Why are health expenditures of very old people decreasing?
An investigation on French data

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Preliminary Version - (Please do not quote)

Abstract: In all developed countries it is shown that health care expenditure is increasing with age for survivors, but decreasing with age for decedents. Moreover, one observes that health care expenditure decreases for very old people, aged 90 or more. The aim of this paper is to examine thoroughly the impact of age on a very rich database provided by the French national health insurance and concerning 203,348 individuals observed in 2009. Controlling with information about conditions, we compare assessments deriving from OLS, with evaluations resulting from quantile regressions, which makes it possible to compare the effects of age all along the expenditure distribution. Our results suggest that the decrease in expenditures observed for very old people is the resultant of two phenomena: a limitation in care use for old decedents and a selection effect which leads to less health care expenditures for very old survivors.

1. Introduction

While population ageing is often considered as a key contributor to the growth of health care expenditures, estimates on cross-sectional or panel data for OECD countries suggest a very small or non-significant influence of age on health expenditures (Getzen, 1992; Gerdtham *et al.*, 1992, 1998). Zweifel *et al.* (1999) put forward a plausible explanation for the small impact of age on expenditure. They follow Lubitz and Riley (1993), who pointed out that yearly payments per person for people dying within the year were 7.1 times larger than for survivors (based on US Medicare beneficiaries in 1988). According to Zweifel, health expenditures might appear to be increasing with age just because health-care costs increase in proximity to death and the probability of dying increases with age. Zweifel et al. (1999) used micro-econometric estimates on Swiss data to support this finding. Subsequently, other papers have investigated the respective influences of time to death and age on health expenditures (Seshamani and Gray, 2004a, 2004b; Stearns and Norton, 2004; Zweifel *et al.*, 2004;Werblow *et al.*, 2007).

A paper written by Yang, Norton, and Stearns (2003) makes it possible to understand the mechanisms at stake. The authors conduct a graphical analysis of person-month data for 25,994 Medicare beneficiaries, distinguishing decedents (people dying in the year) from survivors. Large differences emerge between the two groups, supporting the role of proximity to death. Interestingly, however, we observe that the curve relative to survivors is increasing with age. Thus, time to death is not the only factor. For survivors, who account for the bulk of aggregate expenditures, health expenditures are still increasing with age.

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Hence, empirical evidence suggests that both age and time to death have an influence on health expenditures. What is at stake with the debate on the role of proximity to death is the relevance of health expenditures projections. If it is death proximity, rather than age, that influences expenditures, increased longevity could actually slow down expenditure growth. Using US projected life tables for 2020, Stearns and Norton (2004) show that omitting time to death leads to an overstatement of around 15% for health expenditures. This downward correction is due to the fact that an increase in longevity is expected in the future.
Addressing the question of the impact of ageing on health expenditure growth, Dormont, Grignon, and Huber (2006) have shown that the main driver of expenditure growth is the upward drift of the age-profile of health expenditures over time, which is a non demographic phenomenon.

One limitation of many studies comes from the fact that Medicare do not cover people younger than 65. As a result, health expenditures are observed for people older than 65 only. Conversely, the paper by Dormont, Grignon, and Huber (2006) suffers from a sample that is not large enough to be representative for people older than 80. In addition, many studies quoted above do not have information about illnesses. Such information is needed for a relevant control in the analysis, given that the impact of age on health expenditures is mainly due the fact that condition prevalence increases with age.

Our purpose is to take advantage of a comprehensive database provided by the French national health insurance to improve our understanding of the age profile of health expenditures. We have at our disposal a representative sample of 511,946 beneficiaries of all ages that permit to observe accurately expenditures of very old people (above 90). Since the French national health insurance covers individuals of all ages, it is possible to study the profile of health expenditures for all ages. However, given the small death rate of young people, our sample, despite its large size, did not provide enough observations of decedents younger than 45. Restricting the analysis to people aged of 45 and more, we obtain a sample that provides detailed information about illnesses and health consumption for 203,348 individuals. It is representative of decedents and survivors of all ages between 45 and 100 and more.

Our database shows quite comparable features with US results. Selecting physician and hospital expenditures for individuals over 65, which is the scope of studies on Medicare data, we find that 34% of health expenditure is associated with the health care use of people in their last year of life, i.e. people named “decedents”, who represent about 3,7% of French insurance beneficiaries over 65. These figures are quite close of most U.S. studies that show that people who die within a year, who represent 5% of Medicare beneficiaries, commit 25% to 30% of Medicare payments (Hogan *et al.*, 2000; Lubitz *et al.*, 1992, 1998). Another interesting feature shown on US data is that only a small minority of decedents have huge health care expenditures pulling up the average decedents’ expenditures (Newhouse, 1992). We find the same result on our French data, where the top 20% of decedents cause more than half of decedents’ expenditures.
Using now our full sample of people aged 45 and more, we find a smaller, but still sizeable proportion of expenditures due to decedents: in 2009, 12,2% of total health expenditure is associated with the health care use of people in their last year of life, who represent 1,7% of individuals. In France also decedents’ health care expenditures

account for a very important part of the expense. And it is true that a majority of among decedents has fairly low costs and only a small minority concentrates a large proportion of the expenditure.

Figure 1 displays the average individual health care expenditure by age group, and age structure of population for years 2005 and 2009. These figures are computed on the full sample of 511,946 beneficiaries of all ages.
Annual health care expenditures increase with age from €950 at age group 0-4 years to more than €5,000 at age group 90-94 in 2009. The average expenditure per person peaks at age 90-94 and decreases afterwards. A sizeable upward drift of the profile is observed between 2005 and 2009: there is an increase in health care spending for each age group, particularly over 65 years. For the period covering year 1992 to 2000, Dormont, Grignon and Huber (2006) have shown that this drift is largely due to changes in practices, for given age and morbidity, and is the main driver of health expenditure growth.

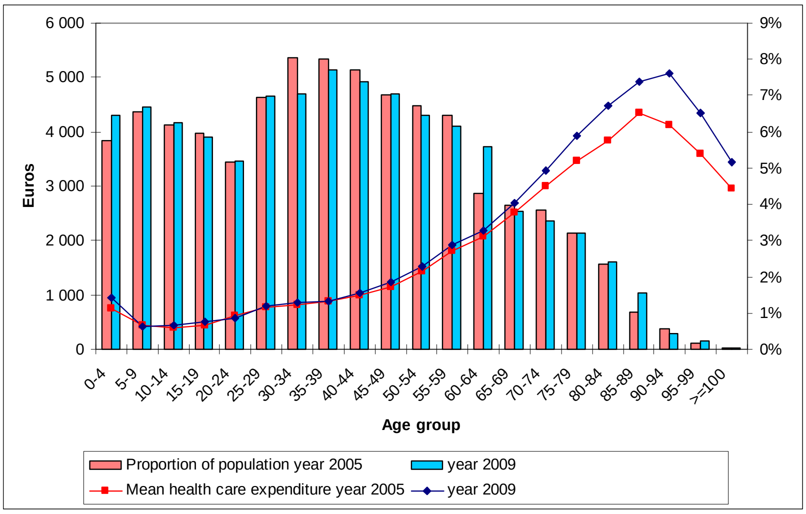

Figure 1. Average individual health care expenditure by age group, and age structure of population, years 2005 and 2009

Following Yang, Norton, and Stearns (2003), we plotted the annual health care expenditures by age group for all individuals taken together, and separating decedents from survivors (see figure 2). Not surprisingly, we find that decedents have much higher expenditures than survivors. As shown by Lubitz *et al.* and many other authors, this explains partly the fact that health expenditures increase with age, because the probability of dying increases with age. This can be seen in figure 2, where the curve relative to decedents and survivors is slightly steeper than the curve relative to survivors only. Two features are worth noticing: firstly, we find that expenditures of survivors decrease for very old people, beyond 95. Secondly, we find that decedent's expenditure decreases with age. These two results are observed on US data too (see Yang *et al.,* 2003). The slope of decedent expenditures is quite similar to the one found by Yang *et al.,* on the same scope, for instance hospital care for people aged at least 65 (Figure 3). Our data makes it possible to observe expenditures of decedents before 65: we find that they are increasing with age from 50 to 69 years old.

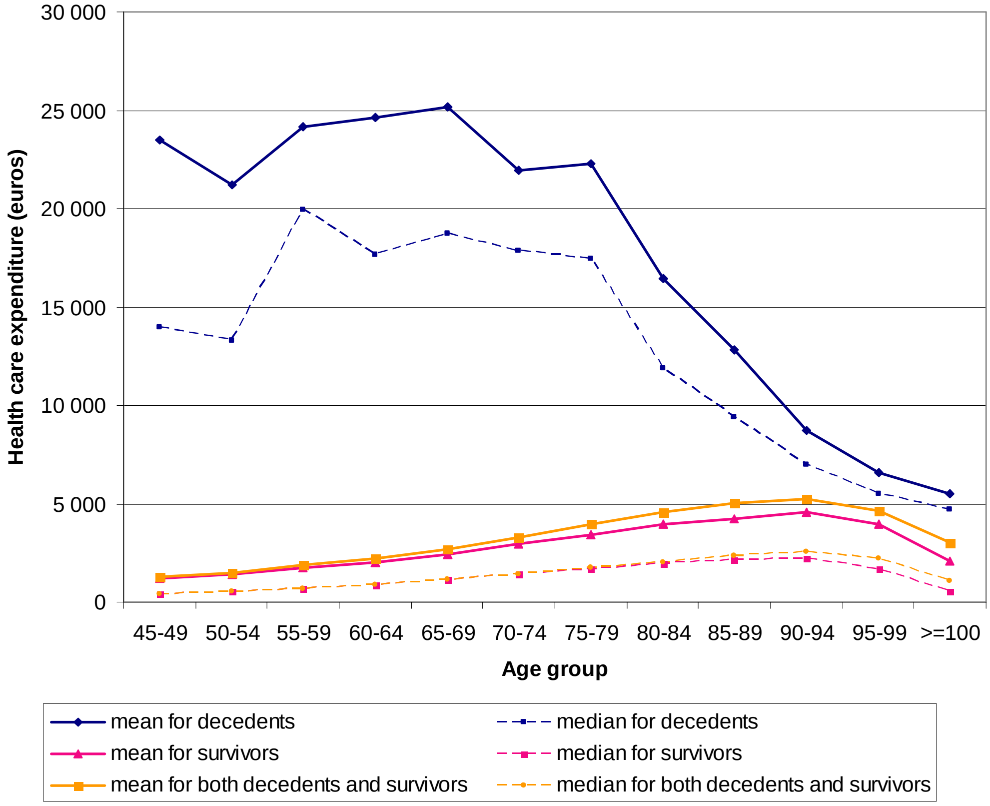

Figure 2. Means and medians of health care expenditure by age group, for decedents and survivors over 45 years, year 2009

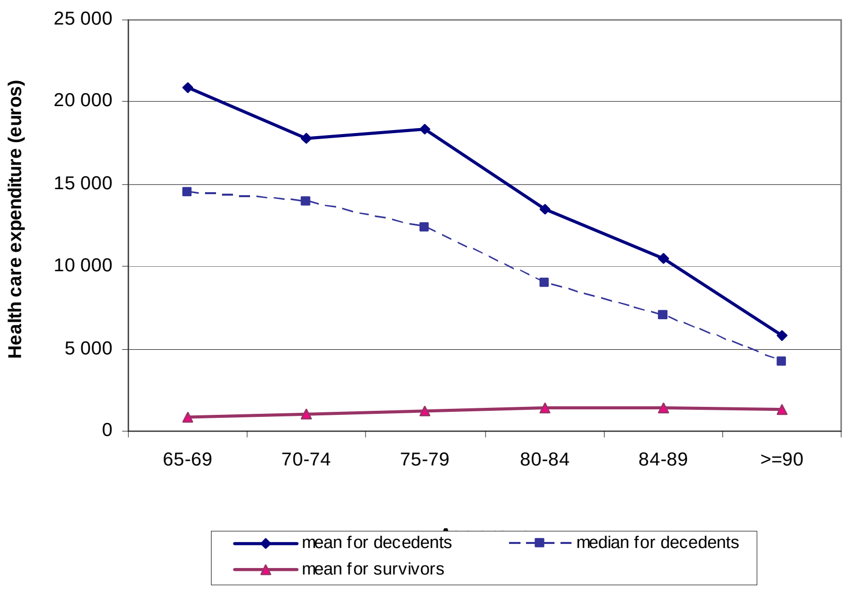

Figure 3. Means and medians of hospital expenditure by age group, for decedents and survivors over 65 years, in 2009

These first results raise two questions we want to address in this paper: why are survivors' health care expenditure decreasing after 95 years? Why are decedents' health care expenditure decreasing after 70 years?

In the following we present the sample and data in section 2, and then perform a descriptive analysis in section 3. Then we present the results of our econometric analysis in section 4 and conclude in section 5.

2. Sample and variables

The French health care system is based on social insurance. Indeed France has universal compulsory insurance with broad coverage, financed through income-related contributions and taxes. The national health insurance acts as a single payer and provides the bulk of the coverage (77% of French health expenditures are covered by national health insurance). The data are extracted from the French national health insurance[1] reimbursement and short-stay hospital admissions database: the National Health Insurance Inter-regime Information System (SNIIR-AM), which cover:
- the health care consumption and reimbursements including date, characteristics and costs;
- the patient characteristics (gender, age, place of residence, date of death);
- medical information, notably medical treatments administered and a list of 30 chronic illness categories.

The data is a representative sample drawn from administrative data relative to health insurance beneficiaries: the Permanent Sample of Beneficiaries (EGB), resulting in a sample of 511,946 beneficiaries. The EGB is a dynamic sample: information concerning EGB beneficiaries (existing or new entrants) is updated on a monthly basis from the National Health Insurance administrative databases. Given that French insurance covers individuals of all ages, our data provide very good information on the real age-profile of health expenditures.

The French health care system is a mix of public and private providers; providers of outpatient care are largely private. Hospital beds are predominantly public or private non-profit-making. We focus on five groups of expenditures in year 2009: physician expenditures, pharmaceutical expenditures related to ambulatory care, allied health expenditures, public and private hospital expenditures. In the following, we call "care expenditures" allied health expenditures, i.e. care provided mainly by self employed or salaried nurses and kinesiotherapists. We don't observe correctly expenditures of dependent people living in residential care homes.

Information about date of death is particularly important for research on end-of-life expenditures. Following Lubitz and Riley, and Yang, Norton, and Stearns, we define decedents and survivors as individuals who deceased within the year and individuals who are still alive a year later. Notice that the availability of observations at monthly-level makes it possible to define rigorously decedents' and survivors' health expenditures: for decedents we sum up all health expenditures during the twelve months preceding death; survivors are defined as individuals who did not die during the year following the year of observation.

Information about illnesses is available: detailed information about medical treatments, drugs and hospitalizations make it possible to identify the illnesses that affect the

[1] CNAMTS : Caisse Nationale d'Assurance Maladie des Travailleurs Salariés

observed individuals. A specific plan providing better coverage for beneficiaries with a chronic disease[2] is an additional source of information. Therefore we can identify with good accuracy beneficiaries with diabetes, renal failure, suffering from Alzheimer's, Parkinson's, cancer, respiratory or heart disease. We also created a variable "disease free" that identifies individuals who are not affected by any of the seven diseases mentioned above. Of course, this term does not mean that these individuals are not ill. Our limited list of chronic diseases leaves room for unobserved morbidity.

From initial dataset we selected a sample of 203,348 people aged 45 or more. One first group of individuals, called the decedents in T, includes the 3,410 observations of people dying in year 2009. The second group, called the survivors, includes 196,644 observations of people who did not die nor in 2009, neither in 2010. We have excluded from our analysis the decedents in T+1, i.e. people living in year 2009 and dying within the following year, in 2010 (3,294 observations). For each age group from 0-4 to 40-44, less than 1 % of individuals are dying in the year. Hence, to guarantee the representativeness of our sample of decedents, we decided to work only on individuals over 45 years (see Appendix A and B).

3. Descriptive analysis

Figures 4 and 5 display the quantiles of health expenditure by age for decedents and survivors. The general pattern of the two figures looks opposite: the variability of expenditures is decreasing with age for decedents, while it is increasing for survivors. However, the expenditure dispersion is at any age larger for decedents than for survivors'. For the oldest individuals, when dispersion is minimum for decedents, it is still greater than the dispersion observed for survivors: the difference between the ninth and the first decile over 90 years, equals around €17,500 for decedents and €11,200 for survivors; similarly, the difference between the third and the first quartile over 90 years, is also greater for decedents, around €8,500, versus €4,800 for survivors. Notice, however, that these evolutions of variability with age are quite proportionate to changes of medians: the same graphs built with the logarithms of expenditures lead to curves that are parallel.

Figures 6 and 7 give information about diseases affecting survivors and decedents. About 20 % of the survivors of age group 45-49 have at least a disease among the seven diseases we have identified. As expected, the frequency of most chronic diseases increases with age for survivors and the proportion of people without disease decreases with age.

[2] List of « *Affections de longue durée* » (ALD)

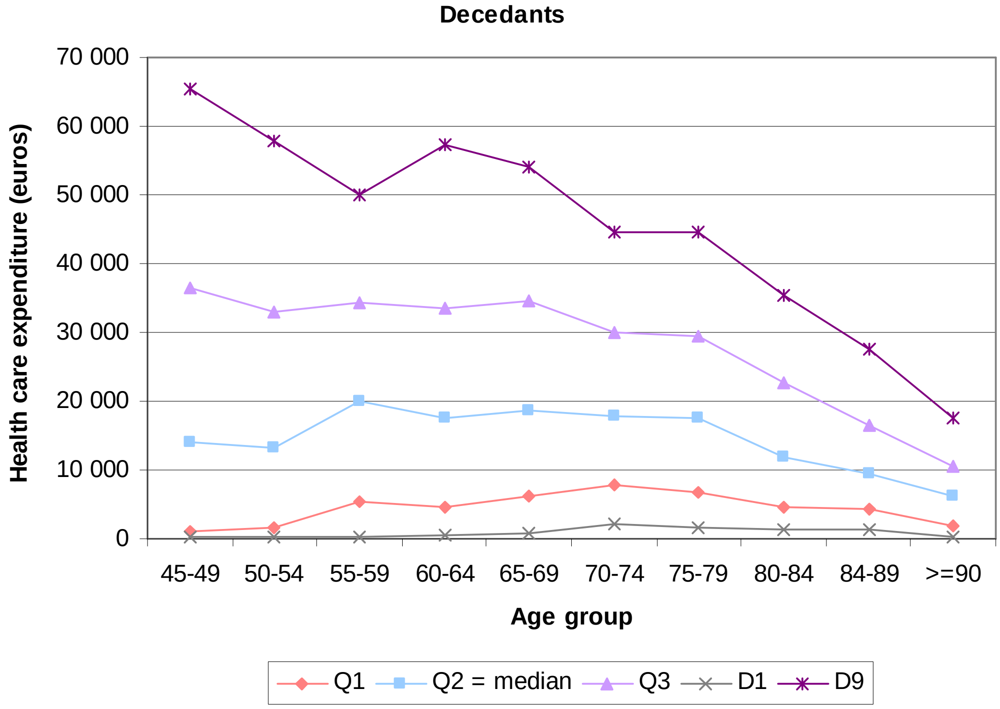

Figure 4. Quantiles of health care expenditure by age group, for decedents, year 2009

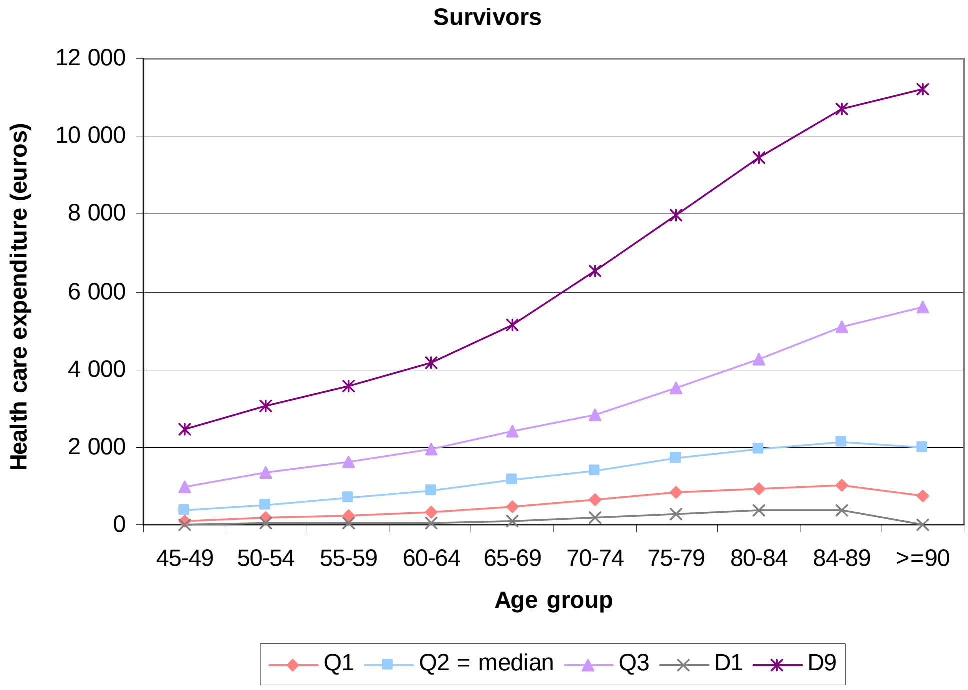

Figure 5. Quantiles of health care expenditure by age group, for survivors, year 2009

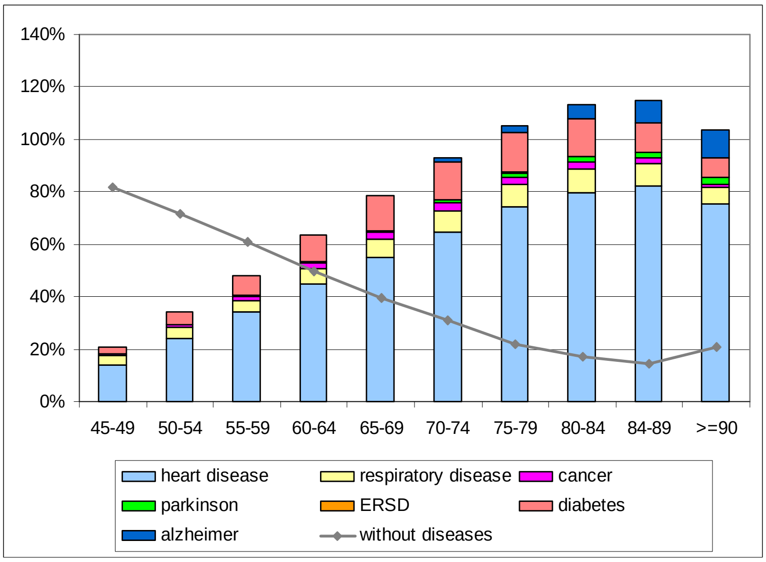

Figure 6. Illnesses of survivors, year 2009[3]

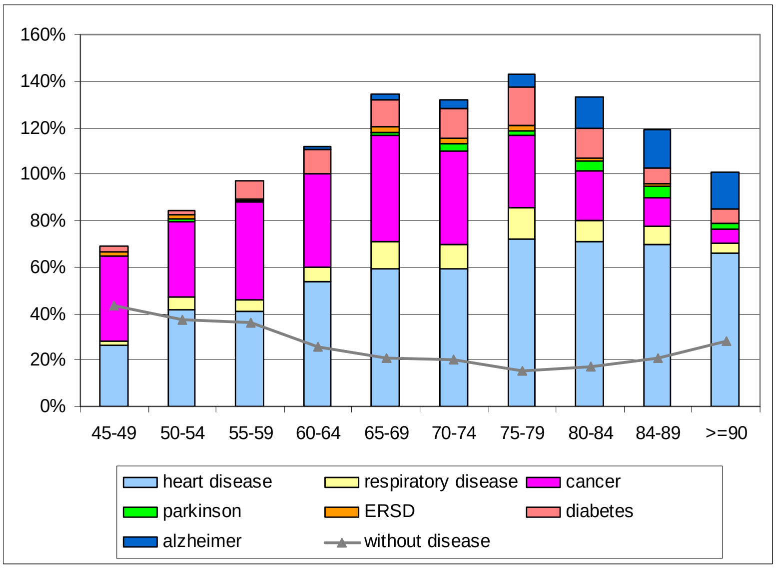

Figure 7. Illnesses of decedents, year 2009

Figures 8 and 9 provide information about the components of health expenditures. The largest part is devoted to hospital. For physician, pharmacy and hospital, survivor expenditures rise until 85 years and decrease afterwards. On the other hand, the age profile of care expenditure is worth noticing: it rises continuously after 85 for survivors. We have found that individual aggregate health expenditure was declining with age from 95 on. Actually, this is the result of a decrease in physician, pharmacy and hospital expenditures after 85, combined with a continuous increase in care expenditures. For decedents, expenditures increase until 65 years and decrease rapidly after 65 years, except for care expenditures.

[3] An individual could have several diseases that's why each bar can be higher than 100 %.

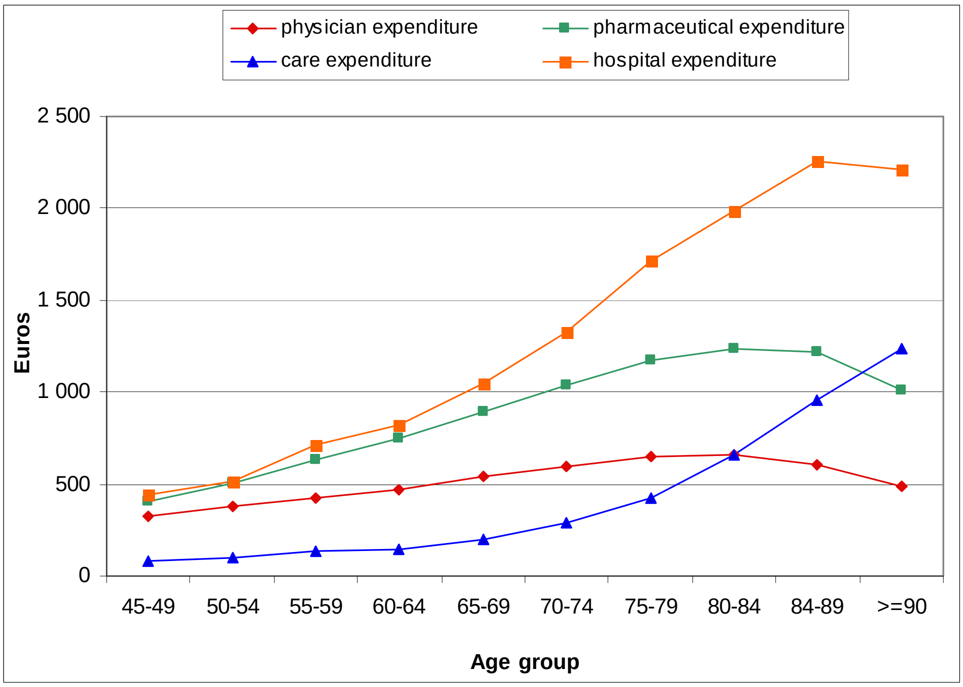

Figure 8. Component of Health care expenditure, all individuals, 2009

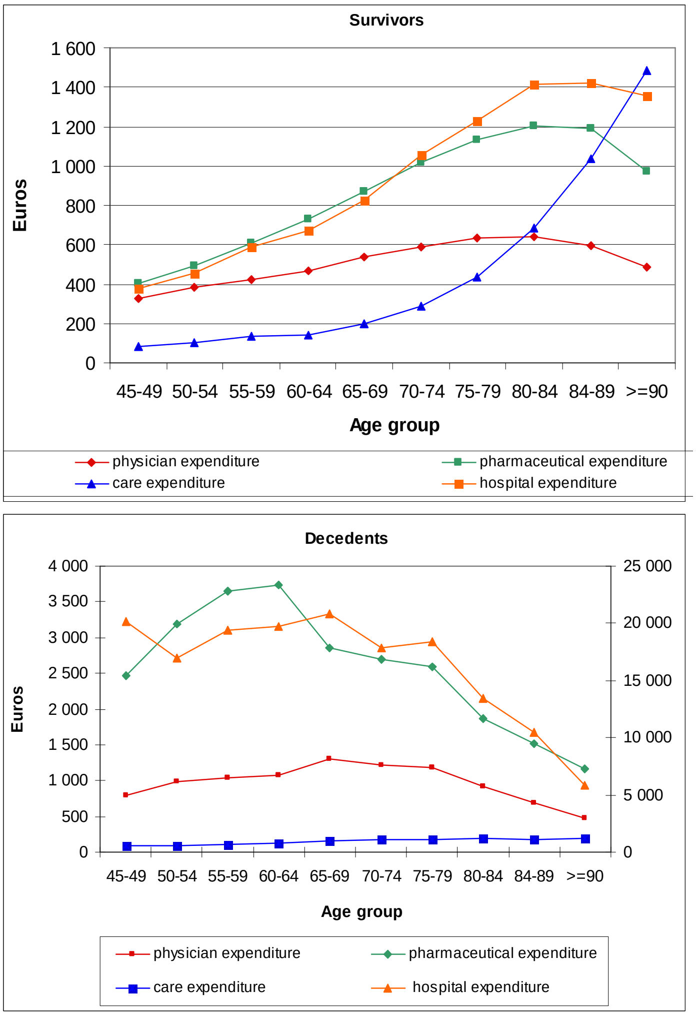

Figure 9. Component of Health care expenditure, survivors and decedents, 2009

Health care expenditures decrease among survivors over 95 years and among decedents over 65. Will this decrease persists when we control for disease? Such a result would suggest that old people might face a care rationing. According to some approach, the statistical value of saving one year of life would decrease at older ages. As concerns decedents, medical care at the end of life often encounters skepticism from people who question its high cost and often minimal health benefits. Some people suggest that medical resources are being wasted on excessive care for a minimal extension of life. As concerns the oldest, Williams (1997) suggest these arguments are reinforced by the idea that somebody aged 70 or more has received a "fair inning" and that it would not be fair to expect the young to make large sacrifices so that the old can enjoy small benefits. Without speaking out for these conceptions, our purpose is to try to understand why health expenditure for decedents decline when they have reached the age of 70.

4. Econometric analysis

After a descriptive analysis of the impact of age on health expenditures among both decedents and survivors, we estimate the impact of age on the expected expenditure by OLS, controlling for the existence of seven chronic conditions. First we have employed conventional least squares regression method. Total health care expenditure (HCE), the response variable, is recorded in Euros. The covariates, six age groups and seven diseases mentionned above, are binary variables. Results are given in table 1.

Table 1 – OLS: Health care expenditures (HCE) for decedents and survivors, year 2009

	Decedents		Survivors	
	Total HCE	Total HCE	Total HCE	Total HCE
age45_54	22266.8***	15275.4***	1301.9***	766.8***
	(17.34)	(12.49)	(67.97)	(44.72)
age55_64	24384.0***	16855.2***	1870.3***	800.3***
	(25.49)	(17.21)	(90.89)	(40.23)
age65_74	23311.9***	14324.0***	2678.4***	1044.2***
	(26.26)	(14.89)	(102.04)	(39.50)
age75_84	19078.3***	12408.7***	3642.7***	1620.6***
	(30.53)	(15.94)	(119.18)	(51.11)
age85_94	11568.9***	7509.1***	4308.6***	2233.8***
	(18.27)	(9.81)	(78.81)	(43.38)
age95	6430.4***	4047.0***	3742.0***	2099.1***
	(5.38)	(3.43)	(21.18)	(13.63)
Cancer		12860.6***		10256.9***
		(16.96)		(137.47)
Heart disease		4155.9***		1457.9***
		(6.14)		(65.11)
Diabetes		-1052.4		1549.2***
		(-0.98)		(43.93)
Respiratory disease		1538.5		1734.1***
		(1.34)		(41.12)
Parkinson		-2458.7		3193.7***

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                                  (-1.31)                          (24.74)

Alzheimer                        -3505.1**                        2698.9***
                                  (-3.21)                          (28.11)

End-stage renal disease          53670.1***                      40838.8***
                                  (18.84)                         (180.32)
----------------------------------------------------------------------------
N observations      3 410           3 410           196 644       196 644
(Permanent Sample of Beneficiaries (EGB))
----------------------------------------------------------------------------
t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
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Therefore we test the difference in age impact on health care expenditures for survivors and decedents. Our test is performed on the estimates deriving from OLS estimation. Results are given in tables 2 and 3: table 2 shows that among survivors, we do not observe nor an increase in health care expenditure before 65, neither a decrease after 95 when we control for disease. Indeed, differences in age impact are not significance (*p>0.05*) for young survivors and very old survivors. So when we control for chronic conditions, expenditure profile seems to be flat for young survivors and very old survivors.

Table 2 – Test of significance of difference in age impact, for survivors, year 2009

Test difference in age impact	Difference in age impact	Survivors		Difference in age impact	Survivors with illnesses	
test age45_54 - age55_64 = 0	-568,36	F(1,196638) = 408.75	*Prob > F = 0.0000*	-33,45	F(1,196631) = 1.82	***Prob > F = 0.1768***
test age55_64 - age65_74 = 0	-808,09	F(1,196638) = 587.04	*Prob > F = 0.0000*	-243,93	F(1,196631) = 69.48	*Prob > F = 0.0000*
test age65_74 - age75_84 = 0	-964,33	F(1,196638) = 572.91	*Prob > F = 0.0000*	-576,39	F(1,196631) = 267.78	*Prob > F = 0.0000*
test age75_84 - age85_94 = 0	-665,90	F(1,196638) = 113.02	*Prob > F = 0.0000*	-613,21	F(1,196631) = 126.31	*Prob > F = 0.0000*
test age85_94 - age95 = 0	566,61	F(1,196638) = 9.39	*Prob > F = 0.0022*	134,65	F(1,196631) = 0.71	***Prob > F = 0.4006***

Among decedents (see Table 3), health expenditure decreases after 65 years (*p<0.05*) and this decrease is always observed after age 65 once controlling for diseases.

Table 3 – Test of significance of difference in age impact, for decedents, year 2009

Test difference in age impact	Difference in age impact	Decedents		Difference in age impact	Decedents with illnesses	
test age45_54 - age55_64 = 0	-2117,27	F(1, 3404) = 1.75	*Prob > F = 0.1862*	-1579,88	F(1, 3397) = 1.16	*Prob > F = 0.2813*
test age55_64 - age65_74 = 0	1072,12	F(1, 3404) = 0.67	*Prob > F = 0.4114*	2531,27	F(1, 3397) = 4.48	*Prob > F = 0.0344*
test age65_74 - age75_84 = 0	4233,63	F(1, 3404) = 15.21	***Prob > F = 0.0001***	1915,23	F(1, 3397) = 3.64	***Prob > F = 0.0565***
test age75_84 - age85_94 = 0	7509,42	F(1, 3404) = 71.27	***Prob > F = 0.0000***	4899,63	F(1, 3397) = 35.31	***Prob > F = 0.0000***
test age85_94 - age95 = 0	5138,50	F(1, 3404) = 14.45	***Prob > F = 0.0001***	3462,12	F(1, 3397) = 7.81	***Prob > F = 0.0052***

Then, we analyze the impact of age at the level of distributions using quantile regressions, for both survivors and decedents. Thus a more complete picture of covariate effects can be provided by estimating a family of conditional quantile functions. For a random variable, Y, with distribution function F(F(y) = P(Y < y)), the qth quantile is defined as: Qq(y) = inf{ y : F(y) ≥ q }. Total health care expenditure, the response variable, is recorded in Euros. The covariates, six age groups and seven diseases, are binary variables. The omitted category is the age group 45-54 years.

Therefore we test the difference in age impact on health care expenditures for survivors and decedents. Our test is performed on the estimates deriving from quantile estimation. Results are given in tables 4 and 5.
Quantile regressions show that the effect of age is not uniform all along the distribution: for survivors (see table 4): the decrease of health care expenditure for individuals above 95 years is not significant for quantiles q70, q80 and q90 (p>0.05). Thus, expenditures are not decreasing for very old survivors over quantile 70, that is to say for individuals with huge expenses. These individuals are treated as well as those of 85 years. This suggests a selection effect: individuals at 95 who have less needs (who belong to lower quantiles) have health care expenditure lower than individuals at 85, so they are probably not sick.

Table 4 – Results of the quantile estimation: pattern of the impact of age, survivors, 2009

	Survivors		Survivors, control by illnesses	
Test difference in age impact	Difference in age impact	*Test diff=0 p-value*	Difference in age impact	*Test diff=0 p-value*
test [q10]age55_64 - [q10]age65_74 = 0	-87,87	*0.0000*	-6,79	*0.0001*
test [q10]age65_74 - [q10]age75_84 = 0	-183,82	*0.0000*	-33,21	*0.0000*
test [q10]age75_84 - [q10]age85_94 = 0	19,4	*0.3886*	24,29	*0.0256*
test [q10]age85_94 - [q10]age95 = 0	300,42	*0.0000*	15,71	*0.1514*
test [q20]age55_64 - [q20]age65_74 = 0	-235,36	*0.0000*	-42,72	*0.0000*
test [q20]age65_74 - [q20]age75_84 = 0	-274,74	*0.0000*	-85,65	*0.0000*
test [q20]age75_84 - [q20]age85_94 = 0	-109,3	*0.0000*	-10,80	*0.5003*
test [q20]age85_94 - [q20]age95 = 0	754,01	*0.0000*	187,92	*0.0000*
test [q30]age55_64 - [q30]age65_74 = 0	-317,56	*0.0000*	-80,57	*0.0000*
test [q30]age65_74 - [q30]age75_84 = 0	-347,93	*0.0000*	-135,23	*0.0000*
test [q30]age75_84 - [q30]age85_94 = 0	-167,3	*0.0000*	-45,60	*0.0258*
test [q30]age85_94 - [q30]age95 = 0	663,53	*0.0000*	384,16	*0.0000*
test [q40]age55_64 - [q40]age65_74 = 0	-393,39	*0.0000*	-125,61	*0.0000*
test [q40]age65_74 - [q40]age75_84 = 0	-432,24	*0.0000*	-187,85	*0.0000*
test [q40]age75_84 - [q40]age85_94 = 0	-229,53	*0.0000*	-98,94	*0.0000*
test [q40]age85_94 - [q40]age95 = 0	629,44	*0.0000*	519,51	*0.0000*
test [q50]age55_64 - [q50]age65_74 = 0	-480,8	*0.0000*	-151,11	*0.0000*
test [q50]age65_74 - [q50]age75_84 = 0	-528,43	*0.0000*	-249,95	*0.0000*
test [q50]age75_84 - [q50]age85_94 = 0	-349,14	*0.0000*	-206,06	*0.0000*
test [q50]age85_94 - [q50]age95 = 0	582,47	*0.0000*	531,99	*0.0000*
test [q60]age55_64 - [q60]age65_74 = 0	-577,0301	*0.0000*	-197,31	*0.0000*
test [q60]age65_74 - [q60]age75_84 = 0	-695,92	*0.0000*	-314,49	*0.0000*
test [q60]age75_84 - [q60]age85_94 = 0	-580,06	*0.0000*	-443,47	*0.0000*
test [q60]age85_94 - [q60]age95 = 0	563,13	*0.0019*	553,77	*0.0003*
test [q70]age55_64 - [q70]age65_74 = 0	-728,79	*0.0000*	-231,35	*0.0000*
test [q70]age65_74 - [q70]age75_84 = 0	-982,03	*0.0000*	-486,73	*0.0000*
test [q70]age75_84 - [q70]age85_94 = 0	-1017,4	*0.0000*	-803,86	*0.0000*
test [q70]age85_94 - [q70]age95 = 0	678,32	*0.0169*	456,31	***0.1172***
test [q80]age55_64 - [q80]age65_74 = 0	-996,05	*0.0000*	-315,16	*0.0000*
test [q80]age65_74 - [q80]age75_84 = 0	-1580,87	*0.0000*	-843,56	*0.0000*

test [q80]age75_84 - [q80]age85_94 = 0	-1904,07	*0.0000*	-1540,10	*0.0000*
test [q80]age85_94 - [q80]age95 = 0	463,46	***0.3607***	136,41	***0.7210***
test [q90]age55_64 - [q90]age65_74 = 0	-1909,06	*0.0000*	-493,37	*0.0000*
test [q90]age65_74 - [q90]age75_84 = 0	-2838,47	*0.0000*	-1698,01	*0.0000*
test [q90]age75_84 - [q90]age85_94 = 0	-2244,86	*0.0000*	-2067,25	*0.0000*
test [q90]age85_94 - [q90]age95 = 0	115,19	***0.8896***	-694,94	***0.4136***

For decedents (see table 5), quantile regressions show that the negative effect of age is not uniform all along the distribution: health care expenditure is decreasing for individuals over 74 years and for quantile above the median. Indeed, it is significant for very high quantiles of expenditures (above the median) and for decedents over 74 years. For individuals over 85 years, the decrease is significant after q40. We show that conclusions based on averages are not good: the negative effect of age is obtained only with high quantiles (>q50); it occurs for specific areas of the expenditure distribution. It indicates that, if expenditures are limited, this is observed for very high costs for old people (above 85 years). Only huge expenses seems to be limited for old decedents. Are these old decedents rationed?

Table 5 - Results of the quantile estimation: pattern of the impact of age, decedents, 2009

	Decedents		Decedents, control by illnesses	
Test difference in age impact	Difference in age impact	*Test diff=0 p-value*	Difference in age impact	*Test diff=0 p-value*
test [q10]age55_64 - [q10]age65_74 = 0	-977,91	*0.0258*	28,15	*0.8401*
test [q10]age65_74 - [q10]age75_84 = 0	-210,85	*0.6317*	-2,69	*0.9826*
test [q10]age75_84 - [q10]age85_94 = 0	588,01	*0.0271*	6,25	*0.8898*
test [q10]age85_94 - [q10]age95 = 0	929,72	*0.0000*	0,00	*1.0000*
test [q20]age55_64 - [q20]age65_74 = 0	-2250,77	*0.0376*	-616,64	*0.2589*
test [q20]age65_74 - [q20]age75_84 = 0	1525,13	*0.0700*	641,64	*0.2341*
test [q20]age75_84 - [q20]age85_94 = 0	982,60	*0.0253*	16,25	*0.9465*
test [q20]age85_94 - [q20]age95 = 0	1586,68	*0.0000*	231,30	*0.2434*
test [q30]age55_64 - [q30]age65_74 = 0	-1735,24	*0.2238*	1425,0302	*0.1502*
test [q30]age65_74 - [q30]age75_84 = 0	1972,42	*0.0263*	863,603	*0.2438*
test [q30]age75_84 - [q30]age85_94 = 0	2051,52	*0.0004*	538,9201	*0.2409*
test [q30]age85_94 - [q30]age95 = 0	2704,90	*0.0000*	1106,26	*0.0068*
test [q40]age55_64 - [q40]age65_74 = 0	-1158,92	*0.5186*	-83,724	*0.9509*
test [q40]age65_74 - [q40]age75_84 = 0	3436,70	*0.0074*	739,081	*0.4936*
test [q40]age75_84 - [q40]age85_94 = 0	3484,51	*0.0000*	1463,358	*0.0133*
test [q40]age85_94 - [q40]age95 = 0	2897,26	*0.0000*	1533,9645	*0.0003*
test [q50]age55_64 - [q50]age65_74 = 0	-113,09	*0.9571*	610,03	*0.6918*
test [q50]age65_74 - [q50]age75_84 = 0	4885,59	*0.0000*	2494,44	*0.0064*
test [q50]age75_84 - [q50]age85_94 = 0	5095,88	*0.0000*	2284,7194	*0.0003*
test [q50]age85_94 - [q50]age95 = 0	2902,71	*0.0000*	2130,0866	*0.0000*
test [q60]age55_64 - [q60]age65_74 = 0	2330,12	*0.2482*	1639,1974	*0.3058*
test [q60]age65_74 - [q60]age75_84 = 0	4727,00	*0.0018*	1974,8066	*0.1444*
test [q60]age75_84 - [q60]age85_94 = 0	7437,89	*0.0000*	3802,786	*0.0000*
test [q60]age85_94 - [q60]age95 = 0	4402,22	*0.0000*	3073,558	*0.0000*
test [q70]age55_64 - [q70]age65_74 = 0	976,52	*0.5627*	3163,0666	*0.1691*
test [q70]age65_74 - [q70]age75_84 = 0	6397,88	*0.0000*	3285,9994	*0.0184*
test [q70]age75_84 - [q70]age85_94 = 0	9406,10	*0.0000*	5246,575	*0.0000*
test [q70]age85_94 - [q70]age95 = 0	5443,15	*0.0000*	3660,556	*0.0000*

test [q80]age55_64 - [q80]age65_74 = 0	1223,70	*0.7144*	4137,0606	*0.0525*
test [q80]age65_74 - [q80]age75_84 = 0	8743,33	*0.0002*	4478,897	*0.0085*
test [q80]age75_84 - [q80]age85_94 = 0	11270,95	*0.0000*	6653,128	*0.0000*
test [q80]age85_94 - [q80]age95 = 0	7284,59	*0.0000*	5010,26	*0.0000*
test [q90]age55_64 - [q90]age65_74 = 0	4274,55	*0.3545*	-83,724	*0.2527*
test [q90]age65_74 - [q90]age75_84 = 0	9396,64	*0.0101*	739,081	*0.0157*
test [q90]age75_84 - [q90]age85_94 = 0	15357,94	*0.0000*	1463,358	*0.0000*
test [q90]age85_94 - [q90]age95 = 0	9482,46	*0.0000*	1533,9645	*0.0001*

In order to study the issue of rationing of care for very old people, we carry out a difference in difference method. The general idea is that for given illnesses and age, the difference in expenditure between decedent and survivors measure the efforts provided to save a life. When a person gets older, however, her frailty prevents the use of too intensive – and generally costly - procedures. To adjust for this frailty possibility, we compute the difference between young and old of the difference of expenditures between survivors and decedents. Finally, expenditures of survivors correspond to a mix of low expenditures for people not very seriously ill and of very high expenditures of people in danger of death, who have been finally saved and hence belong to the survivor category. We have no information about which individual of our sample was in this case. Our assumption is that their expenditures belong to the highest quantiles of the distribution. Therefore our test is performed on the estimates deriving from a quantile estimation.

We estimate the impact of age, for both decedents and survivors, on the expected expenditure, by a quantile regresion, controlling for the existence of four chronic conditions (cancer, heart disease, diabetes and respiratory disease).

Results are given in tables 6 and 7. Difference in difference are computed for different old age groups, with respect to the “young” 55-64 age group. We find that they are not significant for the age group 75-84 until the fortieth quantile, and then significant. For the age group 85-94, they are not significant until the twentieth quantile. As for the oldest, it is not significant for the first decile only. These results suggest that after the age of 75, there is effectively a limitation in care that has been provided to people that finally deceased.

Table 6 - Health care expenditure and difference tests, year 2009

Test difference in age impact	Difference in age impact	*Test diff=0 p-value*
test [q10]die55_64 - [q10]age55_64 = 0	274,9	*0.2058*
test [q10]die65_74 - [q10]age65_74 = 0	895,7	*0.0546*
test [q10]die75_84 - [q10]age75_84 = 0	813,2	*0.0000*
test [q10]die85_94 - [q10]age85_94 = 0	335,5	*0.0370*
test [q10]die95 - [q10]age95 = 0	28,0	*0.6648*
test [q20]die55_64 - [q20]age55_64 = 0	2 127,8	*0.0006*
test [q20]die65_74 - [q20]age65_74 = 0	3 726,8	*0.0001*
test [q20]die75_84 - [q20]age75_84 = 0	2 253,6	*0.0000*
test [q20]die85_94 - [q20]age85_94 = 0	1 326,9	*0.0000*
test [q20]die95 - [q20]age95 = 0	657,1	*0.0005*
test [q30]die55_64 - [q30]age55_64 = 0	5 282,4	*0.0000*
test [q30]die65_74 - [q30]age65_74 = 0	6 463,3	*0.0000*
test [q30]die75_84 - [q30]age75_84 = 0	4 599,0	*0.0000*
test [q30]die85_94 - [q30]age85_94 = 0	2 686,7	*0.0000*
test [q30]die95 - [q30]age95 = 0	1 578,5	*0.0000*
test [q40]die55_64 - [q40]age55_64 = 0	9 071,1	*0.0000*
test [q40]die65_74 - [q40]age65_74 = 0	9 532,2	*0.0000*
test [q40]die75_84 - [q40]age75_84 = 0	6 731,1	*0.0000*
test [q40]die85_94 - [q40]age85_94 = 0	4 055,1	*0.0000*
test [q40]die95 - [q40]age95 = 0	2 352,1	*0.0003*
test [q50]die55_64 - [q50]age55_64 = 0	13 833,4	*0.0000*
test [q50]die65_74 - [q50]age65_74 = 0	12 875,7	*0.0000*
test [q50]die75_84 - [q50]age75_84 = 0	9 145,5	*0.0000*
test [q50]die85_94 - [q50]age85_94 = 0	4 911,5	*0.0000*
test [q50]die95 - [q50]age95 = 0	3 619,4	*0.0000*
test [q60]die55_64 - [q60]age55_64 = 0	17 405,6	*0.0000*
test [q60]die65_74 - [q60]age65_74 = 0	15 816,1	*0.0000*
test [q60]die75_84 - [q60]age75_84 = 0	10 889,4	*0.0000*
test [q60]die85_94 - [q60]age85_94 = 0	5 483,5	*0.0000*
test [q60]die95 - [q60]age95 = 0	3 672,8	*0.0000*
test [q70]die55_64 - [q70]age55_64 = 0	22 260,1	*0.0000*
test [q70]die65_74 - [q70]age65_74 = 0	18 000,3	*0.0000*
test [q70]die75_84 - [q70]age75_84 = 0	13 840,0	*0.0000*
test [q70]die85_94 - [q70]age85_94 = 0	6 166,8	*0.0000*
test [q70]die95 - [q70]age95 = 0	2 905,6	*0.0007*
test [q80]die55_64 - [q80]age55_64 = 0	26 941,2	*0.0000*
test [q80]die65_74 - [q80]age65_74 = 0	22 466,0	*0.0000*
test [q80]die75_84 - [q80]age75_84 = 0	16 453,5	*0.0000*
test [q80]die85_94 - [q80]age85_94 = 0	6 262,3	*0.0000*
test [q80]die95 - [q80]age95 = 0	936,5	*0.3338*
test [q90]die55_64 - [q90]age55_64 = 0	34 789,6	*0.0000*
test [q90]die65_74 - [q90]age65_74 = 0	30 015,6	*0.0000*
test [q90]die75_84 - [q90]age75_84 = 0	22 405,9	*0.0000*
test [q90]die85_94 - [q90]age85_94 = 0	6 916,1	*0.0000*
test [q90]die95 - [q90]age95 = 0	-634,6	*0.4290*

Table 7 - Difference in difference tests, quantile regressions, year 2009

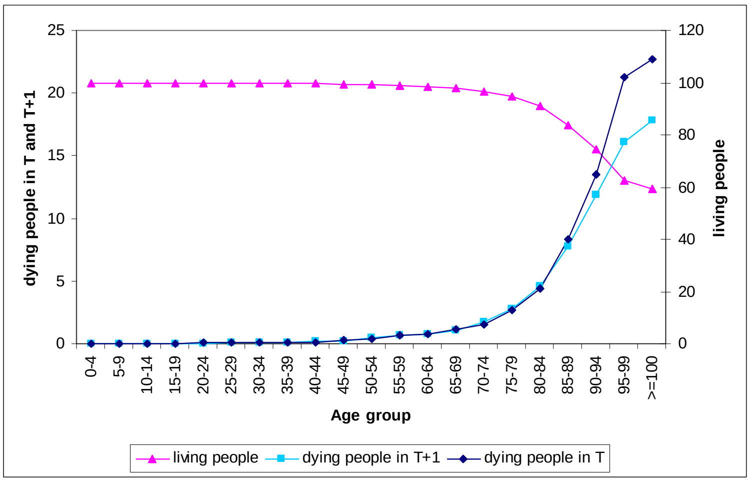
		55-64 years
Q10	55-64 years	
	65-74 years	
	75-84 years	*0.0543*

	85-94 years	*0.8312*
	>= 95 years	*0.2334*
Q20	55-64 years	
	65-74 years	
	75-84 years	*0.8708*
	85-94 years	*0.1948*
	>= 95 years	*0.0072*
Q30	55-64 years	
	65-74 years	
	75-84 years	*0.4275*
	85-94 years	*0.0091*
	>= 95 years	*0.0000*
Q40	55-64 years	
	65-74 years	
	75-84 years	*0.1440*
	85-94 years	*0.0026*
	>= 95 years	*0.0000*
Q50	55-64 years	
	65-74 years	
	75-84 years	*0.0003*
	85-94 years	*0.0000*
	>= 95 years	*0.0000*
Q60	55-64 years	
	65-74 years	
	75-84 years	*0.0000*
	85-94 years	*0.0000*
	>= 95 years	*0.0000*
Q70	55-64 years	
	65-74 years	
	75-84 years	*0.0000*
	85-94 years	*0.0000*
	>= 95 years	*0.0000*
Q80	55-64 years	
	65-74 years	
	75-84 years	*0.0000*
	85-94 years	*0.0000*
	>= 95 years	*0.0000*
Q90	55-64 years	
	65-74 years	
	75-84 years	*0.0014*
	85-94 years	*0.0000*
	>= 95 years	*0.0000*

5. Conclusion

There is a presumption of limitation of care for very old decedents. Of course, more effort has to be provided for a better understanding on the test we perform on quantile regressions. More investigations have to be done to obtain other results on components of health expenditures such as care and hospital. Combined with a selection effect which leads to less expense for survivors, our results explain why health expenditure decreases for very old people.

6. Appendix



Appendix A. Decedents and survivors by age group, year 2009

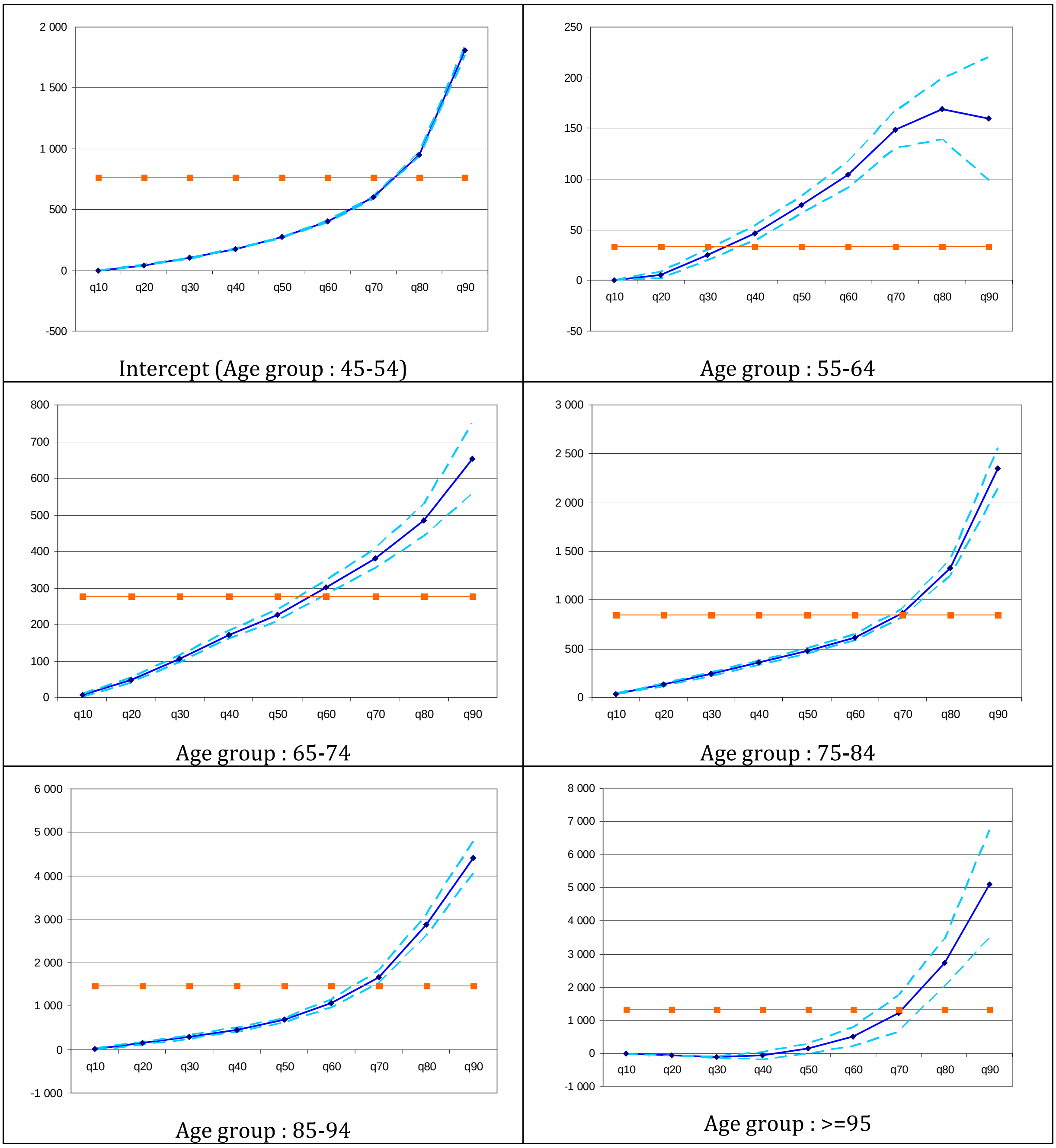
Age group	N Survivors	N decedents
0-4	34 598	15
5-9	35 191	4
10-14	32 839	4
15-19	31 716	6
20-24	27 810	14
25-29	35 185	24
30-34	35 304	31
35-39	38 629	35
40-44	36 957	51
45-49	35 152	110
50-54	32 054	127
55-59	30 610	202
60-64	27 614	225
65-69	18 674	214
70-74	17 112	282
75-79	15 325	450
80-84	11 065	551
85-89	6 612	673
90-94	1 636	302
95-99	692	237
>=100	98	37

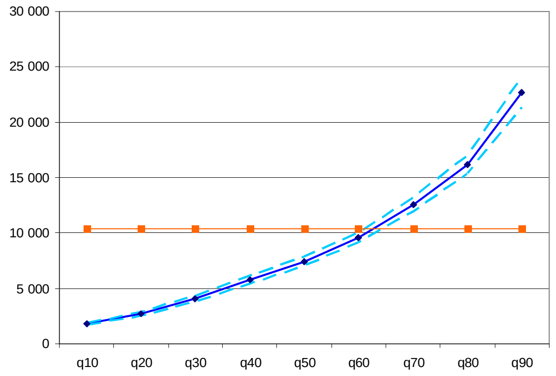
Appendix B. Nudber of observations by age group, year 2009

Appendix C presents a summary of quantile regression results for survivors, and appendix D, for decedents. For each of the 12 coefficients (11 covariates plus an intercept), we plot the 9 distinct quantile regression estimates for q ranging from 0.10 to 0.90 as the solid blue curve with filled dots. The solid orange curve with filled dots in each figure shows the ordinary least square estimate of the conditionnal mean effect. The two dashed lines represent 95 percent confidence intervals for the quantile regression estimates.

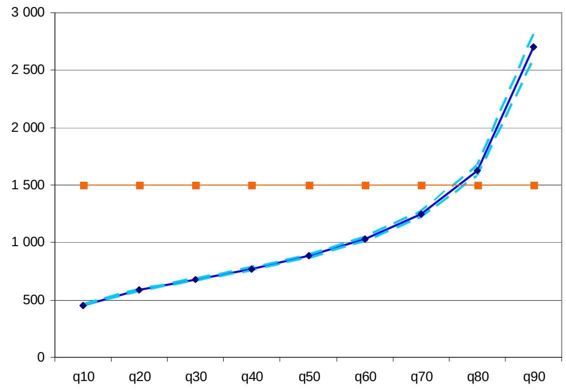
The intercept of the model for decedents may be interpreted as the estimate conditional quantile function of the health care expenditure for a person died in 2009 (12 last months of life) who was between 45 and 54 years old, without diseases. Older people, for example between 85 and 94 years old, had smaller health care expenditure, by about

€7,700 per annum according to the ordinary least squares estimate of the mean effect, but as is clear from the quantile regression results, the disparity is much smaller in the lower quantile of the distribution and considerably larger than €7,700 in the upper tail of the distribution. For example, health care expenditure of people between 85 and 94 years old and people between 45 and 54 years old are the same until the 0.50 quantile (the median) but health care expenditure of people between 85 and 94 years old are smaller of about €15,000 at the 0.80 quantile. The conventional least squares does a poor job of representing this range of disparities.
The disparity between people suffering from cancer and without disease is important : at the 0.10 percentile of the conditional distribution, the difference is roughly €7,600, at the median, it is about €14,900 and at q = 0.90, it is €13,800.



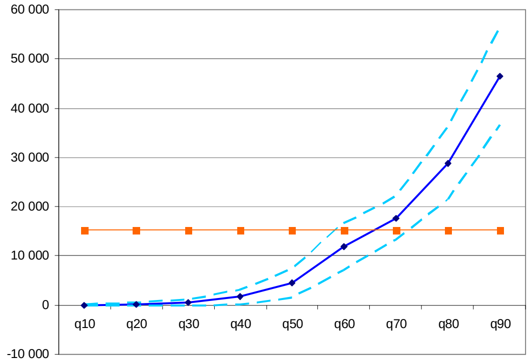


Cancer

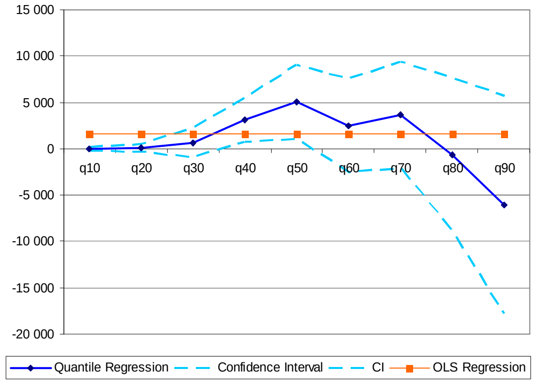


Heart disease

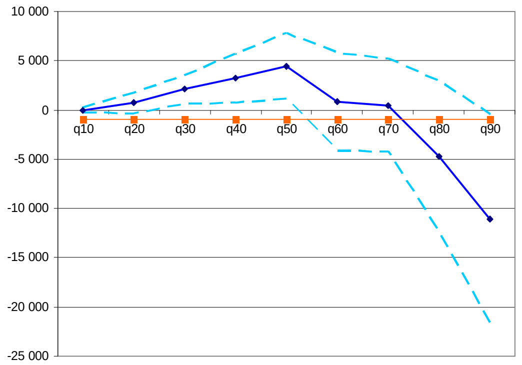
Appendix C. Pattern of the idpact of age, survivors, 2009



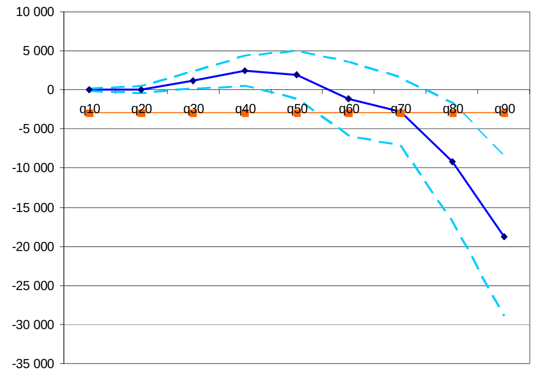
Intercept (Age group : 45-54)



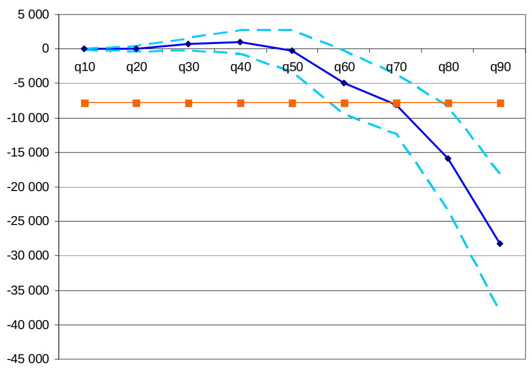
Age group : 55-64



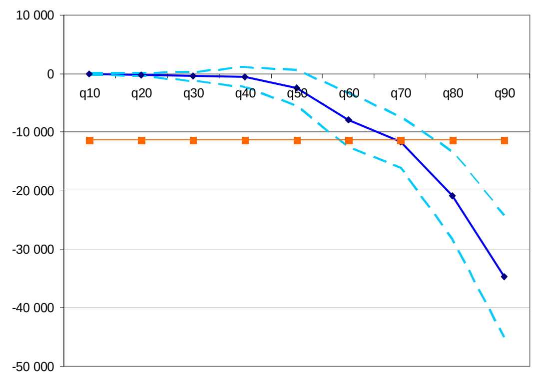
Age group : 65-74



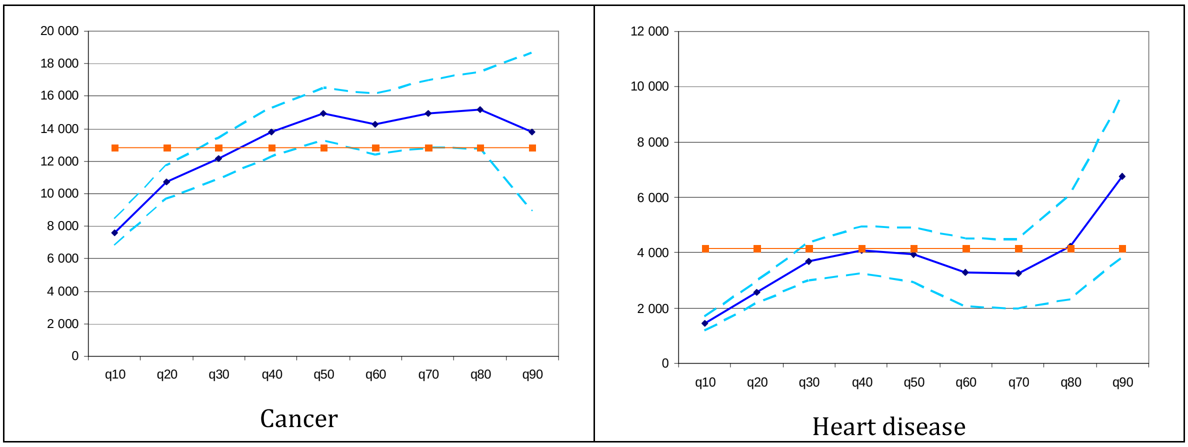
Age group : 75-84



Age group : 85-94



Age group : >-95



Appendix D. Pattern of the impact of age, decedents, 2009

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