Lower Bound Estimates of Price Elasticities of Pharmaceutical Consumption

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Abstract

The aim of this study is to estimate the price elasticity of pharmaceuticals for the elderly. Under the Spanish system of co-payment for prescription pharmaceuticals, working-age people must pay either 40% (non-chronic drugs) or 10% (chronic drugs) of their prescription pharmaceutical bills. Retirees are exempted from co-payment. We exploit the jump in the probability of retirement (and thus the exemption from pharmaceutical co-payment) at age 65 due to legal incentives to apply a *fuzzy* regression-discontinuity analysis. We use administrative data from all individuals aged 58-64 covered by the National Health System in Catalonia, Spain (n=447.888), from 2004-2006. Our findings show that prescription drug use is price sensitive, with elasticities of -0.2 for non-chronic drugs and -0.06 for chronic drugs. These elasticities must be interpreted as lower bounds because retirees have a lower opportunity cost of time.

Key words: Price elasticity, pharmaceuticals, co-payment, moral hazard, regression discontinuity analysis.

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“No me quieras tanto, quiéreme mejor.”

I. Introduction

Governments and health insurance companies have used different instruments to deal with asymmetric information consequences in markets related to health care. Patient cost-sharing mechanisms, e.g. co-payments, co-insurance and deductibles, are established in an attempt to reduce the excess of consumption caused by non-restricted access to health care. Arrow (1963) was the first to introduce the concept of moral hazard into health economics. From a traditional point of view, the additional health care that is purchased when an individual becomes insured (i.e. moral hazard) is considered inefficient (Pauly, 1968).

Following conventional economic theory, the magnitude of moral hazard in applied health economics papers has been classically inferred from price elasticities observed from changes in cost sharing in non-elderly (Newhouse, 1993; Chandra et al, 2010a) and elderly people (Chandra et al, 2010b; Puig-Junoy et al, 2011). However, reliability of moral hazard implications that rely on price elasticity estimates for prescription pharmaceuticals have long been criticised from three main perspectives: the existence of income effects that may reduce the importance of moral hazard (Nyman, 2004), offset effects through positive cross-price elasticities for other health services such as hospitalization (Chandra et al, 2010b), and reduction in appropriate and necessary treatments (Rice and Unruh, 2009).

The main contribution of this paper is to estimate the price elasticity of pharmaceuticals for the elderly using a regression discontinuity (RD) design which is highly regarded for its internal validity. Pharmaceutical spending accounts for a significant proportion of total health costs in developed countries. Mean expenditure on pharmaceuticals and other medical non-durables in OECD countries in 2009 amounted to 16.9% of total expenditure on health; 12% in the United States and 18.9% in Spain (OECD Health Data, 2011). Moreover, in Spain, public expenditure in pharmaceuticals was 1.3% of the GDP in 2007 -one the highest rates in the EU. Spanish pensioners amount to 73.3% of the pharmaceutical consumption, and this percentage has been increasing in the last decades (CGCOF, 2010).

This study contributes valuable evidence to the empirical understanding of co-payment and its effects, using an appropriate evaluation method that provides potentially more credible causal inferences than those arrived at by typical evaluation method (Lee and Lemieux, 2010). It is also important to highlight that in our study besides the change in pharmaceutical co-payment all the rest (co-insurance scheme applied to other types of health care) stays constant. Also, at least for a large fraction of our analysis there are no caps, deductibles or stop losses which means that we do not need to worry about non linearities in the budget constraint[1]. Finally, we use a very rich administrative dataset which is well suited for the RD design –usually described as data hungry.

The price elasticity of pharmaceuticals is a key parameter in the optimal linear insurance contract (Besley, 1988). Classical insurance literature has recognized the trade-off between increasing consumption (moral hazard) and risk reduction (Zeckhauser, 1970). Several studies have tried to evaluate the impact of insurance on the demand for health services. Manning *et al.* (1987) and Newhouse (1993) used data from the RAND Health Insurance Experiment, where people were randomly assigned to insurance schemes with different levels of co-payments. In France, an exogenous change in co-payment regimes provided Chiappori *et al.* (1998) a natural experiment to analyse the impact of different health insurance coverage on health care consumption.

Other studies relied on non-experimental settings to measure this effect (Cameron *et al.* (1988), Coulson *et al.* (1995), Holly *et al.* (1998), Pita Barros et al 2008). The main problem with non-experimental settings is the necessity to take into account the potential endogeneity of insurance choice. We go around that by applying a different approach which provides causal inferences that are potentially more credible than those from typical evaluation methods. We exploit the jump in the probability of retirement (and thus the exemption from pharmaceutical co-payment) at age 65 to implement a RD analysis.

Methodology in our paper is related to the one applied in Card *et al.* (2008). They use a RD design to analyse the impact of nearly universal coverage on health care in the US. They find that Medicare eligibility (reached mainly at age 65) causes a sharp increase in

[1] General co-payment rate is 40%. A lower coinsurance rate of 10% is applied to AIDS patients and to medicines mainly prescribed for chronic diseases, with a price cap of €2.64 per prescription.

the access and utilization of health care services (routine doctor visits, access to care and hospitalizations). Our study also shares common features with Chandra *et al.* (2010b). They examine policy changes for Californian civil servants under Medicare programme that increased the level of co-payment both for physician visits and prescription drugs. They provide one of the first robust estimations of price elasticity of pharmaceuticals for the elderly, as this group was excluded from the RAND Health Insurance Experiment. The prescription drug elasticities they find are very similar to those of the RAND Health Insurance Experiment.

There is very few evidence on the effects of the Spanish co-payment system. Puig-Junoy *et al.* (2011) examine the impact of coinsurance exemption for prescription medicines applied to elderly individuals in Spain after retirement using a difference-in-difference strategy (before and after retirement). Their most conservative results for previously pharmaceutical users show that the co-payment exemption increases the consumption of prescription medicines on average by 9.5%, total pharmaceutical expenditure by 15.2% and the costs borne by the insurer by 47.5%, without evidence of any offset effect in the form of reduced hospitalization. Although the aforementioned study and the present one share part of the objective and the data, the methodological approach and the population of study are different.

We find that retirement generates a positive and significant effect on pharmaceutical consumption for those individuals who experience a drastic change in their co-payment rate: from 40% to 0. We only find significant effect in the consumption of chronic drugs for which users pay only 10% of the price before gaining their exemption when pharmaceutical consumption is measured as the number of daily doses or prescriptions (not as expenditure). We also find that price elasticities are similar to those found for other types of care and populations.

The paper is organized as follows. Section 2 briefly describes the institutional framework. Section 3 describes the datasets and makes a graphical analysis of the data. Section 4 describes the evaluation method, the identification and estimation strategy. Section 5 is devoted to the interpretation of the econometric results and to some extensions and robustness checks. In Section 6 main conclusions are summarized.

II. Institutional framework

In Spain, since 1986 General Health Act (*Ley General de Sanidad*) was passed, we have a National Health Service (NSH). It is mainly publicly financed through general taxation, and it offers practically universal coverage, a wide basket of health care benefits and a low level of co-payments. Besides, it is a decentralised system, where the health services of the seventeen autonomous communities form the NHS.

Health care is free at the point of use to all residents, and user co-payments are restricted to pharmaceuticals and prosthesis. There are two regimes of pharmaceutical co-payment. On the one hand, users under the general regime pay 40% of medicine prices prescribed by out-patient NHS doctors (100% on private prescription drugs), with the exception of some specific groups (and their dependents): for retired, handicapped and invalids there is no co-payment. There is also a reduced co-payment rate (10%) applied to drugs for chronic and serious diseases and to drugs for AIDS treatment, with a maximum amount of 2.64 € per prescription[2].

Regarding the public social insurance, Spain has a mandatory pay as you go system. In our period of analysis[3] the legal age for retirement, although not mandatory, is 65 for both men and women. Earlier retirement is penalized through a decrease in the drawn benefit.

[2] This is the maximum amount that establishes the Law 29/2006 on Guarantees and the Rational Use of Medicines and Healthcare Products (*Ley de Garantías y Uso Racional de los Medicamentos y Productos Sanitarios*). The Ministry of Health can bring this amount up to date.

[3] In July 2011 Spanish parliament passed law 27/2011 (*Ley sobre Adecuación, Adaptación y Modernización del Sistema de Seguridad Social*) that modifies retirement age. This law becomes effective in 2013 and extends gradually legal retirement age up to 67 years old.

II. Data and graphical analysis

We are not able to observe both pensioner status and pharmaceutical consumption for each individual in the same dataset. Thus, we need two different datasets. As we explain in section IV the design we apply allows this empirical strategy.

III.a. Information on pharmaceutical consumption

On the one hand, we use administrative data of health care utilization of the elderly population covered by the National Health System in Catalonia (Spain). In particular, we have data from all individuals between 58-64 years-old covered by the Catalan Health Service (*CatSalut*) (n=447,888) during 2004-2006 period. To obtain information about pharmaceutical consumption and other covariates we have merged the following sources of information: Central Register of Insured (*RCA, Registre Central d'Assegurats*) from the Catalan Health Service, *CatSalut* pharmaceutical consumption record, discharges from hospitals record (*CMBD-AH, Conjunt Mínim Bàsic de Dades d'Alta Hospitalària*) and database "Nomenclator DIGITALIS-INTEGRA" from the Spanish Ministry of Health, Social Policy and Gender Equality[4].

Our variable of interest is pharmaceutical consumption. There are different measures in our dataset: prescriptions, drugs retail price (in euros) and "Defined Daily Dose"[5] (DDD). We present our estimates using all three measures although our baseline results are expressed in drugs retail price as this is the most common measure used in the literature. Also, we are able to identify which kind of drug is prescribed, i.e. (i) if it is classified as a chronic or serious drug and thus subjected to a reduced copayment rate (10% of the price with a maximum amount of 2.64 € per box) or normal contribution pharmaceutical (which should pay a 40% copayment) and, (ii) if it is a generic or a non-generic drug[6]. Besides, we also have socio-demographic variables such as gender and level of education.

[4] Accessed in June 2010.

[5] DDD is an international accepted classification system for drug consumption. World Health Organization defines DDD as "the assumed average maintenance dose per day for a drug used for its main indication in adults" (http://www.whocc.no/atcddd/).

[6] Generic condition is established at the national drug code level. However, as we do not have pharmaceutical information at the national drug code level but at the ATC (Anatomical Therapeutical

Raw data was collected on a monthly basis. Following Card *et al.* (2008) we have converted it into quarters. Bin width is also conditioned to the availability of data as we only were able to obtain microdata on pensioner status at quarter level. We have restricted our analysis to individuals between age 63 and 67. The main incentive for going into retirement is at age 65. Hence, despite we had information for individuals from 54 to 67 years-old we have taken this window to preserve the same number of bins on each side of the threshold.

The descriptive statistics for key variables of interest of our final dataset are listed in table 1. The data we use contains 2,019,826 observations of 281,589 individuals. Even though we conduct separate analysis regarding different co-payment rate (10% or 40%) and type of pharmaceutical (generic or non generic) here we show the statistics referred to all observations for period 2004-2006. The mean age of our sample is 64.5 and 51% of the observations are referred to women. Regarding the educational level, most of the individuals have no studies or are elementary school dropouts (60%), some of them have elementary school diploma or have completed junior high school (24.3%) and the less have achieved high school or college diploma (15.7%). Regarding the variable of interest, we observe a mean expenditure of 70.1 €, 5 prescriptions and 121.9 DDDs a quarter.

TABLE 1. DESCRIPTIVE STATISTICS FOR KEY VARIABLES

Age	64.5 (mean)
Female	51%
Elementary school dropout	60.00%
Elementary and junior high school	24.30%
High school and college	15.70%
Drugs consumers	49,8%
Expenditure	70.1 (mean)
Defined Daily Doses*	121.9 (mean)
Prescriptions	5 (mean)
n (# individuals)	281,589
N (# observations)	2,019,826

Source: Own elaboration. *Restricted to 1,500 DDD per quarter.

Chemical classification system) code level we classify all drugs under the same ATC 7 digits code as generic if at least one of them is classified as generic.

Figure 1 reports pharmaceutical consumption (actual and fitted) on normal contribution drugs (subjected to a 40% co-payment rate by the user) by each age quarter from 63 to 67, based on our dataset. First, we have plotted the residuals of the regression of the dependent variable (pharmaceutical expenditure) on a time variable (month in which the drug was consumed). We condition on the month of consumption because pharmaceutical consumption might be seasonal and the average age in the sample is not uniformly distributed across the months in the sample. Then, we allow for a discontinuity at the threshold and fit regressions from models that assume a first order polynomial age profile on both sides of the cut-off point. Figure 2 replicates the same graph with reduced contribution drugs –those in which the patient only pays 10% co-payment rate or less due to 2.64 € price cap per prescription.

Figure 1 suggests that there is a discontinuity in the consumption of normal contribution drugs at age 65 which might be related to the change of health insurance coverage. However, we can not conclude from figure 2 that there is change in pharmaceutical consumption at age 65 for chronic drugs.

FIGURE 1. PHARMACEUTICAL CONSUMPTION, BY AGE. NORMAL CONTRIBUTION (40%)

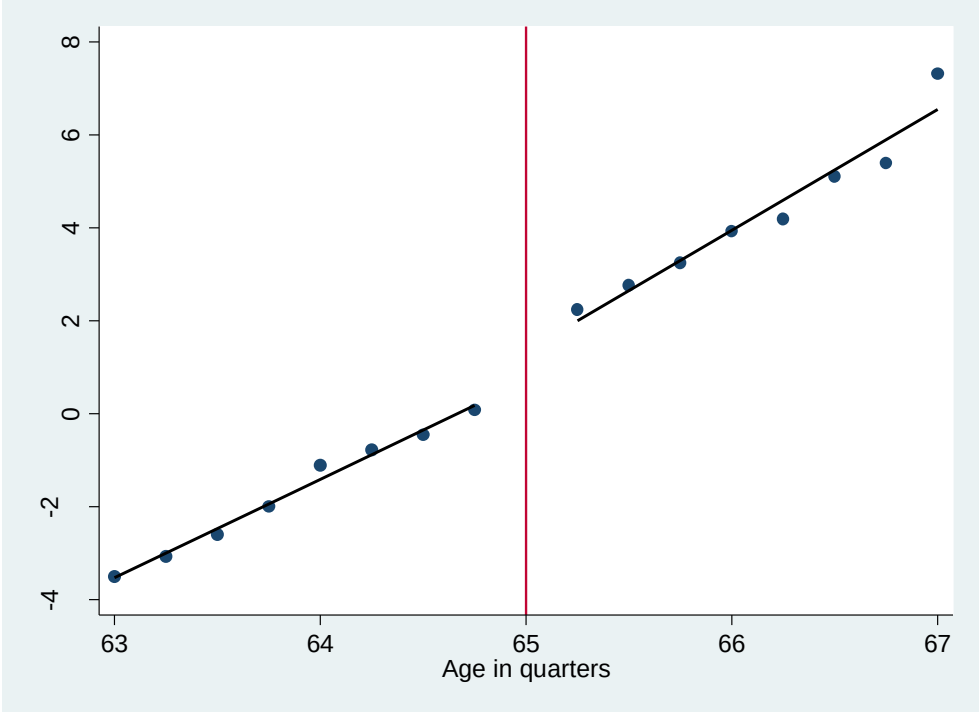
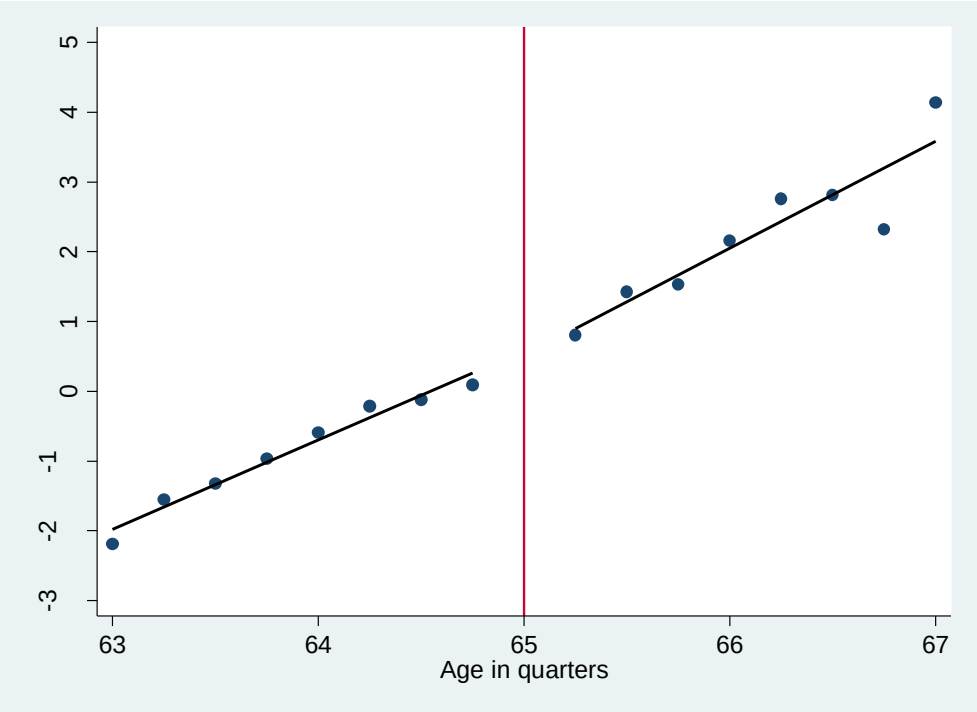


FIGURE 2. PHARMACEUTICAL CONSUMPTION, BY AGE. REDUCED CONTRIBUTION (10% OR LESS)



III.b. Information on labour/pensioner status

On the other hand, after examining different datasets we use the Active Population Survey (*Encuesta de Población Activa*). This dataset consists in a survey conducted by the Spanish National Institute of Statistics (*INE - Instituto Nacional de Estadística*) which focuses on information regarding labour force and their categories, and includes pensioners and inactive population. This survey provides cross-sectional data and it is recorded by quarters. Therefore, we asked the microdata for the 12 quarters that cover our period of analysis (2004-2006).

Our variable of interest is the pensioner status, which is defined as a dummy variable that equals 1 if the individual receives a retirement or early retirement benefit, invalidity benefit or a different kind of pension and 0 otherwise. Socio-demographic information such as gender and level of education is also available. The analysis is restricted to individuals between 63-67 years old living in Catalonia.

Table 2 lists the descriptive statistics for key variables of our sample. Final dataset contains 7,174 observations, 64.1% of whom are pensioners. Observable characteristics such as age (mean 65) and gender (51.6% of our individuals are women) are very similar to the ones in the other dataset, except for the level of education[7]. This is the reason why we limit the analysis to low educated group (which encompasses both elementary school dropout and elementary and junior high school) and high educated group (high school and college).

TABLE 2. DESCRIPTIVE STATISTICS FOR KEY VARIABLES

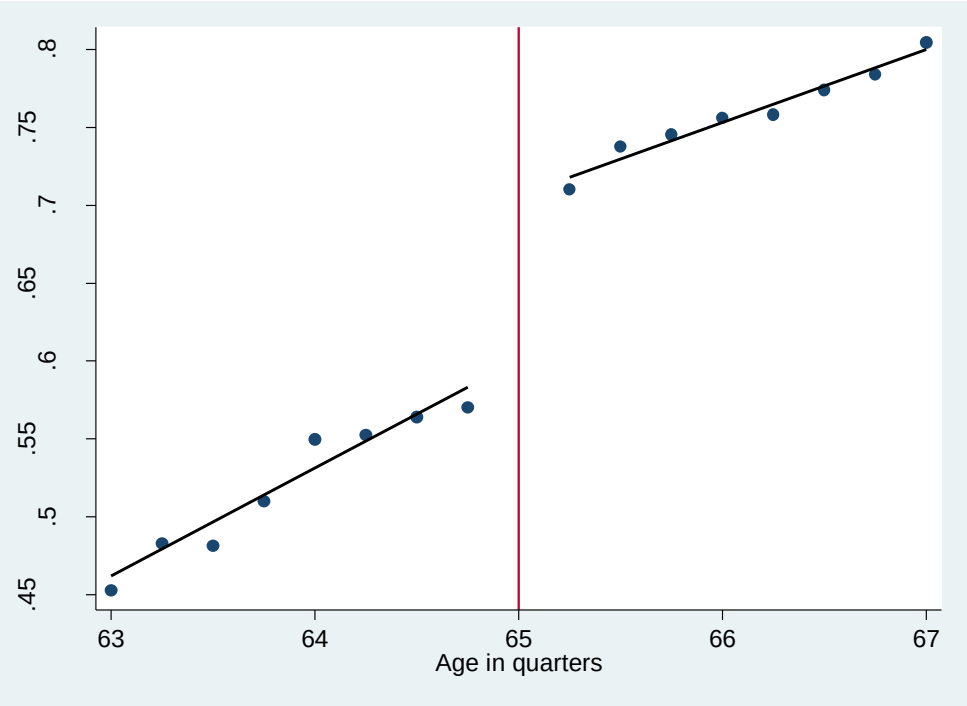
Age	65 (mean)
Female	51.6%
Elementary school dropout	19.6%
Elementary and junior high school	61.7%
High school and college	18.7%
Pensioners	64.1%
N	7,174

Source: Own elaboration

As mentioned above, in our period of analysis in Spain there are incentives to retire at age 65. The legal age for retirement, although not mandatory, is 65 for both men and women. Earlier retirement is penalized through a decrease in the drawn benefit. Figure 3 reports the probability of going into retirement (actual and fitted) by each age quarter from 63 to 67, based on our dataset. We regress the dependent variable (pensioner status) on a dummy variable indicating 65 or older, age, an interaction term between age and dummy variable for being older than 65 and a time variable that indicates the quarter in which the survey was conducted. Then we plot the fitted values of this regression collapsing by age, allowing for a discontinuity at the threshold and plotting the fitted regression on both sides of the threshold. The discontinuity at age 65 suggests that legal incentives have a powerful effect on retirement decision.

[7] Individuals at the administrative dataset might be underreporting their education level for instance to avoid eligibility in polling stations or to do jury duty.

FIGURE 3. PROPORTION OF PENSIONERS, BY AGE



Retirement involves co-payment exemption on pharmaceutical consumption. The pensioner status entitles the individual to obtain prescribed pharmaceuticals free of charge. Our hypothesis is that this exemption causes an increase in pharmaceuticals consumption which is attributable exclusively to the change in insurance coverage. The methodology we apply, which is discussed in the next section, enables us to use a regression discontinuity framework to compare drug consumption among individuals just before and after their retirement.

III. Evaluation method

We use a Regression Discontinuity (RD) framework to analyse the causal effect of co-payment exemption on pharmaceutical consumption. Since the late 1990s, this design has been broadly applied to the estimation of programme effects in different fields of social science. It was first introduced by Thistlethwaite and Campbell (1960) as a research method to estimate treatment effects in a non-experimental setting. An RDD arises when treatment is determined by whether an observed "forcing" pre-intervention variable exceeds a known cut-off point.

Following Angrist and Pischke (2008: 251), RD designs exploit precise knowledge of the rules determining treatment. As we have pointed out above, in the Spanish NHS, going into retirement entails the exemption of co-payment in pharmaceuticals. In Spain, legal retirement age in our period of analysis is 65. Although it is not mandatory, earlier retirement is penalized. This means that despite the fact that individuals have some influence over their decision to retire, they can not precisely manipulate the forcing variable. A consequence of this is that the variation in treatment near the cut-off point is randomized as though from a randomized experiment (Lee and Lemieux, 2009). It would imply that all baseline characteristics should have the same distribution before and after the threshold, and that any discontinuity in the relationship between the variable of interest and the forcing variable should be attributable to the treatment.

Depending on the size of the discontinuity, there are two different RD design styles (Trochim, 1984). In our study, as compliance with retirement at age 65 is imperfect, we apply a *fuzzy* RD design.

VI.a Identification and estimation of Treatment Effects in RD design

Following the notation of the potential outcome approach to causal inference[8], let Y_1, Y_0 be the two potential outcomes, respectively, by participation (being retired with no co-payment on pharmaceuticals) and non-participation (active workers with a 40%/10%

[8] This section is based on Battistin and Rettore (2008). We have also considered that β varies across individuals. See the aforementioned study for the conditions we need to impose for identification.

cost-sharing). $\beta = Y_1 - Y_0$ is the causal effect of the treatment, which is not observable. I is the binary variable that denotes treatment status, with I =1 for participants and I = 0 for non-participants. S is an observable and continuous pre-intervention variable (age in our case) and there exists a known point in the support of S, $\bar{s}$ (age 65 in our case), where the probability of participation changes discontinuously.

Equation (1) identifies the mean impact of the programme on the *compliers* being those subjects in a neighbourhood of $\bar{s}$ who would switch their treatment status if the threshold for participation switched from just above their score to just below it (see Imbens and Angrist, 1994, and Angrist *et al.*, 1996). It is the analogue of the LATE (Local Average Treatment Effect) in this context.

$$E\left\{\beta \middle| I(\bar{s}^+) \neq I(\bar{s}^-)\right\} = \frac{E\left\{Y \middle| \bar{s}^+\right\} - E\left\{Y \middle| \bar{s}^-\right\}}{E\left\{I \middle| \bar{s}^+\right\} - E\left\{I \middle| \bar{s}^-\right\}} \quad (1)$$

Hahn *et al.* (2001) were the first to show the important connection between how the treatment effect is defined in the *fuzzy* RD and in the "Wald" formulation of the treatment effect in an instrumental variables (IV) setting. The idea is that we can use the discontinuity to produce instrumental variables estimators of the effect of the treatment. There are many examples in the literature that uses IV as an application of RD designs for evaluating the effect of programmes (see Campbell (1969), Angrist and Lavy (1999), Van der Klaauw (2002), Card *et al.* (2008)).

The legal age for retirement at 65 provides a candidate instrumental variable for the decision of retirement. Legal retirement age does not completely determine retirement, but as shown in Figure 1 it creates a discontinuity in the probability of being retired, implying that the instrument has a powerful effect. This would naturally lead us to a two-stage procedure, in which going into retirement is instrumented by being older than 65.

However, we are not able to observe both pensioner status and pharmaceutical consumption for each individual in the same dataset. Given the way the parameter of interest is identified in equation (1) we can use different dataset to estimate separately

the numerator and the denominator. Our estimation procedure has then three steps. In the first stage, we estimate as a linear probability model[9] equation (2) using survey data on labour market participation.

$$P_{it} = X_{it}\beta + g(S_{it}) + D_{it}\pi_a + q_t + u_{it} \quad (2)$$

where P_{it} is a dummy variable indicating whether individual i is a pensioner at time t, X_{it} represents a set of measured characteristics, β is a vector of coefficients, $g(S_{it})$ is a smooth function representing the age profile of the outcome (e.g. a low order polynomial), D_{it} is a dummy for being older than 65, q_t is an indicator variable for quarter t, and u_{it} is an unobserved error term.

Second, we estimate by ordinary least squares equation (3), i.e. the change in pharmaceutical consumption at age 65 using a pharmaceutical consumption dataset.

$$y_{it} = X_{it}\alpha + f(S_{it}) + D_{it}\pi_b + q_t + v_{it} \quad (3)$$

where y_{it} is pharmaceutical consumption for individual i at time t, X_{it} represents a set of measured characteristics, α is a vector of coefficients, $f(S_{it})$ is a smooth function representing the age profile of the outcome (e.g. a low order polynomial), D_{it} is a dummy for being older than 65, q_t is an indicator variable for month t, and v_{it} is an unobserved error term.

Finally, to obtain the parameter of interest (δ, which is the causal effect of retirement status on pharmaceutical consumption), we divide both effects of being older of 65 computed in equation (2) and (3), $\delta = \left(\frac{\pi_b}{\pi_a}\right)$. This provides us a LATE estimate (i.e. the

[9] In the choice between probit or logit and linear regression in the first-stage we have followed Angrist and Krueger (2001: 80). They argue that "In two-stage least squares, consistency of the second-stage estimates does not turn on getting the first-stage functional form right (Kelejian, 1971). So using a linear probability model generates consistent second-stage estimates even with a dummy endogenous variable. Moreover, using a nonlinear first stage to generate fitted values that are plugged directly into the second-stage equation des not generate consistent estimates unless the nonlinear model happens to be exactly right, a result which makes the dangers of misspecification high"

average effect of treatment for *compliers*) of being retired on pharmaceuticals consumption.

For estimating equation (3) we use longitudinal data, which allows us to estimate more precisely changes at age 65 as most behaviours and outcomes are strongly positively correlated over time. However, it is important to note that our variable of interest (pharmaceutical consumption) is increasing over time. To capture this time-specific component, we have estimated a fixed time effects model, including time dummy variables for each month.

IV.b Estimation Issues

Standard theoretical treatments of RD designs assume that the forcing variable is continuous. In our case, however, age is measured in quarters. This makes impossible to compare outcomes for observations just above and just below the threshold (age 65), and requires choosing a parametric functional form for the relationship between the treatment variable and the outcome of interest. Lee and Card (2008) propose different procedures to account for uncertainty in the choice of the functional form for RD designs with discrete support. One of these options consists in modelling potential specification error using clustered standard errors for the different values of the treatment-determining covariate (i.e. cluster by age). This is the approach we have taken in this paper.

Nevertheless, cluster robust inference asymptotics are based on that the number of clusters tends to infinite. As shown in Cameron *et al.* (2008), if there are only a few clusters (5 to 30) standard asymptotic tests can over-reject. In our data set we have 17 age groups so we need to introduce asymptotic refinement.

Besides, as one of our datasets is longitudinal we need to account for within-individual correlation of the errors over time. It seems that imposing a specific dynamic structure introduces more restrictions without any gain in identification (Lee and Lemieux, 2010) so we use individual clustered standard error. This means that we face two-way clustering in the estimation in one of the datasets (pharmaceutical consumption).

Hitherto, we have not found any other study that solves the same problem (two-way clustering plus asymptotic refinement) so we have developed an *ad hoc* estimation procedure which is the most accurate for multi-cluster-robust inference. First, we apply a wild bootstrap-se procedure to create pseudo samples based on a modification of the residuals using so-called Rademarcher weights (+1 with probability 0.5 and -1 with probability 0.5), with this assignment at the age cluster level and we obtain the standard error using the bootstrap coefficients in both datasets.

Second, to deal with the multi-cluster (age and individual) structure in the pharmaceutical dataset we follow Miller et al. (2009). We sum the variance matrix estimate computed using bootstrap-se cluster by age to the variance matrix estimate computed using clustering by individual. Then, we subtract to this sum the variance matrix estimate computed by using clustering on both levels –which in our case means no cluster at all as clustering by individual and age collapses to each single observation in our dataset.

Finally, as our RD estimate $\delta = \left(\frac{\pi_b}{\pi_a} \right)$ is a non linear combination of estimators we apply the delta method to compute the variance.

V. Results

We have tried different specifications allowing the coefficients to differ on both sides of the threshold interacting variables with a dummy variable for being older than age 65 and with different polynomial forms of the age variable. Finally, all models include age with no interactions and time fixed effects. All models are fit to micro data and standard errors (in parenthesis) are computed using bootstrap techniques and assuming a cluster structure by age (also cluster structure by individual in the pharmaceutical consumption dataset). Standard errors from the RD estimates are calculated using the delta method.

V.a Changes in Co-payment Rate at Age 65

Table 3 presents estimates of reaching age 65 on the probability of going into retirement, based on equation (2) fit by linear probability models. As suggested in Figure 3, the probability of going into retirement experiments a sharp increase when reaching age 65. Our results indicate that reaching legal retirement age increases the probability of being out of the labor force by 10 percentage points. The impact is quite similar for high educated (12 percentage points) than for low educated (10 percentage points).

TABLE 3. PROBABILITY OF GOING INTO RETIREMENT AT AGE 65

All	0.100***
	[-0.0084]
Low educated	0.096***
	[-0.0126]
High educated	0.123***
	[-0.0377]

Notes: *** statistically significant at 1%. Standard errors (in brackets) are calculated using a wild bootstrap-se by age.

V.b Changes in Pharmaceutical Consumption at Age 65

Table 4 presents estimates for the impact of going into retirement on pharmaceuticals consumption. These parameters identify the mean impact of full health insurance coverage on the *compliers*, i.e. those people in a neighbourhood of age 65 who would become a pensioner when they reach legal retirement age.

We have conducted separate analyses regarding the level of co-payment for chronic drugs (10%) and non-chronic drugs (40%). We then disaggregate further away and look at not only co-payment rate but also whether the individual consumes generic or non-generic drugs (the results shown here are only expressed as pharmaceutical expenditure).

First, for non-chronic drugs, we find an increase of €15.41 (41.3%), 25.72 DDDs (37.8%) or 1.28 (39.2%) prescriptions filled in a quarter. This effect is statistically significant. For chronic-drugs, the increase in consumption is also positive, but much smaller than for non-chronic drugs (note that the reduction in copayment is much larger for non-chronic drugs -from 40% to 0%- than for chronic drugs -10% to 0). In fact, only the quantity estimates (number of prescriptions and DDDs) are statistically significant in this latter case (9.768 more DDDs and 0.265 more prescriptions).

The estimates are very similar for highly educated individuals (high school or college) and for those with lower education.

Table 4. Regression Discontinuity Estimates

		Normal contribution drugs		Reduced contribution drugs	
All:	Expenditure	15.41***		3.321	
		(2.8186)	*41.3%*	(2.5245)	*10.6%*
	Doses	25.72***		9.767***	
		(4.7906)	*37.8%*	(1.8142)	*17.3%*
	Prescriptions	1.28***		0.265***	
		(0.2674)	*39.2%*	(0.0848)	*16.1%*
Low educated:	Expenditure	15.55***		0.38	
		(2.2555)	*38.7%*	(-2.6023)	
	Doses	24.44***		6.03	
		(3.9660)	*33.2%*	(0.4903)¥	
	Prescriptions	1.24***		0.197	
		(0.2024)	*35%*	(0.0136) ¥	
High educated:	Expenditure	13.62***		4.617**	
		(4.8904)	*42.2%*	(2.2976)	*16.7%*
	Doses	22.62***		16.18***	
		(8.2147)	*39.6%*	(5.5504)	*35.7%*
	Prescriptions	1.25***		0.281**	
		(0.4463)	*49.1%*	(0.1249)	*20.9%*

Normal contribution + generics		Normal contribution + non-generics		Reduced contribution + generics		Reduced contribution + non-generics	
9.730***		5.430***		3.669***		-0.041	
(1.4709)	*38.56%*	(1.535)	*46.26%*	(1.2292)	*19.8%*	(1.9089)	*-0.34%*

Note: *** statistically significant at 1%, ** 5%, * 10%. Standard errors (in parenthesis) are calculated using Delta method. In italics the percentage of change compared to the average consumption in the just-before period (age 64.75). ¥ Negative variance due to matrix algebra does not allow us to compute delta method variance so robust standard errors of the regression of equation (3) with no cluster are shown here.

To our knowledge, this is the first study to analyze this effect using an RD design. This makes impossible to compare our results with those from other studies. Nevertheless, it is worth mentioning main results from previous studies that analyze a similar effect. In the US, Coulson *et al.* (1995) found that Medicare supplementation for prescribed drugs or doctor visits increases the number of prescriptions filled in an amount that goes from 0.56 to 1.42 additional prescriptions in a two-week reference period depending on the type of Medicare-gap supplement insurance. More specifically, these authors found that enrolling on PACE programme (Pharmaceutical Assistance Contract for the Elderly) which offers prescription-drug coverage involved an increase of 1.05 prescriptions filled in two-weeks.

Results from Puig-Junoy *et al.* (2011) find no significant increase in consumption or in expenditure when copayment rates are below 30% before the co-payment exemption. Results for the average individual with a previous co-payment rate above 30% and no higher than 40% show a large and statistically significant increase of 108.4 DDDs per year per person (an 18.5% increase), and an increase in total pharmaceutical expenditure of €71.54 per person (a 25.4% increase). Potential offset effects on hospital utilization are not statistically significant for any of the co-payment groups analysed.

V.c Price Elasticities of Pharmaceuticals

Table 5 shows the arc elasticities of pharmaceutical consumption obtained using our model. These figures differ by the type of pharmaceutical. For non chronic drugs in which individual pays 40% of the price we find an arc elasticity of -0.2. The price elasticity is much lower (-0.05) when patient faces a 10% or lower co-payment (due to price cap). Regarding generic and non-generic drugs, we find that response to changes in price is slightly higher when generic drugs are prescribed. We do not find significant variation of price elasticity by level of education.

TABLE 5. ARC ELASTICITIES OF PHARMACEUTICAL CONSUMPTION

	Normal contribution	Reduced contribution	Generic	Non generic
All	-0.2	-0.05	-0.15	-0.11
Low Educated	-0.19	-0.01		
High Educated	-0.2	-0.08		

Our price elasticies estimates are very similar to those obtained for other types of care and populations. In the RAND Health Insurance Experiment the plan response for prescription medicines was similar to that of total outpatient care (Leibowitz *et al*., 1985). The arc elasticity for outpatient care was -0.13 for nominal coinsurance rates in the range 0-25%, and -0.21 for nominal rates between 25 and 95% (Manning *et al*, 1987). Other recent studies based on non-experimental settings, like Landsman et al. (2005) find price elasticites from -0.16 to -0.10 for asymptomatic condition drugs and

from -0.6 to -0.24 for symptomatic condition drugs. Gaynor et al. (2007) find price elasticities that range from -0.5 to -0.8 for different model specifications.

With respect to elderly, Chandra et al (2010b) find price elasticities of drug utilization of -0.15 or -0.08, depending on the plan examined. Puig-Junoy *et al*. (2011) find an unweighted median arc elasticity of -0.13 for individuals who had a co-payment rate between 30% and 40%. Their median arc elasticities for individuals with previous coinsurance rates lower than 15% or between 15% and 30% are lower (-0.07 and -0.04) and only statistically significant at 90%.

V.d Other discontinuities at age 65

RD continuity condition requires that all other factors that might affect the outcome of interest trend smoothly at age 65. Our main concern is that a potential decrease in the opportunity cost of time due to retirement could bias our estimates. In this sense, retirees could have more time to visit doctors and possibly obtain more prescriptions. If this happens we would be overestimating the change in consumption and thus our elasticity measures would be too negative and so we can only interpret our results as lower bound estimates. However note that our estimates are already reasonably small, so even as lower bounds they are quite informative.

Whether the bias above is important or not is an empirical issue. It is relatively easy to think that career concerns would be small for those over 60 so workers would not feel afraid of taking time off to visit the doctor. Moreover, we believe, most colleagues would understand that over 60s need to visit the doctor more often. So far, our results do not indicate that the bias described above is major. One would expect that it would be most important for the higher educated because their opportunity cost of time is higher while working, so their visits to the doctor should increase more upon retirement if the mechanism described above was in place. However, we find that the price elasticities are very similar for higher and lower educated which seems to indicate that visits to the doctor does not increase discontinuously at 65.

To check this we use data from Catalonian Health Survey (*Enquesta de Salut de Catalunya*). We use microdata from all its editions (1994, 2002 and 2006) to maximise sample size (N=1,596). We find no discontinuity in visits to the GP in the last 15 days with a non-statistically significant coefficient of -0.008 (robust standard error 0.0588, p-value 0.888).

Other minor concern would be if hypothetical changes in income due to retirement could affect pharmaceutical consumption. We do not think that this is an issue given that co-payment rate is 0 after retirement.

VI.d Extensions

In order to find out more about the behavioural response of the change in health insurance coverage we replicate the analysis differencing medication according to their appropriateness. For this purpose we apply the Beers criterion (Beers et al., 1991) updated by Fick et al. (2003) to our dataset. This is the most predominant explicit classification of the quality of the prescription for the elderly and has been broadly applied in the literature (see, for instance, Costa-Font et al. 2010). Their criteria are based on expert consensus by experts in geriatric care in the US and they define inappropriate medications as medications that entail more potential risks than benefits.

Applying this criterion we identify 29 active principles in our sample, which represents 7.4% of all observations. We find no significant change in inappropriate medication (coefficient equals 0.173, delta standard error 0.1053).

VII. Conclusions

This study analyses whether co-payment exemption (which is associated to retirement) causes an increase on pharmaceutical consumption and estimates the price elasticity of pharmaceuticals for the elderly. Although there is a broad literature on the evaluation of the impact of insurance on the demand of health services, there is very little evidence that examines this effect on the elderly. Therefore, this study contributes valuable evidence to the empirical understanding of co-payment and its effects, using an appropriate evaluation method that provides more credible causal inferences than those arrived at by typical evaluation methods.

After taking into account the potential endogeneity of the retirement decision, we find that retirement generates a positive and significant effect on pharmaceutical consumption. The effect differs depending on the type of drugs and co-payment rate. For non-chronic drugs which experience a drastic change in their co-payment rate -from 40% to 0-, we find a 38-41% increase. For those who are paying 10% of the price of prescription medication, we find a statistically significant consumption increase of 16-17% only when pharmaceutical consumption is expressed as doses or prescriptions. Furthermore, we find no significant change in inappropriate medication which suggests that the change in healthcare insurance affects equally both appropriate and inappropriate prescription.

Finally, we find that prescription drug use is price sensitive, with elasticities of -0.2 for non-chronic drugs and -0.05 for chronic drugs. Our price elasticies estimates are very similar to those obtained for other types of care and populations. We interpret our results as lower bound estimates as a potential decrease in the opportunity cost of time due to retirement could bias our estimates. However, so far our results do not indicate that this bias is major.

Some limitations may affect the results presented in this paper. First, the design we apply allows us to measure the effect of co-payment exemption on pharmaceutical consumption only in a short-term basis. This is a limitation but at the same time prevents the effect we are measuring to be affected by the consequences that retirement could have on health which may only occur in a longer period of time. Second, if there

is any substitution effect between private and public pharmaceutical consumption due to co-payment exemption we can not disentangle it from our results.

These findings have implications for the design of an optimal coinsurance scheme for prescriptions to elderly and retired people. It also reveals significant information to policy makers as our results allow the accurate prediction of the expected impacts of reforms in the prevailing Spanish co-payment scheme for prescription medicines.

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