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FREE MEDICINES THANKS TO RETIREMENT: IMPACT OF COINSURANCE EXEMPTION ON PHARMACEUTICAL EXPENDITURES AND HOSPITALIZATION OFFSETS IN A NATIONAL HEALTH SERVICE

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ABSTRACT

This paper examines the impact of coinsurance exemption for prescription medicines applied to elderly individuals in Spain after retirement. We use a rich administrative dataset that links pharmaceutical consumption and hospital discharge records for the full population aged 58 to 65 years in January 2004 covered by the public insurer in a Spanish region, and we follow them until December 2006. We use a difference-in-differences strategy and exploit the eligibility age for Social Security to control for the endogeneity of the retirement decision. Our results show that this uniform exemption increases the consumption of prescription medicines on average by 17.5%, total pharmaceutical expenditure by 25% and the costs borne by the insurer by 60.4%, without evidence of any offset effect in the form of lower short term probability of hospitalization. The impact is concentrated among consumers of medicines for acute and other non-chronic diseases whose previous coinsurance rate was 30% to 40%. Copyright © 2015 John Wiley & Sons, Ltd.

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1. INTRODUCTION

Over the past four decades, all developed countries have been struggling with the rise in government and private health expenditure, which have increased in most countries faster than gross domestic products. The recent economic recession has reduced government revenues, increasing the pressure to control costs. Pharmaceutical spending accounts for a significant and increasing proportion of total health care costs in developed countries. Over the last decade, public and private insurers have intensified their efforts to slow down pharmaceutical expenditure growth through a mix of price regulation and volume controls targeted towards the pharmaceutical industry, physicians and pharmacies, as well as increasing the share of the cost borne by users. Pharmaceuticals are typically covered with less generosity than other health care services in nearly all Organization for Economic Co-operation and Development countries (OECD, 2010).

Despite the widespread use of cost sharing arrangements to finance pharmaceuticals, in many countries, the actual level of out-of-pocket expenses for covered medicines is undermined by population-wide and generous exemptions from these cost sharing arrangements. In 2008–2009, out of 29 OECD countries, 24 countries exempted from cost sharing those individuals with specific medical conditions and disabilities, 13 countries

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exempted seniors and 13 countries exempted pregnant women (Paris *et al*., 2010). Therefore, the exemption affects those patients who concentrate most of the pharmaceutical consumption. This leads to formal cost sharing to be applied to a very meagre proportion of overall pharmaceutical consumption.

The existent evidence on the impact of cost sharing exemptions in the context of national health services (NHS) is scarce, and most of the evidence comes from US-based studies. The Rand Health Insurance Experiment (HIE), a large randomized social experiment performed in the USA from 1974 to 1982, provided evidence on the sensitivity of pharmaceutical expenditure and health care use to its own price for the non-elderly when simultaneous similar copayment rates with an income-related cap are applied to all health services (Newhouse, 1993). Average expenditure on prescription medicines of consumers in the least generous plan were 57% of those on a free plan. The response to the plan for prescription medicines was similar to that for 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). Free care appeared to increase both appropriate and inappropriate use of antibiotics. However, no adverse effects on health were found to be associated with cost sharing, except that free care led to improvements in hypertension, dental health, vision, and selected serious symptoms.

Nowadays, despite its random nature and despite being still widely held as the 'gold standard' of evidence for cost sharing policies (Aron-Dine *et al*., 2013), the usefulness of the Rand HIE for the design of optimal pharmaceutical cost sharing is limited for four main reasons. First, it is more than three decades old and since then, there has been a notable increase in cost and extension of treatment possibilities in all health systems, especially in pharmaceutical treatments. Second, elderly people, who in many countries are responsible for more than three quarters of the pharmaceutical expenditure, were excluded from the randomized experiment. Third, the HIE does not allow us to disentangle the adverse offset effects of pharmaceutical cost sharing from those stemming from copayment on other health services. And fourth, potential biases driven by differential participation and reporting across plans introduce uncertainty about the magnitude of the impact of different cost sharing schemes on medical expenditures (Aron-Dine *et al*., 2013).

More recently, Chandra *et al*. (2010) estimate modest but significant price sensitivity for both physician visits and prescription drug consumption among the elderly Medicare population in California, USA. They evaluate the effects of a simultaneous increase in patient cost sharing for physician visits and medicines, which does not allow them to disentangle changes in the level of pharmaceutical copayment from those of visit copayments as individual contributors to the offset effect observed in the form of increased hospital utilization in response to higher copayments by the most ill populations.

Therefore, we find that a large proportion of the vast literature concerning the effects of pharmaceutical cost sharing provides evidence on the impact of cost sharing increases (not cost sharing reductions) on the number of prescriptions, use of other health services and, less commonly, health outcomes. At the same time, most evidence comes from health systems in which sizeable copayments apply to nearly all health care services, and patients usually pay for services at the point of access. Also, it is rare for the copayment of one type of health service to change while that of all the others remain constant, and complementarities or substitutability between different health care services could bias the results if prices change simultaneously (Puig-Junoy, 2013).

In our opinion, the literature on pharmaceutical cost sharing has paid little attention to the impact of widespread age-related cost sharing exemptions (copayment reductions that may reach gratuity) in health systems where all other health services, except pharmaceuticals, are provided for free by an NHS. In fact, we consider that specific evidence is needed to evaluate whether the conclusions of the existing evidence can be extended to other settings. In addition, insights from the behavioural economics literature suggest that moving to a zero price (free provision) may be completely different from offering services at a price that is lower than before (Shampanier *et al*., 2007). This hypothesis is being confirmed by the small but growing literature in development economics (Cohen and Dupas, 2010; Ashraf *et al*., 2010), and similar results could also be expected when healthcare services are provided free of charge (Ellis, 2012).

Many previous cost sharing studies that focus on drug copayment impact on the elderly populations are simple cross-section or before/after comparisons without a control group (Rice and Matsuoka, 2004; Goldman

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et al., 2007). A survey of this literature, mainly based in the USA and Canada, reports that increasing prescription cost sharing is associated not only with lower rates of drug treatment but also with worse adherence and therapy discontinuation (Goldman *et al*., 2007). Recent non-US-based studies on the impact of pharmaceutical copayment using individual data on the elderly population are relatively few and have not produced irrefutable evidence on its magnitude or price sensitivity. Grootendorst (1997) finds that eligibility for zero copayment of British Columbia residents aged 65 years or over living in single person households has a minor contribution to overall expenditure increase compared with trend effects. Atella *et al*. (2006) argue that Italian hypertensive patients treated with ACE inhibitors strongly reduce compliance after copayment increases, which leads to increases in hospitalization and mortality rates. The latter effect is obtained by comparing compliers with non-compliers. This may not reflect the behaviour of those who have been affected by copayment changes.

We extend the existing literature examining the effects of an exogenous drop in the percentage paid for pharmaceuticals among the elderly population. We examine the important change in cost sharing for prescription medicines that was taking place in the Spanish NHS for elderly patients after retirement until July 2012. When Spaniards transited into retirement, they were exempted from the previous high coinsurance rate for prescription medicines and got complete free access for them and all their dependants. To evaluate this coinsurance change, we use a rich administrative dataset that links pharmaceutical consumption and hospital discharge records for the full population aged 58 to 65 years in January 2004 covered by the public insurer in a Spanish region. Following them until December 2006, we compare consumption trends of individuals who transited into retirement with those of individuals whose exemption status did not change and exploit the institutional features of the Spanish Social Security System to instrument the retirement decision in an instrumental variables fixed effects (FE) estimation.

We find that this change in cost sharing has strong effects on both consumption and total pharmaceutical expenditure. Our estimates show that pharmaceutical consumption (measured as the number of daily defined doses [DDDs]) increases by 17.5% because of copayment exemption and total pharmaceutical expenditures by 25%. The increase in pharmaceutical expenditures is concentrated among individuals who were consumers of acute and other non-chronic pharmaceutical treatments with a previous coinsurance rate in the range 30% to 40%. The effect on the public insurer is larger as it includes not only the increase in pharmaceutical consumption but also a cost shift from the patient to the insurer because of the exemption. Therefore, we find that the costs of the public insurer increase by 60.4% because of copayment exemption.

In addition, there is hardly any evidence of the existence of substitution effects for the elderly on ambulatory and inpatient hospital care and health effects in NHS systems. An offset effect could be hypothesized to exist for elderly patients in the form of reduced hospital utilization when they become eligible for high cost sharing exemption. This offset effect may arise from increased initiation of chronic treatment or improved patient compliance for effective prescription medicines under free care. A literature review finds that increased cost sharing is associated with lower rates of drug treatment, worse adherence among existing users and more frequent discontinuation of therapy (Goldman *et al*., 2007). For example, in a non-elderly population, Gaynor *et al*. (2007) find that part of the expenditure savings on consumption drugs after an increase in copayments is offset by increases in outpatient spending. Similarly, the results of Page *et al*. (2008) suggest that increased cost sharing of prescription drugs for elderly beneficiaries appears to exert negative effects on health outcomes and may be related to an increase in utilization of other healthcare services, and a recent meta-analysis shows lower adherence to medicines in publicly insured populations after introduction (or increase) of copayments for medicines (Sinnott *et al*., 2013). We use the same identification strategy to evaluate whether a decrease in pharmaceutical copayments has a causal effect on the consumption of other health care resources. In particular, we test the existence of offset effects in Spain and find that we cannot reject the null hypothesis that copayment exemption does not impact the probability of hospitalization the year after the change in the pharmaceutical copayment. Furthermore, the absence of statistically significant offset effects in the short term remains in all the different subgroups.

The rest of the paper is structured as follows. Section 2 provides some background information on the Spanish health system. Section 3 describes the data and section 4 the empirical strategy. Section 5 presents

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our results on price sensitivity and hospitalization offsets for the average patient and provides evidence of the heterogeneity of the results. The paper concludes with a summary of the conclusions and the discussion of the main limitations and policy implications.

2. THE SPANISH NATIONAL HEALTH SYSTEM

Until July 2012, the Spanish NHS provided generous free health care coverage to all Spanish residents, except civil servants, with the exception of a non-refundable coinsurance rate for outpatient prescription pharmaceuticals, which had been 40% of the retail price since the early 1980s. A lower coinsurance rate of 10% was applied to AIDS patients and to medicines mainly prescribed for chronic diseases, with a price cap of €2.64 per prescription. Thus, effective coinsurance rates for insured patients ranged from 40% to a rate slightly above zero for highly priced medicines under the lower coinsurance rate. In addition, drugs provided to hospitalized patients were provided free of charge.

Pensioners and their dependants were exempted from this coinsurance scheme,[1] so the previously mentioned coinsurance rates were applied only to economically active people and their dependants, independently of their socio-economic characteristics. Caps or ceilings on maximum out-of-pocket expenditure did not exist either. Active individuals who transited into retirement or received an incapacity pension, independently of their age, and all their dependants were automatically exempted from the pharmaceutical coinsurance scheme and got free access to outpatient prescription medicines (Costa-Font and Puig-Junoy, 2007).

Nominal coinsurance rates (40% and 10%) remained unchanged in the two decades previous to the 2012 reform, although the effective average coinsurance rate had halved since the eighties (from 15% in 1980 to 7% in 2009). The reduction in effective cost sharing might be explained by the increasing ageing process, a larger number of medicines with a 10% coinsurance rate, and the fact that pensioners could be obtaining prescriptions for other household members who were not exempt from copayments (Puig-Junoy, 1988).

Our analysis focuses on the exemption from the coinsurance scheme for the outpatient prescription medicines of retired people in Spain applied until June 2012.[2] We are interested in the change in consumption because of the change in the coinsurance rate among those insured individuals who were cost sharing and became exempted from the coinsurance (zero price) after retirement.

3. DATA

3.1. Sample construction

We use an administrative database of pharmaceutical and inpatient care utilization containing all the population aged 58 to 64 years who were covered by the public insurer in Catalonia on 1 January 2004 and were still alive on 31 December 2006 (447 888 individuals). We observe for each individual over the period 2004–2006 monthly pharmaceutical consumption prescribed by a Spanish NHS doctor. The resulting dataset includes individual information on the monthly number of prescriptions, the number of prescribed DDDs,[3] total

[1]Copayments for pensioners and their dependents were introduced in July 2012, which is outside our observation period.

[2]After more than three decades of free medicines for the elderly, in July 2012, a new copayment policy was adopted as one of the policies to reduce public expenditures after the severe economic crisis in Spain. The main changes in the copayment structure of the pensioners were the following (Puig-Junoy *et al*., 2014): (i) a national coinsurance rate of 10% for retirees with a monthly income-related cap of €8, €18 or €60, depending on income; (ii) two regions (Catalonia and Madrid) temporarily charged a €1 copayment per prescription; and (iii) a long list of medicines indicated for minor symptoms were excluded from funding from the public insurer, which is equivalent to a 100% coinsurance rate for those medicines. Under the new coinsurance formula, medicines remain free for disadvantaged people.

[3]A DDD is defined as the average daily dose of a new chemical entity used by an adult for treatment of the main indication of the pharmaceutical.

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pharmaceutical expenditure, pharmaceutical costs borne by the individual, number of prescriptions and average retail price per prescription.[4]

We do not directly observe the type of pharmaceutical coverage (active individuals under the coinsurance scheme or retired individuals/pensioners exempt from it) of each individual, but this can be inferred from the amount of the retail price borne by the patient. Thus, an individual with positive cost sharing (pharmaceutical cost borne by the patient greater than zero) in all the observed monthly consumptions can be classified as an active individual affected by the coinsurance scheme, while an individual who does not participate in the cost of the drug is identified as a pensioner with free prescription medicines. Note that if the cost sharing of an individual is zero, we will not observe him/her with positive copayment as the information refers to the drugs prescribed to the individual. In addition, we identify individuals who at the beginning of our observational period do participate in the cost of the drug but from one point in time onwards have zero cost sharing. This last group can be classified as new pensioners who become eligible for exemption from the coinsurance scheme. We cannot identify changes in coverage for individuals with zero pharmaceutical consumption. These are therefore excluded from our analysis (210 896 individuals).

We are interested in the causal effect of the exemption from the coinsurance scheme on total pharmaceutical consumption and expenditure (valued at retail prices) and on inpatient care utilization. Therefore, we analyse the effects of the coinsurance exemption on the following three pharmaceutical outcome variables: number of DDDs, total expenditure and cost borne by the public insurance. We also analyse one hospital utilization outcome variable: whether the individual spent any days in the hospital during the year (probability of hospitalization).

The analysis of the effects of the coinsurance exemption on pharmaceutical consumption and hospitalization requires longitudinal information on individuals who change their insurance coverage status during our observational period, as well as on individuals whose coverage remains unchanged. Regarding the new pensioners, we are interested in their pharmaceutical consumption and hospital utilization before and after the change occurs, but the effects on the year in which they become pensioners may be misleading as they will depend on the month in which the transition takes place. Therefore, we restrict the analysis to pharmaceutical consumption in the years 2004 and 2006 for individuals who are observed as active and covered by the coinsurance scheme throughout the period and individuals who retire and become pensioners in 2005.

Our final analysis sample corresponds to 88 800 individuals: 22 909 new pensioners who become eligible for coinsurance exemption in 2005 and 65 891 individuals who are active and under the coinsurance scheme in all three periods. In what follows, we will refer to new pensioners as the treatment group and to active individuals as the control group.

3.2. Descriptive statistics

Table I presents the means of the outcome variables for each analysis group in 2004 and 2006. The number of DDDs and total pharmaceutical consumption in 2004 are higher among the treatment group, individuals reaching copayment exemption, than for the control group, those who remain active.

Average pharmaceutical expenditure jumped from €296 in 2004 to €449 in 2006 (53% increase) among the treatment group, while it increased by 21% among the control group (from €262 in 2004 to €317 in 2006). Similar differences are observed in the evolution of the average number of DDDs. The cost of the medicines for the public insurer jumped 100% for people in the treatment group (from €224 in 2004 to €449 in 2006) but 'only' 22% for the control group. This difference is driven not only by higher consumption but also by the effect of providing free drugs for the treatment group in 2006.

In addition, we show means for hospitalizations by year and population group. The probability of any hospital stay is significantly higher for individuals in the treatment group. This clearly indicates that individuals

[4]Similarly to other administrative datasets, information on socio-economic characteristics is very limited. We only observe area of residence, educational attainment and nationality, all measured in January 2004.

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Table I. Means of key outcome variables

	2004			2006		
	Control group	Treatment group	*p*-value	Control group	Treatment group	*p*-value
Medicines						
Number of DDDs	512 (598)	568 (643)	0.000	650 (696)	873 (866)	0.000
Total expenditure (€)	262 (354)	296 (376)	0.000	317 (510)	449 (565)	0.000
Insurance cost (€)	198 (304)	224 (317)	0.000	242 (464)	449 (565)	0.000
Hospitalization						
Probability of any hospital stay	0.083	0.117	0.000	0.096	0.118	0.000
Other variables						
Coinsurance	0.283	0.279	0.000	0.278	0	0.000
DRGs	0.144	0.270	0.000	0.199	0.282	0.000
Age	59.96	61.41	0.000	61.97	63.41	0.000
Men	0.535	0.527	0.033	0.535	0.527	0.033
Analgesics/anti-inflammatories	0.672	0.709	0.000	0.699	0.801	0.000
Anti-hyperlipidemics	0.037	0.035	0.098	0.043	0.049	0.001
Anti-infectives	0.313	0.341	0.000	0.311	0.374	0.000
Biologicals	0.116	0.135	0.000	0.152	0.191	0.000
Cardiovascular agents	0.298	0.320	0.000	0.351	0.392	0.000
Neurological agents	0.461	0.496	0.000	0.495	0.550	0.000
Dermatologicals	0.361	0.383	0.000	0.381	0.449	0.000
Diabetes drugs	0.344	0.359	0.000	0.364	0.420	0.000
Eye, ear, nose and throat p reparations	0.257	0.295	0.000	0.277	0.402	0.000
Endocrine/metabolic agents	0.100	0.109	0.000	0.103	0.141	0.000
Genitourinary agents	0.127	0.140	0.000	0.133	0.170	0.000
Gastrointestinal drugs	0.288	0.329	0.000	0.353	0.467	0.000
Immunological agents	0.258	0.290	0.000	0.262	0.342	0.000
Nutritionals	0.131	0.150	0.000	0.126	0.187	0.000
Pulmonary drugs	0.021	0.021	0.944	0.019	0.026	0.000
Upper respiratory agents	0.025	0.029	0.001	0.023	0.029	0.000

DDD, daily defined doses; DRGs, diagnosis-related group.
p-value of Ho: mean(control) = mean(treated). Standard deviations of consumption of medicines in parentheses.

in the treatment group are more ill than those in the control group and emphasizes the importance of controlling for differences in initial health using FE. Hospital use weighted by diagnosis-related group (DRG) is also 110% higher for the treatment group in 2004. DRG-weighted hospital use remains higher for the treatment group, but the difference has been reduced to 41% 2 years later.

Average age is slightly (1.44 years) higher for individuals in the treatment group than for those in the control group. However, we find that some individuals in our sample become pensioners at the age of 59, while others are still employed at the age of 67.

4. EMPIRICAL STRATEGY

4.1. Empirical model

We aim to identify the effect of copayment exemption on the different outcomes. This could be identified by the parameter δ in the difference-in-difference model (1) estimated by FE using data for 2004 and 2006, while the change in coverage is identified in 2005.

$$Y_{it} = \alpha + \phi C_i + \delta LC_{it} + X_{it}^{'}\beta + \lambda_t + u_i + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome of interest of individual i in year t; α is a constant, C_i is a dummy variable that identifies the treatment group; LC_{it} is a dummy for a decrease in the coinsurance for the treatment group (it combines an

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indicator of being treated and a dummy for being in the post-treatment period, which is the year 2006 in this case); X_{it} is the set of covariate explanatory characteristics; λ_t is a time fixed effect; u_i represents the individual fixed unobserved heterogeneity; and ε_{it} is a purely random error term. In this model, the effect of the exemption from the coinsurance is identified by δ, which measures the change in the outcome of interest of those with an exemption in their copayment compared with those who remain under the coinsurance.

The individual fixed effect allows us to control for the effect of time invariant characteristics like gender, country of birth, education, occupation, work history or initial health that can possibly confound the retirement decision and the amount of pharmaceutical expenditures. In addition, we control for age in all our models using a quadratic function and for changes at the aggregate level driven by, for example, either changes in economic conditions or pharmaceutical policies, using year dummies.

A potential problem with this approach is the assumption that becoming a pensioner in 2005 is independent of the factors that condition medicine consumption, which is not likely to hold as one would expect individuals who suffer a sudden or even a progressive health deterioration to be more likely to retire and become a pensioner on the one hand and at the same time increase their pharmaceutical consumption. A selection problem arises if people self-select into retirement based on their health status, LC_{it} then being correlated with the unobservables. In this situation, the FE estimate of δ is not consistent. We deal with this problem using instrumental variables. Large spikes in the retirement hazards at the earliest retirement age and at the normal retirement age have previously been found in the literature (Gruber and Wise, 2004). In Spain, individuals can first claim old-age benefits at the age 60, and the normal retirement age is 65 years (Boldrin, Jiménez-Martín and Peracchi, 2004). Therefore, we use the early and full statutory retirement ages to instrument the probability of becoming a new pensioner, as they are expected to have an effect on the probability of retiring while not having an effect on health after controlling for a quadratic age polynomial. We provide evidence that supports this hypothesis in Section 4.3. We identify the coinsurance effect δ in equation (1) using a two-stage least squares FE estimator.

We also create individual pharmaceutical profiles using the RiskSmart Global Stand Alone application version 2.0 (Verisk Analytics, Jersey City, NJ, USA) (DxCG Inc, 2005), which builds so-called Aggregated RxGroup (ARXG) categories. ARXGs use detailed information on outpatient claims data on the type of drugs consumed in each period using 18 non-exclusive categories (Zhao *et al*., 2001; DXCG Inc, 2005). ARXGs have been designed to encompass broad categories of drugs (active ingredients), based upon their most common uses. ARXG categories typically identify the major organ systems with which an agent interacts (e.g. cardiovascular drugs and central nervous system drugs) or the agent's primary pharmacologic activity (e.g. anti-infectives, anti-hyperlipidemics and diabetes drugs). In this paper, we use ARXG categories as proxies of treated diagnoses for all individuals. We construct a set of 16 dummies for disease categories, which take value 1 when the individual consumed drugs related to each ARXG category. We analyse whether the effect of copayment exemption is different among individuals with different (non-exclusive) morbidities, measured by the ARXG categories.

4.2. Common trends assumption

As Table I shows, the treatment and control groups differed substantially in 2004. This can cast some doubts about the 'common trends assumption', that is, that trends in drug expenditures would have been the same for the treatment and control groups in the absence of the change in the cost sharing at retirement. Figure 1 depicts average DDD per year for the treated and the control group as well as for the group of pensioners and the group of individuals who became pensioners in 2004 and in 2006.[5] The evolution of average DDD in the years 2004–2006 follows a similar pattern for individuals who are active and individuals who are pensioners during the period of analysis. In addition, the average number of DDDs of individuals who became pensioners in 2006 increased at the same rate from 2004 to 2005 as among individuals who were active in all years. This evidence provides support in favour of the common trends assumption.

[5]Similar trends are found for total pharmaceutical expenditure (available from the authors upon request).

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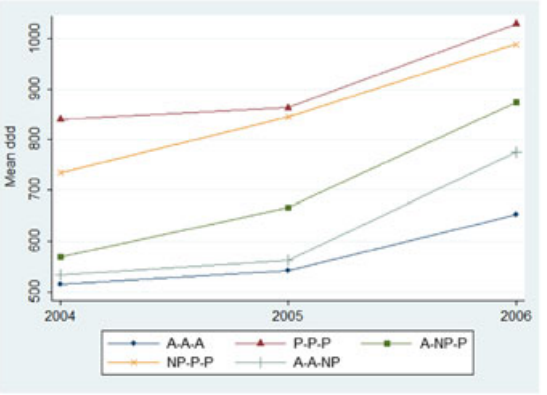

Notes: A-A-A, subsample of individuals active in the period 2004–2006 (control group 1); P-P-P, subsample of pensioners in the period 2004–2006 (control group 2); A-NP-P, subsample of individuals who became pensioners in 2005 (our treatment group); NP-P-P, subsample of individuals who became pensioners in 2004; A-A-NP, subsample of individuals who became pensioners in 2006.

Figure 1. Average daily defined doses, by coverage and year.

Table II. Test of common trends assumption. Fixed effects estimates

Medicines	
Number of DDDs	−2.79 (3.74)
Total expenditure (€)	0.35 (2.02)
Insurance cost (€)	1.62 (1.75)
Hospitalizations	
Probability of any hospital stay	0.006 (0.003)*
Number of observations	182,735

DDD, daily defined doses.
Each column shows coefficients from a different regression. All regressions include individual fixed effects, age and age^2, and time dummies. Standard errors are in parentheses.
Significance levels:
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

We further test the common trends assumption using the subsample of active population and individuals who became pensioners in 2006. We estimate a FE model as described in equation (1), where we evaluate whether the change in pharmaceutical consumption from 2004 to 2005 among those who became new pensioners in 2006 is different from the trend among those who were active in all three periods.[6] The results are shown in Table II. We see that all the coefficients are statistically insignificant. These results support the use of active individuals as a comparable control group in our identification strategy.[7]

In addition, we estimate the same model to evaluate the plausibility of the common trends assumption for the probability of any hospital stay. The results in Table II show that individuals who became pensioners in 2006 are more likely to have been hospitalized in 2005 compared with individuals who remain active in 2006. Therefore, controlling for the endogeneity of retirement and health in the retirement decision is crucial in this case.

[6]Unfortunately, we do not have access to more years of data, so we cannot test the common trends assumption using a longer time period.
[7]Individuals who are pensioners at the beginning of our observational period could also be considered a plausible control group. We use a similar strategy to test the common trends assumption between new pensioners and existing pensioners. We find that the increase in pharmaceutical consumption among pensioners from 2004 to 2005 was statistically significantly higher than among active individuals who became pensioners in 2006. Therefore, we only use the group of active individuals as a control group.

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4.3. Instrument validity

The statutory retirement ages can be used as instruments as long as they explain the probability of retiring.[8] Figure A1 in the online Appendix shows the retirement hazard as a function of age of the stock sample of individuals who were active in 2004. We see that the hazard of retirement peaks at the ages of 60 and 65, being highest at the age of 65. The estimated hazard is similar to that found by Boldrin *et al.* (2004).

Table A1 in the online Appendix shows the first-stage regression of the probability of retiring in 2005 for our sample of analysis. Statutory early retirement age and full retirement age are important predictors of retirement decisions, and we can see that they are jointly highly significant. The probability of retiring increases by 2 percentage points after the statutory early retirement age and by 39 percentage points after the full retirement age. The effect of age is also significant, and it shows the expected quadratic relationship. In addition, we estimate the Hansen *J*-test of overidentifying restrictions for each of the models, and we do not reject the null hypothesis in all cases.[9]

On the other hand, our analysis identifies the effect of cost sharing exemption as long as retirement does not have an effect on the individual's health. If retirement had a negative effect on health, then the increase in pharmaceutical consumption would be partly due to a worsening in health status. There is limited health information in our dataset to rule out this hypothesis. We use information from the 2006 Catalan Health Survey and use the same set of instruments to estimate the effect of retirement on several health outcomes (probability of reporting good or very good health, having circulatory problems, having respiratory problems, having digestive problems, reporting depression, staying in bed in the last 15 days and the reported health status on the visual scale). We did not find any significant effect.[10] In addition, we use DRG from the hospital information to construct a measure of the annual sum of DRG weights as a proxy for severity of health problems.[11] We estimate the effect of copayment exemption using the same empirical strategy (FE-instrumental variables) and find insignificant effects.[12] These results provide some support to the hypothesis that the effects shown in the succeeding paragraphs are not because of a causal effect of retirement on health.

5. RESULTS

5.1. Impact of cost sharing exemption

Cost sharing exemption reduced the average copayment rate for the treatment group from 27.9% in the year before retirement (2004) to zero in the year after (2006). The causal effects of this exemption on medicine consumption and hospital utilization are shown in Table III. Each cell reports the estimate of the effect (δ) and its standard error in parentheses.

The second column (Model 1) shows the FE estimates when the endogeneity of the retirement decision is not controlled for. The results obtained from Model 1 show that on average, copayment exemption has a sizeable and highly statistically significant effect on the number of DDDs, amounting to 160.46 DDDs per year per person. There is also a high and statistically significant increase in total pharmaceutical expenditure and in the cost borne by the public insurer. However, these results ignore the endogeneity of retirement and health, and the estimates will be biased if individuals who suffer health deterioration are more likely to retire.

[8]It is unlikely that individuals decide to retire in order to benefit from the copayment exemption as the maximum amount paid by an individual before retiring is €77/month, and 99% of the sample spend less than €33/month on pharmaceutical expenditure.
[9]Results not shown but available from the authors upon request.
[10]Results available from the authors upon request.
[11]We have for each hospitalization the DRG code and the economic weight associated with each code. These weights have been constructed using hospital data from the USA and therefore should be taken as a relative measure as they inform about the relative cost with respect to a diagnosis with weight equal to one. By adding the weights of the different episodes, we aim to obtain an indirect measure of the complexity of the health problems experienced by the individual.
[12]Coefficient = −0.004 and standard error = 0.062.

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Table III. Effects of coinsurance exemption on medicines and hospital utilization

	Model 1	Model 2
Medicines		
Number of DDDs	160.46*** (4.57)	129.90***(22.89)
Total expenditure (€)	100.39***(3.29)	90.07***(14.15)
Insurance cost (€)	182.65*** (3.13)	169.16***(13.77)
Hospitalization		
Probability of any hospital stay	−0.016*** (0.003)	0.009 (0.02)
Instrumental variables	No	Yes
Number of observations	177 600	177 600

DDD, daily defined doses.
Each column shows coefficients from a different regression. All regressions include individual fixed effects, age and age^2, and time dummies. Standard errors are in parentheses.
Significance levels:
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Once we control for the endogeneity of the retirement decision (Model 2), we find that the effect of copayment exemption amounts on average to 129.90 DDDs per person per year among those individuals who retire because they reach the early or the normal retirement age. Individuals who retired in 2005 consumed on average 873 DDDs. Our estimates suggest that in the same year, they would have consumed 743 DDDs without the copayment exemption. Therefore, there is a 17.5% increase in the number of DDDs that can be associated with the copayment exemption. There is also a high and statistically significant increase in yearly total expenditure per person, €90.1, which represents a 25% increase in total pharmaceutical expenditure. Our estimates report an even larger response to the copayment exemption from the insurance cost for the average patient: there is a statistically significant increase of €169.2 in the cost of pharmaceuticals borne by the public insurer, which accounts for a 60.4% increase. This extremely large response of the insurance cost to copayment exemption represents the accumulated effect of the reduction of the copayment rate from a maximum of 40% to zero and the effect of the increase in consumption induced by the policy change.

The so-called "offset effect" related to reduced patient cost sharing for the elderly could reduce the delay in consumption of prescription medicines or lack of compliance and results in reduced hospitalizations. The FE estimates suggest that the probability of hospitalization is reduced after copayment exemption (Model 1), but the sign of the effect is reversed, the magnitude is reduced and it becomes insignificant once we control for the endogeneity of the retirement decision (Model 2).[13] Therefore, our results in Table III clearly indicate that copayment exemption does not significantly reduce the probability of any stay. Thus, our results do not support the existence of a potential offset or compensating hospital effect of pharmaceutical copayment exemption, in contrast to Chandra *et al*. (2010) and in accordance with the results of the Rand HIE for non-elderly people.

5.2. Heterogeneity

We are concerned that coinsurance exemption may have different effects on medicine price sensitivity and hospitalization offsets among different groups of people, which may have implications for a more efficient coinsurance design. We explore heterogeneity by the previous coinsurance rate, sex and the main disease categories.

As the overall effect of exemption on medicine consumption and expenditure for the average patient is large, the existence of potential heterogeneity in these effects, and also in the offset effect, deserves attention in order to derive policy implications for improved copayment designs. We explore the heterogeneity of the effects of the pharmaceutical copayment exemption by the level of the individual copayment rate reduction, which the exemption represents, by sex and by the presence of the main chronic and acute disease categories, classified

[13]This difference in estimates could be explained if part of our treatment group became pensioners as a result of an acute hospitalization in 2004. Therefore, controlling for the endogeneity of retirement and health in the retirement decision seems crucial in this case. In addition, we re-estimate Model 2 excluding individuals who have more than 30 hospitalizations in any of the years and excluding individuals who went to hospital in 2004. The results remain unchanged in both cases (results available from the authors upon request).

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Table IV. Heterogeneity in effects of coinsurance exemption on medicines and hospital utilization according to coinsurance rate previous to exemption

	Patients with previous coinsurance rate		
	<15%	15% to 30%	>30% to 40%
Medicines			
Number of DDDs	59.72 (50.69)	99.24** (48.40)	173.10*** (29.62)
Total expenditure (€)	94.03** (43.47)	55.96** (26.48)	106.29*** (15.90)
Insurance cost (€)	148.74*** (42.57)	146.87*** (25.56)	187.65*** (15.39)
Hospitalization			
Probability of any hospital stay	0.007 (0.036)	0.028 (0.032)	0.002 (0.020)
Number of observations	34 980	50 364	92 256

DDD, daily defined doses.
Each column shows coefficients from a different regression. Results correspond to the specification of Model 2 (Table III). All regressions include individual fixed effects, age and age^2, and time dummies. Standard errors are in parentheses.
Significance levels:
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

under any of the 18 ARXG disease categories. All heterogeneity effects are estimated using the difference-in-difference model with instrumental variables, as in Model 2 in Table III.

Table IV reports the effects of the copayment exemption or free pharmaceuticals for those individuals with a previous average copayment rate lower than 15%, between 15% and 30%, and above 30% (with a maximum 40% rate).[14] Our results show that the effect on the number of DDDs and on total pharmaceutical expenditure is only statistically significant for the group of individuals who had a copayment rate between 15 and 30% or higher than 30% before retirement. In contrast with most of the previous literature, there is no significant increase in consumption or in expenditure when copayment rates are below 15% before the copayment exemption. It is important to note that medicines mainly indicated for chronic diseases had a copayment rate below 10%, and that individuals with an average copayment rate below 30% were consuming a very large proportion of chronic prescriptions. Results for the average individual with a previous copayment rate above 30% and no higher than 40% concentrate the effect of the exemption and show a large and statistically significant increase of 173.1 DDDs per year per person (a 33% increase) and an increase in total pharmaceutical expenditure of €106.3 per person (a 43% increase). As expected, the exemption from the copayment represents a statistically significant increase in the insurance cost per person of €148.7 for those individuals who had a copayment rate lower than 15%, €146.9 for those with average copayment rates between 15 and 30% and €187.7 for those with copayment rates higher than 30% (these represent a 36%, 37% and 113% relative increase). For the first group, the increase in the insurance cost per person after the exemption only captures the effect of the cost shift from the patient to the insurer, without any significant consumption increase associated with the copayment reduction. Potential offset effects on hospital utilization are not statistically significant for any of the copayment rate groups.

Table V reports the effects of copayment exemption by gender. Results for the average woman show a greater increase in the number of DDDs and in pharmaceutical expenditure than for the average man. We find a large and statistically significant increase of 166.6 DDDs per year per woman (a 23% relative increase) and a smaller increase of 106.5 DDDs for the average man (a 14% increase). There is also a statistically significant increase in the expenditure per woman of €102.3 and of €82.4 for men (a 30% and 22% increase, respectively). Once again, we find that offset effects on hospital utilization are not significant for women or for men.

[14]The 52.4% of consumption (valued at retail price) by all the patients in our initial sample (population aged 58 to 64 years who were covered by the public insurer on 1 January 2004 and still alive on 31 December 2006) not exempted from copayment was subject to a 40% coinsurance rate, and the remaining 47.6% was under the reduced copayment scheme (short list of drugs primarily prescribed for chronic conditions).

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Table V. Heterogeneity in effects of coinsurance exemption on medicines and hospital utilization by gender

	Women	Men
Medicines		
Number of DDDs	166.60*** (36.49)	106.49*** (29.22)
Total expenditure (€)	102.56*** (21.25)	82.37*** (18.95)
Insurance cost (€)	183.44*** (20.55)	159.29*** (18.50)
Hospitalization		
Probability of any hospital stay	0.006 (0.022)	0.011 (0.022)
Number of observations	82 922	94 678

DDD, daily defined doses.
Each column shows coefficients from a different regression. Results correspond to the specification of Model 2 (Table III). All regressions include individual fixed effects, age and age^2, and time dummies. Standard errors are in parentheses.
Significance levels:
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Table VI reports the effects of copayment exemption by the 16 ARXG disease categories. Our non-exclusive disease categories are formed by individuals according to the type of pharmaceutical consumption observed in the period before the exemption (year 2004). We run regressions separately for each of the 16 disease groups:[15] analgesics/anti-inflammatories, anti-hyperlipidemics, anti-infectives, biologicals, cardiovascular agents, neurological agents, dermatologicals, diabetes drugs, eye, ear, nose and throat preparations, endocrine/metabolic agents, genitourinary agents, gastrointestinal drugs, immunological agents, nutritionals, pulmonary drugs and upper respiratory agents. We therefore use a wider and more complete range of chronic and non-chronic diseases than the classifications previously used in the literature on medicine price sensitivity (Chandra *et al*., 2010; Goldman *et al*., 2004).

We find that the copayment exemption significantly increases total pharmaceutical expenditure for individuals who before retirement consumed any of the following 13 drug categories: analgesics/anti-inflammatories (€112.6, a 30% increase), anti-infectives (€134.1, a 33% increase), biologicals (€138.2, a 23% increase), neurological agents (€69.9, a 14% increase), dermatologicals (€106.8, a 24% increase), diabetes drugs (€117.2, a 24% increase), eye, ear, nose and throat preparations (€120.0, a 29% increase), genitourinary agents (€156.9, a 36% increase), gastrointestinal drugs (€123.5, a 27% increase), immunological agents (€131.2, a 32% increase), nutritional drugs (€78.5, a 16% increase), pulmonary drugs (€207.8, a 51% increase) and upper respiratory agents (€201.7, a 42% increase).

On the other hand, we find no exemption effect on total pharmaceutical expenditure for individuals treated with anti-hyperlipidemics, cardiovascular agents and endocrine/metabolic agents. Once again, we did not find a significant hospitalization offset effect for most of the disease categories, except for upper respiratory agents. Furthermore, we find a significant negative offset (a positive coefficient) for the probability of any stay in individuals treated with upper respiratory agents, indicating that this probability is even higher after copayment exemption. Our results indicate that increased prescription pharmaceutical use does not translate into reduced hospitalization.

Contrary to Chandra *et al*. (2010), who only use a rough dichotomous classification for chronically ill individuals, in a more detailed heterogeneity analysis, we find an increase in total pharmaceutical expenditure after copayment exemption not only for consumers of drugs for more acute or less chronic conditions such as analgesics/anti-inflammatories, anti-infectives, dermatologicals and ear, eyes, nose and throat preparations but also for those treated with pharmaceuticals for chronic conditions or diseases such as diabetes drugs, neurological agents and gastrointestinal agents. It is important to consider that these individuals are treated with medicines indicated for those main chronic conditions, but at the same time, they may be treated with medicines indicated for other less chronic or acute conditions. However, previous results

[15]We estimate the previous model for each of the 16 different subsamples.

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Table VI. Heterogeneity in effects of coinsurance exemption on medicines and hospital utilization by Aggregated RxGroup categories

	Medicines				
ARXG category	DDDs	Total expenditure	Insurance costs	Probability of any stay	Number of observations
Analgesics/anti-inflammatories	159.10***	112.56***	201.36***	0.006	121,060
Anti-hyperlipidemics	157.18	22.73	116.88	−0.139	6,440
Anti-infectives	153.14***	134.13***	220.68***	−0.006	56,814
Biologicals	124.73	138.18**	256.84***	−0.045	21,542
Cardiovascular agents	38.00	32.26	130.17***	−0.006	53,958
Neurological agents	122.20***	69.92***	164.04***	0.027	83,466
Dermatologicals	165.59***	106.76***	202.46***	−0.001	65,094
Diabetes drugs	127.64**	117.23***	214.75***	−0.001	61,704
Eye, ear, nose and throat preparations	124.38**	120.05***	224.10***	0.008	47,422
Endocrine/metabolic agents	126.05	114.13*	218.65***	−0.032	18,124
Genitourinary agents	181.00**	156.88***	250.25***	0.022	23,164
Gastrointestinal drugs	170.63***	123.49***	221.29***	−0.023	52,974
Immunological agents	159.94**	131.17***	225.02***	0.028	47,274
Nutritionals	85.07	78.50*	208.07***	0.054	24,066
Pulmonary drugs	69.35	207.81*	312.27**	−0.056	3,680
Upper respiratory agents	94.01	201.73*	329.53**	0.231**	4572

ARXG, Aggregated RxGroup; DDD, daily defined doses.
Each column shows coefficients from a different regression. Results correspond to the specification of Model 2 (Table III). All regressions include individual fixed effects, age and age^2, and time dummies. Standard errors are in parentheses.
Significance levels:
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

indicate that the expenditure effect is not significant for those medicines for chronic conditions charged with a 10% or lower coinsurance rate before the exemption, which may indicate that the observed effect for individuals with some chronic conditions may be mainly attributed to medicines that are not intended to treat the chronic illnesses.

5.3. Arc elasticities

We estimate individual arc elasticities using the results of the difference-in-difference model with instrumental variables and FE including disease categories after copayment exemption. We then compute the median unweighted arc elasticity and a weighted arc elasticity using expenditure in the before period (year 2004) as individual weights. The results are presented in Table VII including 95% confidence intervals for median arc elasticities. Confidence intervals are obtained using 1000 bootstrapped replications.

The arc elasticity for the median individual is −0.13 and −0.14 when weighted by expenditure. This arc elasticity for the average individual is similar to the arc elasticities calculated for the elderly by Chandra *et al*. (2010) and to the ones obtained from the Rand HIE for the non-elderly. These results are also similar to those previously obtained from aggregated Spanish cross-section and time series data (Puig-Junoy, 1988). The unweighted median arc elasticity is higher for those individuals with a higher previous coinsurance rate, approximately −0.19 for those who had a copayment rate between 30% and 40% (−0.21 when the median arc elasticity is weighted). Median arc elasticities for individuals with previous coinsurance rates lower than 15% or between 15% and 30% are lower (−0.10 and −0.07, respectively) and only statistically significant at 95%.

The median arc elasticity is higher for women (−0.16) than for men (−0.11). Arc elasticities are not statistically significant at 95% for individuals with ARXG categories such as anti-hyperlipidemics and cardiovascular agents. Statistically significant median arc elasticities higher than the median for all individuals are observed for individuals in the pulmonary drugs ARXG category (−0.26).

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Table VII. Price elasticity for total expenditure on prescribed medicines

	Median elasticity		95% confidence interval	
	Unweighted	Expenditure weighted	Unweighted	Expenditure weighted
All patients	−0.126***	−0.136***	[−0.142, −0.089]	[−0.139, −0.084]
Coinsurance rates:				
<5%	−0.101**	−0.101**	[−0.163, −0.023]	[−0.163, −0.023]
15% to 30%	−0.066**	−0.070**	[−0.103, −0.012]	[−0.100, −0.012]
>30% to 40%	−0.191***	−0.214***	[−0.207, −0.129]	[−0.198, −0.119]
Sex:				
Women	−0.156***	−0.156***	[−0.177, −0.089]	[−0.177, −0.089]
Men	−0.106***	−0.106***	[−0.132, −0.060]	[−0.132, −0.060]
ARXG categories:				
Analgesics/anti-inflammatories	−0.143***	−0.143***	[−0.161, −0.099]	[−0.160, −0.095]
Anti-hyperlipidemics	−0.026	−0.038	[−0.128, 0.101]	[−0.127, 0.095]
Anti-infectives	−0.161***	−0.161***	[−0.197, −0.089]	[−0.197, −0.087]
Biologicals	−0.101**	−0.101**	[−0.184, −0.029]	[−0.182, −0.029]
Cardiovascular agents	−0.030	−0.030	[−0.073, 0.011]	[−0.073, 0.011]
Central nervous systemagents	−0.081***	−0.081***	[−0.110, −0.038]	[−0.109, −0.037]
Dermatologicals	−0.129***	−0.129***	[−0.160, −0.065]	[-0.160, -0.199]
Diabetes drugs	−0.121***	−0.121***	[−0.152,−0.066]	[−0.150,−0.063]
Eye, ear, nose and throat preparations	−0.158***	−0.158***	[−0.182,−0.079]	[−0.181,−0.076]
Endocrine/metabolic agents	−0.080*	−0.080*	[−0.204, 0.003]	[−0.204, 0.003]
Genitourinary agents	−0.217***	−0.217***	[−0.229,−0.079]	[−0.229,−0.079]
Gastrointestinal drugs	−0.132***	−0.132***	[−0.172,−0.081]	[−0.172,−0.080]
Immunological agents	−0.167***	−0.167***	[−0.197,−0.087]	[−0.194,−0.085]
Nutritionals	−0.064**	−0.064**	[−0.152,−0.003]	[−0.151,−0.003]
Pulmonary drugs	−0.256**	−0.256**	[−0.151,−0.003]	[−0.380,−0.030]
Upper respiratory agents	−0.194**	−0.194**	[−0.331,−0.005]	[−0.334,−0.005]

ARXG, Aggregated RxGroup.
Arc elasticities are calculated as $[(Q_2 - Q_1)/(Q_1 + Q_2)/2]/[(P_2 - P_1)/(P_1 + P_2)/2]$. Arc elasticities have been calculated using the specification of Model 3 (Table II).
Significance levels:
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

6. CONCLUSIONS AND IMPLICATIONS

Our results show that the uniform exemption from pharmaceutical copayment granted to retired people in Spain has a strong effect on total expenditure on prescription medicines and on insurer cost without an offset effect in the form of short-term reduction in the probability of hospitalization.[16] Our estimates show that individuals who were consumers of pharmaceuticals financed by the NHS before retirement increase their total pharmaceutical consumption on average by €90.1 per year, which represents a 25% increase in total pharmaceutical expenditure and a 60.4% increase in insurer cost. This estimate is a lower bound effect of the expected overall effect because our analysis sample is made up of individuals who were buying NHS-prescribed medicines before the copayment exemption. The effect on the subsample of the population who were buying their medicines either without a prescription or with a prescription from a private doctor is expected to be larger, as the change in copayment is from 100% to 0% among this group.

A back-of-the-envelope calculation allows us to estimate the magnitude of the effect on total public pharmaceutical expenditures. In 2006, the last year of our data, there were around 7.8 million pensioners or retired people in Spain. Of the pensioners covered by the NHS, 90.5% consumed pharmaceuticals were prescribed within the public system during 2006. From our estimates, we know that their individual pharmaceutical consumption was on average €90.1 higher because of the copayment exemption. This amounts to €636 million or

[16]However, one cannot conclude from these results that pharmaceuticals do not have an effect on the probability of hospitalizations in general, as several papers estimate that new drugs introduced in recent decades have increased pharmaceutical expenditure, but that a large part of this increase has been offset by a reduction in hospital expenditure (Lichtenberg 2007, 2009 and 2014).

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5.7% of total pharmaceutical expenditure financed by the NHS. The effect on the amount paid by the insurer is greater than in a situation in which the individuals share part of the cost, as the insurer has to pay the full cost. We know that on average, the amount paid by the insurer increased at least €169.2, yielding a total increase in pharmaceutical expenditures of €1194.38 million. This magnitude represents 11.4% of the total pharmaceutical expenditure financed by the NHS.

The effect of copayment exemption is different depending on previous consumption (types of drugs and average copayment rate). Our results show that the impact is concentrated among consumers of medicines for acute and other non-chronic diseases whose previous coinsurance rate was 30% to 40%. The higher impact of the coinsurance exemption estimated in this paper corresponds to more than half of drug consumption, as 52.4% of the consumption of drugs by the population aged 58 to 65 years were not exempted from copayment was subject to a 40% rate, and the remaining 47.6% was under the reduced copayment scheme.

In particular, we find a highly significant own-price elasticity for the pharmaceutical consumption and expenditure of patients mainly consuming medicines for acute and other non-chronic diseases with a previous coinsurance rate in the range 30 to 40%. The estimated own-price elasticity for this group of patients is −0.19, which falls within the range of the estimates obtained in the literature (Gemmill *et al*., 2007). Second, contrary to much of the preceding literature (Baicker and Goldman, 2011), we find that consumption and expenditure of prescription medicines is not significantly price sensitive when free access is obtained by those patients who were previously consuming medicines mainly for chronic conditions under reduced coinsurance rates (no higher than 10% of the price). Although heterogeneity in patient morbidity may not be perfectly captured by our disease categories, it seems unlikely that the non-significant effect is driven by an increase in consumption by one subgroup of patients compensated by a decrease in consumption by another group, as in no case is the cost sharing of pharmaceuticals increased.

According to our results, the arc price elasticity estimates are −0.13 and −0.14, which are similar or slightly lower than previous estimates obtained for populations insured under an NHS (Gemmill *et al*., 2007). Gemmill *et al*. (2007) use meta-regression analysis to provide a corrected measure of the drug price elasticity that accounts for the heterogeneity in the institutional setting, the study characteristics and the publication determinants including published studies until 2005. Their results indicate that the corrected elasticity is −0.209, but there is great heterogeneity: higher elasticity values if the study used aggregated data and lower when estimated for tax-based insurance systems, as is the case of Spain. Similarly, Chandra *et al*. (2010 and 2014) obtain a similar arc price elasticity of −0.15 for Health Maintenance Organization enrollees (−0.16 for low income individuals) for prescription drugs in an elderly US population. These values are also similar to the arc elasticities obtained from the RAND HIE for the non-elderly (Keeler and Rolph, 1988; Aron-Dine *et al*., 2013).

However, we cannot rule out the possibility that our elasticity estimates may be lower because of the fact that the copayment change is mainly concentrated among consumers of medicines for acute and other non-chronic diseases. Our results are ranked as low in the wide range of elasticity estimates observed in the literature: between −0.02 and −0.80 (Table II in Gemmill *et al*., 2007) or between −0.2 and −0.6 when studies that involved very small cost sharing changes or did not have an adequate control group were excluded (Goldman *et al*., 2007). Likewise, Pauly (2004) reports an arc elasticity between 0.3 and 0.4 for the privately insured population aged under 65 years; Gaynor *et al*. (2007) find a 'short-run' elasticity of −0.6 and 'long-run' elasticity of −0.8 for drug spending for US non-elderly and private insurance, and Lichtenberg and Sun (2007), based on 28 monthly observations, report an elasticity estimate of −0.72. However, all these studies with larger estimates are based on a private insurance setting, which may explain the difference in the magnitude of the estimates with respect to our study (Gemmill *et al*., 2007).

Unlike some previous studies (Chandra *et al*., 2010), we did not find a significant offset effect through a decline in hospitalization rates for elderly people exempted from coinsurance rates, which may be explained by the previous low coinsurance rates that affect more ill patients with chronic diseases. However, our estimates measure the short term impact of the zero copayment in the year after exemption but are not able to capture other dynamic effects. Chandra *et al*. (2010) find evidence of substantial 'offset' effects in terms of increased

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hospitalization after a rise in copayment for prescription drugs in California introduced in January 2002 by observing hospital utilization until September 2003, and Gaynor *et al*. (2007) find that the effects after one year were larger than the contemporaneous effects. Therefore, our observational period may be too short to test the existence of these effects. Future research should follow individuals through a longer time span in order to evaluate whether similar results would hold in our sample. This analysis would also make it possible to evaluate whether the absence of health effects is also found in the longer run. In addition, one can argue that hospitalizations capture the onset of severe health events, so data on emergency and office visits would also be valuable. Therefore, future research should provide evidence on potential offset effects for outpatient services such as visits to the physician or emergency visits.

These findings have implications for the design of an optimal coinsurance scheme for prescriptions to elderly and retired people. There is a significant increase in pharmaceutical consumption due to the reduction in the coinsurance rate from 40% to 0% among less sick people without any observed compensation through a health improvement requiring less hospitalization in the short term. Medium or long-term compensation effects on hospital use and effects on outpatient or emergency services have not been evaluated in this paper. At the same time, it seems that a reduced coinsurance rate of around 10% for medicines mainly prescribed for chronic diseases for elderly people is not a barrier to access pharmaceutical treatment and does not lead to short-term adverse or negative health effects requiring hospital use that could be avoided by granting free prescription medicines. However, there is no case against free medicines or against a 10% or lower copayment rate for chronic diseases based on traditional theory. In our opinion, both implications point to high welfare costs from the indiscriminate exemption granted to elderly and retired people for prescription medicines mainly for non-chronic conditions that were previously affected by the 40% copayment rate.

In this respect, recent changes in the copayment structure applied to the elderly population since mid-2012 may point in the right direction. In particular, most Spanish pensioners are subject to a coinsurance rate of 10% with a monthly income-related cap of €8, €18 or €60, depending on their income level. The descriptive evidence shows that there has been a reduction in the use of drugs, as one would expect from the results shown in this paper. Moreover, Puig-Junoy *et al*. (2014) evaluate the first effects of this reform using aggregate data and show that after a continuous increase in the number of dispensed prescriptions in Spain during the last two decades, insensitive to the many price control measures, the total number of prescriptions has decreased by more than one-tenth in 15 out of 17 Spanish regions. The evaluation of the effects of this reform on both pharmaceutical expenditures and health outcomes using individual data remains a pending research question.

Our results show that there is an economically significant increase in pharmaceutical consumption due to copayment exemption at retirement. There is suggestive evidence that this increase is not driven by a worsening in health status in the short term. However, as in other studies on cost sharing effects, the increase in consumption associated with zero copayment is compatible with, but is not a proof of, moral hazard (Pita-Barros *et al*., 2008). Concurrent changes in the opportunity cost of time of retired people that could influence the demand for physician visits and prescriptions have not been measured, and their influence on the consumption effect has not been examined. As long as one assumes that our estimates are also a good approximation of the average treatment effect, the magnitude of the estimate for women could shed some light on the importance of the effect of changes in the opportunity cost of time once retired. A large proportion of women in the age range of this study are inactive and officially obtain coinsurance exemption as dependants of their husbands when they retire.[17] We may presume that the change in the opportunity cost of time should on average be greater for men than for women. We find that the magnitude of the effect is greater for women than for men. This allows at least two non-exclusive interpretations. First, changes in the opportunity cost of time are irrelevant for the subsample of individuals who were already consumers before retirement. And second, pensioners often may be obtaining prescriptions for other household members who are not exempt from copayments (Puig-Junoy,

[17]Unfortunately, we cannot identify husbands and wives from our sample, so we cannot use as an instrument a dummy for whether the husband reached the retirement age in 2005.

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1988). This second effect is more concentrated among women and dominates the gender differences in the changes in the cost of time. The likelihood of these assumptions remains a pending research question beyond the scope of this paper. Future research could include data for civil servants who are covered by a health plan with a 30% pharmaceutical copayment independent of their labour status, so their inclusion as a control group would make it possible to control for the effect of the changes in the cost of time upon retirement.

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