Department of Economics and Finance

Chair of Econometrics

Italy's ageing population and its impact on healthcare expenditure

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Introduction

In the last one hundred years the Italian population has grown continuously reaching almost 61 million inhabitants, however this is changing. Low fertility rates are reversing the trend while longevity is causing people to live longer and it is provoking an increase in the number of elderlies in the country. This phenomenon is called ageing and it is particularly marked in our country.

At the moment, Italy has a share of individuals over the age of 60 equal to about 29% of the population, making it the first country in Europe with the oldest population. This is creating tensions under the economic profile and is destined to become an even more important phenomenon as the proportion of the elderly will increase in the future. In 2050, individuals which will have 60 years of age or over will reach a share of 41%. These changes will have profound consequences for our society particularly on long-term care and healthcare spending which is expected to rise even further. The main objective of the thesis is to analyze through data from a survey, run by the SHARE project, how the out-of-pocket payments for healthcare expenditure are influenced by different variables associated with ageing. The goal of the estimation is to find which of the main variables can explain a change in private healthcare spending of individuals. This information is useful for Governments which will have to reform the healthcare systems through policy advice since there is now more demand on health and long-term care services, which need to be managed more efficiently so that everyone can enjoy dignity and security throughout their lives.

Chapter 1 of the thesis focuses on presenting a general overview of the phenomenon in the world, by describing its main trends. It then analyses more in depth the situation in Italy and the demographic change of the population. It concludes by describing what could be the economic consequences of an ageing population focusing more on the consequences of the national health system and its current situation.

In Chapter 2, there is the presentation of the econometric model used, the Fixed Effect Regression, its main assumptions and properties and it concludes describing and discussing the results of the three different models.

Chapter 3 introduces a forecast of future out-of-pocket payments in 2050 and discusses about how knowledge of certain factors, associated with health expenditure would help policy makers plan for a better future.

Chapter 1

Ageing and Demographic Change Globally and in Italy

1.1 Ageing of Population in the World

To obtain a better perspective of Italy's ageing population, it is essential to examine population ageing at a global level.

Population ageing is defined as the inevitable increase in the share of older persons that results from the decline in fertility and improvement in survival that characterize the demographic transition [1]. Ageing is occurring throughout the world with now being at its highest level yet. It started during the mid-twentieth century in high income countries and is now shifting to low-middle income countries which are experiencing the greatest change. Today the projections evidence the trend to continue in the upcoming years. However, there are countries and regions which present different characteristics and are experiencing ageing at a varying pace, overall the rate at which the population is ageing is faster than the past as shown in Figure 1 below.

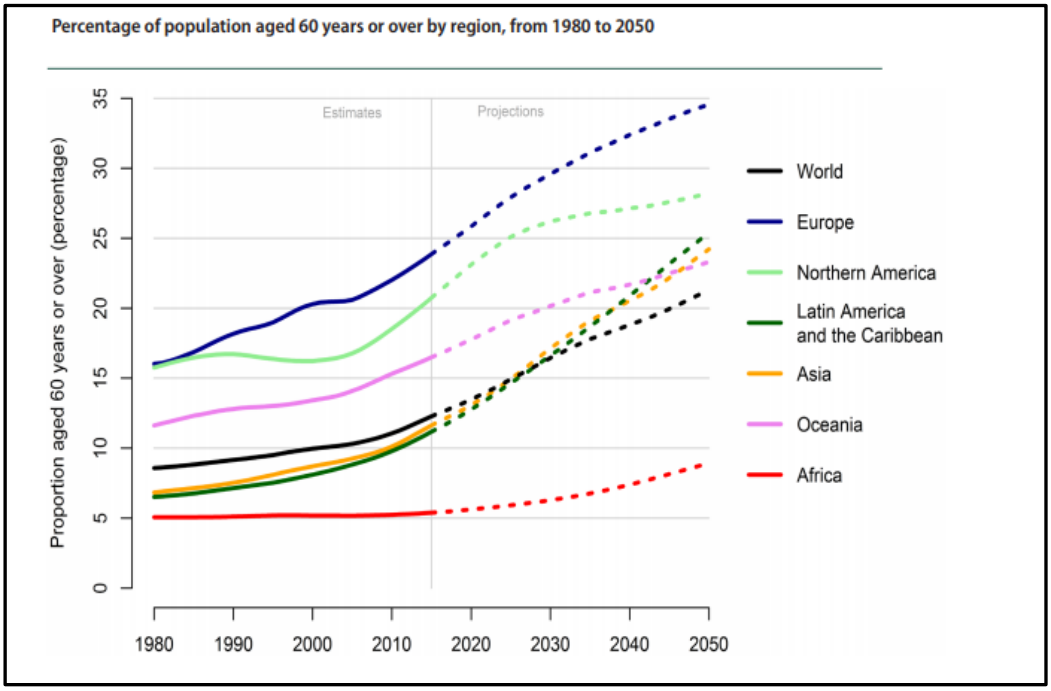


Figure 1: Percentage of population 60+ from 1980 to 2050. Source: United Nations (2017). World Population Prospects: the 2017 Revision.

[1] United Nations, Department of Economic and Social Affairs, Population division. "World Population Ageing 2007". New York: United Nations, 2007

1.2 Trends Affecting Global Ageing

Population ageing is commonly accepted to be the consequence of two major factors: increased longevity and low fertility rates.

The first is due to better economic conditions, successes of new technologies and health advances due to the development of new vaccines or antibiotics, people now have a better possibility of surviving childhood and reaching an old age. In fact, studies have shown that at 65 years of age there has been a 24-year increase in global life expectancy. There is now also a better understanding of certain needs such as a nutritious and healthy diet, clean water standards, and the probability of a child contracting a serious infection has decreased dramatically with respect to the past. This has allowed many children to grow immunities and survive what could have potentially been a life-shortening disease.

Reductions in fertility is a consequence of societal changes such as values and behaviors but can also be affected by public health interventions, policies which influence families, moreover also labor practices. Thus, when fertility rates fall below the replacement rate, the balance between young and old shifts and older citizens come to represent a larger portion of the population. Referring to the two factors affecting global ageing Figure 2 below shows the increase of the amount of people 65 years old and over and the decrease of amount of people who are 5 years old or younger among the global population.

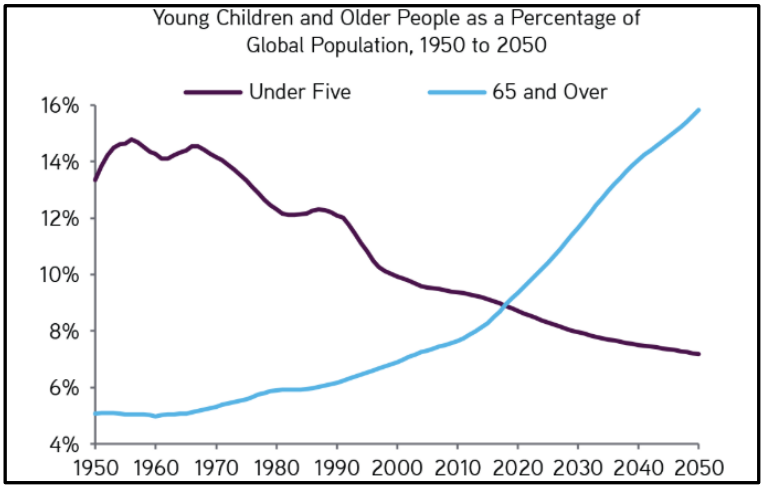


Figure 2: Increased longevity and decline in fertility rates. Source: United Nations, Haver Analytics.

Currently, immigration rates are not high enough to affect the age composition of countries and so are considered to be small factors which could one day condition population ageing due to changes in immigration policies.

Studies suggest that industrialization has a strong relation with ageing and it is defined as the process of converting an economy based on primary activities like agriculture, into a more manufacturing one. Currently we are experiencing the "Fourth Industrial Revolution" as announced by the World Economic Forum in January 2016 defined as the "technological revolution" which focuses on new technologies such as artificial intelligence or 3-D printing. All of these are further improving the quality of life, longevity and raising the standards of living.

The notion as "industrialized countries" refers to those countries which have a high per capita income and inclination towards a free market economy. Other characteristics include a stagnant population which tends to be an ageing one and a market which offers a wide range of high-tech products. The countries are members of the Organization for Economic Co-operation and Development (OECD). They include the United States, Canada, the Western European countries, Japan, Australia and New Zealand.

The "developing countries", are more than 150 and include African, Asian and Latin American countries which are under-developed in economic terms with respect to the industrialized ones. Characteristics of developing countries include the following:

- A low real per capita income
- Low life expectancy
- A high rate of population growth
- A high proportion of the labor force which is involved in agriculture and other primary activities
- Restriction of trade with other countries

In between industrialized countries and developing countries there are the so-called "economies in transitions" which include former Soviet Union countries which were past command economies and are now moving towards a market based one.

Following a comparison between industrialized and developing countries, the most rapid ageing is taking place in industrialized countries, consequently, elderly proportions are much higher in industrialized nations, as shown in the Table 1 below.

2017		2050	
Country or area	Percentage aged 60 years or over	Country or area	Percentage aged 60 years or over
Japan	33.4	Japan	42.4
Italy	29.4	Spain	41.9
Germany	28.0	Portugal	41.7
Portugal	27.9	Greece	41.6
Finland	27.8	Republic of Korea	41.6
Bulgaria	27.7	China, Taiwan Province of China	41.3
Croatia	26.8	China, Hong Kong SAR	40.6
Greece	26.5	Italy	40.3
Slovenia	26.3	Singapore	40.1
Latvia	26.2	Poland	39.5

Table 1: Comparison between countries' shares of population 60+ in 2017 and 2050. Source: United Nations Population Division (2017)

As highlighted in the report by the United Nations, Japan's population in 2017 was formed by 33.4% of people that were aged 60 years or older and was closely followed by Italy and then by Germany. Hence, this ageing trend is becoming one of the most outstanding transformations, effecting the whole society of the twenty-first century and it can have many implications in different sectors. The demographic shifts can reshape a country by creating future challenges which will demand a reply also by the government. As we have now an overview of population ageing in the world and its main trends, it is now possible to investigate more in depth the population ageing of Italy, the country of focus of the thesis.

1.3 Population Ageing in Italy

1.3.1 Population Pyramid

The ageing of the population can be represented through a population pyramid also defined as the "age-sex pyramid" considered the main graphical illustration of the distribution of the age of a population. It is formed by two symmetric histograms with respect to a vertical axis representing age groups. On the horizontal axis, there is the amount of the population for each age group which in our case is the percentage of the total population. On the left of the vertical axis the individuals who are male are represented while on the right the female individuals are illustrated.

In the following page, there are four population pyramids in different time periods: in 1959, 1989, 2019 and a future projection in 2049. What emerges from these graphs is a problematic and urgent situation for the country as a decrease in fertility and an increase in life expectancy have completely changed the age structure of the population, which at the time of the postwar period was formed to a large extent by young people and which today has strongly aged.

The pyramid transforms through time and from the shape of a pyramid we can deduce the demographic history of the country and the trend demographic to which it is tending. In particular, a pyramidal shape, such as that of 1959 indicates a growing population; a pyramid shape tending to a rectangle, approximately that of 1989, indicates a zero growth; while a pyramid tending to a trapeze like the one in 2019 and 2049 indicates a population decrease. The 2049 projection has been constructed by the United Nations Department of Economic and Social Affairs/Population Division using the medium projection variant. The main assumption of the projection is the decline of fertility for those countries where families that have two or more children on average and an increase in fertility for other countries where women have fewer than two children on average. Among this, survival and longevity prospects are also taken in consideration as to improve in all countries.

What also arises from the future projection is that people will have a better chance of living past the age of 85 and even reach age 100 than previously in human history.

Thus, the risk of the pyramid is that it may reverse, if active support policies will not be adopted.

Figure 3: Population Pyramid of the Italian Population in the years: 1959, 1989, 2019 and 2049. Source: (www.populationpyramid.net)

1.3.2 Old Dependency Ratio

Another important tool used to study the process of population ageing is the is old dependency ratio. The indicator is equal to the ratio between the number of people over the age of 65 years, this age corresponds to when a person is economically inactive, and the number of people between 15 and 64 years of age[2].

The value is expressed as a percentage:

$$Old\ dependency\ ratio = \frac{n°\ of\ people\ 65+}{n°\ of\ people\ 15-64} * 100$$

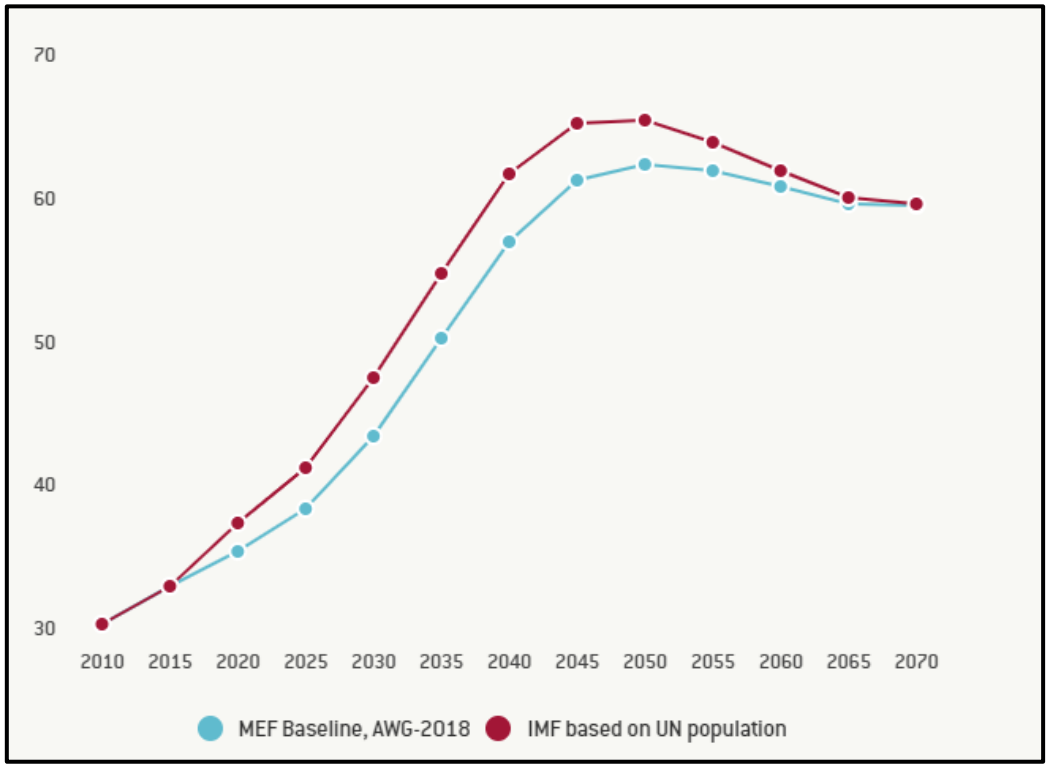


Figure 4: Old dependency ratio graph of Italian population. Source: Andrle et al. (2018).

As we can see from the graph, reported by the Ministry of the Economy and Finance (MEF) the old dependency ratio has been increasing considerably since 2010. However, in the coming years an even greater increase is expected, at least until 2050, the year after which the indicator will then stabilize, and it will follow a decrease. The tools explained are used to underline the demographic trends in order to understand better what the economic consequences for the

[2] Definition provided by Eurostat.

country could be, for example the sustainability of the pension system or the effect on the health system.

1.3.3 Economic Consequences

The consequences which can be evinced analyzing the demographic trends may be the following: with less people, there will be fewer young workers who make products and services for the rest of the population, meaning fewer taxes to finance health and fewer contributions to pay pension benefits. In other words, these people who produce resources face an increase in the expense load. This means that economic resources will have to be reallocated. The resources can go from research and development, improvement of educational systems, technological advancements and elder care, more funds are needed to pay for senior healthcare but also to maintain pension fund payouts. Nations experiencing a shrinking population will see a reduction in financial capital and in public savings since governments will tend to use those funds for the elderly, which could have been used for long-term investments and to enhance economic growth. The key point is that an increasing ageing population will have an effect on the rate of economic growth and therefore an impact on each member of the society.

According to the report of 2007 on the pensions of the OECD countries, since 2011 there is a link between life expectancy and retirement age. The result is that the pension systems are hurt financially with an increasing ageing population as a matter of fact in 2015 Italy's total pension expenditure stood at 16.5% of GDP ranking it at the second highest in the EU28, after Greece. The retirement age for the generation born in 1996 is projected to increase further to 71.2 years, from Figure 5 illustrated below we can see how the retirement age in the future will increase. Thus, pension spending may increase due to increase in the older population.

Indeed, policymakers are facing a problem of critical proportions.

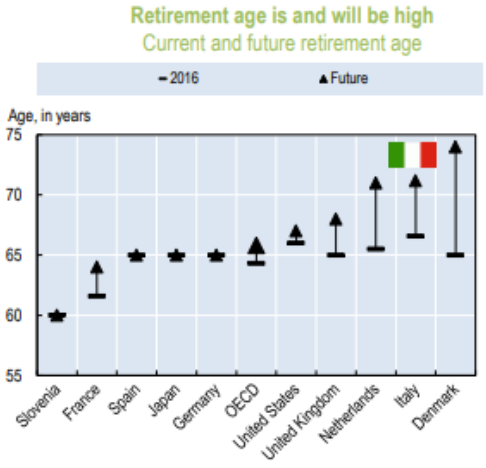


Figure 5: Projections of future retirement age Source: Pension at a Glance 2017 report OECD

1.3.4 Effect on Healthcare System

As the Italian population ages, the health generally declines as the physical condition changes. This means that there is an increase in disabilities but also chronic diseases such as cancer, heart problems or Alzheimer's disease. This will provoke more spending for health treatments in order to provide care for the elderly. Depending on the national health program, the treatments have to be paid somehow. In general, those aged 65 and over are presumably at the greatest risk for incurring healthcare costs. For example, in Italy according to the ISTAT (Istituto Nazionale di Statistica) report for the period 2012-2016, in the year 2016, the healthcare expenditure was equal to 149,500 million euros, that is a 8.9% incidence on GDP. About 75% of it was financed by the public sector while the rest 25% by the private sector.

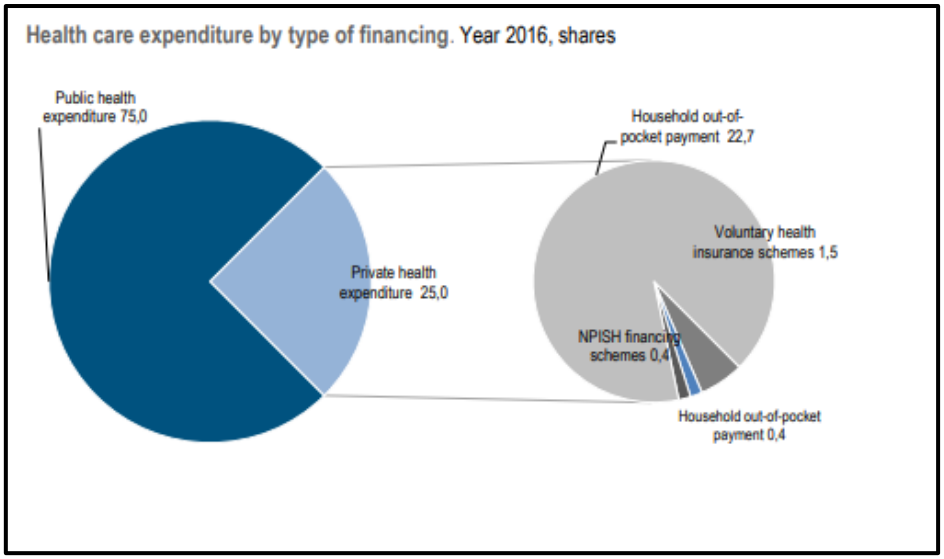
Private health expenditure in the same year accounted for 37,318 million euros, while its incidence to GDP was 2.2%; 90.9% of this component was directly incurred by the private households. With respect to the year 2012, there was an increase of 0.7%.

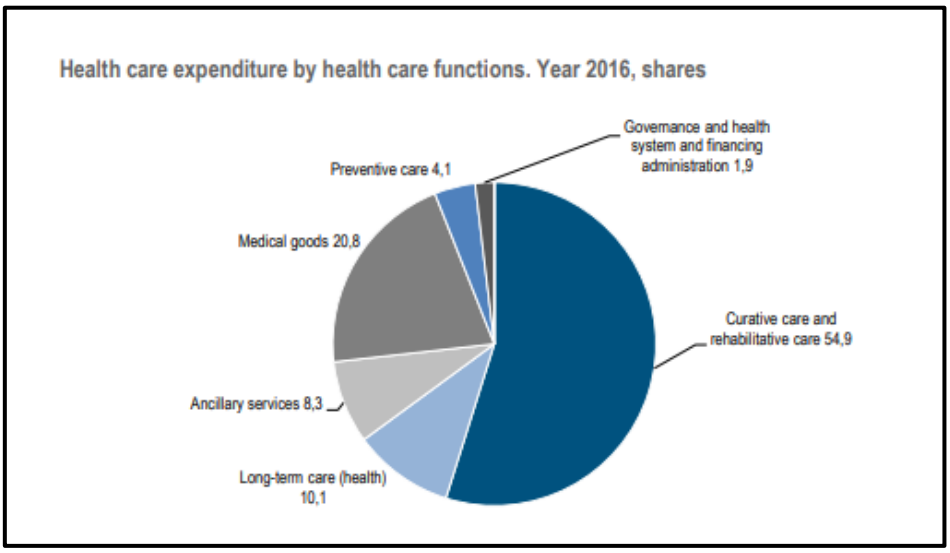
The first component of healthcare expenditure is mainly for curative and rehabilitative care. The second component is for purchasing medical goods either pharmaceutical products or other medical equipment.

Hospitals are the main providers of assistance in the Italian healthcare system as reported in the last chart below.

As the elderly population continues to increase and get older, healthcare costs are expected to rise even further. Italy in order to be more efficient and effective must improve its healthcare system to provide better treatments for the elderly at a lower cost.

Below are three figures which summarize the above paragraph.





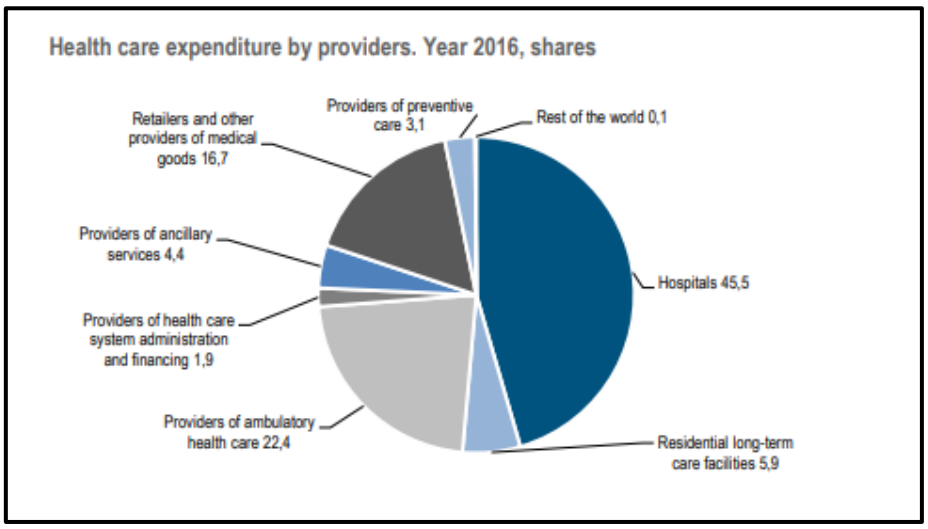


Figure 6: System of Health Account in Italy. Source: ISTAT (2017)

Chapter 2

Effects of Italy's ageing population on healthcare spending

The motivation of the study is to find the main cost drivers of private healthcare expenditure of the Italian ageing population.

2.1 The SHARE Project

The empirical work uses data from the SHARE project (Survey of Health, Ageing and Retirement in Europe) coordinated by the Munich Center for the Economics of Aging (MEA) and Max Planck Institute for Social Law and Social Policy. Among the studies on ageing conducted in Europe, undoubtedly it is the most complete.

SHARE is a European multidisciplinary and cross-national database which contains detailed information on health status, on the socio-economic characteristics, on the family relationships of individuals who have more than 50 years of age in Europe.

The study is organized over different periods called waves, where each wave corresponds to an interview year as shown in the Table 2 below.

Country/Wave	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Italy	2004	2006/07	2008/09	2011	2013	2015	2017

Table 2: Interview years for SHARE Project. Source: Own Representation

Each interview for the survey is conducted through a personal computer-assisted face-to-face interview (CAPI) plus a paper questionnaire and it is performed at family and individual level. The selected families and individuals are based on the presence of at least one member born before 1952 from 27 European countries and Israel. The same individuals have been interviewed approximately every two years about their economic, social and health situation. The survey consists of 21 modules; The first module is a cover screen (CV), useful because it contains demographic information. The other modules contain a wide variety of aspects: physical health, measured by the presence of chronic diseases, other modules have been added that aim to capture the situation economic situation of families and make specific reference to the sources and composition of income.

In a separate section of the project, SHARE asks more detailed questions contained in the additional modules that include generated health variables (generated variables-GV), on education, work, income and on social support.

The SHARE data set has been used for countless jobs and many interesting results have emerged from the studies elaborated through the SHARE dataset. Investigation by this kind are helpful in policy decisions, as it provides information on the economic, social and medical conditions of the ageing Europeans in order to formulate forecasts and to understand which are the real needs of these people.

2.2 Preparing the dataset

Of particular relevance for this type of study are the first module called cover screen which contains demographic information and the additional modules which include the generated variables on private healthcare expenditures. These two datasets have been merged together into one.

For this type of work, a dataset with panel data (also called longitudinal data) has been used.

Panel data refers to data for n different entities, in this case only Italian individuals have been taken in consideration among the other 27 European countries and Israel.

In the model, more precisely, were taken only individuals not born after 1939 so they have 65 years of age at the moment the first interview is done (in 2004) or are older as we are focusing on the study of an ageing population. Each individual has been observed for T time periods, in this occasion for five time periods (2004, 2006/07, 2013, 2015, 2017) unless he or she has deceased earlier.

Data from Wave 3 and Wave 4 has been excluded since in Wave 3 which is also entitled SHARELIFE, the data collected corresponds to the life histories of the respondents and there is no information about the current life circumstances at the time of the interview. Data from Wave 4 has also been excluded since it does not contain any information about private healthcare expenditures, the main variable of interest.

2.2.1 Dependent Variable selected for estimation

In this study we have focused on out-of-pocket payments (op), the response variable, which is classified as private health expenditure and is a major component of national health spending. Out-of-pocket payments refers to payments made by patients to healthcare providers at the moment the service is received, and in this particular case it is equal to the sum of the payments

for inpatient and outpatient care, nursing homes/home care and drugs and it is expressed in euros.

Inpatient and outpatient care procedures may regard medical treatments or surgeries. The main difference is the time required by the patient to remain in the facility where they have the operation done. Inpatient care involves overnight hospitalization. Patients must stay at the medical facility where their procedure is done (which is usually a hospital) for at least one night. During this time, they are supervised by either a nurse or doctor. Patients receiving outpatient care don't require hospital admission and are free to leave the doctor's office, clinic or hospital once the procedure is over.

2.2.2 Explanatory Variables selected for estimation

The explanatory variables or cost drivers of healthcare are independent variables which are used to describe how the response variable, the main focus of the study, can change.

In the first model, the explanatory variables mainly are of demographic type and are the following:

- Age (age): the age of the individuals in the five time periods.
- Years of education (yedu): number of years of education of the individuals.
- Employment status (cjs): this type of variable is categorical.
  Categorical variables identify a group to which the person belongs to.
  People according to their employment status are categorized as retired, employed, unemployed, permanently sick, homemaker or other.
- Total income (thinc1000): Income is identified as an important factor to explain differences across countries in the level and growth of private healthcare expenditures. In the survey it corresponds to the sum of earnings from employment, old age early retirement and survivor pensions, private and occupational pensions, disability pensions and benefit, unemployment benefits and insurances, social assistance, sickness benefits and pensions, other private pensions, private transfers, earnings from self-employment, income from rent/sublet, income from other household member, interest/dividend from financial asset. It is expressed in euros.

The second model among the demographic cost drivers also includes genetics cost drivers such as the tendency of individuals to inherit particular conditions that affect life expectancy. In this case the variable is:

- Chronic diseases (chronic): the number of chronic diseases the patient has.

The third model includes the following variables used as regressors:

- Age (age)
- Hospitals visits (nhospital): number of times the person has stayed in the hospital
- Limitations in daily activities (adl): the number of limitations the individuals have in their activities of daily living.
- Doctor visits (doctors): number of times the person has seen and talked to a doctor.

2.3 Econometric Method

The econometric methodology chosen for the study of the variables under examination is the model of the fixed effects regression. This part of the chapter is therefore dedicated to the introduction of the model, presenting the basic assumptions, the hypothesis testing and the explanation of the aspects relevant to the empirical analysis.

2.3.1 Fixed Effects Regression

The method used is called fixed effects regression which is employed in a panel data dataset and allows to control over time variables which cannot be observed or measured, it takes the following general form:

$$y_{it} = \beta' x_{it} + v_i + e_{it}$$

where *i* represents the individual (in total 3169 individuals have been observed), and *t* represents a year, in this case the interview year, *v* represents the effects of those variables particular to the *i -th* individual which are invariant over time and are treated as fixed rather than random. X_{it} is an exogenous vector of explanatory variables that is uncorrelated with the error term $e_{it.}$ The vector β is a vector of coefficients for the vector of variables x_{it}.

The explanatory variables are concerned with explaining the variations in out of pocket payments for healthcare associated with the dependent variable $y_{it.}$

Assumptions:

The Fixed Effect Regression Model has four assumptions which are the following:

1. The error term e_{it} has conditional mean zero, that is E(e_{it}|Xi1,Xi2,…,XiT)=0. This means that the error term has conditional mean equal to zero, given all T values of X for that individual (entity). This implies that there is no omitted variable bias.
2. (Xi1,Xi2,…,Xi3,ei1,…,eiT), i=1,…,ni=1,…,n are i.i.d. draws from their joint distribution. This assumption is based on the fact that variables for one entity are distributed identically to but independently of the variables for another entity. This holds if entities are selected by simple random sampling from the population.
3. Large outliers are unlikely: (Xit,e_{it}) have nonzero finite fourth moments.
4. There is no perfect multicollinearity.

When there are multiple regressors, Xit is replaced by X1it,X2it,…,Xkit.[3]

Properties: Hypothesis Testing

The coefficient estimates contained in vector β are certainly subject to an error sample. Therefore, the fact that a parameter is different from zero in the sample does not necessarily imply that it is also in the population. This possibility must be verified with the following hypothesis test:

$$\begin{cases} H_0: \beta_k = 0 \\ H_1: \beta_k \neq 0 \end{cases}$$

Thus, if we fail to reject the null hypothesis, the k-th regressor has no influence on the dependent variable. When there are many entities, the hypothesis tests can be computed using the large-sample normal critical values. A t-ratio must be also computed and a significance level (α) must be chosen and can be either of 10%, 5% or 1%. By choosing a level of significance, we fail to reject the hypothesis H0 if | T | ≤ $t1 - \alpha / 2$, otherwise it is rejected.

If the hypothesis is rejected then it is stated that βk is statistically significant, hence there is evidence that the explanatory variable has an impact on the dependent variable.

The hypotheses on βk can also be verified using the p-value, which represents the minimum value (α) for which the null hypothesis is rejected. That is, the null hypothesis will fail to be rejected if P-value ≥ α otherwise it is refused.

[3] Assumptions of the Fixed Effect Regression Model-Introduction to Econometrics (Third Edition)

Model 1 Fixed Effects Regression

$op_{it} = \beta\,'\,(age_{it}, cjs_{it}, yedu_{it}, thinc1000_{it}) + v_i + e_{it}$

The regression results are reported below:

```
Fixed-effects (within) regression               Number of obs      =      3162
Group variable: id                              Number of groups   =      1168

R-sq:  within  = 0.0437                         Obs per group: min =         1
       between = 0.0070                                        avg =       2.7
       overall = 0.0184                                        max =         5

                                                F(8,1986)          =     11.33
corr(u_i, Xb)  = -0.2077                        Prob > F           =    0.0000
```

op	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	47.69105	5.369421	8.88	0.000	37.16076	58.22134
cjs						
Employed or self-employed	63.34477	343.3083	0.18	0.854	-609.9375	736.6271
Unemployed	-51.57595	954.3397	-0.05	0.957	-1923.188	1820.036
Permanently sick	-154.3528	198.8147	-0.78	0.438	-544.2601	235.5546
Homemaker	-182.4669	115.8322	-1.58	0.115	-409.6322	44.69844
Other	164.9939	199.477	0.83	0.408	-226.2123	556.2001
yedu	-6.338624	20.10121	-0.32	0.753	-45.7603	33.08305
thincl000	1.369736	1.530952	0.89	0.371	-1.632704	4.372176
_cons	-3149.238	423.2058	-7.44	0.000	-3979.212	-2319.264
sigma_u	828.08426					
sigma_e	1154.1102					
rho	.33985509	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(1167, 1986) =     1.09          Prob > F = 0.0481
```

Figure 7: Fixed Effects Regression Model 1. Source: Own Representation Stata.

General descriptive results of Model 1:

After the regression is run, the results obtained, more specifically the coefficients observed, are used to estimate the relationship between the predictor variable and the response variable.

It is shown that an increase in one year of age causes healthcare expenditure to increase circa €47,69, showing that it is strongly age dependent. When looking at the p-value of the coefficient we can say it is statistically significant because the it is lower than the significance level of 1% and the null hypothesis can be rejected.

For the categorical variables, **i.cjs** generates dummies for the observed employment level and it omits one of these dummies which is the base or reference category. In this case the reference group belongs to those people who are retired. Therefore, a coefficient of 63,34

means that employed individuals have to pay about €63,34 more compared to those who are retired.

However, when looking at the p-value of this coefficient it can be noticed that it is not significant. For this reason, it can't be said that employed individuals spend more in terms of out-of-pocket payments than those who are retired because the test rejects the hypothesis that 63,34 is significantly different from the reference group.

Always with respect to the excluded category, the unemployed, spend €51.57 less than the retired individuals. While those who are permanently sick and are homemakers spend about €-154,35 and €-182,46 compared to the retired. Those individuals who are part of the "other category" spend €164,99 more than the retired ones. The years of education variable has little relevance to the change in the out of pocket payment, because as the years of education increase by one healthcare spending will decrease by €-6,33. Of little relevance is also the income variable, if income increases by €1 the out-of-pocket payments will increase by €1,36. All of the regressors except for the age explanatory variable are not statistically significant.

Model 2 Fixed Effects Regression

$$op_{it} = \beta' (age_{it}, cjs_{it}, yedu_{it}, thinc1000_{it}, chronic_{it}) + v_i + e_{it}$$

```
Fixed-effects (within) regression               Number of obs      =      3123
Group variable: id                              Number of groups   =      1166

R-sq:  within  = 0.0481                         Obs per group: min =         1
       between = 0.0179                                        avg =       2.7
       overall = 0.0302                                        max =         5

                                                F(9,1948)          =     10.94
corr(u_i, Xb)  = -0.1573                        Prob > F           =    0.0000
```

op	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	47.83284	5.522175	8.66	0.000	37.00284	58.66283
cjs						
Employed or self-employed	30.4097	346.3006	0.09	0.930	-648.7489	709.5683
Unemployed	-76.61575	959.2171	-0.08	0.936	-1957.816	1804.584
Permanently sick	-128.2912	201.9967	-0.64	0.525	-524.4437	267.8613
Homemaker	-149.6307	117.9551	-1.27	0.205	-380.9621	81.7007
Other	166.622	200.7385	0.83	0.407	-227.0629	560.3069
yedu	2.534385	21.36947	0.12	0.906	-39.37504	44.44381
thincl1000	.7842813	1.635428	0.48	0.632	-2.423092	3.991655
chronic	33.82277	19.68841	1.72	0.086	-4.789796	72.43534
_cons	-3276.299	430.1746	-7.62	0.000	-4119.95	-2432.648
sigma_u	816.67576					
sigma_e	1159.8917					
rho	.33143994	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(1165, 1948) =     1.03          Prob > F = 0.2768
```

Figure 8: Fixed Effects Regression Model 2. Source: Own Representation Stata

General descriptive results of Model 2:

In this model there is the addition of one regressor called chronic which counts how many chronic diseases the individual has at the time he or she is interviewed. The effects on the previous coefficients calculated in the model above are that they vary by a small amount.

An increase in one year of age causes healthcare expenditure to increase circa €47,83, a €0,14 increase with respect to the first model.

The reference group for the employment level always refers to those people who are retired. Therefore, a coefficient of 30,40 means that employed individuals have to pay about €30,40 more compared to those who are retired.

Being unemployed means that individuals will pay about €76,61 less than the retired.

While those who are permanently sick and are homemakers spend about €-128,29 and €-149,63 compared to the retired. Those individuals who are part of the "other category" spend €166,62 more than the retired ones.

If the years of education increase by one, healthcare spending will decrease by €2,33. Of little relevance is the income variable, as if it increases by €1 the out of pocket payments will increase €0,78.

By adding the variable chronic, it is shown that if the number of chronic diseases increases by one the healthcare costs for individuals will increase by €33,32. All of the variables except one, age, are not statistically significant.

Model 3 Fixed Effects Regression

$op_{it} = \beta\,'\,(age_{it}, adl_{it}, nhospital_{it}, doctor_{it}) + v_i + e_{it}$

```
Fixed-effects (within) regression               Number of obs      =      3169
Group variable: id                              Number of groups   =      1168

R-sq:  within  = 0.0732                         Obs per group: min =         1
       between = 0.0572                                        avg =       2.7
       overall = 0.0573                                        max =         5

                                                F(4,1997)          =     39.43
corr(u_i, Xb)  = -0.1530                        Prob > F           =    0.0000

------------------------------------------------------------------------------
          op |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   34.52891   5.322446     6.49   0.000     24.09079    44.96704
         adl |   143.5622   24.26067     5.92   0.000     95.98333    191.1411
   nhospital |    13.6918    3.29988     4.15   0.000     7.220235    20.16337
      doctor |   4.409851   2.401084     1.84   0.066     -.299041    9.118742
       _cons |  -2341.455   409.0331    -5.72   0.000    -3143.632   -1539.279
-------------+----------------------------------------------------------------
     sigma_u |  793.40316
     sigma_e |  1141.2987
         rho |   .3258136   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(1167, 1997) =     1.13                 Prob > F = 0.0094
```

Figure 9: Fixed Effects Regression Model 3. Source: Own Representation Stata

General descriptive results of Model 3:

The last model shows how an increase in one year of age provokes an increase of out-of-pocket spending of €34,52. If an individual has an increase in the number of limitations in the daily acitivities then the expentiure will be associated with an increase in €143,56. While if an individuals stays in the hospital an extra night, its increase in healthcare spending will be of about €13,69. Lastly, if the person sees a doctor it will provoke an increase of €4,40, making the coefficient statistically significant at 10% level.

2.4 Discussion of Results

What can be concluded from observing these three different models presented in the above paragraph, is that healthcare expenditure as the population ages tends to increase. Unexpectably, factors like employment level, years of education and income level, even if they tend to have a predictive character are not statistically significant, thus it cannot be evinced that the explanatory variable has an impact on the dependent variable. Other variables which have a considerable explanatory power for out-of-pocket payments and are considered more relevant are the number of limitations in the daily activities, the number of stays in the hospital and the number of times and individual has seen a doctor.

Chapter 3

Forecasting and discussion of possible solutions to prevent an increase in healthcare spending of an ageing population.

3.1 Forecasting out-of-pocket payments in 2050

The data gathered in order to forecast future out-of-pocket payments of the Italian ageing population in 2050 includes facts on age and on the employment level. Nowadays, one Italian out of four is over 65 which corresponds to 22,6% of the population. While, in 2050 there will be one Italian out of three which will have more than 65 years of age corresponding to 34% of the population. From the demographic data, gathered through the official online platform Geo Demo provided by ISTAT, I have analyzed how the average age for the class of individuals with 65+ years of age changes in 15 years. What emerges is that the over 65 individuals' mean age in 2003 was 74,72 years of age while in 2018 it was 75,80 years of age. It can be concluded that in 15 years the mean approximately raises by 1 year. Therefore, in 2050 the average age will increase by 2 years. Concerning the level of employment of the over 65 there has approximately been an increase of 2% in the rate of employment every year[4]. If we assume that the last data available for 2018, that is 629'000 people over 65 employed, to increase by 2% every year, in 2050 the number of employed will reach 1185'000 people. In this case the level of employment will increase of 88%. As explained in Chapter 1 this is true since the retirement age will be higher in the future.

The estimation of the out-of-pocket expenditure uses the coefficients of the first model presented in Chapter 2 and it is the following:

$$Op_{2050} = 47{,}69(age_t) + 63{,}34(employmentlevel_t) + e_t$$

What can be concluded is that a 2-year age increase is associated with a €95,38 euro increase in the out-of-pocket payments for health. An 88% increase in the employment level will

[4] Calculation based on the increase of the employed over 65 in Italy provided by http://dati.istat.it/Index.aspx?DataSetCode=DCCV_OCCUPATIT1#

provoke a €55,73 increase in private healthcare spending with respect to the retired ones. Thus, as shown ageing can bring additional costs to individuals.

3.2 Context for Policy Implications

The analysis of the previous paragraph has shown how the factors have carried an impact. Although ageing will bring additional costs, these can be reduced by exercising appropriate health and social policies that can decelerate the rate of health decline related with ageing, consequently the amount of healthcare services required. The trends of health among the elderly people are quite complex. Older people have potential to remain healthy. However, this capability requires a supportive environment, including well-living conditions, suitable healthcare and access to economic resources. Health and social policies are required to supply appropriate systems and to reply to the needs of the ageing population. This phenomenon is relevant due to the long-term implications it has, even if we are now facing a period of economic and financial instability. Policy makers have opportunities to prepare for this change and for the future and must take initiatives to help the nation not to be unprepared for the social and economic effects of a population structure which is altered. Since it was not possible to identify all the projections of the increase in factors associated with ageing, therefore in the course of this chapter, we will analyze some of them and the possible policies or interventions public institutions could embrace.

3.3 Chronic conditions and Policy Options

In Italy as outlined by the ISTAT Annual Report of 2017, chronic-degenerative diseases are more frequent in certain age groups such that of 55-59 years of age as 55,5% of the population suffer from it and among those aged over seventy-five, the share reaches 85,8%.

The most common chronic diseases or conditions are hypertension (17,8 %), arthrosis / arthritis (16,1 %), allergic diseases (10,7 %), osteoporosis (7,9 %), chronic bronchitis and bronchial asthma (5,9 %), diabetes (5,7 %), all of these pathologies except for the allergic disease may increase with ageing.

Chronic diseases are an important factor to assess the health of the population. Health problems are complex and will increase as populations age, with more people suffering from chronic diseases. These are defined to persist at least more than three months. These conditions require

continuous medical treatments since the person has to adjust to what the illness demands and what type of therapy is used to treat the condition. Elderly patients often see a number of providers of both social and healthcare services which can be costly and might be a challenge for them.

This is creating challenges also for social policy and health services, nevertheless, data can be a useful reference to determine the actions that the Government and the SSN (Sistema Sanitario Nazionale), the National Health System, will take in the future.

Policy options

Interventions by the Government can be of different kinds. They can target prevention programs can yield cost savings for healthcare associated with ageing by ensuring a healthier life also for the elderly. Other options can include encouragement to change behaviors, to live healthier by doing physical activities or changing the nutritional diet. Nutritional needs change with ageing and often the older population has scarce nutrition in terms of what they should consume. Intervention approaches can tackle a community or the society as a whole, and tailor different situations in order to be effective at population level. Interventions can include exercise programs and professional advice in order to encourage adults to be more active physically as this can improve their well-being. As people expect to live a longer and healthier life they will also invest more in developing their skills at a young age and will expand their working lives and this will provoke economic benefits. In order to reach and to implement the prevention programs social media marketing campaigns can be used in order to target older adults and to increase knowledge.

3.4 Limitations in daily activities and solutions

Daily activities involve daily routine tasks and normally do not need assistance to be performed, however a limitation can play an important role on how much can be spent on health by the household. The ability to perform these tasks is useful in order to determine what could be the long-term care decisions, thus if the person needs to be assisted or needs to live in a nursing facility. Not being able to perform daily tasks affects how a person lives. Therefore, most of the times especially when the elderly lack of families and relatives who can assist them they enter into nursing homes and the common age is after retirement, after the person has reached 65

years of age. Health workers who work at home can also assist the elderly to live an independent life.

Solutions to ADL's

The challenges above mentioned which regard the limitations of the daily routine tasks can be solved partly by ensuring a response from health systems and building adequate systems of long-term care. This can include also a greater use of assistive technology. IBM has recently introduced a new type of technology which allows the elderly to live independently, as the main objective is to make them live the longest time possible with no need of assistance and guarantee a better quality of life. This can have an impact on the fact that there will not be a need to build new facilities and therefore to manage them as the fees can be a weight for the households and for the system since it requires investing a high amount of euros. The main objective of IBM which has a long history in the social services, is trying to understand what could happen in the future. In the homes of the elderly in Bolzano, Italy IBM has already installed a small system which has the opportunity to check when a person wakes up, when they eat, and other events which happen throughout the day and if certain things are done or not. The sensor of the system can understand if there are anomalies and if a person shows signs of illness, and therefore it can eventually send alarms to the personnel of the social services which goes immediately to the house of that individual to control whether something has happened or not. This allows to avoid and prevent certain events which could be dangerous for the people. IBM estimates a 30% in the savings and assistance and also in the care. IBM can satisfy the needs of the elderly as there will be an increase in demand due to the increase in elderly people. This solution is of great relevance and interest for Italy but also for other countries which are dealing with issues related to an ageing population.

Conclusion

In the course of the paper hereby presented, we have started with the study of the structure of the Italian population and have become aware that the share of older people in the Italian population has increased and it is destined to increase furtherly. This is putting pressure on the country, mainly on the health system and the economic consequences which could originate from this phenomenon. Through the survey conducted by the SHARE Project it was possible gather data in order to estimate how private healthcare spending (out-of-pocket payments), using the Fixed Effects Regression method, is influenced by certain factors associated with ageing. Of particular relevance were the factors such as: age, employment level, number of chronic conditions, number of stays in the hospital, number of doctor visits and limitations in performing daily activities. The last part of the thesis concludes with projecting the private healthcare expenditures in 2050 based on an increase in the average age of the class of individuals who have over 65 years of age and an increase of the employment rate of those individuals 65+, a consequence of a possible increase in the retirement age. Following an analysis of the forecast, it is shown how an increase in the elderly population also increases out-of-pocket payments. This can help policy makers to further improve the efficiency of the health system for a better future.

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