Public expenditures on Health and Pensions in OECD Countries

Their Simultaneous Estimation

Maria da Alegria Miller Fleming Pinheiro Torres

152214006

Dissertation written Under the Supervision of Professor Miguel Gouveia

Dissertation submitted in partial fulfilment of requirements for the MSc in Economics with specialization in Public Policy and Regulation at the Universidade Católica Portuguesa, April 2017.

“Our greatest weakness lies in giving up.
The most certain way to succeed is always to try
just one more time.”

Thomas A. Edison

Abstract

This dissertation aims to explore the simultaneous determination of public expenditures on health and old-age pensions regarding 31 high-income OECD countries during the period 1990-2011. To take into account that each country and year can´t be treated as homogenous, the thesis uses a panel data model with country and year fixed effects. Regarding pensions and health individual determination, it was verified through an OLS regression with Dummy Variables, that GDP is the most important determinant of health expenditures and that it also has a strong impact on old-age pensions expenditures. Given that old-age pensions expenditures have a statistically significant impact on health expenditures and vice versa, a 2SLS model was used in order to estimate this simultaneous determination. Per capita pensions expenditures have a positive and robust impact on health expenditure per capita mainly because pensions expenditures will redistribute income for those that have a larger propensity to spend on health. Additionally the expectations of the future pensions payments serve as an incentive to invest in living longer. (Yonghong An 2015) The impact on pensions expenditures of expenditures on health was not so clear. The impact is positive and significant, but the instruments for health used in the pensions 2SLS equation, though relevant, seem not to be strong enough to totally validate this causality relation. If true, this relation would indicate that when the Government invests in health, invests in a higher life expectancy which means that also it will have to pay for pensions during a longer period.

Esta dissertação tem como objetivo explorar a determinação simultânea dos gastos públicos com pensões de velhice e saúde em 31 países da OCDE durante o período 1990 - 2011. Como os países e períodos de tempo não podem ser tratados de forma homogénea, um modelo de dados de painel com efeitos fixos por país e ano é utilizado. No que se refere à determinação individual dos gastos, verificou-se através de regressões OLS com Dummy Variables que o é a variável com maior impacto na despesa em saúde e que também tem um forte impacto nas despesas com pensões. Dado que as despesas com pensões de velhice tiveram um impacto nas despesas de saúde e vice-versa, um modelo 2SLS foi utilizado. A despesa com as pensões tem um impacto positivo e robusto nas despesas em saúde, devido ao facto das despesas com pensões redistribuírem o rendimento por aqueles que têm maior propensão para gastar em saúde. (Yonghong An 2015). Por outro lado as expectativas dos pagamentos futuros das pensões servem como um incentivo para se investir em viver mais tempo. O impacto nas despesas com pensões das despesas em saúde não é tão claro. Apesar do impacto ser significativo, os instrumentos utilizados para a saúde na equação de 2SLS das pensões, apesar

de relevantes, não parecem ser suficientemente fortes para validar totalmente esta relação. Se verdadeira ela indicará que quando o Governo investe em saúde, investe na esperança de vida o que implicará pagamentos de pensões durante períodos mais longos.

“

Acknowledgments

First and foremost, I would like to give a special thanks to my supervisor Professor Miguel Gouveia for his advice and availability. It was a pleasure to work with such a great academic that not only patiently supported me during my dissertation, but also shared his knowledge with me and always pushed me to try my best. I also want to thank to the other professors that, though it was not their obligation, helped me through this process as Professor Leonor Modesto, Professor Pedro Raposo, Professor Pedro Pita Barros, Professor Conceição Figueiredo, Professor Luís Martins, Professor Geraldo Cerqueiro, Professor Mark Schaffer and Professor João Santos Silva.

Of course, I want to thank my family, friends and co-workers for always believing in me and in my work. I want to specially thank Maria Madre de Deus for teaching me that in order to present an idea, we need to pay attention to the way that we do it, to Sebastião Dias for his recommendations and interest in this research , to Tomás Mourão Ferreira for his unconditional support during this period, and at last but not the least, to my father and mother that teach me every day the ethics of hard work and always believe in my skills and abilities - I dedicate this thesis to you.

Table of Contents

Index of Figures

Index of Appendix A- Figures

Index of tables

Index of Appendix A- Tables

I. Introduction

The demographic trends in high-income OECD countries in the last decades and their consequences for the Government expenditures on Health and on Old-age Pensions are the main motivation for this thesis. The thesis aims to study econometrically the relationship of these two important social expenditures during the period 1990-2011. The econometric model used is a 2SLS with dummy variables to control for country and year specificity, as the Two-Way Fixed Effects technique does, explaining health and old-age pension's public expenditures. The sample used includes 31 selected OECD countries.

In the last decades, life expectancy has been rising, old age population represents an increased share of the population and the old-age dependency ratio has the same trend which lead to a substantial increase of public expenditures on Health and Pensions, generating many challenges to Governments in a time when budget pressures are high for most OECD countries (since Health and Pensions are major components of national public expenditures,). (OECD, Health at a Glance 2015).

In fact, regarding 31 OECD countries, in 1990 the average spending on health was 1377.15 US$ per capita and in 2011 this value was 2591.52 US$ per capita. Regarding old-age pensions per capita, the expenditure in 1990 was 1632.63 US$ per capita and in 2011 it was 2788.95 US$ per capita.[1] These expenditures increases, especially in health expenditure, attracted a large attention in the literature, even more when the conventional empirical explanations for this growth left a lot to be explained.

The first step was to find what determines Pensions and Health expenditures and what it is the best method to deal with 31 countries during 22 years. The second step deals with the fact that Pensions and Health expenditures determine each other simultaneously, which means that we are in the presence of a structural model in which endogeneity should be considered through the two-stages least squares estimation.

This is different from previous studies estimating he public expenditures on old-age pensions and health and it serves as a complement to the these previous studies, specially to Zhao (2014) and Yonghong An (2015) that concluded that an increase in pensions expenditures robustly and significantly increased health expenditures in the USA, which will be confirmed in this

[1]Both pensions and health expenditures are inflation corrected, being the deflator 2010US$ and PPPs.

research, now with a different sample, with the complement of the health contributions for pensions expenditures increase.

The thesis organization is as follows: in Chapter II a revision of the relevant literature will be made; in Chapter III the source and descriptive statistics of the variables used in analysis will be presented; in chapter IV the econometric methodology regarding Fixed Effects and Instrumental Variables will be presented; chapters V and VI present the results of the regressions and their interpretations and, at last, in VII the main conclusions will be drawn.

II. Literature review

Health and pensions' expenditures are some of the biggest levers of the increase in public expenditure in developed countries especially in the last 40 years and there is a large body of literature regarding these themes.

Health expenditure literature

Given the heterogeneity associated to levels of health expenditure across countries, there have been many regression analyses based on international data sets in the last forty years. The first-generation studies on health expenditure simply focused on the relation between GDP per capita and health expenditure per capita, having a cross-section bivariate regression (Newhouse e Culyer 2000), i.e. the studies compared health expenditure across countries, using health expenditure per capita as the dependent variable, and GDP per capita as independent variable. Since (J. Newhouse 1977) this variable has been considered the principal factor explaining the variations of health expenditures between and within countries, with the elasticity of the relation generally around, and sometimes higher than one, which generated the debate around the hypothesis of health being a luxury or a necessity (because, if the elasticity it is higher than 1, health is a luxury and if it is lower than 1 it would be a necessity).

Despite the importance of GDP per capita, this variable it is not the only one that explains the expenditure on health, and some authors attempted to introduce other covariates to prevent the misspecification of estimates. Leu (1986) presented some demographic characteristics as the share of persons under 15 and over 65 (under the assumption that these groups tend to demand more health care than others). Also, other authors explored the share of young and old in the population but the results presented small and /or insignificant coefficients (Grossman 1972); ((Jes Sogaard 1992); (Hitiris T. 1992), (Matteo 1998); (Jönsson 2003).

Regarding the second-generation studies, these focused mainly, on panel data analysis, in the sense that this econometric method allows for the study of a certain number of entities (as firms / countries / individuals, etc.), observed for several time periods (Cameron and Trivedi 2005). For instance, the application of fixed effects model allows to study the determinants of health expenditure controlling for time-specific effects, country-specific effects or both, as was the case of Gerdtham (1992) that studied 22 OECD countries during the period 1972-1987 testing for five different models, also addressing lags and dynamic models. This model studied the total health expenditure as a function of four variables besides GDP per capita and reinforced the idea that GDP per capita is the main explanatory variable regarding health expenditure. Later, Gerdtham et al. (1998) studied the same data set for the period 1970-1991 to examine the effect of different ways that health expenditure is arranged institutionally through dummies and involving non-institutional dummies as tobacco consumption that was shown to increase health expenditure.

Also, Hitiris T. (1992) replicated Newhouse and Leu studies using panel data for 20 OECD countries for the period 1960-1987. The results re-confirmed the importance of GDP. Other variables showed statistical importance, although with a small coefficient values, as was also verified by (Gouveia 1993).

Barros (1998) also estimated a model for 24 OECD countries in which the author attempted to study the same as the authors above but in a different perspective in the sense that the study focus was on the determinants of growth of aggregate health expenditure, having as covariates the GDP per capita growth rate, the health system characteristics, the existence of gatekeepers and aging population. These variables were found to be insignificant in explaining the growth rates of health expenditure, but capable of explaining the "static" model that aims to explain health expenditure.

Technological progress has also been used as an important determinant of health care expenditures. Newhouse (1992) considered that all the reasons present in past studies that explained the medical expenditure increase "account for well under half- perhaps under a quarter-of the 50-year increase in medical care expenditure.", believing that the residual left to explain is attributable to technological change, a theory that was developed by followers that used some proxies in order to explain the technological progress such as time trend, infant mortality , surgical procedures and the numbers of some specific medical equipments (Sampayo e Vale 2012) .

Nevertheless, there are a lot of limitations in this literature, either because of econometric limitations, the lack of data or the difficulty in finding good proxies to some of the variables.

Old age pensions literature

OECD countries present large differences regarding pensions, and most of the retirement income (around 60%) comes from the State: most of the OECD countries offer a minimal pension to those who have no income, independently of someone´s work and contributions history. In the typical social insurance scheme the employer and employees contribute to a pay-as-you- (PAYG) system. Some alternatives exist as in the case of funded systems in which the current contributions are used to accumulate assets to be paid in the future.

Many determinants of pension expenditures, as the retirement age, have changed from 1970 onwards. This phenomenon derives mainly from the increase in life expectancy at age 65 and the decline of mortality rates, caused by the great medical and pharmaceutical improvements that have occurred since 1970. (Miroslav e Rok 2014).

Furthermore, OECD developed countries had high gross replacement ratio (the gross income after retirement, divided by the gross income before retirement), which along with high taxation of earnings lead to distortions in the labor market, and decreasing labor market participations rates. The benefits implicit in the retirement pensions became a disincentive to work, even more as labor market regulations did not provide incentives for working in later ages, and instead provided incentives for early retirement. (Miroslav e Rok 2014)

All the demographic, economic and social factors mentioned in the Introduction lead to debates involving policymakers and academics regarding the sustainability of pay -as- you-go systems / present in the 31 OEC countries.

Many authors developed empirical models of old-age pensions and tried to evaluate the solvency of public pensions systems. Even though the models cannot capture all the influence of demographic, economic and institutional factors in the sustainability of public pensions´ expenditures, important developments were presented in the last decades.

The early literature starts with (Samuelson 1958) that through his overlapping- generations general equilibrium model considers that the necessary condition for the sustainability of PAYG systems is the equality of population growth rate plus the growth rate of real wages that together will dictate the rate of return regarding the pensions´ system contributions. If this equality holds it is possible to sustain a constant consumption pattern to retired generations (generational equivalence) that will imply a stationary growth of the population. (Miroslav e Rok 2014).

Also, related with PAYG systems, some authors pointed out the negative side effects of this system, Feldstein and Liebman (2001) concluded that PAYG schemes impose high deadweight losses because being the taxes too high, there is a disincentive to work and to save, proposing a transition to a private funding pensions systems.

Regarding the demographic changes that had an impact on pensions´ expenditures, most of the literature considers early retirement policies as the major cause of the fiscal imbalances. The literature suggests that a major source of the fiscal problems is the taxation on work at later ages, proposing "(…) a decrease in implicit tax rate that would substantially reduce the probability of early retirement". (Boskin, quoted in Miroslave and Spruk 2014). Also Herbertsson and Orszag (2001) and Scarpetta (1999) studied the consequences of early retirement concluding that this phenomenon is more recurrent in the OECD countries in which labor markets are less flexible, as in the case of UE countries. In fact, labor market flexibility it is a strong influence in the sense that, for example, effective retirement age rules are related to disincentives to work at older ages, which are exacerbated by the high net replacement rates in most high-income OECD countries. (Blondal e Scarpetta 1999)

In Miroslave and Spruk (2014), the panel data fixed effect model results "demonstrate the rise in life expectancy at various ages as the cause of higher net replacement rates upon withdrawal from the labor market and, consequently, higher old- age expenditure in the share of GDP". The authors also studied the effects of fertility rates (significant and negative impact on expenditures), gross savings (significant and negative impact in expenditures) and net replacement rate (significant and positive impact on in expenditures) on public pensions' expenditures in OECD countries.

Pensions and Health expenditures literature

The aging of the population in OECD countries and the growing dependency ratio, among other factors mentioned above, have a strong impact on public budgets implying a mutual dependence between both pension and health policies. There is a relation between these two variables that some authors studied, though most of the studies focused on determining the expenditures individually.

(Zhao 2014) studied the determinants of health expenditure in the USA between 1950 and 2000. This paper suggests that Social Expenditure increases total health expenditure in the sense that it redistributes resources to elderly individuals whose marginal propensity to spend in health is high. On the other hand, the author also argued that public pensions´ transfers increase expected future utility in the sense that they work as an insurance for later periods of life. This mechanism induces people to spend more on health care in order to increase longevity.

(Yonghong An 2015) is a panel data study of 21 OECD countries over the period 1980-2005 of health spending determinants that concludes that a one percent increase in public pension payments per elderly person leads to a one third percent increase in total health spending (public and private health expenditure). This paper aimed to analyze the large gap existent in the literature explaining the rapid growth in health spending, and found out that pensions may be an important determinant because (and again) "(…) the public pension program redistributes resources to the elderly whose marginal propensity to spend on health care is much higher than the rest of the population." Follet and Sheiner (2005) cited in (Yonghong An 2015)

The influence of pensions per capita expenditure on health seems clear and the dissertation will test this relation and will also test if health expenditure has some impact on pensions per capita.

.

III. Presentation of the Data Sources and Descriptive Statistics

III.I Data Limitations

When doing research based on country related macro-data, the researcher should expect some methodological problems. As expected, this research had some obstacles regarding its data-set.

When working with cross-country data, missing values are something common and various procedures have been suggested to overcome the problem. In fact, the lack of data may lead the investigator to biased estimates, with overestimated t-tests and underestimated standard errors, which makes the inference invalid in the sense that the models work as if the data was complete. (StataCorp 2013). The ideal is to have non-missing values, but when confronted with the situation, there are solutions to deal with the problem. The main solutions are the complete case analysis (listwise deletion), single imputation and multiple imputation. In the case of imputations there is the creation of plausible values for the missing data, substituting the missing that with those plausible values. On the other hand, the listwise deletion method also presents an efficient alternative that consists on the deletion of all observations with at least one missing value, creating a "complete" data set.

In fact, listwise is the most used method even when one may have biased estimates, in the sense that the investigator loses cases, but the alternatives (imputation), do not consider the uncertainty about the values of the missing values. Also, listwise deletion presents true standard errors being the most "honest method" compared the others (D.Allison 2001)

III.II Descriptive statistics

The data set is composed by 31 OECD countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States of America, during the period 1990 – 2011.

The initial plan was to study the period between 1980 and 2011 in order to have a larger sample and more efficiency, but if it is true that bigger data set lead to more robust results, it is also true that there is a lot of missing data between 1980 and 1990 and that is why the initial plan shifted from 1980-2011 to 1990-2011. In fact, only from 1990 on countries started to update indicators and methodologies that could be used to acquire consistent time series (1990 was the year in which most of the countries started to present the health accounts as was suggested in 1963 by the World Health Organization. (Poullier, Hernandes e D.Savedoff 2002)). It was also acknowledged that Mexico and Turkey are not considered high income countries as the rest of the sample, and that is why they were excluded from the analysis. Also, Chile was excluded given its big percentage of missing values between 1990 and 2011.

In the table below (table 1) the descriptive statistics of the variables of interest used in the final model and in the body text are presented in. A deeper description of the variables will be shown in the next sub-chapters.

The source of all the variables is the OECD data base. Isalso important to reefer GDP per capita, health expenditures and old-age pensions per capita are inflation corrected being the deflators used are 2010 US$ and PPPs.

Because Gatekeeper is a binary variable (dummy variable) , only takes values between 0 and 1, and the mean is0.37 because 37 % of the countries do not have incentives / requirements for the population to be assisted by a first-care professional before accessing the service of health.

Table 1 – Descriptive statistics. The table includes not only the variables that are presented in the final model but also the ones that motivated this study. The first column presents the number of available variables; "Mean" stands for the average value of the variable of 31 countries during 22 years; "Std.Dev." stands for the standard deviation and the minimum("Min") and maximum ("Max") values registered in the sample are presented.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Alcohol consumption (liters per capita)	682	10.02	2.65	1.5	16
Gatekeeper - No incentive	682	0.37		0	1
GDP per capita (2010 US$)	666	32774.64	12339.44	9180.67	89973.15
Health expenditure per capita (2010 US$)	647	1950.47	881.8	169.18	4548.7
Life expectancy (at 65)	682	17.60	1.80	0	21.55
Old - age pensions expenditure per capita (2010 US$)	636	2193.21	1045.05	70.13	5089.38
Old - age population (%)	682	14.34	2.76	5.12	23.28
Old-age dependency ratio (%)	682	21.39	4.23	7.2	37.3
Retiremente Age	657	62.37	3.09	56.7	71.34
Total fertility rate	682	1.65	0.35	1.08	3.03
Young-age population (%)	682	18.53	3.32	13.06	31.29

Public Spending on Health

Health expenditure is defined as the final consumption of health care goods and services, including personal health care and collective services, but excluding spending in investments. Health can be financed through a mix of arrangements including Government and compulsory health insurance ("public"), as well as out-of-pocket household spending, voluntary health insurance and health insurance provided to workers by private corporations ("private"). (OECD 2016)

The thesis focus on the public arrangement, this is, on the Government and compulsory public health insurance, the type of spending that is controlled and managed by the Government and that aims to guarantee the universal access to health.

As it is observed in Table 2 (to facilitate the reading, the values regarding health expenditure were replicated in an individual table), the overall mean regarding health per capita expenditure is 1950.47 US$ which means that, on average, the 31 OECD countries spent this value between 1990 and 2011, with a relatively large dispersion of 881.8 US$ which shows that the data set regarding health expenditure does not tend to be close to the average value.

The minimum value registered of public spending per capita on health it was 169.18 US$ (Korea in 1990) and the maximum was 4545.7 US$ (Norway in 2011). The number of observations it is 647 (N= number of countries (n) multiplied by the number of years (t) – regarding solely the number of available observations).

Table 2 – Overall statistics regarding public expenditure per capita on health in 31 OECD countries during 1990-2011

Health expenditure	Mean	Std. Dev.	Min	Max	Observations
Overall	1950.47	881.8	169.18	4548.7	N = 647

Between 1990 and 2011 the 31 OECD countries, on average, registered an increased in public spending per capita on health. In 1990, on average, 1377.149 US$ per capita were spent on health. This value almost doubled in 2011, when public spending on health was 2591.522 US$ per capita, as is it shown on Figure 1.

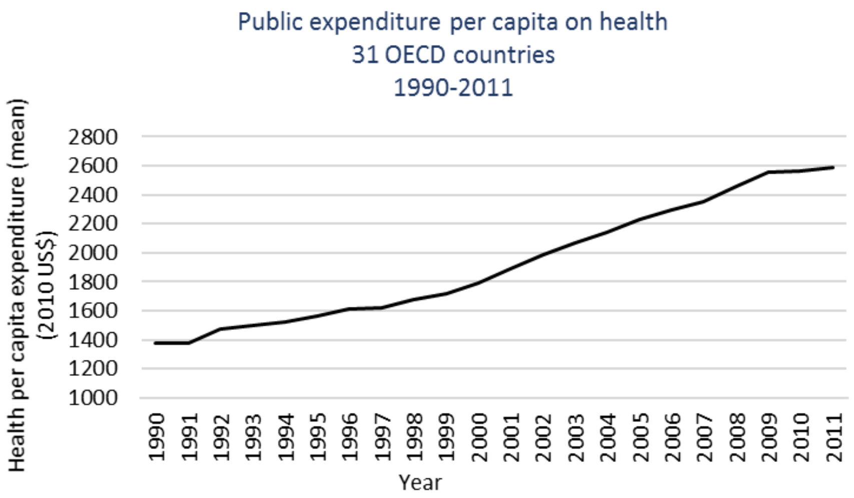

FIGURE 1 – Public expenditure per capita on health, 1990-2011, 31 OECD countries.

A more detailed analysis is presented in the Appendix A (Figure A.1 and Figure A.2), in which each country average value spent with health is confronted with OECD average spending between 1990 and 2011.

Public Spending Per Capita on Old-age Pensions

An old-age pension is a monetary benefit paid regularly to retired people. I this case, we focus on public arrangements: pensions paid by the Government.

As was the case of per capita expenditure on health, the following table (Table 3) allows us to understand the large heterogeneity presented in the 31 OECD countries during the period 1990-2011 (to facilitate the reading, the values regarding old-age pensions expenditure were replicated in an individual table).

The overall value shows that on average, during the period of this study, the 31 OECD countries spent 2193.US$ on old-age pensions with a relatively large dispersion of 1045.05 US$, which shows that the data set regarding old-age pensions expenditure does not tend to be close to the average value, and the public spending on old-age pensions varied between 70.13 US$ (Korea in 1990) and 5089.38 US$ (Luxembourg in 2011).

Table 3 – Overall statistics regarding public expenditure per capita on health in 31 OECD countries during 1990-2011.

Pensions expenditure	Mean	Std. Dev.	Min	Max	Observations
Overall	2193.21	1045.05	70.13	5089.38	N = 636

Between 1990 and 2011 this sample of countries, on average, verified an increased on public spending on old-age pensions. In 1990, on average, the 31 OECD countries spending was 1632.63 US$ per capita on old-age pensions, and in the next decade the value was 2116.70 US$ per capita, and after 11 years the average value per country 2788.952 US$ per capita, as is shown in the figure bellow.

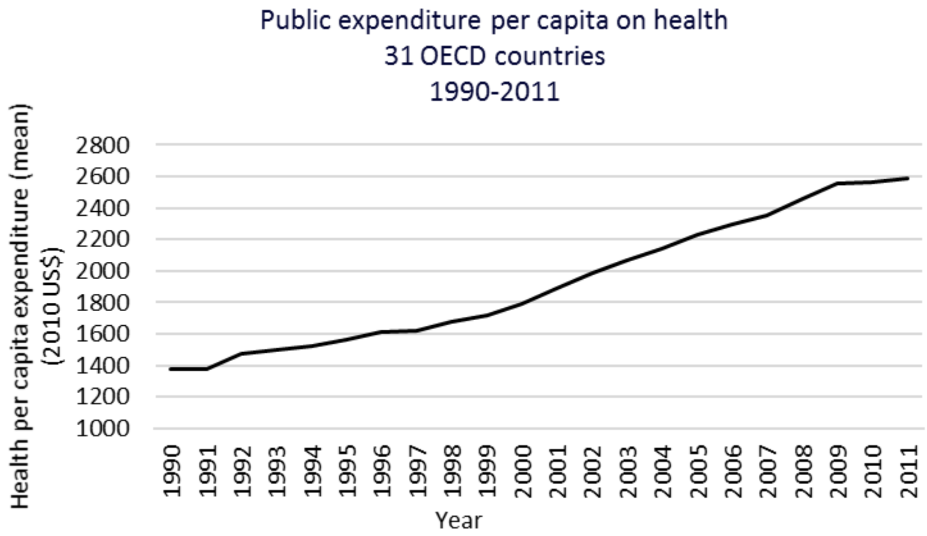

FIGURE 2 - Public expenditure old-age pensions per capita, 1990-2011, 31 OECD countries.

III.II Descriptive Panel Data Statistics

STATA, through its command. *xtsum*, reports means and standard deviations for panel data; the overall statistics presented in Tables 2 and 3 are one of the analysis reported, but this command also decomposes the standard deviation into between and within components.

The between component examines differences between the 31 countries regarding health and pensions expenditure, and it will allow to determine if and to what extent the countries present differences in these expenditures. The within-entity effect measures how much the 31 countries of this sample tended to vary over the average time that they were observed – it refers to the deviation from each country´s average. (StataCorp. 2015)

Noticing Tables 4 and 5, the variation in health spending across the 31 countries was US$ 764.04 and within the countries it was US$ 483.63. The variation in pensions spending during the time of the study across the 31 countries was US$ 976.87 and within the countries over time it was US$ 422.20.

`.xtsum` also reports minimums and maximums. Average health spending for each country during 20.9 years (the average time that countries were observed) varied between US$ 705.82 and US$ 3569.79 , and given that the within number refers to the deviation from each country´s average , one may be tempted to think that some country actually at some point deviated from its average by US$ 3569.79 , but the within definition states that it is necessary to add back in the global average presented at Table 2 - US$ 1950.478 , meaning that some country deviated from its average by 3569.79-1950.47 =1619.32 dollars.

Regarding pensions spending, the minimum deviation verified was 1072.70 and the maximum was 3496.03-2193.21= 1302.781.

And at last, between countries variations verified a minimum of US$ 559.77 and a maximum value of US$ 3331,12 regarding Health and Pensions spending minimum variation value was US$ 293,902 and the maximum verified it was US$ 4385.57.

Table 4 – Panel data statistics regarding public expenditure per capita on old-age pensions. The values refer for the 31 OECD countries during the average period in which they were observed (20.871 years).

Health expenditure	Mean	Std. Dev.	Min	Max	Observations
Between		764.04	559.77	3331.12	n = 31
Within		482.63	705.82	3569.79	T-bar = 20.871

Table 5 - Panel data statistics regarding public expenditure per capita on old-age pensions. The values refer for the 31 OECD countries during the average period in which they were observed (20.5161 years).

Pensions expenditure	Mean	Std. Dev.	Min	Max	Observations
Between		976.87	293.90	4385.57	n = 31
Within		422.20	1072.70	3496.03	T-bar = 20.5161

III.IV The Determinants of Old-age Pensions and Health Public Expenditures

The following figures, regarding the determinants of public expenditures on Health and Pensions, will be presented as the average values from 1990 until 2011 in order to expose the trends that were presented in chapter I and chapter II and also to have a general picture of those social and economic indicators during this analysis period regarding the 31 OECD countries.

GDP per capita

The variable GDP per capita (Gross Domestic Product *per capita*), that is measured as real 2010 US$ and PPPs, during the period 1990-2011 presented the minimum value of US$ 5088.48 US$ (Korea, 1980) and the maximum of US$ 89973.15(Luxembourg, 2007), being the overall mean US$ 29187.57 per capita.

Real GDP per capita had an increasing trend over time, though it was not linear as it was the case of old-age pensions and health public expenditures, which leads to a conclusion that many authors discussed: income is one of the most important drivers of this type of expenditures and, for instance, in the last 50 years' health expenditure have tended to grow faster than GDP. (OECD, Health at Glance: OECD countries 2011).

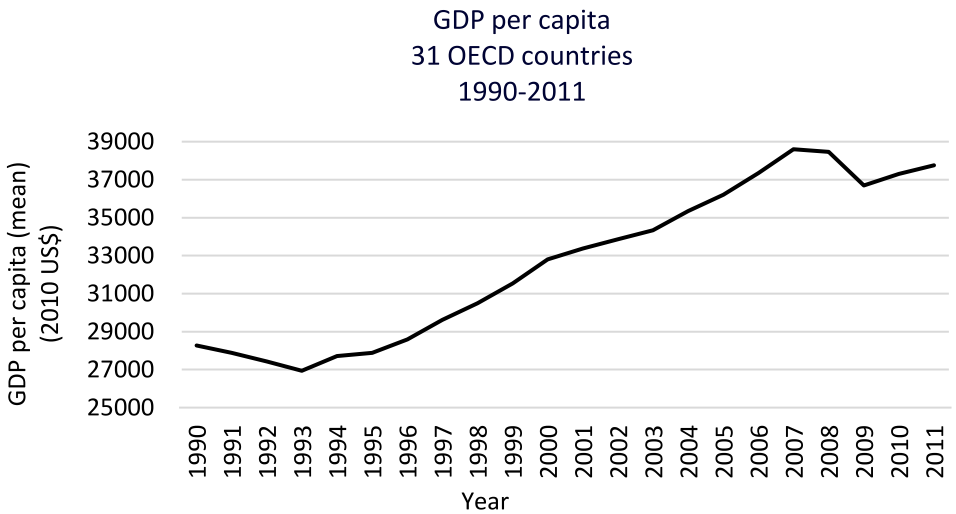

FIGURE 3 - GDP per capita evolution during the period 1990-2011, regarding the 31 OECD countries.

Old age Population (65+)

Old-age and young age population percentages in the total population are important regarding the study of the demographic trends, having strong implications for Governments, public spending on pensions, health, education and of course for economic growth (OECD, Young population (indicator) 2016).

Old age population accounts for the percentage of the population 65 years old or above. This indicator is the source of many Governments worries regarding the sustainability of social expenditures, and looking at Figure 12, it is easy to see why: between 1990 and 2000, the share of the old population in the total population increased 3,3 pp.. This trend that will be maintained in the future, given that, according to the OECD forecasting, the population with ages between 65 and 80 will represent 27% of the total population. (OECD, Health at a Glance 2015: OECD Indicators 2015). In this sample, in 2000 it represented on average, 14,34% of the total population.

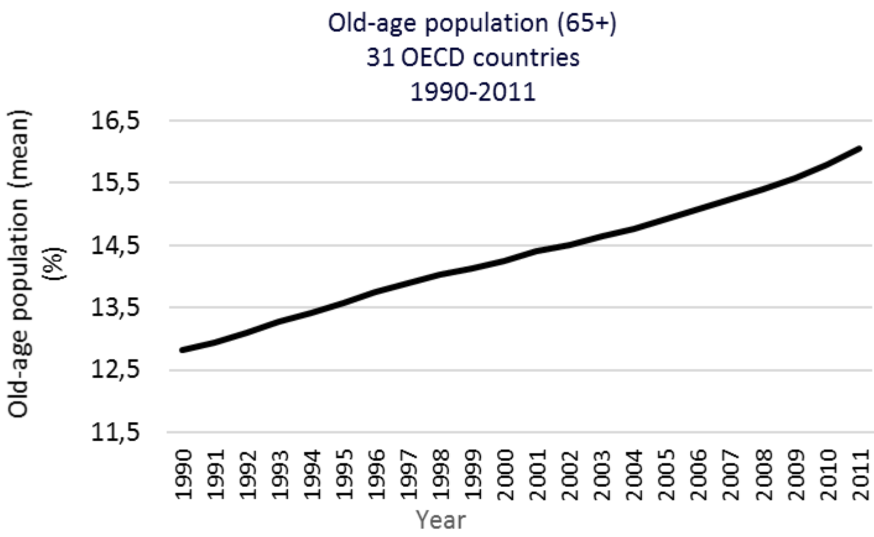

Figure 4 – Percentage of the persons 65 years old or above in the total population, 1990-2011, 31 OECD countries.

Young-age population

Young age population, expresses the percentage of population less than 15 years over the total population. This indicator presented, in average, a decreasing trend over the period 1990-2011, which goes along with the fertility rates trend that will be presented bellow and with the reality of an aged population. In 1990 the young population represented on average almost 21% of the total OECD countries' population and in 2011 this value decreased to 16,84 %.. The average value presented in this sample of countries is 18.53%.

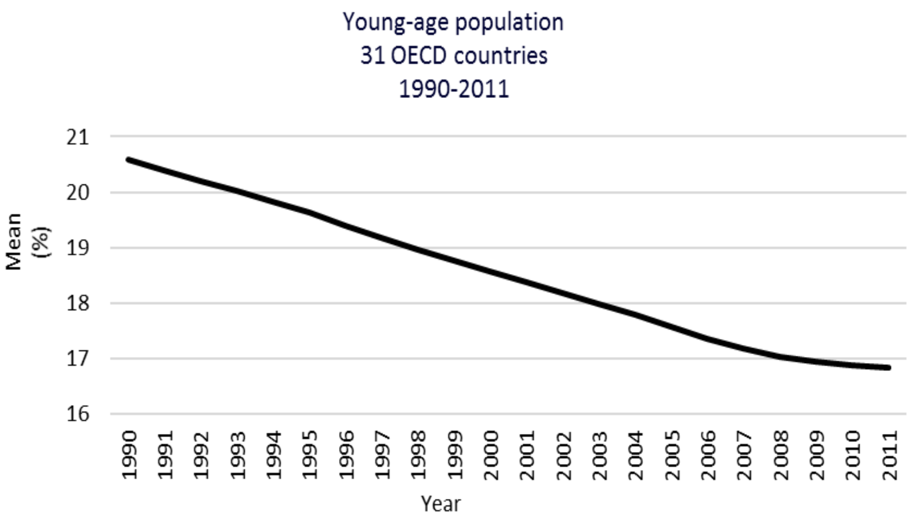

Figure 5 - Percentage of the persons 15 years old or less on the total population, 1990-2011, 31 OECD countries.

Old- age dependency ratio

The continued increased of life expectancy, beyond other factors like the fertility rates, mortality and migration, allowed for the old age dependency ratio (the proportion of the population 65 years old or above on the active age population) present the trend verified in figure 6: in 1990 the average value was 19,21% and in 2011 it was 24.12%. The overall average it is 21.39%.

Also, by 2025 the average value of this indicator will be 34,1% and in 2050 the OECD forecast indicates a value of 51%, being this value even more dramatic for some countries as is the case of Korea that is predicted to have 72 individuals per 100 working age individuals. (OECD, Old age dependency ratio 2015).

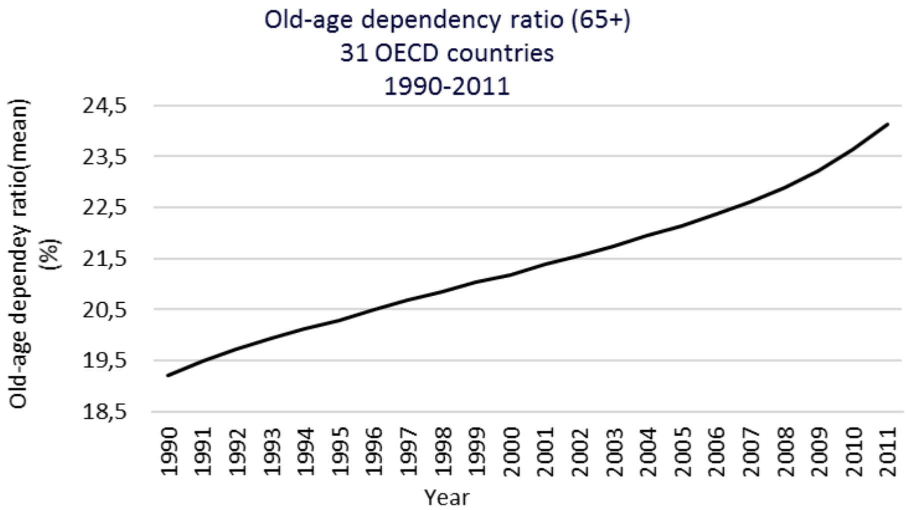

Figure 6 – Old-age dependency ratio, during the period 1990-2011, regarding the 31 OECD countries.

Total Fertility rate

This indicator reveals the "*total number of children that would be born to each woman if she were to live to the end of her child-bearing years and give birth to children in alignment with the prevailing age-specific fertility rates*". (OECD, Fertility Rate (Indicator) 2016) .

In 1980, 2.17 was the number of children that would be born to each woman. 1,91 was the value in 1990, presenting its minimum on 2002 with a value of 1,63. In the following years an increasing trend with some ups and down happened - until 2008 the values increased, and after 2008, when the number of children per woman was 1,76, in 2011 was 1,71. This indicator goes along with the previous indicators showing the aging of population and thus with the PAYG sustainability problem, that was presented in the Literature Review.

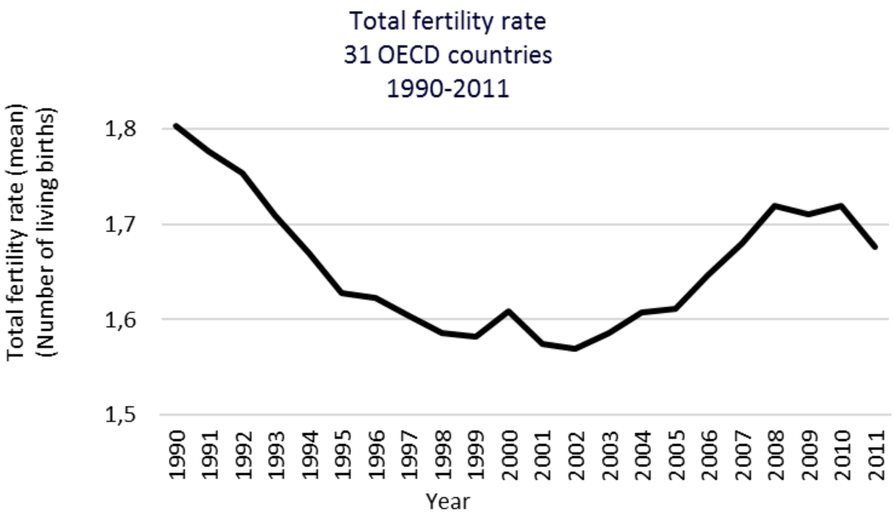

Figure 7 – Total fertility rate, during the period 1990-2011, regarding the 31 OECD countries.

Life expectancy (at age 65 years old)

"*Life expectancy at age 65 years old is the average number of years that a person at that age can be expected to live, if that age-specific mortality levels remain constant. Life expectancy measures how long on average a person of a given age can expect to live, if current death rates do not change*." (OECD, Pensions at a Glance: OECD and G2O indicators 2013).

This indicator has consequences in terms of health expenditures in the sense that older people tend to be have higher needs regarding health care, and in terms of old-age pensions expenditures because the increase in life expectancy verified between 1990 and 2011 (Figure 7) is one of the causes that lead some OECD countries to increase the pensionable ages.

In fact, if in 1990 the average additional life expectancy at 65 was 13.2 years, in 2000 this value was 17,5 years and in 2011 the value was 19.5 years. which means that: in a country where the pensionable age is 65 years old, in 1990 it was expectable that someone, will receive his/ her pensions during 13 years, in 2000 during 17.5 years and in 2011 during almost 20 years! Of course, this fact combined with the fertility rate evolution, beyond others, shows one of the problems that many OECD governments are facing.

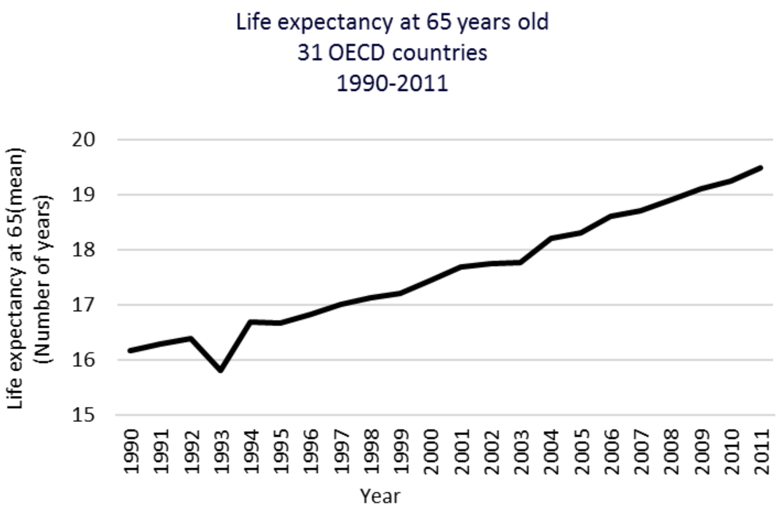

Figure 8 – Life expectancy at 65, during the period 1990-2011, regarding the 31 OECD countries. The values of the Y axis represent the number of additional years that someone could expect to live after completing 65 years old.

Retirement Age

The retirement age is defined as the age that an individual effectively retires and starts to receive his/her old-age pensions. The average value verified in this sample is62.37 years old.

Though this variable it is not econometrically significant to explain t pensions´ expenditures, a lot of importance was giving to it by the literature, and the analysis of its evolution seems interesting.

As observed in figure 9, between 1990 and 2000, the variable experienced a decreasing trend: in 1990 the average retirement age was at 63,4 years old and in 2000 it was 61,7 years old. The tendency started to change when in 2002 the average retirement age was 61,8 years old and in 2011 it was 62, 8 years old already. Probably the demographic situation made the Governments take some action in order to sustain the PAYG system, being one of the measures the increase in the effective retirement age.

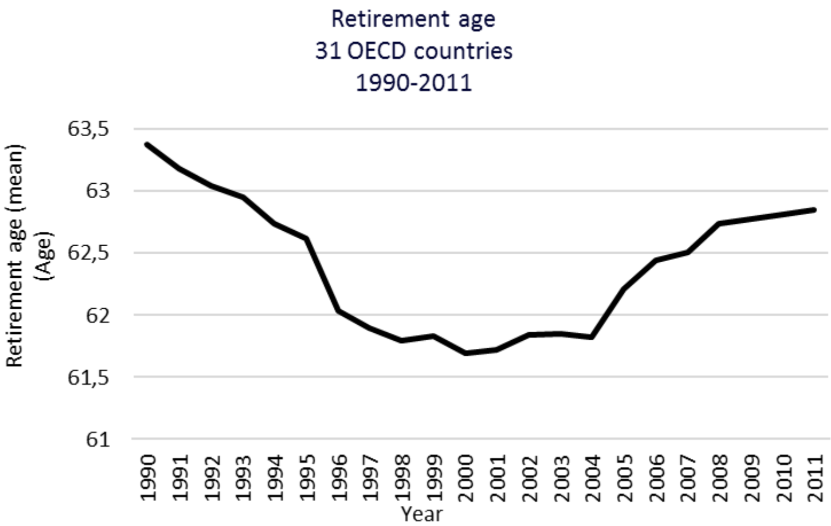

Figure 9 – Retirement age at 65,during the period 1990-2011, regarding the 31 OECD countries.

Alcohol consumption

Alcohol consumption is one of the non-medical, demographic or economic determinants of health expenditure and is considered responsible or related with 200 diseases, according to World Health Organization. (WHO 2015). How can this indicator influence health?

We think that it can go by two ways: in one way, is logic that a country in which the average population consumes a lot of alcohol beverages will have a worse level of health which means that will demand more health services. But also, when a country has a level of income inferior to the desirable one, its population is more prone to have social conflicts which in turn can lead to a higher consumption of alcohol. This means that though alcohol is a driver of health expenditure, it can happen that countries that have a smaller GDP per capita, have a smaller level of spending on health, though their populations consume high levels of alcohol. We will be back to this point in chapter V.

Alcohol consumption is measured in liters per capita sold to the population with 15 or above and verified an average value of 10.02 liters per capita. As observed in Figure 10 in 1990, average consumption of alcohol per capita it was 10.7 liters and the value decreased to 9.5 liters per capita in 1998. This value increased during approximately 6 years and decreased again from 2004 to 2011 when the value was the same as 1998: 9.5 liters per capita.

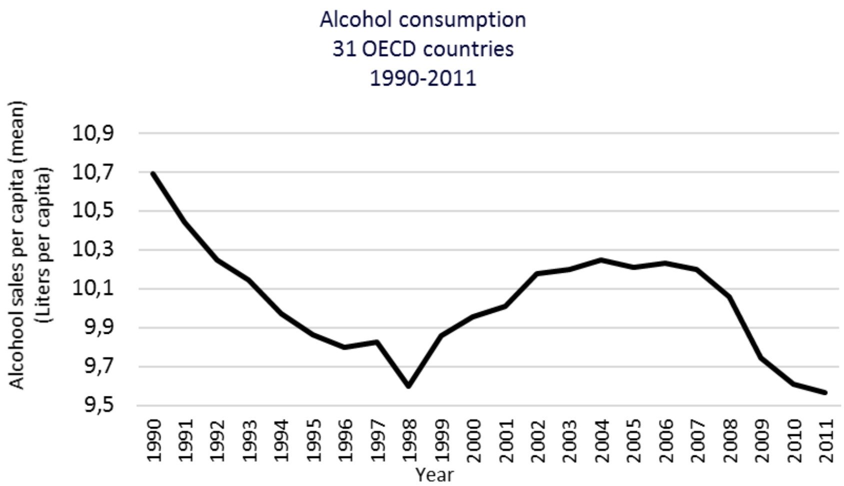

FIGURE 10 – Alcohol consumption during the period 1990-2011, regarding the 31 OECD countries.

IV. Presentation of the Econometric Methodology

IV.I The determinants of public spending on Health and Old-age pensions: Panel Data equations

Panel data models assemble two types of methodology: cross-section analysis and time series analysis – this type of data has "observations on the same units in several different time periods". (Kennedy 2008)

Panel data may have individual (group) effects, time effects or both, in order to deal with heterogeneity or individual effects that may or may not be observed, being these effects fixed or random. The fixed effects model examines if intercepts vary across group/time, and a random effect model will explore differences in error variance components across individuals or time group.

But why should these effects be controlled? Why can´t one simply use OLS in the presence of heterogeneity?

OLS consists of five assumptions, being one of them the exogeneity assumption that says that the expected value of the disturbance is zero (and the disturbances are not correlated with any repressors). If individual effect, contained in the disturbance term, it is not zero and therefore it is correlated with the repressors, assumption 2 it is violated and OLS it is not the best unbiased linear estimation and panel data models provide a solution for this type of problems. (Greene 2002)

Another advantage appointed by (Baltagi 2005) is that panel data gives more informative data, less collinearity among the variables, more degrees of freedom, more variability and more efficiency.

The basic framework of panel data is defined as bellow (1) and it is different from a regular time-series, cross-section regressions in the sense that has the double subscript assigned for time-series dimension (t), for years in this case and being (i) assigned for cross section dimensions, for countries in this case

There are K regressors contained in X_{it} representing the determinants of the dependent variable $Y_{it}$and the referred heterogeneity assemble to each country is $z_i\alpha$, where z_i contains a constant term and the set of individual/ group specific variables that are not observed, such as individual heterogeneity in preferences / ability/ culture and so on, all of which are taken as constant over time (Greene 2002).

$$y_{it} = z'_i\alpha + X'_{it}\beta + \varepsilon_{it}\ ,\ \ i=1,2\ldots N\ ;\ t=1,2,\ldots T$$

EQUATION 1 – Panel data formulation

If z_i is observable for all individuals/ groups, then pooled OLS[2] provides an efficient and consistent estimate of the constant term α and also of the slope vector β. (Greene 2002)

In this research, it was concluded that Fixed Effects were the best option and in the next sub-sections an overview of this model will be made, with less details provided for random effects. Also, the tests used in order to make the choice between random and fixed effects specifications will be presented.

IV.I.I FIXED AND RANDOM EFFECTS MODELS

The difference between fixed and random effect models lies in the role of dummy variables – recalling the definitions given above, a parameter of a dummy variable ispart of the intercept in a fixed effect model and of the error component in a random effect model. (Park 2011)

Fixed effects model

When z_i is unobserved, but correlated with X_{it}, then the least square estimator of β isbiased and inconsistent (omitted variable bias) and the solution is to use a Fixed Effects Model. (Greene 2002).

These fixed effects approach (equation 2) will take α as a group-specific constant term which does not vary over time.

$$y_{it} = \alpha_i + X'_{it}\beta + \varepsilon_{it}$$

EQUATION 2 – Fixed effects formulation

Several strategies exist to estimate a fixed effect model and this thesis will focus in the Least Square Dummy Variables (LSDV). The other alternatives are the Within and Between estimators.

[2] Pooled OLS stands for the use of OLS in the presence of time-series and cross section.

The LSDV uses dummy variables through an OLS regression, the Within estimation does not use dummies but instead uses variation within each entity and the Between estimator uses variation between entities.

Though within estimator reproduces identical coefficients estimation to those of LSDV, this estimator has several disadvantages regarding some statistics (reports incorrectly the SSR (sum of squared residuals) and the standard errors) and furthermore the output representing LSDV is more informative regarding group and year effects in the sense that presents the (dummy) coefficients associated to each one of the countries. (Park 2011)

Basically, what LSVD does is to drop one dummy variable that will be used as baseline reference to the other dummies, and the other dummies coefficients represent how far the parameter estimates are away from that reference point or baseline (i.e. overall intercept).

Also, when indeed specific individuality affects the outcome, the introduction of country/ year-dummies will improve all the goodness-of-fit measures (when compared with OLS without dummies) such as the F-test, SSE, SE and R squared (though it will lose as many dummies that are included degrees of freedom).

Introducing year effects

The LSDV approach can be extended to include time specific effects as well through the introduction of time-specific intercept $\lambda_t$on equation 2, that becomes equation (3), called two-way fixed effects model. (Greene 2002)

The utility of this type of model is that will allow to control year specific effects (besides the group effects),.

$$y_{it} = \alpha_i + \lambda_t X'_{it}\beta + \varepsilon_{it}$$

EQUATION 3 – Two way fixed effects formulation

Testing the significance of the group/year effects

If the differences across groups/years should be accessed, the F test represented in equation 4 can be conducted, where LSDV indicates the dummy variables model and the Pooled indicates the pooled OLS model with a single constant term – the test compares a LSDV (robust model) with the pooled OLS (efficient model)

F- test accesses if α_i = 0, this is, will test the hypothesis that the constant terms are all equal.

Under the null-hypothesis of equality, the efficient estimator isthe pooled OLS, otherwise the fixed effects are needed and the goodness-of-fit measures improve in the presence of α_i. (Greene 2002)

Random Effects model

An alternative to the fixed effects is the random effects model. This type of model considers that the unobserved heterogeneity it is not correlated with the independent variables, and it is represented in equation 5. Let´s say that, the constant term is treated as random, and the independent variables also vary randomly across individuals as well. (Greene 2002).

$$y_{it} = \alpha + X'_{it}\beta + u_i + \varepsilon_{it}$$

Equation 4 – Random Effects formulation

Also, random effects model assumes that the differences among individuals / time periods lies in their individual specific errors being u_i a group specific random element similar to the disturbance termε_{it}.

Given that the individual effect is not correlated with any regressor, the random effects model will estimate the error variance specific to groups/times of period through Generalized Least Squares (GLS) when the covariance structure of each group it is known and trough a Feasible Generalized Least Square estimator when the structure it is unknown. (Greene 2002).

Random effects are tested through the Breuch and Pagan´s (1980) Lagrange multiplier (LM test) being the null hypothesis that individual specific variance components are zero. If the null-hypothesis it is not rejected, one should use pooled OLS instead. (Greene 2002)

Hausman specification test for the Random Effects Model

If none of the previous presented tests leads to the conclusion that pooled OLS is the right choice, it is necessary to decide between Random and Fixed effects through the Hausman test devised by Hausman (1978). (Greene 2002)

This test presented at equation 6 is used to test for the orthogonality of the random effects and the repressors – the null hypothesis is that there is no correlation and LSDV and GLS are both consistent, but LSDV is inefficient and if this hypothesis is rejected it means that OLS is consistent, but GLS is not.

The rationale behind this test is that “the covariance of an efficient estimator with its difference from an inefficient estimator is zero” (Greene 2002), which will imply that under the null, the GLS and LSDV estimates should not differ systematically.

$$H = (b_{LSDV} - b_{RANDOM})' \, \widehat{w}(b_{LSDV} - b_{random}) \sim \chi 2(K)$$

Equation 5 – Hausman Test formulation

Where, $W = Var(b_{LSDV} - b_{RANDOM})$ is the difference in the estimated covariance matrices of LSDV and GLS models.

A limitation regarding this test is that does not allow to include robust standard errors, and given that the final regressions include robust standard errors, an alternative but equivalent formula was used in order to confirm the Hausman test results- Hansen's J test that its

Heteroskedasticity

In this LSVD regression, as is with the other OLS regressions, it is assumed that regression disturbances are homoscedastic with the same variance across individuals and time, and if this happens the standard error estimation is reliable. But assuming this is restrictive since this research considers 31 cross-sectional units that vary a lot in size and thus, may exhibit a different variation. (Baltagi 2005)

When heteroskedasticity is ignored and the error disturbances are treated as homoscedastic, the model will still result in consistent estimates of the regression though the results are not efficient anymore, furthermore the standard errors of these estimations will be biased (smaller).

The solution found in this research was simple to add the option `robust` in STATA, correcting for the presence of heteroskedasticity that was verified through the Breuch-Pagan test in which the null hypothesis of homokedasticity rejected.

Cross-section dependence / contemporaneous correlation

When estimating LSVD , a natural assumption is that the error term is iid (independently and identically distributed) , but a large literature on Panel Data in the last 10 years has been showing concerns for this assumption , in the sense that many times it is violated given the presence of "cluster errors" , this is , within groups (countries in this case) the error components are correlated and in the presence of clustered errors, coefficients are still unbiased but standard errors may be wrong, leading to incorrect inference. (Austin Nichols 2007)

The solution is to use the option `cluster()` in STATA , which it is pretty simple and it will allow a better estimation , but the problem is that this solution is asymptotic in the number of clusters (being the number of clusters as large as the number of countries , in this case) and if the number of observations per cluster it is not big enough the use of cluster option may make estimation even worse and with finite number of observations per cluster, much less than 50 , the bias can be substantial , so it was decided not to include the cluster() option. (StataCorp 2013)

IV.II The simultaneous determination of Public spending on Health and Old-age pensions: 2 Stages Least Squares

Again, OLS consists of five Gauss-Markov assumptions, being one of them the Exogeneity assumption that says that the expected value of the disturbance is zero (and the disturbance term is not correlated with any repressor). (Greene 2002)

If this assumption is violated we should not use OLS because its estimates will be biased and inconsistent, and therefore an alternative is needed.

In this case, we are in the presence of two equations in which both dependent variables are endogenous. Why? Let´s call our dependent variables: $y_1$and y_2 : y_1 is one of the regressors of y_2 and y_2 is one of the regressors of y_1, which means that both equations contain one regressor (y_1 or y_2) that is a linear function of the error term and hence that regressors is correlated with the error term , and being one of the GM assumptions violated, OLS would be biased. (Wooldridge 2009)

In this cases, the solution is to use instrumental variables through the 2-Stages Least Squares estimation. This technique is easily applied to the panel data cases in the sense that the introduction of dummies for country and years will control for the fixed effects.

Consider the structural equation above:

$$y_1 = \beta_0 + \beta_1 y_2 + \beta_2 z_1 + u_1$$

Equation 5 – Structural equation with an endogenous regressor

The variables y´s are endogenous and the z variable is exogenous. Since the endogenous variable it's correlated with u, it is necessary to find an instrument for y_2 - a variable that is correlated with y_2 but not correlated with the error term, this is, a variable that is relevant and exogenous and that we will call w.

For each included endogenous variable, we must have at least one instrument (one exogenous variable that does not appear in the equation – satisfying the exclusion restriction) – this is the order condition for identification that must be satisfied. (Wooldridge 2009)

In this research, both health and pensions expenditures are endogenous because some forces that affect these expenditures, are not present in the equations, and given that we have more instruments than endogenous variables, we are in the presence of over-identified equation that are modeled easily by 2SLS.

2SLS procedure is as follows: first it unties an exogenous variation in y_2, which is due to variation in the instrument w, using OLS regression of y_2 on exogenous variables z_1 and in the instruments w. In the second part/stage, the coefficients of endogenous and exogenous variables are estimated via the OLS regression of y_1 on z_1 , and the exogenous part of y_2, obtained during the first stage. (Wooldridge 2009)

Under assumptions of Exogeneity and relevance of instruments, the 2SLS estimator of β_ is consistent and asymptotically normal.

How can we access the instruments veracity?

Given that the errors are not *i.i.d* in the presence of heteroskedasticity, not all assessments to instrument relevance can be applied, but the ones available under this condition are enough.

Given that the first stage runs the instrument as the dependent variable and the exogenous variables (including the instruments) as the independent ones, we can use that equation to test the correlation of the instruments with its endogenous variable through the Kleibergen-Paap rk LM statistic distributed as chi-squared with (L1-K1+1), where L1 stands for the number instruments used and K1 for the endogenous regressors. This test accommodates errors that are not i.i.d and a rejection of the null indicates that the model is identified and therefore some correlation exists between the instruments and the endogenous regressors.

Though the rejection of the null is necessary, it is not enough to guarantee that the estimator will have a good performance because we can have a weak identification problem that arises when the excluded instruments are weakly correlated with the endogenous regressors. This test it's the Kleibergen-Paaprk F statistic distributed with (N-L)/L1 degrees of freedom and a rule of thumb has been created: if the F – test its lower than 10, probably the instruments are weak[3].

Besides de instrument relevance, it's also necessary to test overidentifying restrictions through Hansen- J statistic that is distributed with chi-squared in the number of (L-K) overidentifying

[3] This rule is related with the (James H. Stock 2011) two criteria for determining the cut-offs for the value of the first-stage F statistics such that if the value of the F-statistics falls above the cuff-of, then it´s safe to assume that the use of 2SLS is the right choice.

restrictions under the null, that states that "*the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation*" (Baum 2010)

V. Regressions results

V.I Panel data regressions

Public expenditure on Health

The first results regard public expenditure on health and the method used is least square dummy variables to control for time and year unobserved heterogeneity. There are 632 available observations.

TABLE 6 – OLS (LSDV) regression regarding the log of public expenditure on health (per capita) regarding. The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T-Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%,

Variables	Coefficients	T-statistics
Intercept	-4.63 *(.703)*	-6.6***
log(Pensions) -expenditure pc	.29 *(.032)*	9.04***
log(GDPpc)	.96 *(.067)*	14.26***
Gatekeeper - not required	.08 *(.036)*	*2.28****
Alcohol - ltr consumption pc	-.01 *(.005)*	-2.97***
Country-dummies		
F- Statistic (30.576)		97.45***
Year-dummies		
F- Statistic (21.576)		4.79***
R-squared	0.9771	
F-Statistic (55. 556)		449.57***
Num.of Obs.	632	

In table 6, the regressions statistics are represented as the regression results are presented. The F-Test with 517 degrees of freedom shows that the model is globally statistically significantly with at least one coefficient different from zero. The R – squared it is 0.97 which means that the independent variables explain 97% of health variance expenditure. Also, the F-test for the global significance of year and country dummies is present and both indicate that the dummies are globally statistically significantly different from zero. The coefficients of each country and year are presented at Appendix B (Table B.1 and Table B2)

The determinants that were found to be significant are presented at table 6. As expected, GDP per capita is the main contributor for this expenditure with an elasticity close to 1 – when the log of *GDPpc* increases 1%, ceteris paribus, the expenditure per capita on health increases, on average, 0.96%. Pensions per capita expenditure (*log(Pensionspc*)) have a coefficient of 0.29, which means that when the expenditure of pensions per capita increases 1% , ceteris paribus, on average the expenditure per capita of health increases 0.29% which goes along with the previous studies (Zhao 2014) and (An, Zhao e Zhou 2015).

Also, the dummy variable *gatekeeper* (1= there is not any incentive or requirement to be assisted by a gatekeeper before being assisted by a medical specialist; 0= there is an incentive/requirement to be assisted by a gatekeeper before being assisted by a medical specialist) was used to test if when a country does not have any incentive or requirement for the citizens to have a first contact with a primary care physician (with a nurse per example) that may or may not route the patient to the secondary health care when the individual will be analyzed by medical specialists. The sign it is the expected one, in the sense that when the health system does not induce the use of gatekeepers, ceteris paribus, the public expenditure on health per capita increases, on average, 8.1%.

The variable consumption per capita of alcohol (*Alcohol – ltr consumption pc*), presents an interesting result: when the consumption per capita of alcohol increases 1 liter, ceteris paribus, the expenditure per capita on health will decrease by 0.01*100= 1%. It is not that alcohol consumption, decreases health expenditures, it is more that this variable captures the cases of countries that had large amounts of alcohol per capita consumed and at the same time low values of health per capita expenditure as is the case of Hungary , Portugal, Slovenia and Czech Republic that are the countries that have average lower values regarding health expenditure when compared with the average 31 OECD countries , and at the same time belong to the top 10 per capita in litters consumed. Also, the opposite cases are represented in the sample as the case of Norway that it is the number one health spender and occupies the forehand place regarding per capita alcohol consumption. Also, possibly, this variable is capturing the effect that income has on alcohol consumption and on health simultaneously: countries with lower income are more prone to verify larger amounts of alcohol consumed per capita (poorer countries tend to have more alcoholism problems related with social conditions or poverty), and also in countries with lower income, lower expenditure on health will be made.

At last, the variable *Intercept* stands for the intercept of public expenditure on health in the omitted country (dropped to avoid multicollinearity when year and country effects are introduced). In this case, the omitted variables are Australia and 1990, and these variables are the reference group for the remaining country and year dummies. (See Appendix B, table B1 and table B2)

Public expenditure on old-age Pensions

Regarding public expenditure on old-age pensions, the method used it is least square dummy variables to control for time and year unobserved heterogeneity and there are 632 available observations.

Table 7 – OLS (LSDV) regression regarding the log of the public expenditure per capita on old-age pensions. The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T-Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Variables	Coefficients	T-statistics
Intercept		
	1.15	1.19
	(.972)	
log(Health) -expenditure pc		
	.52	8.29***
	(.006)	
log(GDPpc)		
	.21	2.02***
	(.010)	
Fertility Rate		
	-*.31*	-5.4***
	(.057)	
Dependency Ratio - 65+		
	.03	9.34***
	(.003)	
Country-dummies		
F- Statistic (30.576)		172.48***
Year-dummies		
F Statistic (21.576)		1.07
R-squared	0.9683	
F (55.556)		404.49***
Num.of Obs.	632	

In table 7, the regressions statistics are represented as the regression results are. The F-Test with 517 degrees of freedman shows that the model is globally statistically significantly different from zero. The R – squared it is 0.97 which means that the independent variables explain 97% of health variance expenditure. Also, the F-test for the global significance of year and country dummies is presented and they indicate that country dummies are globally statistically significantly different from zero, but year dummies are not. The coefficients of each country and year are presented at Appendix B (Table B3 and Table B4).

The determinants that were found to be significant are presented in Table7. The log of the expenditures per capita on health is the determinant with the highest explanation power – when the expenditure per capita on health increases 1%, on average and ceteris paribus, old-age pensions expenditure per capita increases 0.52%.

Given that the pension that an individual will receive is conditioned to the his/her country income, the log of GDP per capita was introduced and presents a statistically significant coefficient of 0.21, which means that a 1% increase on *GDPpc*, on average and ceteris paribus, increases pensions expenditure per capita expenditure by 0.21%. Regarding the fertility rate, when increased by one child, the pensions expenditure decreased on average and ceteris paribus, 31%. At last, the old-age dependency ratio presents a positive and statistically significant coefficient that indicates that when the dependency ratio increases 1 %, on average and ceteris paribus, the pensions per capita expenditure increases 8%.

Again, the variable Intercept stands for the intercept of public expenditure on health in the omitted country (dropped to avoid multicollinearity when year and country effects are introduced) and it will be used as the reference values for the remain dummies. Again, the omitted variables are Australia and 1990, and these variables are the reference group for the remain country and year dummies. (See table B3 and table B4 – Appendix B) .

V.II TWO-STAGES LEAST SQUARES EQUATIONS

After the LSDV estimation, one thing is clear: pensions and health expenditure determined each other robustly and significantly between the period 1990-2011 regarding the 31 OECD countries. This simultaneous determination means that we are in the presence of endogeneity, and we should calculate two 2SLS equations in order to get an efficient and unbiased estimation.

The first step was to find out good instruments, then it was to see how the coefficients changed in the presence of the instruments and in the end, it was necessary to test the instruments validity.

Health per capita equation – 2SLS estimation

Regarding health per capita equation, the endogenous predictor is pensions per capita expenditure, therefore this variable must be instrumented and the validity of its instruments must be tested.

The chosen instruments are fertility rate and dependency ratio given that these variables determine pensions robustly and significantly.

The regression results are shown at table 8. The R-squared value was excluded because it has not any statistical significance. The F- test indicates that the model is globally statistically significantly different from zero and year and countries dummies remain also globally significant. The coefficients of each country and year are presented at Appendix B (Tables B7 and B8).

Regarding coefficients values, now the log of pensions per capita expenditure increased its explanatory power by 3 percentage points, the log of GDP per capita decreases its explanatory power by 3 percentage and the remaining variables practically maintain its coefficients as they were before the instruments introduction.

Table 8 2SLS regression regarding the log of public expenditure per capita on health. The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Variables	Coefficients	T-statistics
Intercept		
	-4.59	7.19***
	(.639)	
log(Pensions) -expenditure pc		
	.31	5.10***
	(.062)	
log(GDPpc)		
	.93	14.35***
	(.065)	
Gatekeeper - not required		
	.08	2.38***
	(.0335)	
Alcohol - ltr consumption pc		
	-.01	-2.87***
	(.004)	
Country-dummies		
Chi-sq (30)		3197.03***
Year-dummies		
Chi-sq (21)		91.78***
F(55. 576)		444.09***
Num.of Obs.	632	

Testing the instruments validity – Health expenditure 2SLS equation

As referred in chapter IV, some tests should be done in order to assess instruments validity and relevance. The tests and the respective p-values are presented at table 9.

Table 9 – Instruments assessment through the identification test (Kleibergen- Papp rk LM - statistic), test of instruments relevance (Kleibergen- Paap rk F - statistic) and overidentifying restrictions(Hansen – J statistic) and the respective p-values.

Test Name	T- Statistic	p-value
Kleibergen-Papp rk LM statistic - Chi-sq (2)	50.74	0.0000
Kleibergen-Paap rk F-statistic - F(315)	70.99	/
Hansen- J statistic (1)	0.053	0.8187

Starting by the identification test, given that we rejected the null-hypothesis, it means that the instruments are valid, i.e. fertility rate and dependency ratio are indeed correlated with the public expenditure on pensions.

The relevance of instruments is also validated by the fact that the F – statistic has a value of 70.99, much higher than the rule of thumb 10.

At last, given that we failed to reject the null-hypothesis of overidentification test of all instrument, it means that the instruments are not correlated with the residuals that belong to health per capita equation and therefore they were correctly excluded from the equation.

Pensions per capita expenditure

Regarding pensions per capita equation, the endogenous predictor is health per capita expenditure, therefore this variable must be instrumented and the validity of its instruments must be tested.

The chosen instruments are the exogenous determinants presented at health equation: alcohol consumption per capita and the non – requirement or incentives for the population to use gatekeepers. Though other instruments were studied as the level of education of the population, they did not show significant, and sometimes made the equation of pensions per capita worse. Also, is difficult to find variables that influence pensions per capita, but have no relation with pensions per capita, in fact, most of the influencers of this variable are the ones that influence health per capita expenditure.

This estimation equation was a lot of more problematic when compared with pensions per capita one. The strong relation between GDP per capita and health per capita brings a lot of troubles when we regress the 2SLS with these two variables as the dependent ones and it is difficult to keep them together in the equation, this is, the equation behaves well when only GDP per capita is included and health per capita is excluded and vice-versa, and though is tempting to exclude GDP per capita from the equation, is not possible to disassociate the income level of some country with the public expenditure on pensions.

Assuming that the problem its related with the simultaneous presence of health and GDP in the equation, the solution found was to estimate the isolate effect of the log of GDP per capita on health (controlling for the year and country effects), and estimating the residual (we called it *health residuals*) The residual therefore will represent the part of health per capita expenditure that is not explained by GDP per capita (controlling for year and country effects) and its inclusion on the 2SLS regression would make the results more consistent and unbiased.

Let´s first check for the differences of LSDV regarding pensions per capita expenditure when we use the original equation (LSDV (1)) VS with the variable *health residuals (*LSDV(2)).

TABLE 10 - OLS / LSDV regression regarding the log of public expenditure per capita on pensions. LSDV (1) stands for the use of health per capita in the equation and LSDV (2) stands for the use of the residuals of the equation that uses health expenditure as the dependent variable and GDP as the independent (controlling for year and country effects). The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T-Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.1%, 5% and 10%.

Variables	Coefficients		T-statistics	
	LSDV (1)	LSDV (2)	LSDV (1)	LSDV (2)
Intercept	1.15 *(.972)*	-.77 *(.987)*	1.19	1.19
log(Health) -expenditure pc	.52 *(.006)*		8.29***	
Health residuals		.52 *(.006)*		8.29***
log(GDPpc)	.21 *(.010)*	.75 *(.090)*	2.02***	8.38***
Fertility Rate	*-0.31* *(.057)*	*-0.31* *(.057)*	-5.4***	-5.4***
Dependency Ratio - 65+	.03 *(.003)*	.03 *(.003)*	9.34***	9.34***

TABLE 11 - OLS / LSDV regressions statistics regarding public expenditure per capita on pensions LSDV(1) stands for the use of health per capita inclusion in the equation and LSDV (2) stands for the use of the residuals of the equation that uses health expenditure as the dependent variable and GDP pc as the independent (controlling for year and country effects) . The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.1%, 5% and 10%.

LSDV (1)			**LSDV (2)**		
Country-dummies			**Country-dummies**		
F- Statistic (30.576)		172.48***	F- Statistic (30.576)		209.08***
Year-dummies			**Year-dummies**		
F Statistic (21.576)		1.07	F Statistic (21.576)		2.15***
R-squared	0.9683		R-squared	0.9664	
F (55.556)		404.49***	F (55.556)		404.49***
Num.of Obs.	632		Num.of Obs.	632	

As its observed at table 10, the variables *log (Health)* and *Health residuals* have the same coefficients values, and what changes it's the impact of GDP per capita that increases a lot its explicative power (robustly and significantly) over the pensions expenditure. Also notice how the constant term, the baseline factor of years and countries, changed, though its value it's not significant. The other variables remain significant, including country dummies and at last, year dummies becomes significant (notice table 11). The coefficients regarding LSDV (2) of each country and year are presented at Appendix B (Table B5 and Table B6) and the ones regarding LSDV are presented at Appendix B (Table B3 and Table B4).

Regarding 2SLS equation, we confronted the 2SLS results when we use health expenditure (2SLS (1)) and when we use the *Health residuals* instead.

With *health residuals* included in the equation, the log of the GDP per capita has a significant impact on pensions expenditure, though the impact did not change a lot (recall that now we should compare the 2SLS regression coefficients with the LSDV when *health residuals* is included): a one percent increase on the log of GDP per capita will increase the pensions per capita expenditure on 0.78%.

The part of the health that is not determined by GDP per capita it's also significant and the coefficient it's the same as the one presented by the log of health per capita.

Fertility rate has the expected sign and so does the dependency ratio. Indeed, we expect the public expenditure on pensions to decrease when fertility rate increases and we expect the dependency ratio to have a positive effect on pensions per capita expenditure.

Notice how the equation gets statistically better when we use health residuals instead of health expenditure:

Table 12 – 2SLS regressions results regarding the log of public expenditure per capita on pensions. 2SLS(1) stands for the use of health per capita in the equation and 2SLS (2) stands for the use of the residuals of the equation that uses health expenditure as the dependent variable and the log of GDP as the independent (controlling for year and country effects) . The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.1%, 5% and 10%.

Variables	Coefficients		T-statistics	
	2SLS (1)	2SLS (2)	2SLS (1)	2SLS (2)
Intercept	2.29 *(1.59)*	-0.61 *(.8723)*	1.44	-0.71
log(Health) -expenditure pc	.78 *(.388)*		2.40***	
Health residuals		.78 *(.388)*		2.03***
log(GDPpc)	-.08 *(.370)*	.74 *(.080)*	-0.23***	9.28***
Fertility Rate	'-.27 *(.067)*	-.27 (.078)	-4.09***	-3.52***
Dependency Ratio - 65+	.02 *(.005)*	.02 *(.005)*	5.15***	5.39***

Table 13 – 2SLS regressions statistics regarding the log of public expenditure per capita on pensions. 2SLS(1) stands for the use of health per capita inclusion in the equation and 2SLS (2) stands for the use of the residuals of the equation that uses health expenditure as the dependent variable and the log of GDP pc as the independent (controlling for year and country effects) . The heteroskedastic standard errors are indicated above the coefficients results with parentheses. The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.1%, 5% and 10%.

2SLS (1)		2SLS (2)	
Country-dummies		**Country-dummies**	
qui-sq (30)	5263.81***	qui2(30)	6022.18***
Year-dummies		**Year-dummies**	
qui-sq (21)	21.92	qui2(21)	53.40***
F (55.556)	346.82***	F (55.556)	346.82***
Num.of Obs.	632	Num.of Obs.	632

Both models are globally statistically significantly different from zero and in both equations, country dummies are significant. What changes now, with 2SLS (2) is that year dummies are also significant. The coefficients of each country and year are presented at Appendix B (Table B9 and Table B10).

With *health residuals* included in the equation, the log of the GDP per capita has a significant impact on pensions expenditure, though the impact did not change a lot (recall that now we should compare the 2SLS regression coefficients with the LSDV when *health residuals* is included): a one percent increase on the log of GDP per capita will increase the pensions per capita expenditure by 0.78%.

The part of the health that is not determined by GDP per capita it's also significant and the coefficient it's the same as the one presented by the log of health per capita.

Fertility rate has the expected sign and so does the dependency ratio. Indeed, we expect the public expenditure on pensions to decrease when fertility rate increases and we expect the dependency ratio to have a positive effect on pensions per capita expenditure.

Testing the instruments validity

Again, the relevance and validity of instruments must be tested, but this time the results are not as encouraging as the ones presented for health per capita equation.

TABLE 14 – Instruments assessment through the identification test (Kleibergen- Papp rk LM - statistic) , test of instruments relevance (Kleibergen- Paap rk F - statistic) and overidentifying restrictions(Hansen – J statistic) and the respective p-values.

Test Name	T- Statistic	p-value
Kleibergen-Papp rk LM statistic - Chi-sq(2)	11.02	0.004
Kleibergen-Paap rk F-statistic - F(315)	5.79	/
Hansen- J statistic (1)	1.87	0.1713

See table 14, starting by the identification test, given that we rejected the null-hypothesis, it means that the instruments are valid, i.e. the inexistence of incentives for the use of gatekeepers and alcohol consumption are indeed correlated with the public expenditure on health, but the relevance of instruments is not validated given the fact that the F – statistic has a value of 5.79, a value that is much lower than the one the rule of thumb 10 relies on.

At last, given that we failed to reject the null-hypothesis of overidentification test of all instrument, it means that the instruments are not correlated with the residuals that belong to the public expenditure on pensions equation and therefore they were correctly excluded from the equation.

Though the instruments are relevant, they seem not be strong enough to confidently validate the coefficient result that indicates that an increase of 1% on health per capita expenditure, indeed increases, on average and ceteris paribus, the expenditure on old-age pensions by 0,78%.

Assuming that this is a valid result, or at least assuming validity of the positive sign, we believe that it's related with the fact that an investment in health will imply better health, which will imply that people will live longer and receive pensions longer. But still, this is not an immediate effect, and maybe this static model cannot capture it.

Another reason for this positive relation, may be that Governments increase public expenditure as a whole and will not increase one expenditure and decrease others. And Governments that are under a bigger budget pressure, may also decrease both.

PART III

VI. CONCLUSION REMARKS

To sum up, this dissertation estimates separately public expenditure on health and public expenditure on old-age pensions on 31 OECD countries during the period 1990-2011, and to take into account country and year heterogeneity, year and country fixed effects were included in all equations specifications.

We reconfirmed the previous studies that pointed GDP per capita as the most important determinant of health expenditure and that the demographic and institutional factors have a lower statistical impact on this expenditure. Regarding pensions expenditure, GDP per capita also seems an important determinant as pointed by previous studies, the fertility rates and dependency ratio have an important impact on this expenditure.

It was also found that pensions' expenditures will have a positive impact on health expenditures and vice versa, which made us study its simultaneous determination trough two 2SLS equations. When determining health expenditure, the regression results go along with An, Zhao and Zhou (2015) and with Zhao (2014) and with their conclusions about the fact that pensions will indeed distribute resources for the parcel of the population that is more prone to require health assistance and services. The validity of the instruments used for pensions was validated by the identification test, relevance test and overidentification test.

Regarding 2SLS estimation of pensions expenditure, the simultaneous presence of health per capita expenditure and GDP per capita as one of the independent variables seemed to create some disturbance in the regression results given their strong statistical relation. The solution was to "isolate" health expenditure from GDP per capita effect and re estimate the equation, always controlling for year and fixed effects. Though the equation gave better results, the relevance test reveals that though the instruments used for health are indeed valid, but not strong enough to make the instruments indeed "good representatives" of health expenditure and therefore we cannot validate, with certainty, that the regressions results are valid.

In the future, two main topics should be approached : in the first place, alternative instruments for health should be studied and tested in order to get consistent results that can make comparable both health and pensions equations. Maybe, when more data is available, it will be a feasible step.

In the second place, after the first step being overcome, the errors structure should be analyzed. Though this dissertation made it not possible to deeply analyze the issue, we firmly believe that the residuals of both equations may correlated, and if this will be verified in the future, more efficient methods of estimation ,that will take that relation into account , can be applied as is the case of 3SLS. If this type of correlation exists, it means that unexplained variance from two variables are correlated and that some macroeconomic shock (let´s say, a budget constraint) may affect both expenditures, which is also part of the possible relation between these two variables.

The fact that the expenditures have a lot of macro and demographic factors in common and the lack of data, made the estimation a difficult task, but we are sure that as the time goes by, more data and indicators will be available and a deeper analysis of these expenditures can be made in order to complement this dissertation.

PART IV

VII. APPENDIX

APPENDIX A

In the following figures, the countries are separated in two groups in order to facilitate the reading. The criteria of clustering were the type of health service provided (Tax - based System (figure A.1) vs Social Insurance Service (figure A.2)).

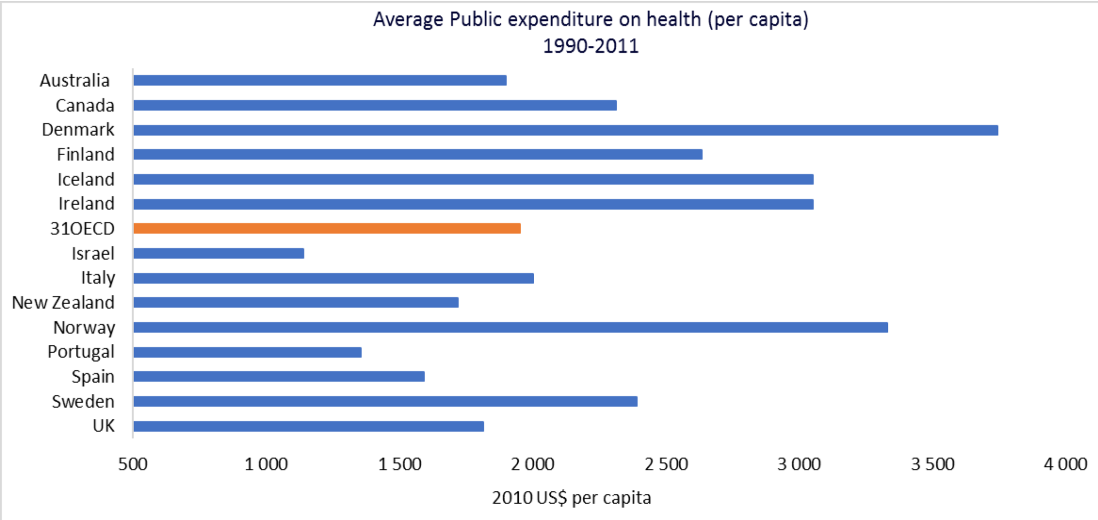

Figure A.1 – This graph presents 14 countries and the average spending on health of each one, compared with the average of the 31 OECD countries. The heterogeneity presented is clear in this graph: if some countries spent much less than the average (like Israel), some others, as Denmark, spent much more.

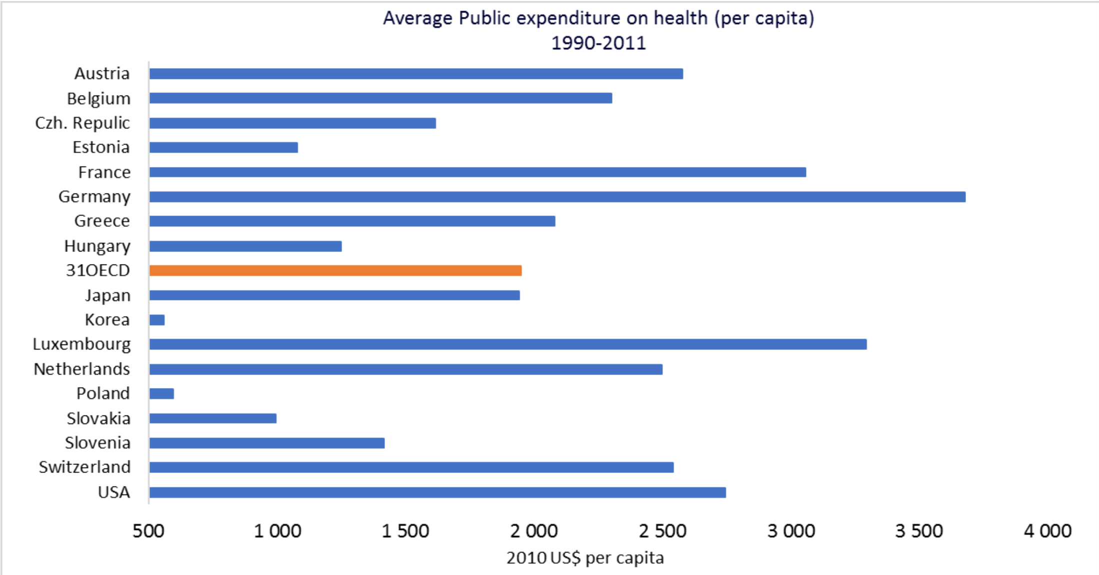

Figure A.2 – This graph presents 14 countries and the average spending on health of each one, compared with the average of the 31 OECD countries. The heterogeneity presented is clear in this graph: if some countries spent much less than the average (like Korea), some others, as Germany, spent much more.

In the following figures, the countries clustering presented in the figures above its maintained in order to facilitate the reading.

.

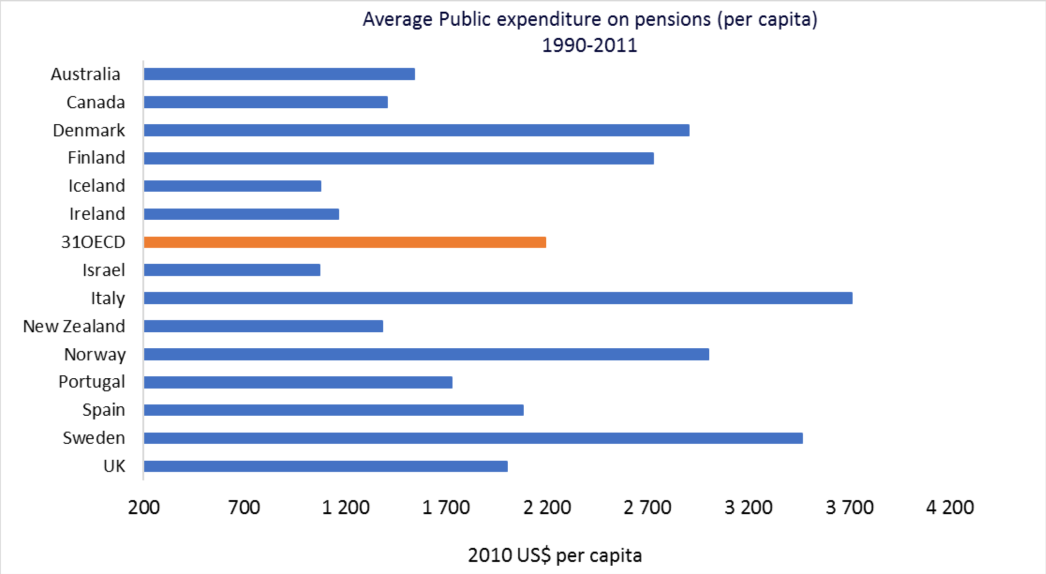

Figure A.3 –This graph presents 14 countries and the average spending on old-age pensions of each one, compared with the average of the 31 OECD countries. The heterogeneity presented is clear in this graph: if some countries spent much less than the average, some others, as Italy, spent much more

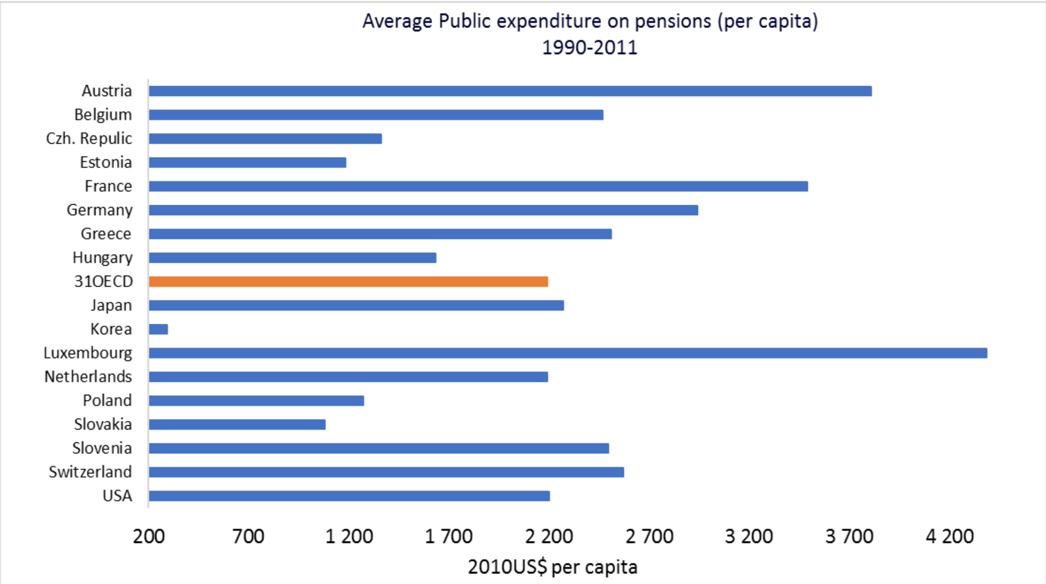

Figure A.4 –This graph presents 17 countries and the average spending on old-age pensions of each one, compared with the average of the 31 OECD countries. The heterogeneity presented is clear in this graph: if some countries spent much less than the average (notice Korea), some others, as, spent much more as Austria did.

APPENDIX B

In the following tables, the country and year dummies coefficients of the main equations are presented. The reading should be as followed: the intercept value will be presented at the top of each table given that this is the baseline value   In the following tables, "Australia" and "1990" will be the dropped variables, and the other dummies coefficients represent how far its parameter estimate is away from that reference point or baseline (i.e. overall intercept).

OLS/LSDV EQUATIONS

HEALTH Intercept COEFFICIENT: -4,63

Table B.1: OLS/LSDV equation regarding health per capita expenditure -country dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Country dummies are globally statistically different from zero (see table 6).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
Austria	-.01	0.051	-0.37
Belgium	.06	0.019	3.46***
Canada	.12	0.043	2.79***
Czech Repulic	.03	0.047	0.72
Denmark	.16	0.025	6.71***
Estonia	-.20	0.055	-3.62***
Finland	-.07	0.031	2.53***
France	.18	0.038	4.78***
Germany	.16	0.047	3.57***
Greece	-.33	0.042	-7.82***
Hungary	-.05	0.063	-0.94
Iceland	.26	0.043	6.14***
Ireland	.14	0.025	5.58***
Israel	-.27	0.054	-4.95***
Italy	-.14	0.034	-4.31***
Japan	-.06	0.038	-1.59
Korea	-.43	0.073	-5.94***
Luxembourg	-.53	0.080	-6.62***
Netherlands	.04	0.039	1.2
New Zealand	.17	0.027	6.64***
Norway	-.07	0.046	-1.53
Poland	-.24	0.060	-3.98***
Portugal	.03	0.039	0.9
Slovak Repulic	-.02	0.041	-0.6
Slovenia	-.04	0.039	-1.11
Spain	-.04	0.022	-1.95
Sweden	-.12	0.054	-2.27***
Switzerland	-.08	0.026	-3.35***
UK	-.10	0.038	-2.74***
USA	.04	0.026	1.82

Table B.2: OLS/LSDV equation regarding health per capita expenditure -year dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Year dummies are globally statistically different from zero (see table 6).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
1991	.01	.037	0,46
1992	.03	.034	1,16
1993	.05	.031	1,63
1994	.02	.032	0,92
1995	.03	.032	1,19
1996	.04	.031	1,37
1997	.03	.031	1,11
1998	.02	.032	0,77
1999	.04	.034	1,41
2000	.05	.033	1,56
2001	.08	.035	2,56***
2002	.11	.034	3,25***
2003	.13	.035	3,71***
2004	.13	.037	3,52***
2005	.14	.038	3,7***
2006	.13	.040	3,33***
2007	.12	.041	3,06***
2008	.16	.042	3,83***
2009	.22	.041	5,43***
2010	.21	.043	4,87***
2011	.19	0.046	4,22***

Pensions Intercept coefficient: 1.15 (the intercept it's not statistically differently from zero)

Table B.3: OLS/LSDV equation regarding old-age pensions per capita expenditure – country dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Country dummies are globally statistically different from zero (see table 7).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
Austria	.45	.040	11.27***
Belgium	.13	.036	3.82***
Canada	-.24	.030	-8.17***
Czech Repulic	.05	.066	0.84
Denmark	.25	.040	6.22***
Estonia	.03	.076	0.48
Finland	.44	.029	15.01***
France	.50	.039	12.86***
Germany	.05	.050	1.10
Greece	.41	.052	7.99***
Hungary	.18	.075	2.43***
Iceland	-.34	.059	-5.79***
Ireland	-.15	.036	-4.29***
Israel	.40	.079	5.11***
Italy	.43	.047	9.25***
Japan	-.01	.043	-0.32
Korea	-.85	.098	-8.69***
Luxembourg	.48	.079	6.02***
Netherlands	.11	.040	2.91***
New Zealand	.10	.065	1.54
Norway	.13	.062	2.23***
Poland	.50	.100	5.07***
Portugal	.01	.055	0.32
Slovak Repulic	.07	.083	0.86
Slovenia	.46	.058	7.91***
Spain	.05	.047	1.21
Sweden	.42	.043	9.72***
Switzerland	.07	.044	1.70
UK	.11	.035	3.19***
USA	.19	.035	5.37***

TABLE B.4: OLS/LSDV equation regarding old-age pensions per capita expenditure – country dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Year dummies are not globally statistically different from zero (see table 7).

Year	Coefficient	Robust Std. Error	t-Statistic
1991	.02	.057	0.35
1992	.03	.051	0.60
1993	.02	.050	0.48
1994	.02	.048	0.44
1995	.02	.046	0.47
1996	.01	.045	0.40
1997	.02	.044	0.50
1998	.03	.048	0.75
1999	.02	.052	0.47
2000	.01	.045	0.16
2001	-.03	.047	-0.77
2002	-.03	.048	-0.75
2003	-.03	.049	-0.63
2004	-.02	.050	-0.47
2005	-.02	.052	-0.56
2006	-.02	.055	-0.47
2007	-.02	.057	-0.47
2008	-.01	.061	-0.22
2009	.01	.062	0.21
2010	.01	.064	0.12
2011	.01	.064	0.10

Pensions Intercept Coefficient (when using health residuals) : -0.77 (the intercept it's not statistically differently from zero)

Table B.5: OLS/LSDV equation regarding old-age pensions expenditure per capita (when we use the variable *health residuals* instead *of log(health)* – country dummies coefficients.

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Country dummies are globally statistically different from zero (see table 11).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
Austria	.60	.039	15.48***
Belgium	.24	.034	6.98***
Canada	-.13	.029	-4.58***
Czech Repulic	.06	.067	1.00
Denmark	.42	.034	12.43***
Estonia	-.10	.071	-1.44
Finland	.50	.029	17.18***
France	.70	.031	22.63***
Germany	.26	.047	5.66***
Greece	.38	.050	7.48***
Hungary	.21	.076	2.78***
Iceland	-.17	.051	-3.51***
Ireland	-.13	.035	-3.84***
Israel	.32	.080	4.01***
Italy	.51	.048	10.56***
Japan	.06	.044	1.50
Korea	-1.27	.077	-16.43***
Luxembourg	.34	.078	4.41***
Netherlands	.19	.040	4.89***
New Zealand	.20	.066	3.08***
Norway	.21	.060	3.60***
Poland	.40	.095	4.22***
Portugal	.04	.055	0.81
Slovak Repulic	.05	.083	0.70
Slovenia	.52	.060	8.75***
Spain	.08	.048	1.83
Sweden	.55	.040	13.60***
Switzerland	.09	.044	2.06***
UK	.14	.035	4.16***
USA	.27	.031	8.65***

Table B.6: OLS/LSDV equation regarding health expenditure per capita (when we use the variable *health residuals* instead *of log(health)* year dummies coefficients)

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Year dummies are globally statistically different from zero (see table 11).

Variables (Years)	Coefficient	Robust Std.Error	t-Statistic
1991	.04	.057	0.75
1992	.07	.050	1.44
1993	.07	.049	1.56
1994	.06	.048	1.41
1995	.07	.045	1.68
1996	.07	.044	1.74
1997	.07	.044	1.78
1998	.09	.047	1.99***
1999	.09	.051	1.84
2000	.07	.044	1.78
2001	.05	.045	1.18
2002	.06	.045	1.51
2003	.08	.046	1.92
2004	.09	.047	2.06***
2005	.10	.048	2.08***
2006	.10	.051	2.01***
2007	.09	.054	1.82***
2008	.13	.055	2.46***
2009	.20	.054	3.82***
2010	.19	.057	3.44***
2011	.19	.058	3.30***

2SLS EQUATIONS

Health Intercept COEFFICIENT: -4.59

Table B.7: 2SLS equation regarding health per capita expenditure– country dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Country dummies are globally statistically different from zero (see table 8).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
Austria	-.04	.073	-0.60
Belgium	.05	.033	1.57
Canada	.12	.040	3.10***
Czech Repulic	.02	.044	0.56
Denmark	.15	.042	3.55***
Estonia	-.20	.050	-4.17***
Finland	-.09	.044	-2.12***
France	.15	.063	2.49***
Germany	.15	.060	2.51***
Greece	-.35	.056	-6.28***
Hungary	-.07	.060	-1.23
Iceland	.28	.045	6.19***
Ireland	.14	.026	5.59***
Israel	-.25	.055	-4.68***
Italy	-.17	.060	-2.85***
Japan	-.07	.042	-1.69
Korea	-.39	.104	-3.83***
Luxemourg	-.54	.084	-6.43***
Netherlands	.03	.041	0.95
New Zealand	.17	.026	6.71***
Norway	-.07	.046	-1.62
Poland	-.25	.058	-4.36***
Portugal	.02	.039	0.58
Slovak Repulic	-.03	.038	-0.80
Slovenia	-.06	.050	-1.29
Spain	-.05	.028	-1.93
Sweden	-.14	.067	-2.09***
Switzerland	-.09	.033	-2.91***
UK	-.11	.042	-2.69***
USA	.04	.027	1.60

TABLE B.8: 2SLS equation regarding health per capita expenditure– year dummies coefficients

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Year dummies are globally statistically different from zero (see table 8).

Variables (Years)	Coefficient	Robust Std.Error	t-Statistic
1991	.01	.036	0.45
1992	.03	.033	1.13
1993	.04	.030	1.59
1994	.02	.031	0.86
1995	.03	.032	1.11
1996	.04	.031	1.29
1997	.03	.031	1.01
1998	.02	.032	0.65
1999	.04	.034	1.26
2000	.04	.033	1.45
2001	.08	.034	2.48***
2002	.10	.034	3.12***
2003	.12	.036	3.54***
2004	.12	.037	3.33***
2005	.13	.038	3.52***
2006	.12	.040	3.19***
2007	.12	.041	2.94***
2008	.15	.043	3.64***
2009	.22	.044	4.95***
2010	.20	.045	4.46***
2011	.18	.048	3.90***

Old-age pensions Intercept coefficient: 61 (the intercept it's not statistically differently from zero)

Table B.9: 2SLS equation regarding old-age pensions expenditure per capita (when we use the variable *health residuals* instead of *log(health)* – Country dummies coefficients.

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Country dummies are globally statistically different from zero (see table 12).

Variables (Countries)	Coefficient	Robust Std.Error	t-Statistic
Austria	.64	.057	11.21***
Belgium	.27	.048	5.59***
Canada	-.12	.030	-4.15***
Czech Repulic	.08	.071	1.13
Denmark	.44	.040	11.08***
Estonia	-.08	.074	-1.11
Finland	.51	.036	14.34***
France	.72	.039	18.27***
Germany	.31	.072	4.35***
Greece	.41	.073	5.68***
Hungary	.26	.110	2.36***
Iceland	-.19	.054	-3.51***
Ireland	-.15	.036	-4.18***
Israel	.26	.103	2.56***
Italy	.55	.078	7.11***
Japan	.10	.068	1.58
Korea	-1.29	.079	-16.27***
Luxembourg	.37	.072	5.15***
Netherlands	.21	.047	4.48***
New Zealand	.19	.065	2.91***
Norway	.24	.056	4.27***
Poland	.39	.088	4.54***
Portugal	.07	.066	1.12
Slovak Repulic	.05	.078	0.74
Slovenia	.54	.068	8.00***
Spain	.12	.074	1.74
Sweden	.58	.054	10.90***
Switzerland	.12	.055	2.24***
UK	.17	.044	3.86***
USA	.27	.031	8.82***

TableB.10: 2SLS equation regarding old-age pensions expenditure per capita (when we use the variable *health residuals* instead of *log(health)* – Year dummies coefficients.

The use of *** near the T- Statistics indicates that the respective coefficient is statistically significantly different from zero for a significance level of 1%, 5% and 10%.

Year dummies are globally statistically different from zero (see table 12).

Variables (Years)	Coefficient	Robust Std.Error	t-Statistic
1991	.04	.055	0.84
1992	.07	.049	1.58
1993	.08	.050	1.69
1994	.07	.050	1.56
1995	.08	.049	1.81
1996	.09	.047	1.89
1997	.09	.046	1.95
1998	.10	.048	2.20***
1999	.10	.051	2.08***
2000	.09	.046	1.99***
2001	.06	.048	1.43
2002	.08	.049	1.76
2003	.10	.049	2.16***
2004	.11	.050	2.31***
2005	.12	.051	2.34***
2006	.12	.053	2.30***
2007	.11	.055	2.13***
2008	.15	.055	2.80***
2009	.22	.054	4.24***
2010	.21	.057	3.82***
2011	.21	.060	3.58***

VIII. Relevant Literature

An, Yonghong, Kai Zhao, and Rong Zhou. 2015. "Health Spending and public pension : evidence from panel data." *Applied Economics* 987-1004. http://dx.doi.org/10.1080/00036846.2015.1090556.

Austin Nichols, Mark Schaffer. 2007. "Clustered Errors in Stata." September 10.

Baltagi, Badi H. 2005. *Econometric Analysis of Panel Data.* Third . England : John Wiley & Sons, Ltd.

Barr, Nicholas, and Peter Diamond. 2006. "The economics of Pensions." *Oxford Review of Economic Policy* 15-39.

Barros, Pedro Pita. 1998 . "THE BLACK BOX OF HEALTH CARE EXPENDITURE GRWOTH DETERMINANTS ." *Health Economics* 7: 533-544.

Baum, C.F,Schaffer, M.e, Stillman. 2010. "ivreg2: Stata module for extended instrumental variables/2SLS,GMM and AC/HAC and k-class regression."

Blondal , Sveinbjorn, and Stefano Scarpetta. 1999. *The retirment decision in OECD countries.* Working Paper , OECD , Paris: Organization of Economic Co-peration and Development.

Boskin, Michal J. 1975. *Social Security and Retirement Decision .* Stanford: National Bureau of Economic Research .

Cameron, A. Colin, and Pravin K. Trivedi. 2005. "Linear Panel Models : Basics ." In *Microeconometrcis - Methods and Aplications*, 697-740. New York: Cambridge University Press.

Coti, Jean-Philippe. 2013 . "Population Ageing - Facing the challeng ." *The OECD Observer* 239: 19-20.

D.Allison, Paul. 2001. "Missing Data." 72-75. New York: Sage Publications.

E.Sleebos, Joel. 2003. *Low Fertility Rates in OECD Countries : Facts and Policy Responses.* Working Paper, Paris: OECD.

Gerdtham, G. 1992. "Pooling international health care expenditure data." *Health Economics* 217-231.

Gerdtham, U.G.,et al. 1998. "The determinants of health expenditure in the OECD countries : a pooled data analysis." In *Health, The Medical Profession , and Regulation*, by P. Zweifel, 113-134. Boston: Kluwer Academic Publishers.

Gouveia, Miguel. 1993. "The Public Sector and Health Care." *International Tax and Public Finance .*

Greene, William H. 2002. "Models for Panel Data ." In *Econometric Analysis* , by Greene H. William, 283-306. New York : Prentice Hall .

Grossman, Michael. 1972. "On the Concept of Health Capital and the Demand for Health." *Journal of Political Economy* 223-255.

Hitiris T., Posnett J. 1992. "The determinants and effects of health expenditure in developed countries." *Journal of Health Economics* 173-181 .

James H. Stock, Motohiro Yogo. 2011. *Testing for Weak instruments in Linear IV Regression.* Department of Economics, Harvard University .

Jes Sogaard, Fredrik Andersson ,Bengt Jonsson. 1992. "An econometric analysis of health care expenditure: A cross-section study of the OECD countries." *Journal of Health Economics* 63-84.

Jönsson, B. & Eckerlund. 2003. "Why different countries spend different amounts on health care?"

Kennedy, Peter. 2008. "A Guide to Econometrics." 281. Malden: Blackwell Publishing.

Khao , Kai. 2014. "Social Security and the rise in health spending." *Journal of Monetary Economics* 64: 25-37.

Kleiman, E. 1974 . "The Determinants of National Outlay on Health ." In *The Economics of Health and Medical Care*, by Mark Perlman, 66-88. London : The Macmillan Press LTD .

Leu. 1986. "The public-private mix and international health care costs." In *Public and Private Health Services : Comptementaries and conflits*. Oxford: Basil Blackwell.

Martin Feldstein, Jeffey B.Liebman. 2011. "Social Security." *NBER Working Paper Series*, September.

Matteo, Di Matteo and Rosanna Di. 1998 . "Evidence on the determinants of Canadian provincial government health expenditures: 1965-1991." *Journal of Health Economics* 211-228.

Miroslav , Verbic, and Spruk Rok. 2014 . "Aging Population and Public Pensions : Theory and Macroeconometric Evidence ." *Panoeconomicus* 61: 289-316.

Moon, Hyungsik Roger, and Benoit Perron. 2006. *Seemnly Unrelated Regressions.* California: University of, July.

Newhouse, J. 1977. "Medical-Care Expenditure: A Cross-National Survey ." *The Journal of Human Resources* 12: 115-125.

Newhouse, Joseph P., and Anthony J. Culyer. 2000. *Handbook of Health Economics.* 1st . Vol. 1A. Amsterdam: Elsevier.

OECD. 2015. ""Capital expenditure in health sector"." *Health at a Glance 2015 : OECD indicators* (OECD Publishing).

—. 2016. Accessed July 19, 2016. https://data.oecd.org/healthres/health-spending.htm.

OECD. 2016 . *Fertility Rate (Indicator)* . July 7.

OECD. 2011. *Health at Glance : OECD countries.* Paris : OECD Publisher .

OECD. 2015. *Health at a Glance.* Paris: OECD Publishing .

OECD. 2015. *Health at a Glance 2015:OECD Indicators.* Paris: OCDE Publishing.

—. 2016. *Health spending (indicator)* . Accessed July 19, 2016. https://data.oecd.org/healthres/health-spending.htm.

OECD. 2016. *OECD Health Policy Overview - Health Policy in Korea.* OECD.

—. 2016. *Pension spending (indicator)* . Accessed July 19, 2016. https://data.oecd.org/socialexp/pension-spending.htm.

OECD. 2013. *Pensions at a Glance : OECD and G2O indicators.* Paris: OECD Publishing.

—. 2015. "Old age dependency ratio." *Pensions at a Glance 2005 : OECD and G20 indicatores*, 158-159.

OECD. 2011. "Pensions at a Glance 2013 OECD and G20 Indicators." Paris , 27-32.

OECD. 2016 . *Young population (indicator)* . Paris , August 07.

Orzag, J.M, and T.T. Herbertsson. 2001. *The Cost of Early Retirement in the OECD Countries* . , Iceland : IoES Worlking Paper Series No W01:02.

Pagan, Adrian, and T. S. Breusch. 1980. "The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics." *Revie of Economic Studies* 239-253.

Park, Hun Myoung. 2011. "Regression Models of Panel Data Using Stata." Master thesis.

Poullier, Jean-Oierre, Patricia Hernandes, and Key Kawabata : William D.Savedoff. 2002. Discussion paper No 51, World Paper Organization.

Sampayo, Filipa Mello, and Sofia Sousa Vale . 2012. "Financing Health Care Expenditure in the OECD." Lisbon.

Samuelson, P. 1958. "An exact consumption loan model of interest with or without the social contrivance of money ." *Journal of Political Economy* 467-482.

Schwarz, Anita M. n.d. *Why consider a Funded Pension System?* . World Bank , Human Development Department - Europe and Asia Region .

StataCorp. 2013. *STATA: Realese 13* . College Staion : StataCorp L.P. .

StataCorp. 2015 . *XTSUM - summarize xt data* . College Station: TX: STATA Press. .

Torres-Reyna, Oscar. 2007. "Panel Data Analysis - Fixed and Random Effects using Stata." Princeton University .

Turk, Erik, and David Mum. 2016. *Excessive Expectations - OECD and EU Comission Should Revise their Return Assumptions.* Wiso Diskurs.

WHO. 2015. *World Health Organization - Media Centre.* January. Accessed March 19, 2017. http://www.who.int/mediacentre/factsheets/fs349/en/.

Wooldridge, Jeffrey M. 2009. "Instrumental Variables and two stage least squares ." In *Introductory Econometrics : a modern approach*, by Jeffrey M. Wooldridge, 515-547.

Yonghong An, Kai Zhao & Rong Zhou. 2015. "Health spending and public pension: evidence from panel data,." *Applied Economics* 987-1004.

Zellner, Arnold. 1962. "An Efficient Method of Estimating Seemnly Unrelated Regressions and Tests dor Aggregation Bias." *Journal of th American Statistical Association Vol.57*, Jun. : 348-368.

Zhao, Kai. 2014. "Social security and the rise in health spending." *Journal of Monetary Economics* 21-37.