DECOMPOSING THE DETERMINANTS OF HEALTH CARE EXPENDITURE: THE CASE OF SPAIN

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ABSTRACT

In this paper the determinants of health care expenditure per capita in Spanish regions are analyzed. The coexistence of several models concerning the degree of spending power decentralization and financing systems makes Spain a singular case and allows us to draw conclusions relevant for other countries decentralizing their health care systems. Analyzing the Spanish case also serves to show a number of pitfalls affecting econometric estimation of the effects of income and demographic structure on health expenditure. Because the reliability of parameter estimates is a key issue in the literature on the determinants of health expenditure, these potential problems should be taken into account when estimating and interpreting results.

JEL classification: I18; I38; H73.

Keywords: fiscal federalism; regional health expenditure; regional inequalities.

I. INTRODUCTION

In this paper the determinants of per capita health care expenditure in Spanish regions are analyzed. The Spanish case is particularly interesting for studying expenditure determinants because of the diversity within its institutional framework. Three different models of expenditure arrangements coexisted in Spain until 2002. The most common model, applied in ten regions or Autonomous Communities (ACs henceforth), was characterized by centralized administration and financing of health care. The second model, found in five ACs, was instead characterized by decentralized administration and responsibility of expenditure. In these ACs, expenditure was financed through specific grants, which yielded low tax autonomy and, in turn, increased difficulty in allocating additional resources to public health care. The final model only existed in two ACs, in which they enjoyed expenditure autonomy and a high level of tax autonomy.

The Spanish case also serves to illustrate the relevance of a number of pitfalls affecting previous empirical works in the field, especially when regional data is used and, as is usually the case, per capita income and demographic structure are included as explicative variables. In fact, research has most often focused on estimating income elasticities and the effect of ageing. Because the reliability of parameter estimates becomes a key issue, a number of caveats should be taken into account when estimating and interpreting results.

First, income elasticities should not be estimated using income as the only regressor. The correct interpretation of income elasticity is the percentage change in health expenditure in response to a given percentage change in income, everything else held constant. Health expenditure may grow because of ageing, technological change, and so on. If those factors are positively correlated with income (as they often are) bivariate regressions will produce upwardly biased estimates of income elasticity.

Second, regions are not countries. In the case of the latter, public revenues rely on national Gross Domestic Product (GDP). The governmental budget constraint tightly binds revenues and expenditure. In the case of regions, this may not be the case. If the responsibility for health care is not decentralized, regional income may be irrelevant. And the same may be true if fiscal equalization is strong and/or public health expenditure is financed by specific grants from the central government. Let us imagine one country composed of two identical regions, A and B, with the responsibility of managing public health. An asymmetrical regional shock created a difference in GDP growth rates: 4% in region A and 0% in region B (national economic growth is then 2%). With full fiscal equalization, a unitary income elasticity at the country level (a growth rate of public health expenditure of 2%) is compatible with a null correlation between income and health expenditure at the regional level. While growth rates of the former are very different, the growth of the latter is equalized at 2%. In sum, the more the fiscal

interdependence of regions, the lower the regional income elasticity of public health expenditure. Therefore, the institutional framework matters.

Third, if changes in the structure of the population are slow and/or the time span of the sample is short, the within-variation of some population brackets may be very low. This becomes a problem if individual effects are included in the estimates and if those effects are correlated with regressors. In this case, the fixed-effects specification is preferable to random-effects, but then the coefficients of variables with little within-variation are imprecisely estimated.

Finally, the correlation between population brackets may also be high, producing multicollinearity if several brackets are simultaneously included into estimates. For instance, the proportion of population aged 0-4 may be negatively correlated to the proportion aged 65 and over; or, the proportion of population aged 65-74 may be positively correlated to that aged 75 and over.

In the European Union, several studies have examined those effects (Hitiris, 1997; Hitiris and Nixon, 2001). However, only limited empirical evidence has been reported on the effect of determinants of health care expenditure at the regional level (Di Matteo and Di Matteo, 1998; Giannoni and Hitiris, 2002; Crivelli *et al*., 2005; Di Matteo, 2003 and 2005). In this manner, some research has been conducted in Spain to disentangle the potential factors in the generation of health care expenditure (Cantarero, 2005; Costa-Font and Pons-Novell, 2007; Lopez-i-Casasnovas and Saez, 2007), but significant methodological and empirical issues have led to questioning the validity of their results.

Using data from the Spanish regions for the period 1992-2003, this paper shows that the health public expenditure income elasticity estimate does change depending on the omission of relevant variables, econometric specifications and techniques, and institutional arrangements. Second, while demographic structure is a very relevant factor when explaining expenditure dynamics, multicollinearity biases econometric parameter estimates.

The structure of the paper is as follows. In the second section we briefly present the main characteristics of the Spanish National Health Service. In the third section the main empirical studies are reviewed. In the fourth section an analysis of data is carried out and the econometric specifications are presented. In the fifth section the main econometric results are shown. Finally, the paper ends with conclusions.

2. THE SPANISH NATIONAL HEALTH SERVICE: A BRIEF DESCRIPTION

The Spanish National Health Service (NHS) is characterized by two main features: universal access to health care for all Spanish citizens and a rapid asymmetric decentralization of health care to the Spanish regions since the early

eighties (Cantarero, 2005). The population, even illegal immigrants, has the right of free access to services and benefits are quite comprehensive, although minimal for long-term care and dental services and some regional diversity exists in some services. Health care expenditure is $2255 PPP (Purchasing Power Parity) per capita and accounts for 8.2 per cent of GDP in 2005. Approximately three quarters (5.8) of this spending corresponds to public expenditure and a quarter (2.4) to private expenditure (see tables I and II).

Table I

COMPARATIVE *PER CAPITA* HEALTH CARE EXPENDITURE AMONG OECD COUNTRIES IN $ PURCHASING POWER PARITY 2005

Country	Total	Public	Private
Australia	3128	2111	1017
Austria	3519	2664	855
Belgium	3389	2450	939
Canada	3326	2338	988
Czech Republic	1479	1310	169
Denmark	3108	2614	494
Finland	2331	1814	517
France	3374	2692	682
Germany	3287	2528	759
Greece	2981	1276	1705
Hungary	1337	943	394
Iceland	3443	2840	603
Ireland	2926	2282	644
Italy	2532	1940	592
Japan	2358	1926	432
Korea	1318	699	619
Luxembourg	5352	4849	503
Mexico	675	307	368
Netherlands	3094	1934	1160
New Zealand	2343	1830	513
Norway	4364	3648	716
Poland	867	601	266
Portugal	2033	1478	555
Slovak Republic	1137	846	291

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Country	Total	Public	Private
Spain	2255	1610	645
Sweden	2918	2469	449
Switzerland	4177	2494	1683
Turkey	586	418	168
United Kingdom	2724	2373	351
United States	6401	2887	3514

Source: OECD Health Data.

Table II

HEALTH CARE EXPENDITURE IN SPAIN 1990–2005

Expenditure	1990	1995	2000	2001	2002	2003	2004	2005
Total Expenditure								
% Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
% GDP	6,7	7,6	7,4	7,5	7,6	7,9	8,1	8,2
Public Expenditure								
% Total	78,7	72,2	71,6	71,2	71,3	71,2	70,9	71,4
% GDP	5,3	5,5	5,3	5,3	5,4	5,7	5,7	5,8
Private Expenditure								
% Total	21,3	27,8	28,4	28,8	28,7	28,8	29,1	28,6
% GDP	1,4	2,1	2,1	2,2	2,2	2,2	2,4	2,4

Source: OECD Health Data.

The devolution process of public health care began in 1981, according to the three models distinguished among ACs until 2002 (Cantarero, 2005; Lopez-i-Casasnovas *et al*., 2005; Costa-Font and Pons-Novell, 2007):

a) Ten regions (approximately half of the population) had no health care responsibilities until 2002. Before this date, the central government carried all responsibility for health care in those regions.

b) Five regions (Catalonia, Galicia, the Canary Islands, Community of Valencia, and Andalusia) kept health care expenditure responsibilities, but with actual fiscal responsibility limited, in the sense that they were held politically more than fiscally accountable. Therefore, most resources devoted to health care in those regions came from specific grants, with self-financing strongly constrained and playing a minor role.

c) While they were granted autonomy in financing health care, they also enjoyed a high level of tax autonomy.

Since 2002, the process of decentralizing health care and financing in Spain has extended to all ACs. Moreover, the new effective system departs from the previous model of specific financing of health care, by integrating it into the general financing system of ACs. Health care financing is now covered by regions basically through three types of resources, as any other service offered by regional governments: regional taxes, shared (totally or partially) taxes and block-grants from the central government. User co-payments play a minor role. Finally, as table III shows, global inequality in terms of per capita expenditure has not significantly increased with decentralization, at least until 2003 (Lago-Peñas, 2006a). Health care is the foremost policy responsibility of the ACs. In conjunction with education, these social expenditure items account for 60 to 70% of total public funds in the hands of ACs (Rico and Sabes, 2000).

Table III

EVOLUTION OF REGIONAL PER CAPITA PUBLIC HEALTH CARE EXPENDITURE IN SPAIN (1992-2005) (euros)

Autonomous Communities	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Andalusia	449	503	527	543	567	583	618	680	766	791	837	903	973	1020
Aragon	529	521	559	569	622	628	684	776	824	899	955	1069	1168	1209
Asturias	521	535	564	576	613	612	664	757	810	872	946	1061	1136	1205
Balearic Islands	427	420	460	470	506	526	552	614	637	677	800	908	950	1121
Canary Islands	479	498	520	550	579	587	613	770	820	840	910	1000	1046	1147
Cantabria	508	528	562	576	584	631	672	773	833	921	1014	1073	1243	1331
Castilla y León	467	464	500	513	548	565	611	726	787	840	898	1029	1093	1177
Castilla La Mancha	433	447	487	501	557	560	588	675	721	774	879	936	923	1157
Catalonia	455	487	525	547	576	591	642	722	777	817	869	958	998	1058
Community of Valencia	462	497	536	540	573	585	616	689	750	790	846	934	989	1029
Extremadura	470	487	504	526	581	588	630	725	786	826	969	1026	1122	1199
Galicia	402	437	479	511	566	585	623	754	797	864	902	980	1088	1122
Madrid	528	522	590	570	598	598	633	725	752	788	815	870	980	1026
Murcia	441	450	466	504	576	589	606	709	768	806	861	951	1037	1114
Navarre	420	424	437	483	542	570	615	878	933	961	1014	1089	1167	1204
Basque Country	459	467	513	539	576	589	613	791	836	894	957	1028	1095	1195
La Rioja	444	451	501	515	514	549	585	720	791	834	910	994	1112	1228
Total	465	488	526	540	574	587	624	721	776	818	874	954	1.023	1191
Var. Coef. (%)	8.36	7.63	8.04	6.09	4.78	4.32	5.10	5.80	5.04	5.58	5.77	6.23	6,58	6,87

Source: Authors' calculation based on Ministry of Health (Spain).

3. THE DETERMINANTS OF REGIONAL HEALTH CARE EXPENDITURE: A SURVEY

Health care expenditure growth and its determinants is one striking issue for western economies (Hitiris and Posnett, 1992; Hitiris, 1997; Hitiris and Nixon, 2001). After the seminal papers by Kleiman (1974) and Newhouse (1977), the examination of the determinants of health care expenditure has been a matter of extensive debate. The increasing availability of international data on health care has led to the development of studies disentangling the underlying factors that determine health care expenditure, such as income, ageing, time effects, availability of factors and even technological progress (Newhouse, 1992). However, most studies are based on cross-country data, to unravel the extent to which income and other determinants, such as demographics (demand side variables) and heterogeneity of health care inputs (supply side variables), explain differences in health expenditure (Vatter and Ruefli, 2003).

Most cross-country studies find that per capita income is the most important determinant of per capita health expenditure. Furthermore, the coefficient of per capita income is most often equal to or greater than one, leading to the conclusion that health care is a luxury rather than a necessity. Interestingly, there is no agreement in the literature about whether health care expenditure is a luxury or a normal good (Blomqvist and Carter, 1997; Devlin and Hansen, 2001; Bac and Le Pen, 2002; Di Matteo, 2003; Atella and Marini, 2004a and 2004b; Carrion-i-Silvestre, 2005; Sen, 2005). Another important element is the consideration of the regional dimension within national health care expenditure, because there may be an aggregation fallacy in estimating the income elasticity of health care expenditure.

In light of the long-lasting debate on whether health care is a luxury and what are the determinants of this expenditure, Di Matteo and Di Matteo (1998) found that key determinants of health care expenditure were real provincial per capita income, the proportion of the provincial population over age 65 and real provincial per capita federal transfer revenues. Also, an income elasticity of 0.77 implied that health care is not a luxury good.

Ariste and Carr (2001) use error correction and cointegration techniques on Canadian provincial health care expenditure data (1966-1998). They find an income elasticity of 0.88 and conclude the same as Di Matteo and Di Matteo (1998). Similarly, Giannoni and Hitiris (2002) attempt to examine the determinants of regional health expenditure in Italy and find significant regional-specific effects.

The principal findings of Freeman (2003) are that health care expenditures and incomes within the US states for the years 1966-1998 are non-stationary and cointegrated. Dynamic OLS cointegrating regressions of the pooled state time-series estimate the income elasticity of health care at 0.817 to 0.844.

In Di Matteo (2003) parametric and nonparametric estimation techniques are compared in estimating the relationship between income and health expenditures with implications for the reliability of past estimates of health expenditure income elasticity. The results for three time series cross-sectional data sets (the US state and Canadian province level data and national level data for 16 OECD countries) confirm that income elasticity does vary by level of analysis, with international income elasticities generally larger than national or regional studies.

The aim of Cantarero (2005) was to analyze the determinants of regional health care expenditure in Spain because important differences exist among regions. Results show that the most important determinant in explaining the volume of regional health care expenditure is the ageing population, while other factors like the regional income and the relative structural characteristics of the supply variables have less importance.

In Di Matteo (2005) the determinants of real per capita health expenditure in the United States and Canada are examined. Ageing population distributions and income explain a relatively small portion of health care expenditures when the impact of time effects, a partial proxy for technological change, is controlled.

In Crivelli *et al.* (2005) income does not have any influence on the level of health care expenditures. This result might be considered surprising, but in reality it shows that one of the main objectives of the Swiss health care system has been reached (horizontal equity).

Lopez-i-Casasnovas and Saez (2007) apply a multilevel hierarchical model, using data for 110 regions in eight countries in 1997 (including Spain). Two sources of random variation (within countries and between countries) are identified. Variability between countries amounts to (SD) 0.5433 and just 13% of that can be attributed to income elasticity, with the remaining 87% to autonomous health expenditure. Within countries, variability amounts to (SD) 1.0249 and the intra-class correlation is 0.5300. They conclude that it is necessary to take into account the degree of fiscal decentralization within countries in estimating income elasticity of health expenditure. Two reasons justify this: where there is decentralization to the regions, policies aimed at emulating diversity tend to increase national health care expenditure; and without fiscal decentralization, central monitoring of finance tends to reduce regional diversity and therefore decrease national health expenditure. The results do seem to validate both these points.

Also, Costa-Font and Pons-Novell (2007) show that Spanish regions exhibit significant heterogeneity as a result of increasing decentralization and region-specific political factors, along with different uses of health care inputs, economic dimensions and spatial interactions. A potential limitation of these studies lies in the fact that no evidence of Spanish private health expenditure is available at the regional level.

Finally, Costa-Font and Moscone (2008) use a spatial panel specification for all Spanish regions. They show some degree of interdependence in spending decisions between neighboring regions. Similar results appears in Costa-Font, Gemmill and Rubert (2009).

Table IV summarizes all the above studies. In short, most of them find a positive income elasticity for regional public health expenditure, but below unity. Moreover, the demographic structure is another key variable. Both factors are analyzed in-depth in the next sections.

Table IV

SUMMARY OF DATA AND RESULTS FOR PREVIOUS STUDIES. DEPENDENT VARIABLE: REGIONAL HEALTH CARE EXPENDITURE

Reference	Countries studied	Period	Model description	Main results
Di Matteo and Di Matteo (1998)	Canadian provincial government health expenditure	1965-1991	Pooled time-series cross-sectional regression analysis	Key determinants: real provincial *per capita* income, the proportion of the provincial population over age 65 and real provincial *per capita* federal transfer revenues Income elasticity: 0.77 (health care is not a luxury good)
Ariste and Carr (2001)	Canadian provincial government health expenditure	1966-1998	Error correction and cointegration techniques	Income elasticity: 0.88 (health care is not a luxury good)
Gionannoni and Hitiris (2002)	Italy's regions	1980-1995	Pooled regional time-series cross-sectional data	The most important determinant is regional income. Among the factors of lesser importance are: (i) the ageing population; and (ii) structural characteristics, relating to economies of scale and productivity
Freeman (2003)	American state-level data	1966-1998	Dynamic Ordinary Least Squares cointegrating regressions	Income elasticity: 0.817 to 0.844 (health care is a necessity good)

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Reference	Countries studied	Period	Model description	Main results
Di Matteo (2003)	American state-level data, Canadian province-level data and national level data for 16 OECD countries	1980-1997 (US), 1965-2000 (Canada) and 1960-1997 (16 OECD countries)	Ordinary Least Squares (OLS) regression model	Income elasticity does vary by level of analysis with international income elasticities being generally larger than national or regional studies
Cantarero (2005)	Spanish regions	1993-1999	Panel data	The most important determinant is the ageing population, while other factors such as income differences and structural characteristics of the supply variables (the physician and bed density) have less importance
Di Matteo (2005)	American state-level data and Canadian province-level data	1980-1998 (US) and 1975-2000 (Canada)	Multivariate analysis	Key factors: Income and population over 65 years, and time effect (proxy for technological change)
Crivelli, Filippini and Mosca (2005)	Swiss cantons	1996-2001	Panel data	Key factors: the physician density, the percentage of over 75 in the population, the percentage of under 5 in the population and the unemployment rate. Income does not have any influence on health expenditures
López-i-Casasnovas and Saez (2007)	110 regions in Australia, Canada, France, Germany, Italy, Spain, Sweden and United Kingdom	1997	Multilevel hierarchical model	Key determinants: Income and population over 65 years and over
Costa-Font and Pons-Novell (2007)	Spanish regions	1992-1998	Ordinary Least Squares and the Lagrange multipliers methods (ML-SER)	Key Determinants: Income, number of doctors ,beds, and stays per population, (foral?) regime, health care responsibilities and political variables. Income elasticity: 0.98 and 0.66 (health care is not a luxury good)

Source: Authors' elaboration.

4. ECONOMETRIC SPECIFICATION AND DATA

As endogenous variable, the logarithm of per capita health care expenditure (Loggspc) is used. The list of exogenous variables includes per capita income (Logy), demographic structure (Pop) and a number of control variables: several physical indicators and a proxy for technological change. In particular, we have considered consumption of medical services through the number of general practitioners per 1000 population (Ch) and acute care beds per 1000 population (Ph). With respect to technological change, empirical literature has given it little attention. Di Matteo (2005) is an exception. While it is often accepted that innovations in medical care boost the cost of health services, there are no aggregated statistical indexes to measure it. As in the literature on economic growth, a time trend (Trend) or a set of time fixed-effects may be used as proxy. Di Matteo (2005) chooses the second option, finding that time accounts for approximately two-thirds of health expenditure increases in the US and Canada. In this paper both alternatives are used.

Information is available for the period 1992-2003 on 17 Spanish regions, which yields 204 observations. The list of variables, definitions, and data sources are shown in table V and basic descriptive statistics in table VI.

Table V

VARIABLE DEFINITIONS AND DATA SOURCES

Variable	Definition	Data Source
Loggspc	Logarithm of health care expenditure *per capita*	Spanish Ministry of Health
Logy	Logarithm of real *per capita* income	Spanish National Institute of Statistics
Ch	Acute care beds per 1000 population	Spanish National Institute of Statistics
Ph	General practitioners (density per 1000 population)	Spanish National Institute of Statistics
Pop4	Population with age below 4 (ratio)	Spanish National Institute of Statistics
Pop75	Population with age over 75 (ratio)	Spanish National Institute of Statistics
Pop6575	Population with age between 65 and 75 (ratio)	Spanish National Institute of Statistics
Trend	Time trend	
FORAL	Dummy variable for Foral Autonomous Communities. 1 for observations corresponding to the Basque Country and Navarre and 0 otherwise	
NOTAX	Dummy variable for Common Autonomous Communities with responsibilities on public health care during the 90's. 1 for observations corresponding to Andalusia, the Canary Islands (since 1995), Catalonia, Community of Valencia and Galicia and 0 otherwise	

Table VI

DESCRIPTIVE STATISTICS

Variable	Mean	Std. Dev. (All)	Std. Dev. (Between)	Std. Dev. (Within)	Min.	Max.
Loggspc	6.47	0.26	0.05	0.25	6.00	6.99
Logy	7.13	0.29	0.20	0.21	6.47	7.79
Ch	3.88	0.63	0.61	0.20	2.68	4.97
Ph	2.43	0.38	0.31	0.23	1.65	3.20
Pop4	4.63	0.82	0.80	0.25	3.03	6.40
Pop75	7.08	1.55	1.42	0.71	4.00	11.07
Pop6575	9.83	1.44	1.42	0.42	5.94	12.35
FORAL	0.12	0.32	0.33	0.00	0	1
NOTAX	0.28	0.45	0.45	0.10	0	1

Source: Authors' calculation.

The basic econometric specification is the following:

$$\text{Loggspc}_{it} = \alpha_i + \beta_1 \text{Logy}_{it} + \beta_2 \text{Ch}_{it} + \beta_3 \text{Ph}_{it} + \beta_4 \text{Trend} + \sum_j \gamma_j \text{Pop}_{jit} + \varepsilon_{it} \qquad [1]$$

where i indicates region and t indicates year. Different numbers (j) of population brackets are used in each estimate. Logarithms are only used in the case of expenditure and income because the remaining variables are expressed in percentages; taking logarithms of percentages makes no sense (Giannoni and Hitiris, 2002).

In order to test differences in the effect of income in the several groups of regions, two dummy variables FORAL and NOTAX are included. Interactions between both variables and *Logy* are then included into the basic specification:

$$\text{Loggspc}_{it} = \alpha_i + \beta_1 \text{Logy}_{it} + \beta_2 \text{Ch}_{it} + \beta_3 \text{Ph}_{it} + \beta_4 \text{Trend} + \\ + \sum_j \gamma_j \text{Pop}_{jit} + \beta_5 \text{Logy}_{it} \text{FORAL} : + \beta_6 \text{Logy}_{it} \text{NOTAX} + \varepsilon_{it} \qquad [2]$$

5. ECONOMETRIC RESULTS

In the case of some regressors, within-variation is clearly lower than between-variation (see table VII). This is the case of Pop6575 (within-variation is 3.4 times lower than between-variation), Popmen4 (3.2 times) and Ch (3.1 times). Collinearity with individual fixed-effects may be problematic when using fixed-

effects is necessary. Unfortunately, this is the case. Econometric results show that individual effects significantly increase the goodness of fit (column 1 versus column 5 and column 2 versus column 6). A simple F-test formally verified the null hypothesis that the constant terms are equal. Moreover, correlation between individual effects and regressors is high, indicating that fixed-effects is a better choice than random-effects. According to the Hausman test applied on column 5, the hypothesis of uncorrelation should be discarded (p-value=0.0006).

As expected, the inclusion of individual effects into the estimates changes the estimated coefficients for variables with a low within-variation. This is the case of variable Pop4. In column 2, its coefficient is positive (p-value=0.198). However, it becomes negative and marginally significant when individual effects are included (column 6).

As expected again, correlation between the different population brackets are high. Multicollinearity is then a serious concern when some combinations of brackets are simultaneously used. For instance, when both Pop657*5* and Pop75 (r=0.89) are included, the coefficient for the first is negative (column 2). But it becomes positive when Pop75 is removed (column 3). Some of the results by Di Matteo (2005) concerning the effect of the structure of population on health care expenditure could be explained by this reason.

As an alternative to the standard within-estimator, the three-stage estimator proposed by Plümper and Troeger (2004a and 2004b) was used. This estimator, called xtfevd, allows simultaneous inclusion of time-invariant variables and individual fixed effects. Moreover, according to Monte Carlo simulations, xtfevd performs better than the fixed-effect model when the between variation clearly exceeds the within variation (by at least a factor of 2.5). Results confirmed the positive sign of variable Pop4.

Correcting for cross-sectional heteroscedasticity and contemporaneous cross-correlation do not significantly change results. In column 6, p-values corresponding to Beck and Katz (1995) robust t-statistics are also reported in brackets.

In column 7, results from the between-groups estimator are reported. Only three regressors are included due to the small sample size. Compared to the within-groups estimator in column 6, results clearly show that our model is much more useful for understanding within variation than cross-sectional variation in Loggspc.

However, estimates in columns 1 to 7 may suffer from biases due to serial autocorrelation. The modified Bhargava *et al.* Durbin-Watson statistic was computed for estimates in column 6. It yielded the value of 0.90. According to critical values calculated by Bhargava *et al.* (1982), the hypothesis $\rho=1$ must be rejected. Estimates in column 8 and the following columns control for this problem. The Arellano-Bond (1991) dynamic panel estimator (*xtabond*) is used in column 9. In the remaining columns we use the Baltagi and Wu (1999)

estimator for cross-sectional time-series regression models with first-order autoregressive disturbance terms (*xtregar*). In the case of the Arellano-Bond estimator, two lags of the dependent variable are included in the model in order to reject the null hypothesis of no second-order serial correlation in the residuals. Moreover, the null hypothesis in the Sargan test of over-identifying restrictions cannot be rejected when the two-step estimator is used. As we will see, some coefficients change when autocorrelation is controlled.

A time trend is included in columns 10 and 13. In columns 11 and 14, the time trend is replaced by time fixed-effects. While results using a common time trend or time fixed-effects are similar, there are significant differences in estimates where the effect of time is not controlled.

The income elasticity of public health care expenditure significantly changes depending on the inclusion of other variables, specifications, and econometric techniques. In columns 1 and 5 Logy is the only regressor. Because the model specification in column 5 is better than that in column 1 (individual effects are included), one should conclude that health services is a "luxury" good: elasticity is over unity (1.11). However, once other regressors are included, elasticity dramatically drops to 0.39 (column 6). Moreover, when serial correlation is controlled for, elasticity becomes 0.12 (column 8) or 0.03 when the Arellano-Bond estimator is used (column 9). Finally, income is not significant when the time trend (column 10) or time fixed-effects (column 11) are included. Assuming that this last result may be partially explained by collinearity between time trends and income (R^2 of *Logy* on *Trend* is 0.870), income elasticity is very low once omitted variable bias and econometric problems are corrected.

In columns 12 and 14, the homogeneity of coefficients for the variable Logy and the three aforementioned groups of ACs is tested. The results indicate that variation of GDP per capita would be more influential, with a positive sign for the foral ACs. In other words, regional GDP growth would be translated into more health care expenditure only in foral AC.

In sum, to understand results concerning income elasticity one must take into account that the decisions in health policy in Spain are strongly affected by a model of health care that puts emphasis on the equality of citizens' access. Strong income elasticities of health care expenditure at the national level are compatible with weak regional elasticities. If the central government controls expenditure directly or equalizes per capita regional revenues (reducing tax autonomy and/or giving grants to less developed regions), expenditure and income may be weakly correlated. In this sense, we have shown that income is translated into higher expenditure only in those Spanish regions with particular fiscal arrangements (Navarre and the Basque Country) entailing a higher income and tax autonomy. They enjoy a greater capacity to convert regional income into public health care expenditure.

Table VII

ECONOMETRIC ESTIMATES OF EQUATION [1] AND [2]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)*	(12)	(13)	(14)*
Intercept	**2.09 (0.000)**	**2.14 (0.000)**	**3.16 (0.000)**	**1.85 (0.000)**	**-1.76 (0.000)**	**2.45 (0.000) [0.000]**	**6.28 (0.000)**	**3.67 (0.000)**	**0.02 (0.009)**	**5.28 (0.000)**	**5.76 (0.000)**	**3.61 (0.000)**	**5.24 (0.000)**	**5.85 (0.000)**
Logy	**0.62 (0.000)**	**0.50 (0.000)**	**0.44 (0.000)**	**0.54 (0.000)**	**1.11 (0.000)**	**0.39 (0.000) [0.000]**	0.015 (0.831)	**0.12 (0.029)**	0.03 (0.229)	0.001 (0.978)	0.04 (0.364)	**0.13 (0.016)**	-0.01 (0.808)	0.03 (0.510)
Ch		-0.04 (0.153)	**-0.06 (0.015)**	-0.03 (0.252)		-0.06 (0.152) [0.177]		**-0.11 (0.012)**	**-0.06 (0.079)**	**-0.08 (0.064)**	-0.03 (0.408)	**-0.11 (0.016)**	-0.06 (0.159)	-0.02 (0.483)
Ph		**0.18 (0.000)**	**0.14 (0.003)**	**0.21 (0.000)**		**0.34 (0.000) [0.000]**	0.01 (0.930)	**0.19 (0.000)**	**0.25 (0.000)**	**0.13 (0.009)**	**0.08 (0.047)**	**0.22 (0.000)**	**0.15 (0.001)**	**0.11 (0.010)**
Pop4		0.03 (0.198)				-0.03 (0.113) [0.140]		0.07 (0.093)	0.01 (0.457)	0.05 (0.144)	0.05 (0.298)	0.04 (0.368)	0.03 (0.378)	-0.01 (0.818)
Pop75		**0.05 (0.000)**	**0.10 (0.000)**			**0.05 (0.000) [0.000]**	0.01 (0.396)	**0.23 (0.000)**	**0.05 (0.008)**	**0.08 (0.003)**	**0.06 (0.028)**	**0.21 (0.000)**	**0.007 (0.006)**	**0.05 (0.030)**
Pop6575			**-0.06 (0.002)**	**0.04 (0.000)**										
Trend										**0.05 (0.000)**			**0.005 (0.000)**	

(Sigue)

(Continuación)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)*	(12)	(13)	(14)*
Logy*FORAL												0.15 (0.204)	**0.21** **(0.016)**	**0.27** **(0.003)**
Logy*NOTAX												0.09 (0.439)	0.001 (0.860)	0.004 (0.477)
$Loggspc_{-1}$									**0.52** **(0.000)**					
$Loggspc_{-2}$									**-0.14** **(0.009)**					
$\hat{\rho}$								0.68		0.59	0.73	0.63	0.52	0.63
R^2	0.481	0.673	0.687	0.641	0.901	0.955	0.06	0.807		0.893	0.893	0.846	0.918	0.932
Observations	204	204	204	204	204	204	17	187	153	187	187	187	187	187
Hausman Test (p-value)					0.0006									
Method	OLS	OLS	OLS	OLS	Xtreg, fe	Xtreg, fe [xtpcse]	Xtreg, be	Xtregar, fe	Xtabond	Xtregar, fe	Xtregar, fe	Xtregar, fe	Xtregar, fe	Xtregar, fe

P-values corresponding to t-statistics appear in parenthesis.

* Include time fixed-effects

6. CONCLUSIONS

In this paper the main determinants of per capita health care expenditure in Spanish regions (autonomous communities) are analyzed. The Spanish National Health Service is based on universal access to health care for all Spanish citizens and health care was decentralized to the Spanish regions during the last 28 years since the new democratic regime (1978). The coexistence of several models regarding the degree of expenditure decentralization and financing systems makes Spain a singular case; it allows interesting conclusions to be drawn for other countries on ways to decentralize their health care system.

According to the literature, our model is based on two main factors: per capita income and demographic structure. As control variables, two physical indicators (acute care beds and general practitioners per 1000 people) and a proxy for technological change are also included. Nevertheless, multicollinearity is a serious concern when some combinations of variables are simultaneously used.

Finally, the income elasticity of public health expenditure significantly changes depending on the inclusion of other variables, specifications, and econometrics. Moreover, it is worth noting that regional GDP growth would be translated into more health care expenditure in regions enjoying higher tax autonomy, but not in the rest. To understand results concerning income elasticity, one must take into account that choices on health care in Spain are strongly affected by the fact that the National Health Service puts strong emphasis on the equality of citizens' access and controls the revenues devoted to regional public health care. For that reason, only in regions with high tax autonomy, a positive (although not very strong) relationship between regional income and public expenditure is found. The models have changed since 2002, when responsibilities for public health care were ceded to all regions and more tax autonomy accorded. While a future increase in regional divergences may be hypothesized, we must wait several years in order to expand the sample.

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SÍNTESIS

PRINCIPALES IMPLICACIONES DE POLÍTICA ECONÓMICA

In this paper the determinants of health care expenditure per capita in Spanish regions are analyzed. The coexistence of several models concerning the degree of expenditure power decentralization and financing systems makes Spain a singular case and allows us to draw conclusions relevant for other countries decentralizing their health care systems. Analyzing the Spanish case also serves to show a number of pitfalls affecting econometric estimation of the effects of income and demographic structure on health expenditure. Because the reliability of parameter estimates is a key issue in the literature on the determinants of health expenditure, these potential problems should be taken into account when estimating and interpreting results.

According to the literature, our model is based on two main factors: per capita income and demographic structure. As control variables, two physical indicators (acute care beds and general practitioners per 1000 people) and a proxy for technological change are also included. Nevertheless, multicollinearity is a serious concern when some combinations of variables are simultaneously used.

Finally, the income elasticity of public health expenditure significantly changes depending on the inclusion of other variables, specifications, and econometrics. Moreover, it is worth noting that regional GDP growth would be translated into more health care expenditure in regions enjoying higher tax autonomy, but not in the rest. To understand results concerning income elasticity, one must take into account that choices on health care in Spain are strongly affected by the fact that the National Health Service puts strong emphasis on the equality of citizens' access and controls the revenues devoted to regional public health care. For that reason, only in regions with high tax autonomy, a positive (although not very strong) relationship between regional income and public expenditure is found. The models have changed since 2002, when responsibilities for public health care were ceded to all regions and more tax autonomy accorded. While a future increase in regional divergences may be hypothesized, we must wait several years in order to expand the sample.

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