The prescribing physician's influence on consumer choice between medically equivalent pharmaceuticals.*

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Abstract

This paper reports on a study of the prescribing physician's influence on consumers' choice between medically equivalent pharmaceuticals. The study was performed using a dataset of 666,000 observations in which consumers were asked whether they were prepared to pay the price difference in order to obtain the prescribed pharmaceutical instead of the cheapest available substitute. The main results support the hypothesis that prescribing physicians have an impact on consumers' choice between medically equivalent pharmaceutical products.

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1 Introduction

In this paper, we study the willingness of a consumer to oppose the switch from a prescribed brand-name, secondary brand, or generic pharmaceutical to the cheapest version of the product. Brand-name pharmaceuticals are original pharmaceutical products that previously were patent protected. Secondary brands are generic versions of the pharmaceutical product, but are like brand-name drugs in that they are sold under their own product name.[1] "True" generics are sold under the substance name, usually followed by the company name.[2]

If consumers' decisions are influenced by the advice of their prescribing physician, we would expect them to accept substitution most often for generics. The names of generic products are often very similar to the brand-name of the product. Thus consumers might consider the generic to be the same product but delivered by a different firm and might assume that substitution does not go against the advice of their physician.

However, when the consumer is offered a substitute instead of a brand or secondary brand, the name of the product offered may be very different. The consumer might get the impression that what is being offered is a different drug, even though the pharmacist states otherwise. In such cases, consumers might feel that accepting this product would be going against the advice of their prescribing physician.

This paper contributes to the existing literature in the following ways: First, we focus on how consumers are affected by the choice of pharmaceutical product that is made by prescribing physicians, and in which circumstances consumers choose to oppose substitution to cheaper alternatives. The results show that consumers are approximately two-and-a-half times as likely to oppose substitution if the prescribed drug is a brand-name product or secondary brand instead of a generic.

Secondly, we were able also to study consumer substitution behavior for parallel imported products, which are sometimes sold under trade names that are less familiar to Swedish consumers.[3] Our results indicate that this affects

[1] Since Reiffen and Ward (2007) used "branded generics" to denote generics that are introduced by patent-holding producers we have chosen to call generic versions sold under their own product names "secondary brands".

[2] To give an example, generics including the substance Bisoprolol, are sold under names such as Bisoprolol Ratiopharm, Bisoprolol Sandoz, and Bisoprolol Stada, while the brand-name and secondary brand are sold under the product names Emconcor and Bisomerck, respectively.

[3] The European system of parallel imports of patented pharmaceutical products is described

consumers' choices of pharmaceutical products.

2 Literature Review

Physicians' prescription choices between medically equivalent pharmaceutical products and therapeutic alternatives have been studied by researchers such as Hellerstein (1998), Coscelli (2000), Richard and Van Horn (2004), and Rizzo and Zeckhauser (2005).

Using data from a survey of physicians and their patients, Hellerstein (1998) found significant differences between physicians' likelihood to prescribe generics and also found that it is difficult to determine why some physicians are more likely to prescribe generic drugs.

Coscelli (2000) used information about doctor and patient characteristics, as well as information about when and how patients switch physicians, to estimate the probability of a switch of pharmaceutical brands. Her results show that there is persistence in the use of pharmaceuticals for both patients and physicians.

Richard and Van Horn (2004) also found that there is persistence in physician prescription choices, especially for incumbent products. They suggested that this is caused by incumbent products' having a larger installed base of patients rather than advertising generating goodwill for such products.

Finally, Rizzo and Zeckhauser (2005) showed that the higher is the share of prescriptions that is filled by generics, the lower is the average brand-name price to consumers. They suggest that this is due to consumers' becoming more likely to substitute brand-name drugs for generics when the price gap is great. They found that this effect is large, with a 10 % increase in generic scrip share associated with a 15.6 % decline in the average price paid for brand-name drugs.

3 Institutional background

A substitution reform came into effect in Sweden on October 1, 2002: This reform requires pharmacists to inform consumers if there are cheaper substitute products available. It also mandates that the cheapest available generic or parallel import substitute product be provided within the Swedish pharmaceuticals insurance system.[4] The Swedish Medical Products Agency (SMPA) considers

below.

[4] According to the SMPA, exchangeable products must have the same active substance, strength, and form (pills, oral fluids, etc.), and the packages must be of similar size.

parallel imports to be perfect substitutes for the original sourced drugs (i.e., drugs that are not parallel imported).

Parallel imported pharmaceuticals are products that are intended for low-price countries within the European Union (EU) that are legally imported to Sweden by parallel traders that take advantage of the price differences. They have the same active ingredient in the same amount and the same dosage form (e.g., tablet or capsule) as the originally sourced pharmaceuticals (i.e., products that are directly supplied by the manufacturer via authorized wholesalers). However, parallel imports may differ from original sourced drugs in packaging and in some cases even in name. For example, parallel imported Diovan Comp may be marketed as Diovan Comp or as Co-Tareg, which is one of the many trade names under which it is available in the EU. Similarly, parallel imported Nexium is marketed in Sweden both as Nexium and as Axagon.[5]

Under the new regulations, pharmacists must inform consumers that they can buy the originally prescribed pharmaceutical product instead of the suggested substitute (in most cases a secondary brand, generic or parallel imported product) if the consumer agrees to pay the difference in price between the products. Pharmacists are also required to substitute the prescribed pharmaceutical product with the cheapest available substitute when the prescribing physician does not prohibit the switch and when the consumer does not choose to pay the price difference between the prescribed product and the suggested substitute.[6]

Physicians can veto substitution by checking a box on the prescription. This may only be done for medical reasons: for example, if the patient is sensitive to inert ingredients in some of the substitutes. During the first 15 months after the reform, physicians chose to oppose substitution in 3% of the cases nationally (National Corporation of Swedish Pharmacies et al., 2004). Physicians chose to oppose substitution in 2% of the cases for the period and county under study in this paper (Granlund, 2009). In cases where the physician prohibits the switch, the cost to the consumer is covered by the Swedish pharmaceuticals insurance system.

[5] For a more complete discussion of parallel imported pharmaceuticals, see Ganslandt and Maskus (2004).

[6] Consumers also have the right to switch to substitute products other than the cheapest available, paying the price difference between that product and the cheapest one, but pharmacists are not obliged to inform consumers about this option.

4 Empirical analysis

4.1 Data and descriptive statistics

The county council of Västerbotten, Sweden, provided a dataset containing information on all prescriptions sold in the county of Västerbotten or to residents of Västerbotten in other parts of Sweden between January 2003 and October 2006.[7]

The dataset allows us to identify opportunities for substitution since it includes a dummy variable that indicates when a consumer opposed substitution to a cheaper alternative, which they could only do if substitution was possible. The data also includes the identity of both the prescribed and the dispensed drug, which means that we can see if substitution was actually done. Prescriptions for which no cheaper alternatives were available were deleted from the dataset. These included cases when the physicians did not allow substitution and cases when all the available alternatives were more expensive.[8]

The numbers of observations for each possibility of product types that were prescribed and bought are shown in Table 1.[9] Table 1 shows that what is most commonly prescribed is an original sourced brand (332,133 observations). The largest category of dispensed products is original sourced generics (217,989 observations).[10]

We also see that it is less common to prescribe a parallel import product than to buy one. In total, the data includes only 91,008 prescriptions of parallel import products, but 220,744 observations of the sale of a parallel import product. This pattern is expected since generics and parallel imports are in

[7] Prescriptions that were sold in November and December 2003 and September 2004 are not available since the county council's data files for these months were damaged. For a more detailed description of the data, the reader is referred to Granlund (2009).

[8] The latter category was identified by the price of the dispensed drug exceeding the price of the prescribed one, without the consumer having opposed getting the cheapest available substitute. For 19,848 prescriptions, we could not identify the price of the prescribed drug since it was not sold in Västerbotten that month (prices are set for one month at a time). These prescriptions were excluded, but estimates including them give results nearly identical to those presented below.

[9] A group of prescriptions consisting of, for example, vitamins and minerals (e.g. Vitamin B-12 and different calcium combinations) has been excluded from the analysis.

[10] Table 1 cross-tabulates prescribed and bought products, while Table 2 contains data on prescribed pharmaceuticals. In 634 cases we were not able to determine which type of product (brand, secondary brand, or generic) was actually bought by the consumer, and thus these observations have not been included in Table 1. Compared to Tables 2, 3 and 4, additional observations are lost in all estimations since some ATC-code and manufacturer fixed effects perfectly predicts success or failure in the estimations.

most cases cheaper than original sourced brands, while original sourced brands have been on the Swedish market the longest and hence are better known by physicians.

Tables 1 and 2 about here.

Table 2 presents descriptive statistics showing whether the prescribed product was a brand-name pharmaceutical ($Brand$), secondary brand ($Sec.brand$), or a generic ($Generic$) and indicating the percentage for each indicator category. Means and standard deviations are presented for continuous variables.

The dependent variable (O_i) takes the value 1 in the 21.20% of the observations when the consumer opposed substitution of the cheapest available substitute. Note also that there are large differences between the categories with respect to how often the consumers oppose substitution. For generic prescriptions, consumers oppose substitution in 11.35% of the observations, while for secondary brands the same number is 38.73%.

The descriptive statistics show that parallel imports ($Parallel$) are most commonly substituted for brands and secondary brands, while almost no parallel imported generics are prescribed. $NotMD$ takes the value 1 in the few cases when the prescription was written by someone other than a medical doctor (e.g., a dentist or a nurse), which is most common for secondary brands.

Table 2 also shows that females ($Female$) receive more prescriptions than do men, and especially so for secondary brands. A more detailed analysis of the data reveals that the high share of prescriptions for women is partly caused by women living longer and partly by women in age groups between 15 and 85 receiving a higher share of prescriptions relative to their share of the population. There do not appear to be any large differences between the categories with respect to age (Age), defined daily doses prescribed (DDD), and the month in which the prescription was dispensed ($Time$).[11]

The variable ΔP shows the difference in price in 100 SEK between the prescribed pharmaceutical and the cheapest available generic substitute, while $\Delta P/DDD$ shows this price difference per defined daily dose.[12] These variables can only be estimated if both the prescribed pharmaceutical and the cheapest substitute are sold during the current month; information for these variables are missing in 20% of the observations.

Table 2 shows that the difference between the prescribed and the cheapest

[11] The DDD is defined by the World Health Organization as "the assumed average maintenance dose per day for a drug used for its main indication in adults".

[12] On 30 April 2008, USD/SEK = 6.00 and EUR/SEK = 9.34.

product is largest for brands, as could be expected, and is smallest for generics. In cases where the consumer opposed substitution, the price differences are much smaller. This is a first indication that there is a negative correlation between the probability that the consumer will oppose substitution and the price of the pharmaceutical product. The average premium that was paid by consumers opposing substitution was SEK 17.45.[13]

The dataset also includes information about the ATC-group to which a drug belongs.[14] We have observations from 252 7-digit ATC groups that are in 13 different 1-digit ATC groups. Table 3 shows that most observations relate to the cardiovascular system (ATC group C), followed by the brain and nervous system (ATC group N) and the respiratory system (ATC group R). Table 4 provides descriptive statistics presented separately for these three largest ATC groups. ATC group R differs from the others by including very few instances where the consumer opposed substitution or where a secondary brand was prescribed.

Tables 3 and 4 about here.

4.2 Empirical specification

The baseline empirical specification (specification 1) is

$$\begin{aligned}\Pr(O_i = 1) = F(&a + \beta_1 Brand_i + \beta_2 Sec.brand_i + \beta_3 Parallel + \beta_4 NotMD_i \\ &+ \beta_5 Female_i + \beta_6 DDD_i + \sum_{a=2}^{20} \eta_a Age_{ai} + \sum_{m=2}^{16} \eta_m Mun_{mi} \\ &+ \sum_{t=2}^{43} \kappa_t Time_{ti} + \sum_{g=2}^{252} \mu_g ATC_{gi} + \sum_{f=2}^{87} \mu_f Firm_{fi} + \epsilon_i). \end{aligned} \quad (1)$$

The indicator variables *Brand* and *Sec.brand* are included as RHS variables to study whether consumers are more likely to oppose substitution if the prescription is for a product that belongs to these groups instead of for a *Generic*. We control for *Parallel* since these products can differ in trade names and packaging, which might affect the likelihood of consumers' opposing substitution.

[13] The National Corporation of Swedish Pharmacies et al. (2004) found that the corresponding average premium for the entire Swedish market during the first 15 months after the substitution reform was SEK 18. For the same time period, it was found to be SEK 19 in our dataset, indicating that our data from Västerbotten is fairly representative for Sweden.

[14] In the World Health Organization's Anatomical Therapeutic Chemical (ATC) classification system, the drugs are divided into different groups according to the organ or system on which they act, and their chemical, pharmacological, and therapeutic properties. See http://www.whocc.no/ for more information about the ATC system.

$NotMD$ is included since the likelihood of consumers' refusing substitution might depend on perceptions about the prescriber's ability to evaluate different pharmaceutical treatments. We control for the consumer's gender by including the indicator variable $Female$, and for age by including indicator variables for five-year age groups. The number of defined daily doses prescribed (DDD) is included as a control variable since those who are prescribed larger quantities might be more frequent purchasers of pharmaceuticals and therefore have better information about generics.

The municipality of residence of the consumer (Mun) and the month that the prescription was dispensed ($Time$) are included to control for socioeconomic differences between municipalities and possible changes in consumer attitudes toward substitution over time. Finally, we control for which 7-digit ATC code group (ATC) that the prescribed pharmaceutical belongs to and which manufacturer produces the pharmaceutical product in question ($Firm$).

Seven additional specifications were estimated and are presented below. The first one differs from the baseline specification by also including an interaction term having the value 1 if the prescribed pharmaceutical is classified as a secondary brand or generic and is also parallel imported ($Parallel * NotBrand$). The second one differs from the baseline specification by including the difference in price in SEK 100 between the prescribed pharmaceutical and the cheapest available generic substitute (ΔP) and also including this price difference per defined daily dose ($\Delta P/DDD$).

As mentioned above, we have missing values for ΔP and $\Delta P/DDD$. Since the probability of missing values partly depends on consumers' choices with regard to substitution, we impute values for observations with missing values to avoid selection bias. The imputation is performed by replacing the missing values for $\Delta P/DDD$ with the predictions for this variable that are obtained by a regression of this variable on the exogenous variables except ΔP. The missing values for ΔP are replaced with DDD times the predictions for $\Delta P/DDD$.

The variables ΔP and $\Delta P/DDD$ are potentially endogenous since pharmaceutical firms can take the proportion of consumers opposing substitution into account when setting prices. We therefore also estimate a specification where these variables are instrumented. As instruments we use $Months36+$, which is a dummy variable that takes the value one if a generic or secondary brand was first sold more than 36 months earlier, as well as this variable interacted with $Brand$, and with $Sec.Brand$.

$Months36+$ affects the price difference because the nominal price of a drug had to be authorized by the Pharmaceutical Benefits Board (PBB) in order to

be included in the Swedish pharmaceutical benefits scheme. Price comparisons were one factor that the PBB took into account when deciding whether to allow price increases during the study period (LFNFS 2003:1). The PBB has been reluctant to allow price increases for drugs for which cheaper alternatives exist, unless the new price does not exceed the price of the most expensive exchangeable product. This means that the real price difference between the most expensive product in the exchange group and the cheapest alternative is likely to decrease with the time since first generic entry.

We use $Months36+$ instead of a continuous variable for the months since generic entry to reduce possible endogeneity bias arising from consumers' knowledge. Their knowledge of generic substitutes may change in the first months after generic entry.

Several other sets of instruments were tested, including instrument sets with a continuous variable for the months since generic entry. The choice between the instrument sets was based on statistical tests of the strength of the instruments.

Specification 4 differs from specification 1 by controlling for which of the 13 1-digit ATC code groups the prescribed pharmaceutical belongs to, instead of controlling for each in the 252 7-digit ATC code group. The purpose of this specification was to obtain a better overview of how the likelihood of opposing substitution differs across pharmaceutical groups. This specification shows only estimates for the 1-digit ATC code groups.

Lastly, we ran separate regressions for each of the three largest 1-digit ATC code groups. In these regressions, we controlled for the same variables as in specification 1, except that the number of 7-digit ATC code groups and firms is smaller.

For specifications 1–3 and 5–8, a maximum likelihood logit estimator was used, while a two-step binary instrumental variable estimator was used for specification 4. The marginal effects for specification 4 were calculated using a logit estimator. Since predicted probabilities, which are necessary for calculating marginal effects, are not available after the two-step estimator for binary instrumental variable estimation in STATA, predictions of the endogenous variables that were obtained using the exogenous variables and the instruments were used to calculate the marginal effects. Thus the average standard errors for specification 4 reported in Table 3 should be interpreted with caution.

4.3 Estimation results

The estimation results are presented in Tables 5 to 7 in terms of estimated probabilities and marginal effects.[15] A predicted probability for, say, *Generics* shows the share of consumers that are predicted to oppose substitution if all prescriptions were for generics. The calculations for the marginal effects were performed using the method suggested by Caudill and Jackson (1989). This method takes explicit account of the fact that we want to measure a discrete difference in probabilities depending on whether dummy variables take the value 0 or 1.

Table 5 about here.

These results for specifications 1–3, presented in Table 5, show that the predicted probability of opposing substitution if a generic is prescribed is 10%, while it is 24–25% if the prescribed drug is a brand or a secondary brand. Thus, these results show a large difference between the probability of a consumer's opposing substitution for brands and secondary brands compared to ordinary generic products. Consumers are on average about two-and-a-half times as likely to oppose the switch when a brand or secondary brand is prescribed instead of a generic.

The estimated effect of the prescribed drug's being a brand is larger in the instrumental variable specification (specification 4) than in specifications 1–3. However, since our instruments are not based on experimental data, the estimates for specification 4 should be interpreted with caution. In specification 4, but not in specification 1–3, the coefficient estimates for brands and secondary brands are significantly different.

The results in Table 5 show that consumers are less likely to oppose substitution if the prescribed drug is a parallel-imported product rather than an original-sourced pharmaceutical. Since parallel imports are sometimes sold under trade names with which Swedish consumers are less familiar, this might indicate that brand-name recognition affects consumers' choices. However, other factors may drive these results; for example, consumers may consider parallel imports to be inferior to original-sourced pharmaceuticals.

Whether the prescriber is a medical doctor has no significant effect at the 5% level. The results also show that women are more inclined to oppose substitution

[15] Estimates for the variable groups Age, Municipality, Trend, ATC, and Firm are not reported, but χ^2- tests (available from the authors on request) show that each of these groups of variables are jointly significantly different from zero.

than are men, and that the probability of a consumer's opposing substitution decreases with the size of the prescription.

The results from specifications 3 and 4 show that the higher is the extra cost (ΔP) of substitution, the less likely consumers are to oppose substitution. Controlling for ΔP, the estimates for extra cost per DDD ($\Delta P/DDD$) are positive, but not statistically significant, and they are dominated by the significant estimates for ΔP. For example, according to specification 3, $\partial \Pr(O_i = 1)/\partial \Delta P = -0.58 + 0.03/70.11 = -0.58$. Thus, the estimates support the well-known fact that, other things being equal, consumers prefer lower prices.

Figures 1 and 2 present the marginal effects for specification 1 related to the age and time variables respectively. Figure 1 indicates that (cet. par.) there are no significant differences in substitution rates among individuals of all ages.

Figure 2 suggests that there was some initial learning about generic substitution. Pharmacists may, for example, have become better at explaining that generics are medically equivalent copies of the brand-name pharmaceuticals and have undergone tests to confirm that they have the same high quality. However, after some time (20 months) the effect seems to decrease. One explanation is that manufacturers adjusted prices in order to reduce substitution: The data show that the average additional cost for buying a prescribed original-sourced brand-name drug was reduced from 94 SEK in January 2004 to 36 SEK in October 2006.

Figures 1 and 2 and Tables 6 and 7 about here.

Table 6 shows that the predicted probability of opposing substitution is largest for ATC group S (sensory organs), and second largest for ATC group C (cardiovascular system). The smallest predicted probabilities are found for ATC group P (antiparasitic products, insecticides, and repellents), which includes only 403 observations, and for ATC group R (respiratory system).

The results for ATC groups C and N (nervous system), which is presented in Table 7, are in line with those for the whole population. However, the results presented for ATC group R are insignificant or have the opposite sign, as compared to those for the whole population. These last results are likely explained by the fact that very few consumers opposed substitution for this group of pharmaceuticals, as well as that there is some indication of multicolinarity, which makes estimation difficult for group R.

We can calculate the average extra cost that is caused by a physician's prescribing an original sourced brand product instead of an original sourced generic by using the estimates from the first specification, and information for each

exchange group, month, and the average price difference between the cheapest alternative and the product that consumers buy when they oppose substitution. For the 177,357 prescriptions of original-sourced brand products that belong to exchange groups and months for which we have data on the price difference, the average extra cost is SEK 10.94. Correspondingly, the average extra cost caused by a physician prescribing an original sourced secondary brand instead of a generic is SEK 7.41. Since the predicted probability of opposing substitution is the same whether the prescribed pharmaceutical is a brand or a secondary brand, the difference is almost entirely explained by the fact that the price difference is higher when the prescribed product is a brand instead of a secondary brand.

Estimates from specification 1 suggest that physicians in the county of Västerbotten increased the total pharmaceutical cost by SEK 2.6 million during the study period by not always prescribing generics. Eighty percent of this cost was caused by prescribing original-sourced brands, 17% by prescribing original-sourced secondary brands, and 3% by prescribing parallel-imported brands. The high proportion of the cost for original-sourced brands is explained by the high prices and the larger number of these prescriptions. These figures are obtained by extrapolating to the whole population by assuming that the price difference for consumers that opposed substitution for brands, secondary brands and generics is the same for the exchange groups for which we do not have data.

5 Discussion

The substitution reform that was introduced in Sweden on October 1, 2002, requires pharmacists to inform consumers if cheaper substitute products are available and that the cheapest available substitute will be covered by the Swedish pharmaceutical insurance system. Pharmacists must also inform consumers that they can refuse substitution if they pay the difference in price between the products themselves. These new regulations provide a way to study the effect of the prescribing physician on consumer choice between medically equivalent treatments.

If consumers care about the advice of their prescribing physician, we would expect them to allow substitution most often for generics since the names of these products are so similar to the brand name that consumers might consider them to be the same pharmaceutical. However, when consumers are offered a cheaper substitute instead of a brand or secondary brand, consumers might be-

lieve that the substitute is different from the pharmaceutical that their physician prescribed because of the difference in names.

The results that are presented in this paper show that the predicted probability of opposing substitution is considerably higher for brands and secondary brands than for generics. For the whole population, the predicted probability of opposing substitution is 10% for a generic and 24–25% for a brand or a secondary brand.

These estimates were also made separately for the three largest ATC code groups in the Swedish market. For two out of three groups, the results agree with those presented for the full sample. However, the results that are presented for ATC group R were insignificant or had the opposite sign compared to the whole population.

The results that are presented in this paper thus seem to indicate that consumers do care about the pharmaceutical product that their prescribing physician writes on the prescription, especially if the names of the prescribed pharmaceutical and the cheapest alternative differ significantly, even if the dispensing pharmacist explains that the products that are offered are medically equivalent treatments. Using the results from the empirical analysis, we have also calculated that if prescribing physicians had always prescribed a generic, this would have saved 2.6 million SEK for consumers in Västerbotten, Sweden, during the study period.

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Table 1. Products prescribed and bought by the consumer, full sample

	Prescribed						
	Brand		*Sec.brand*		*Generic*		Sum
Bought:	*O.S.*	*P.I.*	*O.S.*	*P.I.*	*O.S.*	*P.I.*	
Brand O.S.	78,352	35,685	5,394	0	15,955	0	135,386
Brand P.I.	152,765	41,995	50	0	844	0	195,654
Sec.brand O.S.	23,168	565	54,941	1,585	11,353	0	91,592
Sec.brand P.I.	0	0	17,898	7,192	0	0	25,090
Generic O.S.	77,848	3,954	29,091	0	107,064	32	217,989
Generic P.I.	0	0	0	0	0	0	0
Sum	332,133	82,199	107,374	8,777	135,216	32	665,731

Note: O.S. stands for original sourced drugs (i.e., drugs that are not parallel imported), and P.I. stands for parallel imported. 634 prescriptions are not included in this table since classification of the bought product is missing.

Table 2. Descriptive statistics, full sample

Variable	*Brand*	*Sec.brand*	*Generic*	All	Min	Max
O	19.51	38.73	11.35	21.20		
Brand	100	0	0	62.26		
Sec.brand	0	100	0	17.43		
Parallel	19.86	7.56	0.02	13.69		
$NotMD$	1.73	1.91	0.54	1.52		
Female	56.97	67.76	57.28	58.92		
Age	58.17±19.12	63.91±15.86	60.97±17.29	59.74±18.36	0	107
DDD	70.85±59.64	68.41±73.63	69.28±48.50	70.11±60.32	0	2500
Time	25.23±12.85	29.70±11.99	29.64±11.94	26.90±12.70	1	46
ΔP	0.70±1.42	0.17±0.24	0.18±0.48	0.50±1.18	0	43.58
$\Delta P/DDD$	0.01±0.03	0.01±0.01	0.00±0.01	0.01±0.02	0	1.45
$Months36+$	35.97	98.33	81.17	56.02		
ΔP if $O = 1$	0.22±0.56	0.14±0.25	0.06±0.14	0.17±0.45	0	24.97
$\Delta P/DDD$ if $O = 1$	0.00±0.02	0.01±0.01	0.00±0.00	0.00±0.02	0	1.31
Prescriptions	414,868	116,153	135,344	666,365		

Note: For ΔP and $\Delta P/DDD$ a total of 166,761 observations are missing. All differences between the three subpopulations are statistically significant at the one percent level except that the difference in Women between Brand and Sec.brand is only significant at the five percent level and that the difference in Time between Sec.brand and Generics is not significant.

Table 3. Descriptive statistics of ATC-groups, full sample

1-digit ATC-groups	All	Description
ATC A	11.06	Alimentary tract and metabolism
ATC B	0.32	Blood and blood forming organs
ATC C	30.76	Cardiovascular system
ATC D	0.93	Dermatologicals
ATC G	6.84	Genito-urinary system and sex hormones
ATC H	0.31	Systemic hormonal preparations, excluding sex hormones and insulins
ATC J	2.76	Antiinfectives for systemic use
ATC L	0.87	Antineoplastic and immunomodulating agents
ATC M	7.14	Musculo-skeletal system
ATC N	22.80	Nervous system
ATC P	0.06	Antiparasitic products, insecticides and repellents
ATC R	15.58	Respiratory system
ATC S	0.56	Sensory organs
Prescriptions	666,365	

Table 4. Descriptive statistics: for the largest 1-digit ATC-groups

Variable	ATC C	ATC N	ATC R
O	29.40	28.85	1.82
$Brand$	55.52	60.20	92.97
$Sec.brand$	20.96	20.62	0.11
$Parallel$	10.52	13.54	17.20
$NotMD$	0.02	0.07	1.25
$Female$	51.68	64.31	58.99
Age	67.45± 12.62	57.17±18.15	49.27±21.35
DDD	98.16±72.24	57.49±48.71	69.90±36.93
$Time$	28.66± 12.19	26.77±12.90	24.97±12.54
ΔP	0.31±0.64	0.85±2.08	0.85±0.82
$\Delta P/DDD$	0.00±0.01	0.01±0.02	0.01±0.01
$Months36+$	65.38	54.66	10.54
ΔP if $O = 1$	0.18±0.40	0.18±0.55	0.95±0.92
$\Delta P/DDD$ if $O = 1$	0.00±0.01	0.01±0.01	0.01±0.01
Prescriptions	204,967	151,963	103,833

Note: For ΔP and $\Delta P/DDD$ 36,594 observations are missing for ATC C, 39,805 for ATC N, and 25,546 for ATC R.

Table 5. Predicted probabilities (a) and marginal effects (b), specifications 1-4 (standard errors in parenthesis)

	1		2		3		4	
	a	b	a	b	a	b	a	b
Generic	9.85		10.23		9.74		7.23	
Brand	24.62	14.78***	24.23	14.00***	24.73	15.00***	29.01	21.78***
		(0.54)		(0.44)		(0.54)		(0.51)
Sec.Brand	23.84	14.00***	24.61	14.38***	23.81	14.07***	20.86	13.63***
		(0.35)		(0.26)		(0.35)		(0.98)
Domestic	21.50		21.55		21.52		22.11	
Parallel	13.38	-8.12***	14.47	-7.08***	13.18	-8.34***	8.81	-13.30***
		(0.78)		(0.68)		(0.78)		(0.88)
MD	20.91		20.92		20.91		20.91	
NotMD	20.11	-0.80*	20.13	-0.79*	20.11	-0.80*	20.19	-0.72
		(0.47)		(0.39)		(0.47)		(0.47)
Male	19.83		19.85		19.83		19.88	
Female	21.68	1.86***	21.69	1.83***	21.68	1.86***	21.64	1.76***
		(0.09)		(0.07)		(0.09)		(0.09)
*P.*NotBrand**				-6.52***				
				(0.94)				
DDDs		-0.01***		-0.01***		-0.01***		0.03***
		(0.00)		(0.00)		(0.00)		(0.00)
ΔP						-0.58***		-25.35***
						(0.09)		(0.54)
$\Delta P/DDD$						0.03		0.77**
						(0.03)		(0.71)
Prescriptions	663,296		663,296		663,296		663,296	
Pseudo R^2	0.3237		0.3223		0.3238		0.3265	

Notes: The reported values are the estimates multiplied by 100. The a-columns report the estimated average probability of a consumer's opposing substitution, conditioned on the observation belonging to each category. The b-columns report the average marginal effects, estimated by the method suggested by Caudill and Jackson (1989), and average standard errors, estimated by the delta method. The marginal effect for the interaction term is calculated by changing the value of the interaction term from zero to one while keeping Brand fixed at zero and Parallel fixed at one. A high ratio between an *average* marginal effect and the *average* standard error indicates that the marginal effect is significant for many observations, but it is not correct to refer to significance for the *average* marginal effects. ***, ** and * denote that the coefficient associated with the marginal effect is significanct at the 1%, 5% and 10% level, respectively. The difference between the coefficient estimates for Brand and Secondary brand is only significant in specifications 4. The instruments are strong with a Kleibergen-Paap rk Wald F statistic: 120.46, However, an Amemiya-Lee-Newey minimum chi-sq statistic suggests that the instruments might be endogenous. 3,069 observations are not used since success or failure were predicted perfectly.

Table 6. Predicted probabilities (a) and marginal effects (b), specification 5 (standard errors in parenthesis)

	a	b
ATC A	15.72	
ATC B	4.01	-11.71***
		(0.44)
ATC C	31.79	16.07***
		(0.20)
ATC D	12.47	-3.25***
		(0.53)
ATC G	12.29	-3.44***
		(0.28)
ATC H	4.23	-11.50***
		(0.46)
ATC J	8.03	-7.69***
		(0.31)
ATC L	22.79	7.07***
		(0.46)
ATC M	29.86	14.13***
		(0.32)
ATC N	24.28	8.66***
		(0.23)
ATC P	0.50	-15.23***
		(0.26)
ATC R	1.71	-14.01***
		(0.17)
ATC S	44.15	28.43***
		(0.98)
Prescriptions	666,094	
Pseudo R^2	0.2277	

Notes: The reported values are the estimates multiplied by 100. The a-columns report the estimated average probability of a consumer's opposing substitution, conditioned on the observation belonging to each category. The b-columns report the average marginal effects, estimated by the method suggested by Caudill and Jackson (1989), and average standard errors, estimated by the delta method. A high ratio between an *average* marginal effect and the *average* standard error indicates that the marginal effect is significant for many observations, but it is not correct to refer to significance for the *average* marginal effects. *** denotes that the coefficient associated with the marginal effect is significanct at the 1% level. 271 observations are not used since success or failure were predicted perfectly.

Table 7. Predicted probabilities (a) and marginal effects (b), specifications 6-8 (standard errors in parenthesis)

	6: ATC C		7: ATC N		8: ATC R	
	a	b	a	b	a	b
Generic	11.41		8.71		2.53	
Brand	34.85	23.44***	36.81	28.09***	1.86	-0.67
		(1.36)		(2.78)		(0.52)
Sec.Brand	39.24	27.82***	26.73	18.02***	0.02	-2.50***
		(0.79)		(2.15)		(0.48)
Domestic	30.97		32.86		1.71	
Parallel	14.63	-16.35***	2.37	-30.49***	3.80	2.09**
		(1.45)		(3.48)		(1.38)
MD	29.41		28.82		1.82	
NotMD	22.86	-6.55	27.07	-1.75	2.23	0.42*
		(6.61)		(2.72)		(0.24)
Male	27.47		27.95		1.84	
Female	31.17	3.70***	29.32	1.37***	1.83	-0.01
		(0.19)		(0.18)		(0.08)
DDDs		-0.03***		0.00		-0.01***
		(0.00)		(0.00)		(0.00)
Prescriptions	204,879		151,576		102,657	
Pseudo R^2	0.1402		0.4240		0.2452	

Notes: The reported values are the estimates multiplied by 100. The a-columns report the estimated average probability of a consumer's opposing substitution, conditioned on the observation belonging to each category. The b-columns report the average marginal effects, estimated by the method suggested by Caudill and Jackson (1989), and average standard errors, estimated by the delta method. A high ratio between an *average* marginal effect and the *average* standard error indicates that the marginal effect is significant for many observations, but it is not correct to refer to significance for the *average* marginal effects. ***, ** and * denote that the coefficient associated with the marginal effect is significanct at the 1%, 5% and 10% level, respectively. The differences between the coefficient estimates for Brand and Secondary brand are significant in all three specifications. Since success or failure were predicted perfectly, 88 observations are not used for ATC C, 387 for ATC N, and 1,176 for ATC R.

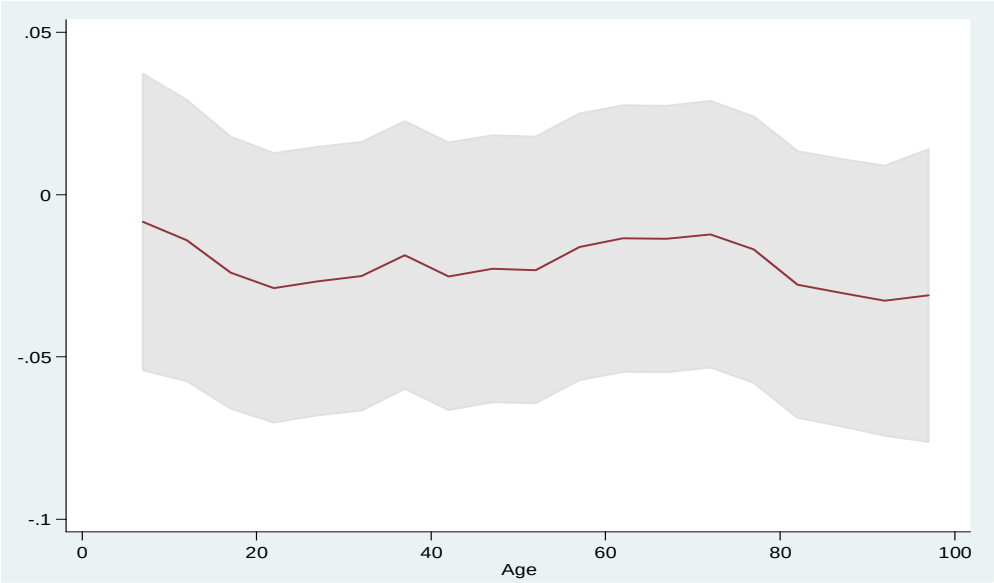

Figure 1. Marginal effects for age with 95% confidence intervals

Note: The confidence interval is calculated using average standard errors. A high ratio between an average marginal effect and the average standard error indicates that the marginal effect is significant for many observations, but it is not correct to refer to significance for the average marginal effects.

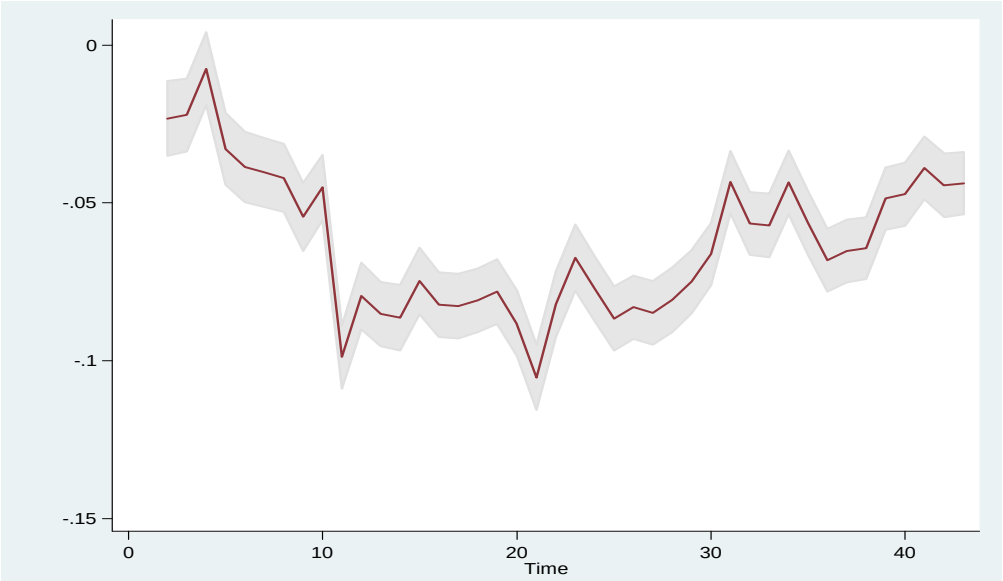

Figure 2. Marginal effects for time-variables with 95% confidence intervals

Note: See note to Figure 1.