ESTUDIOS DE ECONOMÍA APLICADA VOL. 31-2 2013 PÁGS. 379–396

Pharmaceutical Expenditure as a Determinant of Health Outcomes in EU Countries

CARLA BLÁZQUEZ-FERNÁNDEZ [a], **NOELIA GONZÁLEZ-PRIETO** [a], **PATRICIA MORENO-MENCÍA** [a]

[a] *Universidad de Cantabria, Facultad CC.EE., Avda. de los Castros, s/n., 39005 Santander, España. E-mail:* carla.blazquez@unican.es, noelia.gonzalez@unican.es, patricia.moreno@unican.es

ABSTRACT

This paper studies the effects that pharmaceutical expenditure and other medical non-durables has on health outcomes, such as mortality and life expectancy. Some recent research is focused on the study of public expenditure in health and the correlation with positive health indicators, and also on the relative effectiveness of various medical health care inputs. As a specific case of this research, we center our interest on the pharmaceutical expenditure among various European countries in order to compare if expenditures are effective in health results, or on the contrary, countries with higher levels of pharmacy consumption do not have better health indicators. We carried out a regression analysis with panel data. The results imply that there is a positive effect between pharmaceutical expenditure and health outcomes.

Keywords: Pharmaceutical Expenditure, Health Outcomes, Panel-Data.

El gasto farmacéutico como determinante de los resultados en salud en países de la UE

RESUMEN

Este trabajo estudia los efectos que el gasto farmacéutico y otros artículos médicos de uso frecuente tienen sobre los resultados en salud, en concreto sobre la mortalidad y la esperanza de vida. Algunos trabajos recientes se han centrado en el estudio del gasto público en salud y su correlación con indicadores positivos de salud, así como la efectividad relativa de varios inputs en salud. Como caso concreto de esta línea de investigación, este trabajo se centra en el gasto farmacéutico en ciertos países de la Unión Europea, con el fin de comparar si dicho gasto es efectivo en los resultados en salud. La aproximación metodológica se basa en el análisis de datos de panel. Los resultados corroboran un efecto positivo entre el gasto y los resultados en salud.

Palabras claves: Gasto farmacéutico, resultados en salud, datos de panel.

JEL Classification: I1, I18

Artículo recibido en julio de 2013 y aceptado en agosto de 2013
Artículo disponible en versión electrónica en la página www.revista-eea.net, ref. ə-31207

ISSN 1697-5731 (online) – ISSN 1133-3197 (print)

1. INTRODUCTION

A considerable number of health economics research has been devoted to explaining the assignment of public expenditures and the returns they have on population, improving the life of the population in some way. Nowadays, there is an important economic crisis, which makes that line of research more necessary. Although the crisis is affecting European Countries in different ways, almost all of them are suffering financial problems. There are a lot of solutions for reducing debt, but one of the most used is the cut in public spending in services such as health, education or dependence. According to all of this, the knowledge about how expenditure on health affects population and the correlation with good effects in life quality is a really important issue. On the other hand, nowadays the economic situation is not as good as we would like it to be, so it is necessary to valuate public resources in order to use them in the most effective way. To sort out and establish effects of policy interventions, it is necessary to apply models that can give us results in terms of effectiveness or in good population indicators.

More specifically, the study of pharmaceutical expenditures and their association with health outcomes has a great interest when looking for efficiency and the evaluation of the best way to assign resources in order to obtain the best results.

Pharmaceutical expenditure has been increasing quickly during the last decades in almost all the developed countries due to the changes in the demographic structure. The OECD (2011) published a report to show the evolution of pharmaceutical spending across countries. They observed that between 2000 and 2009, real pharmaceutical expenditure had grown by around 3.5% per year on average, more or less in the same magnitude as total health spending, which had increased by 4.0%. On the other hand, there were several differences between countries; some countries such as Luxembourg, Norway and Italy had negative growth in pharmaceutical spending over this period, while in Ireland and Greece pharmaceutical spending was growing really fast and governments had taken emergency measures in order to reduce public expenditure. In other countries, such as France, Germany or the United Kingdom, price reductions on pharmaceuticals have been used as adjustment variables to contain health spending growth.

We show that expenditures on pharmacy and other medical non-durables have a positive effect on life-expectancy at birth while its influence is negative for infant mortality, and in all cases the magnitude for the variables are higher for men than for women.

The structure of this paper is as follows: in Section 2, a revision of the literature is presented; in Section 3, the data and methodology are described and finally the results and conclusions are shown in Sections 4 and 5, respectively.

2. LITERATURE REVIEW

As we said before, while there are a significant number of studies that are focused on the research of productivity of health care resources on health status, only a few of them have disaggregated pharmaceutical expenditures from total health expenditures.

If we focus on the first international studies analyzing these aspects; Wolfe (1986) and Wolfe and Gabay (1987) tried to find a positive marginal effect in the association between change in medical expenditures and change in health status. They used 22 countries which have data in 1996, 1997 and 1998 and estimated simultaneous equations to find a positive link between change in medical expenditures and changes in health outcomes. Besides, Anand and Revallion (1993) worked in a cross-sectional study of 22 countries in the mid-1980s. They concluded that the capability of producing health was not related directly to economic growth. Furthermore, Babazono and Hillman (1994) analyzed the relationship between health outcomes and total health care spending. They concluded that health outcomes and health care spending are not correlated. Also, the results indicated that the way the resources are allocated is more important than how much money is spent. Some years later, Zeynep Or (2000) studied the determinant associated with health outcomes for 21 OECD countries over the period 1970-1992. He studied GDP, public health expenditure, NOx emissions per capita, the consumption of alcohol and tobacco and also the diet as explaining variables. The study concluded that all the style life variables are related with the years of life lost and health expenditure was difficult to separate from GDP because of the high correlation that exists between them.

Crémieux *et al.,* (2001) studied the relationship between one particular health outcome (infant mortality at the state level in the U.S.) and pharmaceutical spending. They showed that pharmaceutical spending is an important determinant of infant mortality, as well as disposable income, the percentage of the population below the poverty line, the number of practicing physicians, the number of hospital beds, teenage birth rate, low-weight births, high school graduation rate and racial composition of state population are. Additionally, Crémieux *et al.,* (2005) analyzed more homogenous data and they included a more complete set of controls for confounding factors than previous studies. Their results showed a strong statistical relationship between drug spending and health outcomes, especially for infant mortality and life-expectancy at 65. This relationship is almost always stronger for private drug spending than for public drug spending. The analysis further indicates that substantially better health outcomes are observed in provinces where higher drug spending occurs.

Gowrisankaran and Town (2004) analyzed county-level mortality rates over time and they found that greater enrollment in Medicare care insurance plans without any drug subsidies was associated with higher mortality, but they did

not find any association between mortality and Medicare managed care plans with drug coverage. Moreover, Day and Tousignan (2005) estimated a dynamic model of the relationship between three variables: real per capita GDP, real per capita spending on health and an indicator of health outcomes. They found evidence of a weak statistically-significant relationship between per capita health spending, health outcomes, and per capita GDP. The absence of a strong statistical relationship may be due to model misspecification or may reflect the fact that at where the population has high levels of health, the returns to increases in health spending are small. A year later, Nixon and Ulmann (2006) estimated the relationship between healthcare expenditure and health outcomes for the countries in the European Union over the period from 1980 to 1995. They used life expectancy and infant mortality as measures of health outcomes. They concluded that increases in health care expenditure are significantly associated with large improvements in infant mortality but only marginally in relation to life expectancy.

Liu *et al.,* in 2008 tried to assess the independent association between pharmaceutical expenditures and health outcomes in 14 industrialized countries. They used data from the Organization for Economic Co-operation and Development (OECD) to construct panel data set from 1985 to 2001. They estimated the relationship between pharmaceutical expenditures and potential years of life lost and life expectancy at ages 65 and 80 years for both males and females, using non-linear fixed-effects regression models that corrected for serial correlation. Pharmaceutical expenditures proved to be a robust correlate of health outcomes from 1985 to 2001 in this sample, when controlling for the effects of other variables likely to impact population health outcomes. Their estimates imply that a 10% increase in pharmaceutical expenditures during these years was associated with a 0.3% increase in female life expectancy at the age of 65, while a similar increase was associated with a 0.4% increase in male life expectancy at the age of 65 and a 0.5% increase at the age of 80.

Martin *et al.,* (2008) developed a theoretical model which allowed them to study the relationship between health care spending and health outcomes using instrumental variables methods. They used programme budgeting data prepared by 295 English Primary Care Trusts to model the link for two specific programmes of care: cancer and circulatory diseases. They showed that health care expenditure has a strong positive effect on outcomes in the two programmes of care investigated. More recently, Caliskan (2009) examined the effect of public and private pharmaceutical expenditures on life expectancy for 21 OECD countries. He used panel data techniques and OECD Health Data (2005) and he showed that pharmaceutical expenditure has a positive, but different effect on life expectancy for females and males of various ages. Finally, Guindon and Contoyannis (2012) examined the robustness of the findings of Cremieux *et al.,* (2005) by considering the appropriateness of the data and statistical approach

used. They found that the results obtained by Cremieux *et al.,* are not robust to alternative specifications.

On the other hand, there are some studies which refer to the Spanish case. García-Sempere and Peiró (2001) tried to identify the explicative factors that are associated with pharmaceutical spending. They used data about expenditure and socio-demographic characteristics in order to explain how these factors affect different health areas in the Valencian Community. They carried out the research doing multiple regression with information about 1997. Their results suggested that the percentage of the population over 67 years old, the mortality, the proportion of the population without studies or who only had primary studies are positively correlated with pharmaceutical expenditure. Other authors such as Cebria *et al.,* (2003) studied the influence of multiple factors related with personal and professional characteristics of family doctors in the pharmaceutical expenditure per capita in primary attention. They studied 220 doctors from Barcelona and they found that pharmaceutical spending increased with the doctor´s age, their experience, if the person has an indefinite work contract, if they work in various centers or if they feel emotionally tired. Finally, Cantarero and Pascual (2008) analyzed the impact of decentralization on health care outcomes in Spain using panel data over the period 1992 to 2003. They found that infant mortality is negatively related to income per capita, health care decentralization and the relative number of practitioners.

Other authors have focused their research on pharmaceutical expenditure. For example, Aaaserud *et al.,* (2006) made a review to determine the effects of pharmaceutical pricing and purchasing policies on drug use, healthcare utilisation, health outcomes and costs (expenditures). They included 10 studies of reference pricing and one study of index pricing. Most of the reference pricing studies were for senior citizens in British Columbia, Canada and they found relatively few studies of pricing policies. The majority of the studies dealt with reference pricing. They concluded that based on the evidence in their review, mostly from senior citizens in British Columbia, Canada, reference drug pricing can reduce third party drug expenditures by inducing a shift in drug use towards less expensive drugs. From another point of view, Navarro and Hernández (2006) analyzed the inclusion of uncertainty in Spanish economic evaluations published to establish the state of the art in this field. They concluded that, despite the fact that all published pharmaco-economic guidelines suggest the use of sensitivity analysis, only 64.61% of studies between 1995 and 2002 in Spain did so.

Recently, Moreno-Torres *et al.,* (2011) studied the impact of some measures taken in Spain to reduce costs; specifically pharmaceutical expenditure per capita, prescription per capita and the average price of pharmaceuticals financed by the public sector. They focused their study on Catalonia from 1995 to 2006

and an autoregressive integrated moving average (ARIMA) time series model was implemented, using dummy variables representing that measures. Their results showed that twelve of the sixteen measures were not effective in reducing the expenditure per capita, the average price of prescriptions or the number of prescriptions per patient, at least in the short term.

Vogler *et al.,* (2011) studied which pharmaceutical policies were implemented in the European Countries consequences of the financial crisis. They used a sample of 33 European Countries which had been asked about pharmaceutical pricing and reimbursement in 2010. They analyzed the response rate and carried out a monitoring exercise, concluding that nearly ninety policy measures were identified in twenty-three of the thirty-three countries. Additionally the most common policy measures were about price reductions, changes in co-payments, VAT changes in medicines and changes in distribution margins. Finally, Toumi *et al.,* (2012) carried out the project to build a model to assess the overall net effect of the entrance of new patented medicinal products versus those that are going off-patent, with a forecast horizon until 2016, on seven selected European Union Member States' pharmaceutical budgets: France, the United Kingdom, Germany, Poland, Portugal, Greece and Hungary. They concluded that in light of the pharmaceutical policy analysis for each country, far-reaching changes were seen in the drug market access environment in most of the Members States under the study. Pricing and reimbursement regulations have shown substantial strengthening trends. Moreover, it was found that there is a wide variability between countries concerning generic entry policy such as time to market entry (from 0 day for the United Kingdom and Germany, to 270 days for Greece), penetration rate (from 25% for Greece and Portugal, to 100% for Hungary) and price reduction versus the branded product (from 45% for Poland, to 75% for the United Kingdom). Even if Europe appears as a leader for the biosimilar market, accounting for 80% of global spending on these molecules, little information was available about biosimilar pricing and reimbursement policies.

In summary, there are many empirical studies which analyze the relationship between pharmaceutical expenditure and health outcomes, but there is no consensus about the significance of that correlation.

3. DATA AND METHODOLOGY

3.1. Data

The data used in the analysis have been obtained from the OECD Health Data (2012). This dataset contains aggregated data for the OECD country members. It covers wide homogenized information about health, such as health care resources, health care expenditure or health status, among others. Besides, it contains information about population and socio-economic characteristics, such

as the as level of education or employment. Finally, it also has information about macroeconomic references such as the Gross Domestic Product (GDP). This allows us to compare the results for the different countries in the OECD. We have focused our study in nine European Union (EU) countries, Denmark, Finland, France, Germany, Ireland, Italy, Portugal, Spain and Sweden, from 1995 to 2010[1]. As our dependent variables, we have chosen life expectancy at birth in years by gender and infant mortality (deaths per 1000 live births). Furthermore, we have used available information about GDP and pharmaceutical and other medical non-durables expenditure, both of them in per capita Purchasing Power Parity (US$ PPP) terms. On the other hand, we have considered two variables about the consumption of fruit and vegetables (kilos per capita) and alcohol (liters per capita). Finally, we have included a variable that indicates the percentage of population which is civilian employees. In Table 1, we can see the definitions and descriptive statistics of the variables.

Table 1
Variables, definitions and descriptive statistics

Variable	Definition	Mean	SD	Min	Max
LE_MALE	Life expectancy at birth - Male	75.89	1.82	71.60	79.50
LE_FEMALE	Life expectancy at birth - Female	81.87	1.64	77.90	85.30
INFANTMORT	Infant mortality	4.15	1.01	2.30	7.40
GDP	Gross domestic product per capita	27935.94	6789.44	13498.50	45532.00
PHARMA_OTHER_EXP	Pharmaceutical and other medical non-durables per capita	392.03	128.61	135.79	686.37
ALCOHOL	Liters per capita of alcohol consumption	11.01	2.43	5.80	15.10
GOOD_FOOD	Kilos of fruit and vegetables per capita	218.21	56.98	117.50	350.20
TECP	Percentage of population who are civilian employees	43.79	4.52	31.60	51.00
ANTIBACTERIALS	Daily dosage per 1000 inhabitants and per day	19.89	5.95	12	34.1

Source: Authors' elaboration based on OECD Health data.

Our data established that life expectancy at birth is lower for men than women, being 75.89 years for men and 81.87 years for women for the entire selected sample. Infant mortality has a rate of 4.15. The GDP, as mean of the sample is 27935.94$ per capita (PPP) while pharmaceutical and other spending amount to 393$ pc on average. Finally, the consumption of fruit and vegetables as an indicator of a good diet is on average, 218.21 kilos but there are a lot of

[1] The most important problem is the availability of homogeneous data because if we extend the period we would have a huge loss of information, especially in the variable "pharmaceutical expenditure and others".

differences between the minimum (117.50 kilos) and the maximum (350.20 kilos).There are also significant differences in alcohol consumption between the data sample (from 5.80 liters per capita to 15.10 liters).

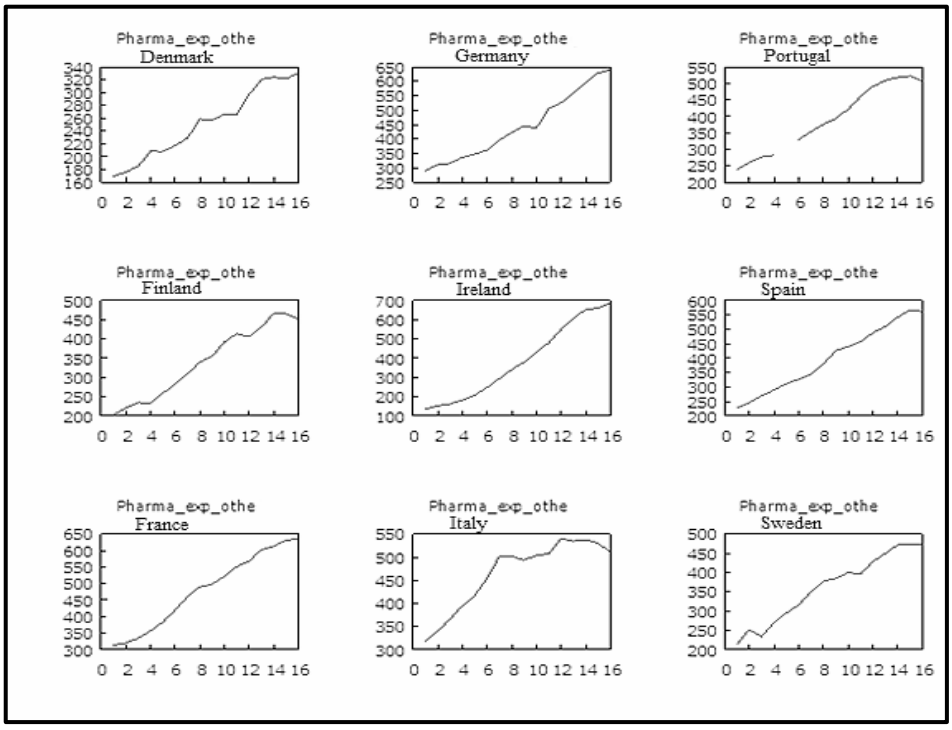
3.1.1. Descriptive analysis

In order to have a better knowledge of the situation we are going to study how the chosen indicators have been changing across countries and time. It is necessary to remember that advances in science and technology are allowing people to live longer and are also reducing infant mortality rates. The main consequence is the ageing of the population and the consequent change in the demographic structure, which is one of the main causes of increase in public spending on health and social services, in the same way it means an increase in pharmaceutical consumption of people who live longer but have lots of diseases and chronic illnesses. That means that unless the ageing of the population and the growth of life expectancy are indicators of the success of welfare European societies, they have not been in parallel with the reduction of the number of diseases suffered (Rodriguez-Cabrero, 2007). The OECD (2012), in the second edition of Health at a Glance, presented comparable data for selected indicators of health and health systems in 35 European countries up to 2010. That publication provides detailed information on health expenditure and its trends, using results from the OECD, Eurostat and WHO annual joint health accounts questionnaire. In recent years, some of the results are that European countries have achieved benefits in health; the improvement in life expectancy can be explained by the improvement of living conditions, but also for better access to care and the quality of that care.

It can be appreciated in Figure 1 that the most significant evolution in pharmaceutical spending is referent to Ireland (5) which changed from 135.79 in 1995 to 686.37 $ in 2010, being the country with higher spending in the last year. Denmark (1), on the contrary, is the country with the least growth from 169.50 in 1995 to 330.95 $ in 2010 and also the country with lower expenditure in 2010.

Life expectancy at birth is on average for all countries and all years set at 78.89 years, Spain and Italy are the countries where population has a higher life expectancy at birth, contrary to Portugal which has on average the lowest. That information relates to the infant mortality rate, which presents the highest indicator in Portugal; on the other hand, on average, Finland has the lowest rate. (See Figure 2).

Figure 1
Evolution of pharmaceutical spending per countries



Notes: The abscissa represents the time period.

Source: Authors' elaboration based on OECD Health data.

Figure 2
Infant and prenatal mortality and Life expectancy per sex

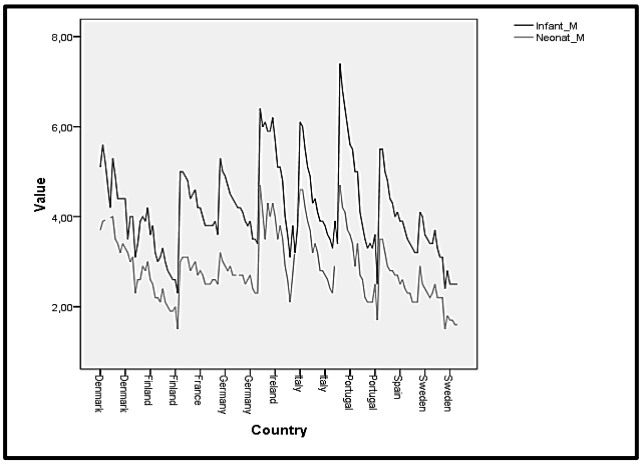
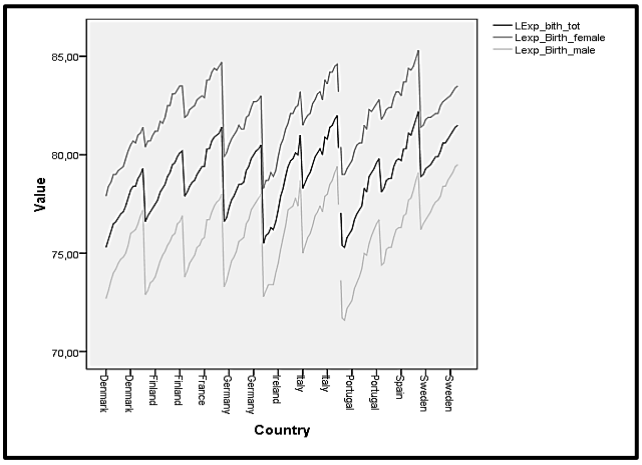


Figure 2 (continue)
Infant and prenatal mortality and Life expectancy per sex



Source: Authors' elaboration based on OECD Health data.

The relationship between the pharmaceutical variable and the two selected outcomes is expected to be in contrary ways. We would expect pharmaceutical spending to be associated with high life expectancy and also with low infant mortality rate. If our premise is not true, countries which spend more will not have the best results, so there could be some inefficiencies to study and evaluate.

3.2. Method

The literature on health economics has suggested different socio-economic determinants on health outcomes. However, the choice of the explanatory variables is often restricted by the availability and quality of the data. Therefore, our empirical model to estimate is the classic one for this kind of studies proposed in the literature review and adapted for the European case.

Specifically in this paper we are working with time-series cross-section data, specifically we have an unbalance panel of 9 UE-countries over the period 1995-2010, being the general model the follows:

$$Health\,outcomes_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 PHARMA\_OTHER\_EXP_{it} + \beta_3 ALCOHOL_{it} +$$
$$+ \beta_4 GOOD\_FOOD_{it} + \beta_5 TCEP_{it} + \alpha_i + \varepsilon_{it}$$

Then, the proposed model tries to contrast the relationship between health outcomes (Life expectancy at birth for females and males, and Infant mortality) and the expenditures in pharmacy and other medical non-durables, with different explanatory variables for the European case.

In order to explore the robustness of the empirical results, the analysis is divided into two sections: section one examines the relationship between our battery of independent variables and health outcomes using a fixed/random effects model due to the results reported by the Hausman test (1978). We applied one-way and two-way[2] fixed/random effects models. On the other hand, in the second step we re-estimate the model with panel-corrected standard errors (PCSE), which assumes that the disturbances are by default heteroskedastic and contemporaneously correlated across panels. Once again, we check the robustness of the results allowing temporal and country effects.

4. RESULTS

The estimation results are presented synthetically summarized in Tables 2-4. Thus, in the first two tables the determinants of life expectancy for females and males are analyzed respectively, while the last one shows the results concerning infant mortality.

Table 2
Panel data results. Dependent Variable: Life expectancy - Females

Variables	FE/RE		PCSE			
LN_PIB	3.640	0.440	1.127	0.093	4.387	0.481
Std error	0.579	0.913	0.526	0.585	0.709	1.237
P-value	0.000	0.630	0.032	0.874	0.000	0.698
LN_PHARMA_OTHER	1.342	1.987	3.099	2.576	0.749	1.377
Std error	0.387	0.373	0.430	0.437	0.434	0.477
P-value	0.001	0.000	0.000	0.000	0.085	0.004
ALCOHOL	-0.173	-0.131	-0.162	-0.158	-0.164	-0.102
Std error	0.034	0.033	0.030	0.030	0.039	0.035
P-value	0.000	0.000	0.000	0.000	0.000	0.004
GOOD_FOOD	0.002	0.002	0.001	0.000	0.002	0.002
Std error	0.001	0.001	0.002	0.002	0.001	0.001
P-value	0.213	0.081	0.695	0.800	0.193	0.062
TCEP	-0.095	-0.040	-0.108	-0.121	-0.088	-0.015
Std error	0.019	0.021	0.018	0.019	0.020	0.025
P-value	0.000	0.064	0.000	0.000	0.000	0.564
Hausman statistic and prob (Hausman)	0.350	0.711				
Temporal effects	NO	YES	NO	YES	NO	NO
Country effects	NO	NO	NO	NO	YES	NO
Temp. and country effects	NO	NO	NO	NO	NO	YES

Source: Authors' elaboration.

[2] Not including year dummies could be problematic because there are time trends and year specific shocks.

As we can see, coefficients are statistically significant and in most cases have the expected signs according to the priori economic criteria. Additionally, it could be said that the estimates are robust and consistent with the inclusion of different specifications. Thereby, it is noticed that after applying the Hausman test (1978) we always use random effects; the only exception is when we introduce time effects for the infant mortality dependent variable.

As expected, income and expenditures in pharmacy and other medical non-durables have a clear positive effect on a health indicator (life expectancy at birth), while its influence is negative for the other (infant mortality), in all cases the magnitude for the variables is higher for men than for women.

Regarding the variables related with habits and lifestyles: alcohol and "good food", both are also significant with the opposite sign as the variable in question and the dependent variable in each case. Only its effect is a bit confusing for infant mortality, so it may be taken with caution. Besides, the relative variable of civilian employees shows a negative effect on life expectancy for both females and males.

Table 3
Panel data results. Dependent Variable: Life expectancy - Males

Variables	FE/RE		PCSE			
LN_PIB	5.099	0.310	4.092	3.329	5.426	-0.632
Std error	0.563	0.988	0.421	0.510	0.545	0.992
P-value	0.000	0.753	0.000	0.000	0.000	0.524
LN_PHARMA_OTHER	1.769	2.460	1.698	1.318	1.501	2.315
Std error	0.376	0.380	0.319	0.321	0.366	0.437
P-value	0.000	0.000	0.000	0.000	0.000	0.000
ALCOHOL	-0.265	-0.171	-0.258	-0.256	-0.237	-0.128
Std error	0.033	0.033	0.019	0.019	0.046	0.036
P-value	0.000	0.000	0.000	0.000	0.000	0.000
GOOD_FOOD	0.001	0.000	0.003	0.002	0.001	0.000
Std error	0.001	0.001	0.001	0.001	0.002	0.001
P-value	0.561	0.899	0.007	0.036	0.667	0.949
TCEP	-0.138	-0.062	-0.067	-0.078	-0.137	-0.035
Std error	0.018	0.022	0.013	0.012	0.019	0.023
P-value	0.000	0.005	0.000	0.000	0.000	0.120
Hausman statistic and prob (Hausman)	0.899	0.585				
Temporal effects	NO	YES	NO	YES	NO	NO
Country effects	NO	NO	NO	NO	YES	NO
Temp. and country effects	NO	NO	NO	NO	NO	YES

Source: Authors' elaboration.

Table 4
Panel data results. Dependent Variable: Infant mortality

Variables	FE/RE		PCSE			
LN_PIB	-1.425	0.804	-1.473	-0.339	-0.995	0.629
Std error	0.501	1.335	0.453	0.518	0.725	1.206
P-value	0.004	0.548	0.001	0.512	0.170	0.602
LN_PHARMA_OTHER	-1.475	-2.084	-1.256	-0.818	-1.703	-1.960
Std error	0.378	0.676	0.322	0.356	0.520	0.588
P-value	0.000	0.003	0.000	0.022	0.001	0.001
ALCOHOL	0.238	0.255	0.180	0.180	0.265	0.223
Std error	0.036	0.056	0.029	0.024	0.052	0.055
P-value	0.000	0.000	0.000	0.000	0.000	0.000
GOOD_FOOD	0.001	0.000	0.002	0.004	-0.001	-0.001
Std error	0.002	0.002	0.002	0.002	0.002	0.002
P-value	0.374	0.876	0.176	0.013	0.709	0.688
Hausman statistic and prob (Hausman)	0.240	0.002				
Temporal effects	NO	YES	NO	YES	NO	NO
Country effects	NO	NO	NO	NO	YES	NO
Temp. and country effects	NO	NO	NO	NO	NO	YES

Source: Authors' elaboration.

Moreover, to show the robustness of the results, we have focused on life expectancy as health outcome. We have made a second analysis using the same methodology, that is PCSE, but we have changed our referent independent variable. Instead of using pharmaceutical and other medical non-durable expenditures, we have used antibacterial consumption for systemic use (which is measured by daily dosage per 1000 inhabitants-day), as proxy variable of pharmaceutical consumption, taking into account that if there is an increase in pharmaceutical consumption, then there would be an increase on pharmaceutical expenditure. The over-use of antibiotics is the main force driving the increase of bacterial resistance, representing a major threat to public health (Filippini *et al.,* 2012).

Table 5
Panel data results. Dependent Variable: Life expectancy by sex

Variables	Female				Male			
LN_PIB	4.610	0.271	5.486	4.018	5.914	2.995	7.444	4.134
Std error	0.836	0.864	0.439	1.151	0.542	0.816	0.419	1.333
P-value	0.000	0.754	0.000	0.000	0.000	0.000	0.000	0.002
Antibacterials	0.021	0.040	0.018	0.024	0.010	0.003	0.009	0.039
Std error	0.031	0.018	0.017	0.013	0.020	0.016	0.021	0.021
P-value	0.508	0.024	0.306	0.066	0.612	0.831	0.688	0.067

Table 5 (continue)
Panel data results. Dependent Variable: Life expectancy by sex

Variables	Female				Male			
ALCOHOL	-0.137	-0.143	-0.155	-0.123	-0.226	-0.226	-0.209	-0.167
Std error	0.056	0.044	0.046	0.041	0.039	0.032	0.059	0.054
P-value	0.014	0.001	0.001	0.003	0.000	0.000	0.000	0.002
GOOD_FOOD	0.004	0.002	0.002	0.003	0.005	0.002	0.002	0.000
Std error	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.002
P-value	0.046	0.293	0.220	0.036	0.004	0.168	0.315	0.878
TCEP	-0.143	-0.147	-0.108	-0.059	-0.101	-0.104	-0.150	-0.076
Std error	0.050	0.035	0.025	0.030	0.034	0.028	0.029	0.035
P-value	0.004	0.000	0.000	0.053	0.003	0.000	0.000	0.028
Temporal effects	NO	YES	NO	NO	NO	YES	NO	NO
Country effects	NO	NO	YES	NO	NO	NO	YES	NO
Temp. and country effects	NO	NO	NO	YES	NO	NO	NO	YES

Source: Authors' elaboration.

Coefficients have the same signs as in previous analysis. This is, income and drug consumption have a positive effect on life expectancy at birth. But bad life styles affect in a negative way. We can see these results in Table 5.

In short, as is expected, income is the most important factor to explain health outcomes.

5. CONCLUSIONS

There are many studies which study the relationship between public expenditure on health and positive health outcomes. In our analysis, we have focused on the relationship between pharmaceutical expenditure and several health outcomes. In particular, we have analyzed life expectancy at birth (by gender) and infant mortality as health outcomes. To carry this out, we have used the OECD Health Data (2012) and we have applied panel data techniques. To prove the consistency of the results, we have used different approaches considering temporal and country effects. In our results, the coefficients are statistically significant and in most cases have the expected signs according to the priori economic criteria. The estimates are robust and consistent with the inclusion of different specifications. As expected, income and pharmaceutical and other medical non-durables expenditures have a clear positive effect on life expectancy at birth, while its influence is negative for infant mortality.

The results indicate that expenditure on health, and particularly, pharmaceutical expenditure and drug consumption, produce better health outcomes, so it should be taken into account by policy makers. Furthermore, we have found that alcohol and fruit and vegetable consumption have the expected effect on health

outcomes, so it would be interesting, from the policy makers' point of view, to implement policies that encourage healthy lifestyles.

REFERENCES

AASERUD M., DAHLGREN, A.T., KÖSTERS, J.P., OXMAN, A.D., RAMSAY, C, AND STURM H. (2006): "Pharmaceutical policies: effects of reference pricing, other pricing, and purchasing policies". Cochrane Database Systematic Review, 2.

ANAND, S. and RAVALLION, M. (1993): "Human development in poor countries: On the role of private incomes and public services". *The Journal of Economic Perspectives*, 7 (1), 133-150.

BABAZONO, A. and HILLMAN, A.L. (1994): "A Comparison of International Health Outcomes and Health Care Spending". *International Journal of Technology Assessment in Health Care*, 10, 376-381.

CALISKAN, Z. (2009): "The relationship between pharmaceutical expenditure and life expectancy: evidence from 21 OECD countries". *Applied Economics Letters*, 16, 1651-1655.

CANTARERO, D. and PASCUAL, M. (2008): "Analyzing the impact of fiscal decentralization on health outcomes". *Applied Economics Letters*, 15, 109-111.

CEBRIÀ, J., SOBREQUÉ, J., RODRÍGUEZ, C. and SEGURA, J. (2003): "Influencia del desgaste profesional en el gasto farmacéutico de los médicos de atención primaria". *Gaceta Sanitaria*, 17 (6), 483-489.

CRÉMIEUX, P.Y., MEILLEUR, M.C., OUELLETTE, P., PETIT, P, ZELDERA, M. and POTVIND, K (2005): "Public and private pharmaceutical spending as determinants of health outcomes in Canada". *Health Economics*, 14, 107-116.

CREMIEUX, P.Y., OUELLETTE, P., MEILLEUR, M.C., LEONG, S. GREENBERG, P. and BIRNBAUM, H. (2001): "Pharmaceutical spending and health outcomes in the United States". *Research in Human Capital and Development*, 14, 59-75.

DAY, K. and TOUSIGNANT, J. (2005): "Health Spending, Health Outcomes, and Per Capita Income in Canada: A Dynamic Analysis". Department of Finance, Working Paper 2005-07.

FILIPPINI, M., GONZÁLEZ ORTIZ, L.G. and MASIERO, G. (2012): "Assessing the impact of national antibiotic campaigns in Europe". *European Journal of Health Economics*, DOI 10.1007/s10198-012-0404-9.

GARCÍA-SEMPERE, A. and PEIRÓ, S. (2001): "Gasto farmacéutico en atención primaria: variables asociadas y asignación de presupuestos de farmacia por zonas de salud". *Gaceta Sanitaria*, 15 (1), 32-40.

GOWRISANKARAN, G. and TOWN, R.J. (2004): "Managed Care, Drug Benefits and Mortality: An Analysis of the Elderly". NBER Working Paper No. 10204.

GUINDON, G.E. and CONTOYANNIS, P. (2012): "A second look at pharmaceutical spending as determinants of health outcomes in Canada". *Health Economics*, 21, 1477-1495.

HAUSMAN, J.A. (1978): "Specification Tests in Econometrics". *Econometrica*, 46, 1013-1029.

LIU, L., CLINE, R.R., SCHONDELMEYER, S. W. and SCHOMMER, J. C. (2008): "Pharmaceutical Expenditures as a Correlate of Population Health in Industrialized Nations". *The Annals of Pharmacotherapy*, 42(3), 368-74.

MARTIN, S. RICE, N. and SMITH, P.C. (2008): "Does health care spending improve health outcomes? Evidence from English programme budgeting data". *Journal of Health Economics,* 27, 826-842.

MORENO-TORRES, I., J. PUIG-JUNOY and J. M. RAYA (2010): "The impact of repeated cost containment policies on pharmaceutical expenditure: experience in Spain". *European Journal of Health Economics*, 12, 563-573.

NAVARRO, J.L. and HERNÁNDEZ, E. (2006): "Health Technologies Assessment: Analysing The Role Of Uncertainty". *Estudios de Economía Aplicada*, 24(3), 731-754.

NIXON, J. and ULMANN, P. (2006): "The relationship between health care expenditure and health outcomes. Evidence and caveats for a causal link". *European Journal of Health Economics*, 7, 7-18.

OECD (2011), "Pharmaceutical expenditure", in Health at a Glance 2011: OECD Indicators, OECD Publishing. http://dx.doi.org/10.1787/health_glance-2011-63-en.

OECD (2012), Health at a Glance: Europe 2012, OECD Publishing. http://dx.doi.org/10.1787/9789264183896-en.

RODRIGUEZ CABERO, G. (2007): "El marco institucional de la protección social de la dependencia en España". *Estudios de Economía Aplicada*, 25(2), 341-372.

TOUMI, M., RÉMUZAT, C. and CREATIV-CEUTICAL (2012): "EU Pharmaceutical expenditure forecast", Executive Agency for Health and Consumers-EAHC-European Commission (DG SANCO), forthcoming.

VOGLER, S. ZIMMERMANN, N.,LEOPOLD, C. and DE JONCHEERE, K. (2011); "Pharmaceutical policies in European countries in response to the global financial crisis" Southern Medical Review, 4(2), 69-79.

WOLFE, B. (1986): "Health status and medical expenditures: Is there a link?" Social Science & Medicine, 22(10), 993-999.

WOLFE, B. and GABAY, M. (1987): "Health status and medical expenditures: More evidence of a link". Social Science & Medicine, 25(8), 883-888.

ZEYNEP OR (2000): "Determinants of health outcomes in industrialised countries: a pooled, cross-country, time-series analysis". OECD Economic Studies No. 30, 2000/I.