overall, the results indicate a significant impact of patient socio-economic characteristics on inpatient and outpatient prescription behavior.

Our final set of estimation results includes the analysis whether doctors deviate in their prescription behavior from the hospital choice. Based on the subsample of patients who received a discharge prescription after hospitalization, we estimate equation (3) and analyze whether patient and doctor characteristics influence a physician's adherence to the hospital decision (see Table 11). The dependent variable in column (1) is a binary indicator that is equal to one if the hospital discharge prescription and the first follow-up prescription from a doctor in the outpatient sector coincide, i.e. both prescriptions contain either a generic or a brand-name drug.

At the patient level, the adherence to the hospital's medication decision is significantly weaker for the youngest patients (-1.5 percentage points) and stronger for high-income patients (2.1 percentage points). Referring to physician characteristics, we find a weaker adherence for female physicians (-1.3 percentage points) and for physicians who run their medical practice in one of the three largest cities of Upper Austria, Linz, Wels, and Steyr (-1.7 percentage points) whereas the physician's age does not have an impact. The adherence of GPs is 2.3 percentage points higher than the one for medical specialists.

The point estimates for two other physician characteristics reveal large and interesting effects. Physicians, who run a primary care pharmacy, follow the hospital recommendations to a lesser extent. The effect is highly significant and with an estimated coefficient of -6.4 percentage point quantitatively important. This result is in line with the above-mentioned interpretation that these doctors have a broad pharmacological knowledge and a good overview of medication alternatives. Therefore, they may be more often willing to deviate from the hospital decision.

Non-contracted doctors have a 13.1 percentage points higher adherence to the discharge prescription than physicians who hold a contract with a health insurance fund. It was already mentioned that the non-contracted doctors may have less pressure to prescribe generic drugs. They have a strong preference for brand-name drugs and seemingly follow the hospitals more often in prescribing the more expensive original drugs. Furthermore, many non-contracted outpatient care physicians are directly affiliated with a hospital. It is common practice in Austria that hospital doctors run a private part-time ordination in the outpatient sector. A particularly close relationship of this group of doctors to hospitals may also explain their high degree of adherence to previous inpatient medication decisions.

For further insight, we split the sample into patients who leave hospital with a generic discharge prescription (column (3)) and those who leave the hospital with a brand-name prescription (column (2)) and analyze the physicians' adherence to the two categories separately. It can be seen that non-contracted private physicians have a 24.6 percentage points higher adherence to hospital brand-name prescriptions than contracted doctors. On

the contrary, the corresponding coefficient for adherence to generic generic prescriptions is negative and significant at the 10 % level (-12.9 percentage points). This group of doctors does not generally follow hospitals prescription choices, but instead indicates a strong preference of non-contracted physicians for brand-name pharmaceuticals. In contrast, the figures in columns (2) and (3) of the table reveal that the negative impact on adherence of physicians, who run their own primary care pharmacy, can be observed for both drug categories. In other words, the results do not indicate a clear preference of these physicians for either type of medication, but rather express their pharmaceutical competence and willingness to deviate from hospital doctors' prescription behavior.

The separate analysis of prescription adherence for the two drug categories also helps explain the stronger hospital impact for high-income and young patients. As was shown above, these groups of patients receive less generic drugs during hospitalization (at least according to their type of discharge prescription). This tendency towards brand-name pharmaceuticals is reinforced by the prescription behavior of primary care physicians. As can be seen from column (2), the physicians follow the brand-name prescription of high-income patients more closely (3.2 percentage points) whereas we do not observe any reinforcing or weakening effect for generic hospital prescriptions for this group of patients. For the youngest patients, we do not find a significant effect on the physicians' adherence to brand-name prescriptions. However, the significantly negative coefficient of -2.0 percentage points for adherence to generic hospital prescriptions also generates a reinforcing effect for brand-name prescriptions in the outpatient sector for these patients. Our results support the hypothesis that inpatient and outpatient doctors treat higher socio-economic groups differently, be it due their belief that generic drugs are not (bio-) equivalent, or for some other reason.

5 Discussion and conclusions

We find a strong influence of hospitalization or the use of pharmaceuticals in hospitals on the prescription behavior and drug consumption in primary care. Patients with a previous hospital stay have a significantly lower propensity to receive a generic drug in their first follow-up prescription as compared to the group of patients with no prior hospital stay. The quantitative effect runs from -6.8 percentage points (based on a simple hospital dummy) up to -20.3 percentage points (based on the subsample of hospital stays with a discharge prescription). This very robust result supports the hypothesis that pharma companies are successful in their marketing efforts to promote brand name drugs in the hospital sector. In Austria, these activities seem to be especially effective because of the two-tiered funding system with separate funds and responsibilities for the provision of inpatient and outpatient healthcare services. The beneficial provision of pharmaceuticals for hospitals or even their free of charge distribution reduces the costs of hospitals,

and later, the expenses of hospital funds financed largely by the provincial governments. However, as can be shown in this analysis, any such conduct will increase outpatient expenditures and put a substantial strain on the budgets of health insurance funds. Since these two different types of funds are separately operated from each other without any transfer payment, the whole procedure is not incentive compatible and most likely not cost minimizing.¹²

The empirical analysis also reveals heterogeneous results for different groups of patients and according to several doctor characteristics. The negative hospital effect on the prescription of generic drugs in the outpatient sector is stronger for young and high-income patients. On the physician level, estimations reveal substantial influence of supply-determined circumstances. The hospital effect is lower for physicians who run their own pharmacy and for non-contracted outpatient physicians. However, whereas doctors with pharmacies tend to deviate from hospital medication decisions irrespective of the drug type (brand-name or generic), non-contracted doctors seem to have a strong preference to prescribe brand-name drugs.

The fact that the socio-economic status of patients and doctor characteristics have an influence on doctors' prescription behavior supports the hypothesis that at least individual physicians or groups of physicians are not convinced by the (bio-) equivalence of generic and brand-name drugs. Young and high-income patients may receive the supposedly better medication. The result that doctor characteristics play an important role, both qualitatively and quantitatively, is another evidence for the fact that well-developed (Bismarckian) healthcare systems are supply side driven to a large extent. We hypothesize that the different behavior of resident physicians may have something to do with the hierarchy between groups of doctors. One could argue that medical specialists (as compared to GPs) and doctors who run a pharmacy (as compared to physicians who do not sell medical drugs) command a higher pharmacological competence and, as a consequence, act more self-confident in their prescription behavior and follow their hospital colleagues to a lesser extent.

The lesson to be learnt from a health policy perspective is to have a closer look at imperfections at the interface between the inpatient and outpatient sector. These two levels of healthcare service provision are in general interconnected, either directly in systems where one single authority is responsible for service provision at both levels, or indirectly via spillovers in systems with only superficially separated inpatient and outpatient sectors. For the Austrian case in particular, a claim must be made for a "single source finance model". It is well-known that the separated two-tiered funding system generates inefficiencies and misallocation of services between outpatient care physicians

¹²A serious statement on overall cost consequences would require an empirical comparison of cost decreases and increases in the inpatient and outpatient sector. Given that we cannot observe prices and quantities for hospital medication, this analysis is not possible.

and hospitals. This analysis reveals that this system creates extra costs in connection with the funding of medication.

The analysis also illustrates a dilemma of health insurance funds. In principle, the funds could prevent the prescription of brand-name drugs in the outpatient sector by their reimbursement policy and require their contracted doctors to prescribe generic drugs whenever available. However, this policy has not been successfully enforced for several reasons. First, the negotiation process between the social insurance institutions and the pharmaceutical companies on the entry of drugs into the reimbursement scheme is complex. For example, acceptance of individual pharmaceuticals often means the implicit acceptance of other drugs (of the same company) as well, such that it is almost impossible for the health insurance funds to exclude single brand-name products from reimbursement without any negative repercussion. The final list of pharmaceuticals that automatically qualify for reimbursement (included in the green box) obviously requires compromises, i.e. not only the cheapest drugs remain in the green box. Second, resident physicians in Austria are self-employed, and to some extent health insurance funds have to accept the doctors' medical choices even if these choices lead to higher costs.

In a second-best world, where health insurance funds are limited in their imposition of cheaper generic drugs, the regulation of marketing activities of the pharmaceutical industry in public hospitals through to prohibition of no-cost distribution, or at least the attempt to promote the use of generic drugs in these hospitals seems to be cost saving. A better documentation of quantities and prices of pharmaceuticals used in hospitals is an important prerequisite to improve transparency and better evaluate implications of regulatory measures.

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6 Tables and Figures

Figure 1: Time between discharge prescription and first outpatient prescription

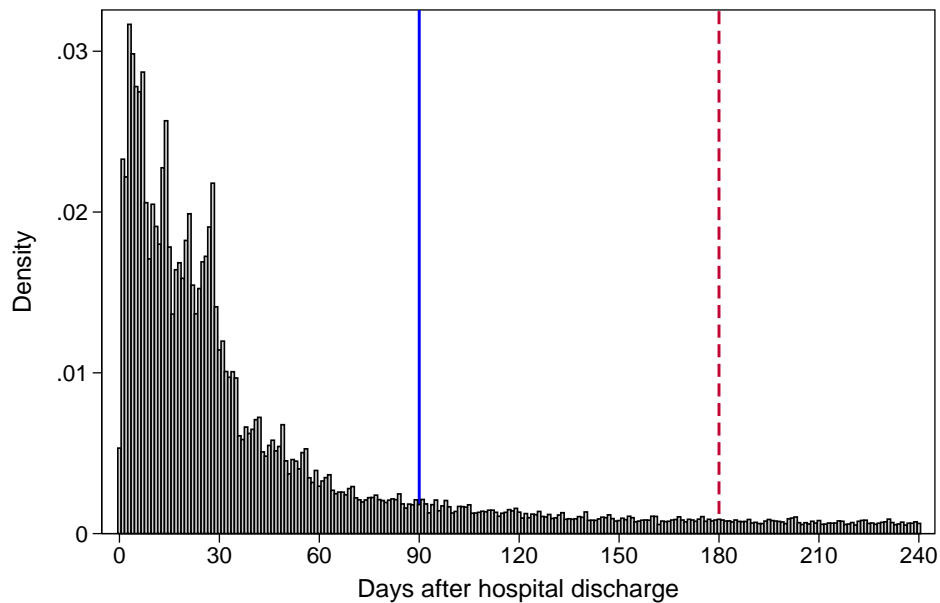


Table 1: Sample characteristics

	Number of observations
Prescriptions	15,945,098
Generic drugs	6,356,649
Brand-name drugs	9,588,449
Therapies	4,880,936
Patients	946,202
Physicians	3,025
Active ingredients	199

Notes: This table shows the number of prescriptions, therapies, patients, physicians, and active ingredients in the data.

Table 2: Matched ATC Codes and ICD Chapters

First level ATC code and description		ICD-10 Chapters
A	Alimentary tract and metabolism	II, XIII, XIX
B	Blood and blood forming organs	IX, V, X
C	Cardiovascular system	IX, V, II
D	Dermatologicals	I, XII, XIX
G	Genito-urinary system and sex hormones	XIV, II, IX
H	Systemic hormonal preparations	II, X, VII
J	Antiinfectives for systemic use	X, XIV, XIX
L	Antineoplastic and immunomodulating agents	II, XI, XIV
M	Musculo-skeletal system	XIII, XIX, X
N	Nervous system	V, XIII, II
P	Antiparasitic products, insecticides and repellents	XI, XIV, I
R	Respiratory system	X, II, IX
S	Sensory organs	VII, I, IX

Notes: This table shows the assignment of outpatient prescriptions to hospital diagnoses for the indicator variable 'hospital stay with matched diagnosis'. For any outpatient prescription with a given ATC code, the variable takes the value of 1 if there is a preceding hospital stay with any of the outlined ICD-10 diagnoses, and 0 otherwise. The links were determined using ATC codes and the three most common corresponding ICD-10 diagnoses of corresponding discharge prescriptions. Description of ICD chapters: I: Certain infectious and parasitic diseases; II: Neoplasms; V: Mental and behavioural disorders; VII: Diseases of the eye and adnexa; IX: Diseases of the circulatory system; X: Diseases of the respiratory system; XI: Diseases of the digestive system; XII: Diseases of the skin and subcutaneous tissue; XIII: Diseases of the musculoskeletal system and connective tissue; XIV: Diseases of the genitourinary system; XIX: Injury, poisoning and certain other consequences of external causes.

Table 3: Descriptive Statistics

	(1) Full sample	(2) Control	(3) Treatment groups: Hospital...	(4) diagnosis	(5) discharge p.
			stay		
Generic drug	0.611	0.627	0.542	0.510	0.423
Age of patient	50.6	47.9	61.8	62.4	62.8
Patient income (in 1,000)	22.4	23.2	19.2	19.6	20.7
Age of physician	52.9	52.9	52.9	53.0	53.4
Physician dispenses drugs	0.241	0.239	0.251	0.253	0.165
General practitioner	0.811	0.798	0.867	0.873	0.919
City practice	0.260	0.263	0.246	0.241	0.349
Female physician	0.131	0.131	0.131	0.132	0.144
Non-contracted physician	0.065	0.069	0.049	0.049	0.032
Number of first prescriptions	4,880,936	3,943,277	937,659	402,425	71,053

Notes: This table shows descriptive statistics for the control and treatment groups (any hospital stay, hospital stay with matched diagnosis, hospital discharge prescription) using the first outpatient prescription of a therapy. Due to missing information, the number of observations is only 3,920,927 for patient income, 4,163,325 for age of physician and 4,573,476 for sex of physician.

Table 4: Comparison of hospital patients with and without discharge prescription

	(1) Discharge prescription?	(2)	(3)
	No	Yes	Diff.
<i>Patient characteristics</i>			
Age	53.7	53.2	0.4
Female share	0.55	0.52	0.03
<i>Outpatient expenditure in year of hospital stay</i>			
Medical attendance	624.2	636.5	−12.3
Medication	1214.3	1342.3	−128.1
<i>Hospital diagnoses</i>			
Neoplasms	14.21	13.12	1.10
Diseases of the circulatory system	10.97	12.18	−1.20
Diseases of the musculoskeletal system and connective tissue	9.47	13.25	−3.79
Injury, poisoning and certain other consequences of external causes	9.38	11.79	−2.41
Diseases of the digestive system	8.01	7.00	1.01
Diseases of the eye and adnexa	7.44	1.08	6.36
Diseases of the genitourinary system	5.83	7.28	−1.44
Mental and behavioural disorders	5.72	6.92	−1.20
Diseases of the respiratory system	5.05	9.97	−4.92
Symptoms, signs and abnormal clinical and laboratory findings	4.95	3.34	1.61
Pregnancy, childbirth and the puerperium	4.64	1.44	3.19
Diseases of the nervous system	4.38	2.65	1.73
Certain infectious and parasitic diseases	2.22	2.94	−0.72
Endocrine, nutritional and metabolic diseases	2.35	1.40	0.95
Diseases of the skin and subcutaneous tissue	1.44	1.85	−0.41
Diseases of the ear and mastoid process	1.18	2.35	−1.18
Factors influencing health status and contact with health services	0.86	0.26	0.60
Diseases of the blood and blood-forming organs	0.75	0.58	0.17
Congenital malformations, deformations and chromosomal abnormalities	0.74	0.55	0.19
Certain conditions originating in the perinatal period	0.41	0.05	0.36
Codes for special purposes	0.00	0.00	0.00
N	1,669,425	213,431	

Notes: This table shows characteristics of patients in hospitals who receive a discharge prescription (column (2)) and patients who do not receive a discharge prescription (column (1)).

Table 5: Comparison of patients with and without a previous hospital stay

	(1)	(2)	(3)
	No previous stay	Previous hospital stay	Difference
<i>Patient characteristics</i>			
Age	47.9	61.8	−13.9
Female share	0.59	0.57	0.01
<i>Outpatient expenditure in year of therapy</i>			
Medical attendance	549.9	783.0	−233.1
Medication	487.2	1320.7	−833.5
<i>Outpatient expenditure in previous year</i>			
Medical attendance	477.8	650.6	−172.8
Medication	430.7	1004.4	−573.7
N	3,943,277	937,659	

Notes: This table shows characteristics of patients with a previous hospital stays (column (2)) and without a previous hospital stay (column (1)) within 3 months before the first outpatient prescription.

Table 6: Effect of past hospital stays on first outpatient prescription of the therapy

	(1)	(2)	(3)
Hospital stay	−0.082*** (0.001)	−0.080*** (0.001)	−0.063*** (0.001)
Hospital stay with matched diagnosis	−0.110*** (0.001)	−0.106*** (0.001)	−0.087*** (0.001)
Hospital discharge prescription	−0.254*** (0.002)	−0.259*** (0.002)	−0.236*** (0.002)
Controlling for fixed effects:			
Time	✓	✓	✓
Active ingredient	✓	✓	✓
Physician		✓	✓
Patient			✓

Notes: This table summarizes the hospital effect on the first outpatient prescription of medical therapies. The dependent variable is a binary indicator for generic versus brand-name choice. Each entry represents the results from a separate regression with different explanatory variables of interest indicated on the left and controlling for different levels of fixed effects indicated at the bottom of the table. The number of observations is 4,880,936 for hospital stay regressions, 4,345,702 for hospital stay with matched diagnosis and 4,014,330 for hospital discharge prescriptions. Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Effect of past hospital stays on first outpatient prescription - varying time window

	(1)	(2)	(3)
Hospital stay in past 3 months	−0.082*** (0.001)	−0.080*** (0.001)	−0.063*** (0.001)
Hospital stay in past 6 months	−0.065*** (0.000)	−0.064*** (0.000)	−0.048*** (0.001)
Hospital stay in past 3 months (spec. II)	−0.084*** (0.001)	−0.082*** (0.001)	−0.065*** (0.001)
Controlling for fixed effects:			
Time	✓	✓	✓
Active ingredient	✓	✓	✓
Physician		✓	✓
Patient			✓

Notes: This table summarizes the hospital effect on the first outpatient prescription of medical therapies with varying time windows. The dependent variable is a binary indicator for generic versus brand-name choice. Each entry represents the results from a separate regression with different explanatory variables of interest indicated on the left and controlling for different levels of fixed effects indicated at the bottom of the table. The number of observations is 4,880,936 for hospital stay in past 3 or 6 months, and 4,557,815 for hospital stay in past 3 months (spec. II), where we exclude patients with hospital stays within months 4 to 6 prior to the outpatient prescription. Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Effect of hospitals on all outpatient prescriptions

	(1)	(2)	(3)
Hospital stay	−0.083*** (0.000)	−0.082*** (0.000)	−0.057*** (0.000)
Hospital stay with matched diagnosis	−0.113*** (0.000)	−0.110*** (0.000)	−0.080*** (0.000)
Hospital discharge prescription	−0.217*** (0.001)	−0.214*** (0.001)	−0.182*** (0.001)
Controlling for fixed effects:			
Time	✓	✓	✓
Active ingredient	✓	✓	✓
Physician		✓	✓
Patient			✓

Notes: This table summarizes the hospital effect on all outpatient prescriptions. The dependent variable is a binary indicator for generic versus brand-name choice. Each entry represents the results from a separate regression with different explanatory variables of interest indicated on the left and controlling for different levels of fixed effects indicated at the bottom of the table. The number of observations is 15,945,098 for hospital stay regressions, 13,413,156 for hospital stay with matched diagnosis and 11,694,960 for hospital discharge prescriptions. Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Heterogeneous effects

	(1) Mean	(2) Estimate	(3) S.E.	(4) 95 % C.I.	(5) N
<i>Physician characteristics</i>					
Age					
Over 50	0.642	-0.231***	(0.003)	[-0.237, -0.226]	2,364,237
Under 50	0.650	-0.248***	(0.005)	[-0.258, -0.238]	1,049,962
Sex					
Female	0.629	-0.220***	(0.007)	[-0.234, -0.207]	493,940
Male	0.636	-0.240***	(0.002)	[-0.245, -0.235]	3,271,232
Type of physician					
General practitioner	0.639	-0.236***	(0.002)	[-0.241, -0.231]	3,211,913
Specialist	0.561	-0.188***	(0.010)	[-0.209, -0.168]	802,417
Drug dispensing of GPs					
Dispenses drugs	0.611	-0.176***	(0.005)	[-0.187, -0.166]	953,533
Does not dispense	0.651	-0.247***	(0.003)	[-0.252, -0.242]	2,258,380
Type of physician					
Non-contracted physician	0.354	-0.146***	(0.025)	[-0.196, -0.097]	275,282
Contract physician	0.643	-0.237***	(0.002)	[-0.241, -0.233]	3,739,048
Place of medical practice					
City (population over 35,000)	0.648	-0.243***	(0.004)	[-0.250, -0.235]	1,060,631
Rural area	0.615	-0.231***	(0.003)	[-0.237, -0.226]	2,953,699
<i>Patient characteristics</i>					
Age					
Under 40	0.617	-0.248***	(0.007)	[-0.262, -0.234]	1,364,816
40-70	0.639	-0.239***	(0.003)	[-0.245, -0.233]	1,889,813
Over 70	0.595	-0.227***	(0.003)	[-0.234, -0.221]	759,701
Income					
Low (under P10)	0.628	-0.216***	(0.009)	[-0.235, -0.198]	318,957
Middle (P10-P90)	0.638	-0.239***	(0.003)	[-0.245, -0.234]	2,552,186
High (over P90)	0.629	-0.254***	(0.010)	[-0.272, -0.235]	319,029

Notes: This table summarizes hospital effects on the first outpatient prescription of medical therapies using discharge prescriptions. The dependent variable is a binary indicator for generic versus brand-name choice. Each line reflects the results from a separate regression for different samples indicated at the very left. Column (1) presents the corresponding sample mean of the dependent variable, columns (2)-(4) show the point estimates, robust standard errors and the corresponding 95 % confidence intervals. The number of observations is indicated in column (5). Additional covariates control for time, active ingredient, physician and patient-fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Comparison of drug choice in hospitals and the outpatient sector

	Discharge prescriptions		Outpatient prescriptions	
	(1)	(2)	(3)	(4)
Patient under 40	−0.014*** (0.002)	−0.009*** (0.002)	0.016*** (0.001)	0.019*** (0.001)
Patient over 70	−0.002 (0.002)	0.003 (0.002)	−0.012*** (0.001)	−0.017*** (0.001)
High income patient	−0.013*** (0.003)	−0.007*** (0.002)	−0.032*** (0.001)	−0.018*** (0.001)
Low income patient	0.005** (0.002)	0.005** (0.002)	0.000 (0.001)	−0.003*** (0.001)
Constant	0.257*** (0.001)	0.254*** (0.001)	0.641*** (0.000)	0.640*** (0.000)
Controlling for fixed effects:				
Time	✓	✓	✓	✓
Active ingredient	✓	✓	✓	✓
Hospital/physician		✓		✓
N	267,260	267,260	3,129,858	3,129,858
Mean of dept.	0.253	0.253	0.640	0.640

Notes: This table summarizes the effects of patient characteristics on hospital discharge prescriptions (columns (1) and (2)) and outpatient prescriptions with no prior hospital stay (columns(3) and (4)). The dependent variable is a binary indicator for generic versus brand-name choice. Additional covariates controlling for different levels of fixed effects are indicated at the bottom of the table. Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Physicians' adherence to hospital choices

	(1) Adherence	(2) Adh. to brand-name	(3) Adh. to generic
<i>Physician characteristics</i>			
Physician over 50	−0.005 (0.004)	−0.001 (0.005)	−0.002 (0.004)
Female physician	−0.013*** (0.005)	−0.010 (0.006)	−0.009 (0.005)
City practice	−0.017*** (0.003)	−0.021*** (0.004)	0.002 (0.003)
General practitioner	0.020** (0.009)	0.025** (0.011)	0.022** (0.011)
Non-contracted physician	0.131*** (0.031)	0.246*** (0.037)	−0.129* (0.070)
Physician dispenses drugs	−0.064*** (0.005)	−0.078*** (0.006)	−0.038*** (0.005)
Physician referred to hospital	−0.005 (0.004)	−0.008* (0.005)	−0.000 (0.004)
<i>Patient characteristics</i>			
Patient under 40	−0.015** (0.007)	−0.012 (0.008)	−0.020** (0.010)
Patient over 70	0.004 (0.003)	0.004 (0.004)	0.002 (0.003)
High income patient	0.021*** (0.005)	0.032*** (0.007)	−0.004 (0.006)
Low income patient	0.002 (0.005)	0.001 (0.007)	0.001 (0.006)
N	52,994	38,804	14,190
Mean of dept.	0.817	0.766	0.955

Notes: This table summarizes the effects of patient and physician characteristics on physicians' adherence to discharge prescriptions. The dependent variable is a binary indicator for adherence and non-adherence. Column (1) depicts overall adherence to the type of discharge prescriptions. Column (2) depicts adherence to a brand-name discharge prescription, column (3) to a generic discharge prescription. All regressions include fixed effects for time and active ingredient. Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.