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DEMAND FOR DRUGS, REIMBURSEMENT POLICY AND MORAL HAZARD

Running head: Demand for drugs and Moral Hazard

Alla Kolyban*[1], Aida Isabel Tavares[1]

[1]CEISUC, Center of Study and Research in Health, Faculty of Economics, University of Coimbra, Av. Dias da Silva, 165, 3000 Coimbra, Portugal.
*Corresponding author

ABSTRACT

The purpose of this study is to test for the existence of moral hazard using a framework of reimbursement policy based on internal reference pricing in Portugal. An econometric model is used to estimate the demand for drugs, employing panel data for the drug market and for different drug reimbursement categories. In general, no evidence of moral hazard is found, but it can potentially appear in two situations. Firstly, moral hazard may occur with the Ministry of Health where the demand for branded drugs includes the most highly reimbursed drugs. Secondly, moral hazard relatively to patients may happen when demanding branded drugs. Another relevant result is the importance of the out-of-pocket difference between generic and branded drugs in determining the demand for drugs.

These results are relevant for policy makers in order to improve the implementation and design of reimbursement policy.

Keywords: moral hazard, demand for drugs, reimbursement policy, reference price

JEL code: I11, D12, C23, I18

INTRODUCTION

A significant part of the pharmaceutical market is shared between off-patent branded drugs and their generic counterparts; while the branded drug keeps its high price, the generic version sells at a lower price. One possible strategy to control (growing) pharmaceutical expenditure (OECD

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2011), is to generalize the use of generic drugs. Generic drugs are defined as drugs which have the same bioequivalence[1] as the originator drug.
While from a chemical and therapeutic point of view, generics and branded drugs are

homogeneous and highly substitutable, patients and physicians may differentiate among them, either horizontally or vertically. So the doctor-patient relationship determines the demand for prescription drugs which in turn is influenced by their preferences and the incentives provided to both parties.

On the one hand, patients may perceive branded drugs as being of high quality or may prefer some shape, size, color and so on. These preferences influence their willingness to pay for a drug.

On the other hand, physicians are detailed by pharmaceutical companies or pressured by patients to prescribe branded drugs – but they are also motivated to prescribe generics by third-party payers and by their own concern for patient expenditure. In this intricate game, the type of prescribed drug is not certain and the doctor, as an agent, may give preference to any of the parties involved.

This work aims to find evidence of the potential existence of moral hazard when the reimbursement policy of prescribed drugs is based on the internal reference pricing and on differentiated categories of reimbursement.

The demand for pharmaceuticals has been extensively studied. A particular thread of this literature focuses on the prescription behavior of physicians and the consumption decisions of patients.

Patients in the USA consider that physicians should have the primary role in selecting from among the different versions of the prescription drug (Mason and Bearden 1980). The habits and tastes of prescribing and consuming are an important determinant of the type of drug chosen, either branded or generic (Coscelli 1998). Nevertheless, patients may be reluctant to take generic drugs due to their perception of lower quality, as signaled by lower prices (Gaither et al. 2001). Moreover, doctors' positions towards generics vary; some favor them and others shun them, while overall their position is one of indifference bordering on negativity (Kirking et al. 2001).

[1] Donald J. Birkett, "Generics - Equal or Not?," *Australian Prescriber* 26, no. 4 (2003).Birkett (2003) defined bioequivalence by stating that, "two pharmaceutical products are bioequivalent if they are pharmaceutically equivalent and their bioavailabilities (rate and extent of availability) after administration in the same molar dose are similar to such a degree that their effects, with respect to both efficacy and safety, can be expected to be essentially the same. Pharmaceutical equivalence implies the same amount of the same active substance(s), in the same dosage form, for the same route of administration and meeting the same or comparable standards."

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Some authors have shown that prescription behavior is influenced by pharmaceutical companies who detail doctors in order to have them prescribe branded drugs (Harris 2004; Harder 2005; Burtka 2007). But doctors are also offered incentives to prescribe generics. These incentives are usually financial, either rewarding the behavior of convincing patients to take generics, or punitive, such as fines, loss of income or disempowerment for prescribing too few generics or too many branded drugs (Mossialos and Oliver 2005; Fuhrmans 2008).

The literature researching evidence of moral hazard in the prescribed drugs market is not extensive. Neither Hellerstein (1998) nor Coscelli (1998) could find evidence of moral hazard. However, both authors' studies have disadvantages: Hellerstein uses data without prices, with the study based on individual observations over a two week period – potentially incompatible for analyzing moral hazard; Coselli studies the Italian drug market, where no price difference exists between generics and branded drugs, thus removing the driving force behind moral hazard behavior.

Some other papers find evidence of moral hazard in the prescribed drugs market in different countries: for the USA, Leibowitz et al (1985) and Coulson et al (1995); for Sweden, Lundin (2000) and Rudholm (2005); for Norway, Dalen et al (2011); for Spain, Moreno-Torres (2011) and for the Netherlands, van Dijk et al (2013).

Another branch of the literature concerns the internal reference pricing and the reimbursement policy. The variety of policies in Europe to control health expenditures is huge. The analysis of the policies which favor the rational use of drugs and the control of the public expenditure in several European countries is done by Carone et al (2012). Vogler (2012) provides an overview of pharmaceutical pricing and reimbursement policies in European countries. Accordingly, the reference price system is a major policy option for promoting generics drugs and it is strongly linked with reimbursement policy. A review of European pharmaceutical price regulation and the price of generics is presented in Puig-Junoy (2010) and Galizzi et al (2011). In general reference pricing is associated with a decrease in prices, increase in savings and increases in the market share of generics. No work was found relating reference prices with reimbursement policy and moral hazard.

The main contribution of this paper comes from the data used to look for potential evidence of moral hazard in the prescription of drugs in Portugal. This country has an NHS that covers the whole population with patients' drug expenditure varying according to different reimbursement categories. Reimbursement is benchmarked using an internal reference pricing based on the price of generic drugs. This internal reference pricing may inhibit moral hazard with the insurance coverage by doctors, nevertheless it may encourage moral hazard for doctors in the doctor-

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The prescribed drugs market in Portugal for the period 2004-2009

The reimbursement system for drugs in Portugal is based on an internal price reference system and on different categories for reimbursement (Simoens 2009).

The price reference is used to calculate the reimbursement value of a prescribed drug within each pharmaceutical homogeneous group[2]. If the drug price (the pharmacy retail price) is higher than the reference price, reimbursement is calculated according to the reference price and the reimbursement category. If the pharmacy retail price is lower than the reference price, then reimbursement is based on that drug's retail price, according to the reimbursement category.

The internal reference price of each pharmaceutical group coincides with the highest price of the generic drug of that particular homogenous group, up to 2010[3]. Over the period 2004- 2006, generic drugs were priced 20% lower than the cheapest branded similar drug with a market-share higher than 10%. From 2007 onwards, the price of generic drugs had to be at least 35% lower than the branded counterpart, or 20% less in the case that the branded drug cost less than 10 euros[4].

For the period 2004-2009, the reimbursement system was based on four different categories,

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which vary according to pharmaceutical groups and subgroups:

-Category A with a reimbursement level of 100% (in 2004) and 95% (in 2005-09)[5]

-Category B with a reimbursement level of 70% (in 2004-05) and 69% (in 2006-09);

-Category C with a reimbursement level of 40% (in 2004-05) and 37% (in 2006-09);

-Category D[6] with a reimbursement level of 20% (in 2004-05) and 15% (in 2006-09).

In 2004, there was an increase in the reimbursement level of 10 percentage points for generic drugs in categories A, B and C, which was rescinded in 2005.

Generic drugs' share of the whole market by value, in 2004, was 7.9%. In 2009, this share was about 18% (Simoens 2009), which corresponds to 16% of the prescriptions.

Finally, physicians are expected to inform the patient about the existence of generic drugs in the market, reimbursement levels and the drugs with the lowest prices. Doctors may allow generic substitution at the community pharmacy but only about 30% do and there are strict rules for the actual substitution (Simoens 2009).Moreover, advertising drugs to the general public is not allowed, even though pharmaceutical companies are allowed to detail physicians within certain limits.

Moral Hazard

Economic theory states that moral hazard exists when the copayments change peoples' behavior in terms of the use of medical care and total spending (Pauly 1968; 2011). When insurance coverage reduces the costs of medical goods and services, people tend to use more and chose more costly options. Moral hazard is in general considered undesirable and inefficient because it induces consumption to the point that the value of the medical care used is worth less than its market price.

[2] The homogeneous group includes drugs with the same active ingredients, pharmaceutical form, strength and route of administration as generics. The same homogeneous group could include several package sizes.

[3] At the time of writing, the reference price coincides with the average price of the five cheapest drugs which exist in the market and are included in the same homogenous group.

[4] In 2008, the Ministry of Health decided to decrease the price of generics by 30%, except for those drugs which have a price of less than 5 euros.

[5] This percentage was changed to 90% in 2010.

[6] Category D covers new drugs, under patent, with transitory reimbursement system.

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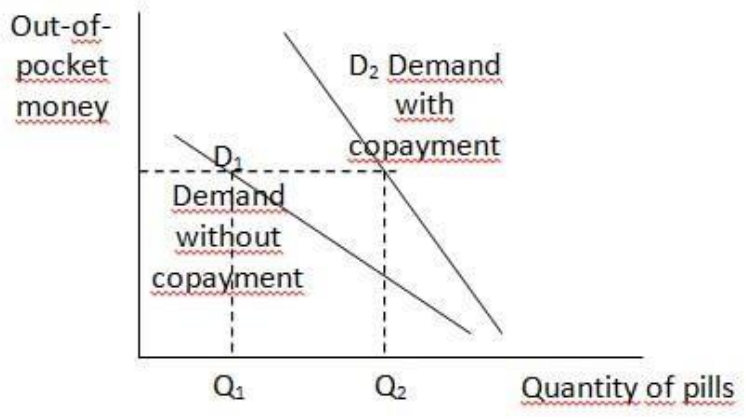
One way to express the additional demand generated by the insurance copayment of drugs is the increased market demand as shown in Figure 1. For the same amount of money spent by the consumer (called out-of-pocket), more medication can be purchased when there is copayment than when there is no insurance coverage.

Figure 1. Moral hazard effect



Therefore, it may be said that with moral hazard the demand for drugs increases because of the insurance coverage and it also becomes more sensitive to changes in the insurance expenses than to the patient out-of-pocket expenses (or in other words the elasticity of demand with insurance expenses is higher than the elasticity for out-of-pocket expenses).

Moral hazard in health also concerns the behavior of the doctor in relation to the patient. Moral hazard is said to exist when the effort exerted by the doctor on behalf of the patient is not sufficient to defend the patients' interests. In the case of prescription drugs and when choosing between branded and generic drugs, moral hazard may emerge when the utility that the doctor draws from prescribing branded drugs is higher than the utility drawn from prescribing generic drugs. This may happen either because the doctor is lazy and does not care about explaining the equivalence between generics and branded drugs to the patient, or he is used to prescribing a certain brand, or even because he follows a prescribing practice as detailed by pharmaceutical companies.

Therefore, moral hazard in the drugs market results in higher consumption of branded drugs.

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MATERIALS AND METHODS

The availability of pharmaceutical consumption data is limited and individual prescription data is not available. Therefore, aggregated data for the drugs market was employed in order to analyze average market trends. The data, provided by INFARMED (Portuguese Drugs Administration), holds monthly observations for the period 2004-2009, for pharmaceutical subgroups divided by three reimbursement categories (Table A in the Appendix).

The dataset covers 38 pharmaceutical subgroups, for 72 months, and 2736 observations. The variables are described, as follows, in Table 1.

The variables

Table 1. Description of variables

Variables		*Definition*
Dependent variables		
Ln D_T	Total demand for drugs	Logarithm of the number of packages of drugs sold in the market
Ln D_B	Demand for branded drugs	Logarithm of the number of packages of branded drugs
Ln D_G	Demand for generic drugs	Logarithm of the number of packages of generic drugs
Independent variables		
Ln Ofo_{AV}	Average Out-of-pocket	Logarithm of (Average) amount of money paid by the consumer for drugs per package (unit:euro)
Ln Ofp_G	Out-of-pocket for generic drugs	Logarithm of (Average) amount of money paid by the consumer for generic drugs per package (unit:euro)
Ln Ofp_B	Out-of-pocket for branded drugs	Logarithm of (Average) amount of money paid by the consumer for generic drugs per package (unit:euro)
ΔOfp	Out-of-pocket Difference	The difference between the out-of-pocket paid for branded drugs and the out-of-pocket paid for generics
Ln Ex	Average NHS expenditure	Logarithm of (Average) NHS expenditure per package sold in the market
Ln Ex_G	Average NHS expenditure in generic drugs	Logarithm of (Average) NHS expenditure per package sold in the market of generic drugs

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Ln Ex_B	Average NHS expenditure in branded drugs	Logarithm of (Average) NHS expenditure per package sold in the market of branded drugs
Ln T_G	Time in market by generics	Logarithm of number of months that generics have been on the market for each pharmaceutical subgroup.

The dependent variables are the demand for drugs (DT), the demand for branded drugs (DB) and demand for generic drugs (DG). Units are measured in packages, which may be questionable in terms of market analysis. In particular, drug packages may have a different number of pills or doses, as well as varying amounts of the active ingredient per unit. These differences are more significant when analyzing the demand within the different pharmaceutical subgroups.

A solution to these disadvantages would be to use the Defined Daily Dose (DDD), which is a unit measurement for the prescribed amount of a pharmaceutical. Using the DDD is advantageous, providing a direct measurement of the pharmaceutical linked to the prescribed quantity of the active agent and overcoming changes in the package size or dosage.

However, it is not possible to use DDD in our dataset because the reference group used for analysis is the pharmaceutical subgroup, which is an aggregated unit of analysis. Moreover, consumers buy packages and not pills, no matter how many pills they truly need for their treatment. On the other hand, to explore the possibility that different pharmaceutical subgroups have different reimbursement levels in Portugal, a high level of aggregation has to be used. Therefore, despite the noted disadvantages, the number of packages is used to measure the relative demand. This is considered to be an acceptable limitation, given that the aim of the paper is to find general market trends within different pharmaceutical subgroups. The reason for this is that most drug policies are based on general social and economic tendencies and the Portuguese reimbursement policy is an example of this.

Table 2 presents the summary statistics for the variables used in this analysis.

The average out-of-pocket expenditure paid for generics or for branded drugs is not very different; the reimbursement expenditure is quite similar for generics and branded drugs; on average the out-of-pocket difference between generics and branded versions is not very high and, in a few cases, it may be favorable to the branded version as for instance with the anti- parkinson drugs, anticoagulants and antithrombotic drugs and acne and rosacea treatment drugs, each from a different reimbursement category. This negative difference[7] only happens because the measurement unit is a package.

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Table 2. Summary statistics

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
D_T	255023.50	368547.40	2857.00	2009874.00
D_G	38788.40	75705.64	0	497257.00
D_B	216239.60	307784.90	2338	1594033.00
Ofp_{AV}	8.474	8.505	0.413	39.1767
ΔOfp	1.292	4.991	-20.796	23.538
Ofp_G	7.698	8.356	0	35.699
Ofp_B	8.859	9.058	0.073	44.709
Ex_{AV}	12.629	10.426	1.067	74.925
Ex_G	10.037	11.791	0.439	75.524
Ex_B	10.793	8.314	0.043	98.655
T_G	32.674	22.016	1.000	72.000

Table 3 shows the correlations[8] between some of the independent variables Strong correlations can be seen between the out-of-pocket expenditures or between the reimbursement expenditures (values in bold), as expected, because there is a legal framework governing how the market price is shared between the patient and the Ministry of Health. These correlations are significant because of the potential multicollinearity problem that they may create in the linear regression estimation.

Table 3 – Correlations between the independent variables

	Ln Ex_G	Ln Ex_B	Ln Ofp_G	Ln Ofp_B
Ln Ex_G	1	-	-	-
Ln Ex_B	**0.844**	1	-	-
Ln Ofp_G	0.428	0.195	1	-
Ln Ofp_B	0.188	0.208	**0.882**	1

[7] Because the difference in out-of-pocket expenditure may be negative, no logarithm may be computed.

[8] The correlation coefficients measure the linear dependence between two variables. Coefficients range from +1 to −1 where +1 is a perfect positive correlation, 0 indicates independence and −1 is a perfect negative correlation.

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The model

The demand function to be estimated is expressed as follows:

$Demand_{it}\ \ \alpha + \beta X_{it} + u_i + \varepsilon_{it}$, where (1)

$Demand_{it}$ – dependent variable representing the demand for drugs; the total demand for drugs (Dt), the demand for generics (DG) and the demand for branded drugs (DB);
X_{it} – independent variables: patient out-of-pocket (Ofpi); reimbursement expenditures (Exi);

difference in out-of-pocket between generics and branded drugs (ΔOfp); and length of time generics are on the market (TG);

α – the overall intercept;

β – the coefficients for independent variables;

u_i – the individual unobservable effect;

ε_{it} – the error term;

i – cross-section observations, per pharmaceutical subgroup;

t – time series observations, per month.

Expected coefficient signs and hypotheses

1. According to economic theory, the coefficient of *Ofp* is expected to be negative. However, this coefficient may be positive in the case where demand is sustained by patients and drugs are said to be a Veblen good, meaning that demand increases with the price. In this case, drugs are seen as a luxury good and price is an indicator of quality. Another view of this phenomenon is to say that drugs are a Giffen good. In this case due to a strong income effect, drugs are considered to be an inferior good. However, the model presented here does not allow us to conclude which type of goods drugs may be in this situation.

The interpretation of a positive sign for *Ofp* in the demand for branded drugs may also indicate the presence of moral hazard in relation to patients. This may happen because doctors may not be

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willing to exert the convincing effort that leads the patients to choose generics.

2. Reimbursement expenditures (*Ex)* are also expected to have a negative effect on the demand for drugs. This is because it is expected that the Ministry of Health promotes the rational use of drugs by means of cost sharing with the patients. This is rational behavior, meaning that the higher the public expenditure, the lower the prescribed and consumed drugs. However, the sign may be positive in the demand for branded drugs. In this case, it may indicate moral hazard behavior by doctors in their relation with the Ministry of Health. This may be explained because of the positive correlations between the demand for drugs and the reimbursement expenditures. If the sign is positive in the demand for generic drugs, then it is the Ministry of Health who sustains the demand through a policy that motivates the use of generics and it does not mean potential evidence of moral hazard.

3. The difference in out-of-pocket *(ΔOfp*) is expected to have a positive influence on the demand for generic drugs, but a negative influence on the demand for branded drugs. The bigger the difference between the prices, the more motivated the patient is to choose generics.

4. Finally, the coefficient for the time generics are on the market (T_G) is expected to be positive for the demand for generics and negative for the demand for branded drugs because of the learning experience with generics obtained with time.

RESULTS

Results are presented in Tables 4-7, in Appendix 2, and estimated models are numbered 1-11. The first line of the tables indicates the model number and the drug demand. The second line indicates the type of estimation effects (RE means random effects and FE, fixed effects), the coefficient and the p-value for the estimated coefficients. In the first column of the tables, the independent variables, constant and statistic values are listed.

Logarithms of the variables are used when estimating the models so that the coefficients can be interpreted as elasticities. The exception is the difference in the out-of-pocket expenditures; because negatives values may possibly appear in the database, no logarithm can be applied in this case.

Regression estimation with panel data requires a test to determine whether to use fixed effects (FE) or random effects (RE). The Sargan-Hansen test[9] can be used to this effect, where an insignificant statistic indicates that the panel data is to be estimated with random effects, otherwise it is best estimated with fixed effects. A fixed effects estimation implies that the unobserved individual effect μ_i is correlated with the explanatory variables X_{it}.

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The results for model 1, the demand for drugs, show that the higher the out-of-pocket payment by patients, the higher the demand for drugs; while the higher the public expenditure, the lower the demand. Comparing the absolute values, the demand elasticity for patients (ε=**0.135**)[10] is lower than that for the Ministry of Health (|ε|=**0.538**). It seems that there is no moral hazard in relation to the Ministry of Health and no excess drugs are sold in the market, meaning that the demand is not increasing due to public expenditure.

When the drug market is divided into generic and branded drugs, the results for each segment are different (models 2-6). The demand for branded drugs is mainly supported by the out-of- pocket money paid by patients, which does not happen with the demand for generic drugs, since the estimated coefficient has no statistical significance. Because the demand for branded drugs is supported by patients money, it may be inferred that there is some moral hazard relatively to them. Doctors may not be inducing patients to buy the alternative generic version.

The difference in the out-of-pocket value between generics and branded drugs has a negative effect (ε=**0.007)** on the demand for branded drugs but a positive effect (ε=**0.029)** on the demand for generic drugs. In both cases the elasticity is quite low, showing a rigid demand.

Reimbursement expenditures have a negative interaction (ε=ε**0.190)** with the demand for branded drugs but a positive (ε=**0.716)** with the demand for generics.

Finally, the length of time generics are on the market contributes to the demand for generics (ε=**1.090)** but not for the demand of branded drugs (ε=**0.103)**.

A closer look at the demand for branded drugs (models 7-8) shows that the reimbursement expenditures in category A are not statistically significant, unlike categories B and C, which also display negative correlation again.

[9]Under conditional homoskedasticity, the Sargan-Hansen test statistic is asymptotically equivalent to the usual Hausman fixed-vs-random effects test. Unlike the Hausman test, this test extends straightforwardly to heteroskedastic and cluster-robust versions. More details on the Sargan-Hansen test can be found in Christopher F. Baum, Mark E. Schaffer, and Steven Stillman, "Instrumental Variables and Gmm: Estimation and Testing," *Stata Journal* 3, no. 1 (2003).Baum et al. (2003) and Semykina (2012), as well as the Stata manual.

[10] The Greek letter ε represents elasticity.

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Finally, models 9-11, estimate the demand for the branded drugs in each reimbursement category. The results show that the three demands are slightly different and the explanatory factors vary among them. The relevant positive determinants for the demand of branded drugs in category A are the difference in out-of-pocket expenditures, the reimbursement expenditure and the time generics are on the market. The demand for branded drugs in reimbursement category B shows that demand is supported by the out-of-pocket payments of patients, but not by the out-of-pocket difference and reimbursement expenditures. Lastly, the demand for branded drugs in reimbursement category C only depends significantly on the length of time generics are on the market.

DISCUSSION

The need to control growing pharmaceutical expenditure requires a more generalized use of generic drugs (OECD 2011). However, the reimbursement policy may be inducing doctors and patients to choose the more expensive alternative in the market, the original branded drugs.

This work aims primarily to check for the existence of evidence supporting moral hazard in prescribed (branded) drugs. For this purpose, an estimation using linear panel data is performed in order to explain the demand for drugs using the out-of-pocket patient expenditures, the reimbursement expenditures from the Ministry of Health and the length of time generics are on the market.

Estimated results show that demand for drugs is mainly driven by the patient expenditures rather than the public reimbursement expenditures. Moreover, the demand elasticity (in absolute values) is higher for the reimbursement expenditures than the patient expenditures, thus it seems no moral hazard relatively to the ministry of health exists.

More interesting is the differentiation between generics and branded drugs. The demand for generics shows that it mainly depends on the reimbursement expenditures but not on the out- of-pocket payments of patients. This may reflect the fact that patients are not at ease with generics and it is the doctors who, on behalf of the Ministry of Health, seem to be more interested in prescribing generics. However, patients are somewhat concerned with the difference in monetary value, showing a positive reaction to the difference in out-of-pocket expenditures which motivates patients to choose generics. Though the demand is rigid in relation to the out-of-pocket expenditures.

The demand for branded drugs shows a different scenario from that of generics. The reimbursement expenditures do not sustain the demand for the branded drugs, which in this instance are more dependent on the patients' out-of-pocket expenditures. In this case, there

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seems to exist some moral hazard in the relation with the patients; they do sustain the demand but they seem to be slightly concerned with the out-of-pocket difference between branded drugs and generics.

Disaggregating the reimbursement expenditures using categories does not bring new results. However, it is observed that for demand as a whole the reimbursement expenditures of category A do not play a role determining demand and the elasticity of reimbursement expenditures is much larger in category B than in category C. This is to be expected because the level of reimbursement is higher in category B than in C and the desire to reduce expenses with drugs must be stronger in drugs of category B.

The demand for branded drugs in each reimbursement category shows some new insights. Firstly, the demand for branded drugs in category A depends on the Ministry of Health and patient expenditures. However, the elasticity is higher for the reimbursement expenditures than for out-of-pocket expenditures. Here it is possible to find evidence of potential moral hazard in the relation with the Ministry of Health. Doctors seem to be more willing to prescribe branded drugs and patients are willing to pay for them. It is these prescribed drugs that sustain the demand for branded drugs. This does not happen in reimbursement categories B and C.

Secondly, the demand for branded drugs in category B gives the expected results: the demand is driven by patients' expenditures but not by reimbursement expenditures and patients do care about the out-of-pocket difference.

Thirdly, for category C, factors other than the patient and Ministry of Health expenditures are responsible for explaining the demand for branded drugs. These results indicate that further research about reference pricing, reimbursement policy and prescription and consumption choices needs to be made.

Fourthly, estimated coefficients of the out-of-pocket expenditures show that the drugs have a positive demand elasticity less than unity, and thus drugs may be considered as luxury goods for patients.

Finally, results indicate that the more time that generics are on the market, the higher the demand for generics and the lower the demand for branded drugs. This reflects a learning process surrounding the prescription and consumption of generic drugs.

The policy implications of this work go in two directions. Firstly, the reimbursement policy based on reference pricing seems to prevent moral hazard in relation to the Ministry of Health. The exception to this statement is the case of the highly reimbursed drugs in category

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A. This is the only situation where it may be important to revise approaches on how to reduce the consumption of branded drugs and increase the consumption of generics.

Secondly, the design and implementation of the reimbursement policy in Portugal should press to increase the difference in prices and in out-of-pocket expenditure differences between branded and generic drugs in order to provide incentives for the consumption of generic drugs.

Thirdly, an emerging concern comes from these results. Drugs seem to be luxury good and this calls for potential equity issues that need further research.

The main limitation of this current work comes from using a methodology based on aggregated data of pharmaceutical subgroups, which only provides trends of market behavior. It may be questioned if the results hold when using data disaggregated at the prescription level or at the level of the active chemical ingredient. Most likely the results will hold for some doctors, some medical specialties and for some active chemical ingredients because the reimbursement policy goes together with a reference price based on generic drug price.

The other notable limitation is the use of the number of packages as a measurement unit, instead of DDD. However, DDD, as unit, is not suitable for aggregating pharmaceutical subgroups, which have to be used to capture the differences in the level of reimbursement which go with the reimbursement policy in Portugal.

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APPENDIX 1

Table A. Pharmaceutical subgroups, divided by reimbursement categories

Category A Reimbursement 95%	**Category B Reimbursement 69%**	**Category C Reimbursement 37%**
Agents for Treatment of Glaucoma	Antiarrhythmic	Analgesics and Antipyretics
Antiepileptic and Anticonvulsants	Antiasthmatic and Bronchodilators	Antiacids and Antiulcerous
AntiParkinson Drugs	Antibacterial Drugs	Antiemetic and Antivertigo Drugs
Hormone and Hormone Antagonists	Anticoagulants and anti-thrombotic	Antifungals
Hypothalamus and Pituitary Hormones, Analogues and Antagonists	Antifungals	Antihistamines
Immunomodulators	Antigout Agents	Antilipemics
Insulin, Oral Antidiabetics and Glucagon	Antihypertensives	Antimigraine Agents
Psychodrugs	Antivirals	Antivirals
	Drug acting on bone and Calcium Metabolism	Corticosteroids
	Drugs used in Arthrosis	Cough Suppressants and Expectorants
	Non-Steroidal Anti-inflammatory Agents	Drugs Altering Gut Motility
	Psychodrugs	Drugs for Acne and Rosacea Treatment
	Sex Hormones	Enzymatic Supplements, Lactic Bacillus and Analogues
		Muscle Relaxants
		Nasal Preparations
		Non-Steroidal Anti-inflammatory Agents
		Other Central Nervous System Drugs

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		Other Genital Disorders Agents
		Psychodrugs
		Stupefacients' Analgesics
		Topical Anti-infectives
		Vasodilators

APPENDIX 2

Table 4. Results for the demand for drugs

Model 1	
Independent variables	Coefficient (P value)
Ln OfpAV	0.135 **(< 0.001)**
Ln ExAV	–0.538 **(< 0.001)**
Ln TG	–0.031 **(< 0.001)**
Cons	12.681 **(< 0.001)**
F value	37.35
(prob > F)	< 0.001
SarganHansen statistic	20.373
(P- value)	< 0.001

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Table 5. Results for the demand for generic and branded drugs

	Model 2 Ln DB	Model 3 Ln DB	Model 4 Ln DB	Model 5 Ln DG	Model 6 Ln DG
Independent variables	RE	RE	FE	RE	RE
	Coefficient (P value)	Coefficient (P value)	Coefficient (P value)	Coefficient (P value)	Coefficient (P value)
Ln Ofpi[a]	0.021 (0.222)	0.081 **(0.001)**	0.056 **(0.043)**	0.010 (0.968)	0.205 (0.391)
ΔOfp	-	–0.006681 **(< 0.001)**	–0.007681 **(< 0.001)**	-	0.029681 **(< 0.001)**
Ln Exi[a]	–0.064 **(0.001)**	–0.079 **(< 0.001)**	–0.190 **(< 0.001)**	0.369 (0.124)	0.716 **(0.003)**
Ln TG	-	-	–0.103 **(< 0.001)**	1.090 **(< 0.001)**	1.090 **(< 0.001)**
Cons	11.501 **(< 0.001)**	11.433 **(< 0.001)**	12.234 **(< 0.001)**	3.852 **(< 0.001)**	2.888 **(< 0.001)**
Wald chi2	14.21 (0.001)	26.52 (< 0.001)	-	1152.84 (< 0.001)	1207.07 (< 0.001)
F statistic	-	-	28.36 (< 0.001)	-	-
SarganHansen	3.735 (0.155)	5.139 (0.162)	17.445 (0.0016)	4.515 (0.211)	8.527 (0.074)

Table 6. Results for the demand of branded drugs

	Model 7	Model 8
Independent variables	Coefficient (P value)	Coefficient (P value)
Ln OfpB	0.084 **(0.001)**	0.048 (0.094)
ΔOfp	–0.006 **(< 0.00**1)	–0.006 **(0.005)**
Ln ExB [cat A]	0.027 (0.520)	–0.045 (0.318)
Ln ExB [cat B]	–0.178 **(< 0.001)**	–0.406 **(< 0.001)**
Ln ExB [cat C]	–0.806 **(< 0.001)**	–0.149 **(0.002)**
Ln TG	-	–1.000 **(< 0.001)**
Constant	11.439 **(< 0.001)**	12.296 **(< 0.001)**
F value	8.54 (< 0.001)	23.40 (< 0.001)
SarganHansen statistic	25.751 (< 0.001)	43.902 (< 0.001)

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Table 7. Results for the demand of branded drugs by reimbursement category

	Model 9 [Cat A]	Model 10 [Cat B]	Model 11 [Cat C]
Independent variables	RE	RE	FE
	Coefficient (P value)	Coefficient (P value)	Coefficient (P value)
Ln OfpB	0.037 (0.164)	0.175 **(< 0.001)**	0.073 (0.189)
ΔOfp	0.007 **(0.066)**	–0.020 **(0.005)**	–0.002 (0.398)
Ln ExB	0.097 **(0.010)**	–0.499 **(< 0.001)**	0.056 (0.346)
Ln TG	0.031 **(< 0.001)**	–0.008 (0.406)	0.113 **(< 0.001)**
Constant	10.671 **(< 0.001)**	13.003 **(< 0.001)**	10.127 **(< 0.001)**
Number of observations	202	647	1373
Wald chi2	69.35 (< 0.001)	121.71 (< 0.001)	--
F statistic	--	--	54.71 (< 0.001)
SarganHansen statistic	7.105 (0.131)	8.270 (0.082)	25.218 (< 0.001)