Measuring Changes in Health Capital

Juan Oliva[1], Rubén Osuna[2], Néboa Zozaya[1]

1. SESAM (Seminario de Estudios Sociales de la Salud y los Medicamentos), Universidad Carlos III, Madrid

2. UNED (Universidad Nacional de Educación a Distancia), Madrid

Contact: Juan Oliva Moreno
Universidad Carlos III, Madrid
Seminario de Estudios Sociales de la Salud y los Medicamentos
Departamento de Economía
Room: 11.2.5
E-mail: juan.oliva@uc3m.es
Phone number: 34 91 624 95 55
Fax: 34 91 624 92 94

Abstract:

This study is aimed to estimate the value of the change in health observed in Catalonia, from 1994 to 2002. Quality-adjusted years of life (QALYs) and years of life (YOL) for genders and different ages were calculated and then transformed in monetary values. Our results shown that the health capital stock has diminished from 1994 to 2002 due to a worsening in the quality of life of the population. Different estimation procedures have been applied for revealing relevant variables that help to explain this negative result.

Key words*: health economics; health capital; quality of life; value of health*

JEL codes*: I00; I10; I12; O10; O20*

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1 Introduction

Developed countries allocate a great amount of monetary and no-monetary resources to the care of their population health. Therefore, the measurement and the analysis of the evolution of the stock of health of a population are relevant elements for health decision makers and for the society at a large.

The main goal of this work is to estimate the value of the changes in the health capital in Catalonia, Spain, between the years 1994 and 2002. Following Grossman's seminal work [Grossman (1972)], we define health capital as the present value of a person's lifetime health. Obviously, the value of health capital is not only expected years of life, taking account of life expectancy and infant mortality, and then assigning a *shadow price* for each year of life. The *quality* of life is not homogeneous through our lives, and this fact also must be considered in the calculations. Fortunately, some surveys ask the people how good they feel, whether their health has improved or worsened and for a self-valuation of some key aspects of their health status. From this information, following different methods, we can estimate an implicit rate of exchange for a year of life with perfect health. This procedure allows the calculation of the 'total years of life of homogeneous quality' for a particular person or collective. Then, assigning a monetary value to these 'homogeneous' years of life we obtain a monetary estimation of the health capital. This calculation is a requisite for a generalized cost-benefit analysis of the public medical spending or for a rational allocation of a pre-determined amount of resources for medical care. The cost per gained quality-adjusted life year (QALY) is the key variable in measuring the 'efficiency' of a particular intervention or policy. Besides, the concept of 'quality of life'–what we can *do* and *be*–is crucial for a correct understanding of poverty and welfare ([Sen (1998)]).

[Cutler and Richardson (1997)], [Cutler and Richardson (1998)], [Cutler and Richardson (1999)], [Burström, Johannesson and Diderichsen (2001)] and [Burström, Johannesson and Diderichsen (2003)] have applied the above methodology to the problem of the valuation of the health stock of a population–the United States and Sweden respectively–from the concept of 'health capital' first introduced by [Grossman (1972)]. In this paper, we apply the same methodology to a concrete region of Spain which authorities elaborate a very complete survey on health status–the Catalonia Health Survey (CHS)[i]. This survey has a very interesting strong point: there exist three sets of specific questions asking for a personal valuation of the health status directly based on the EuroQol-5D questionnaire (see [Brooks and EuroQol Group (1996)] and [Badia et al. (1999)]). The EuroQol questionnaire provides a well-tested methodology for gathering information on health status of the population[ii].

2 Data and methods

Our primary source of data is the Catalonia Health Survey (CHS) for the years 1994 and 2002. The data for the first survey was collected throughout the year 1994, asking 15,000 inhabitants of Catalonia, a Mediterranean region of the northeast of Spain with 6,106,401 inhabitants in that year (for instance, 2.6 millions more than Ireland, 1.5 millions more than Norway and 2.8 millions less than Sweden; and a 15.5 per cent of the Spanish population). The second survey was carried out from October of 2001 to April of 2002, with a sample of 8,400 people residing in Catalonia (6,343,818 habitants in 2001). The surveys included questions on the state of health, the habits of life–including feeding, physical exercise and tobacco and alcohol consumption–and the utilization of the health services-managed by the regional government. The surveys are similarly designed and their results are comparable, the only differences being that the survey of 1994 does not include a representative sample of people below 16 years old and, besides, registers a smaller number of illnesses. Several measures of the health state are provided by the CHS: first, a numeric selfevaluation of the health state; second, a detailed valuation of five dimensions determining the health state; and third, a visual score of the health state by means of a graphical 'thermometer'.

We will focus on the 30th question of the survey (40th in 2002). This question provides information on the five dimensions of the EuroQol-5D (EQ-5D), asking for a valuation (from 1 to 3) of five different functional states related to mobility, personal care, daily activities, pain or discomfort and anxiety or depression. The value 1 means absence of problems in a particular dimension, 2 means moderate problems and 3 means incapacity to perform the activity or strong pain or depression. Combining the 5 dimensions we get a five digits number known as 'EuroQol'. There exist 243 possibilities, plus death and unconsciousness.

In order to translate this number to a particular score of health status, a 'preferences tariff' (or 'tariff', for short) is needed. There are several theoretical possibilities for building one such tariff, all of them by means of surveys (see [Cutler and Richardson (1997)], p. 250-251; see also [Torrance (1986)]). The first one would be based on *standard gamble questions*, asking if a person with a particular health state would participate in a game where a possibility is immediate death and other possibility is a year of perfect health and measuring what probability of death is needed in order to accept the game. The second possibility is based on a *time trade-off method*, asking for how much years in a hypothetical state of health would be exchanged for a year in perfect health[iii]. The third possibility is based on 'rating scales and *visual analogue* methods'. A survey based on any of these methods provides 'social weightings' or 'average scores'. Actually, there are two tariffs for these 'scores' for Spain, the first based on a visual analogue scale (the VAS tariff, see [Badia, Fernández y Segura (1995)]) and the other on the temporal equivalence method (TTO tariff, see [Badia, Roset, Herdman and Kind (2001)]). The two possibilities were applied in our estimations, but the results derived from both tariffs are not directly comparable in spite of some attempts to connect them (see, for instance, [Dolan and Sutton (1997)], based on EuroQol). None of both is, in principle, preferable to the other [Arnesen and Norheim (2003)][iv]. These tariffs are valid for a particular population and a particular moment in time. However, the self-valuation of a particular health state for each person can be different to that of the ‘social average’ tariff, even if we ask to the person in the same moment in which the survey for obtaining the average is carried out–and usually this is not the case. Besides, the ‘social weight’ could be different for population sub-groups defined from age, gender and other variables[v].

EQ-5D also includes a personal subjective numerical valuation of the health status and for an additional measure of it based on a visual ‘health thermometer’–questions 28 and 31 in the 1994 survey and 39 and 41 in the 2002 survey. The 28th (39th) question of the survey offers five possibilities: excellent, very good, good, fair and bad. The 31th (41th) question of the SCH presents a visual ‘thermometer’ with values from 0 to 100 in a continuous scale in which the chosen health status can be marked.

We used the questions 28th (39th) and 31th (41th) for checking the consistence of our primary data, which are the EQ-5D based questions on five ‘dimensions’ of the health status[vi]. Besides, these variables will be used as indexes of happiness or optimism–a bad valuation of a good health state could be interpreted as the result of a pessimist aptitude, thus considering a variable that takes care of the ‘positional objectivity’ problem (for the concept, see [Sen (1993)])[vii].

EuroQol allows for negative values, this is, health states worse than the death[viii], a possibility that is not allowed in the ‘thermometer’ or in the health state self-valuation response. [Burström, Johannesson and Diderichsen (2003)] point to some controversies on these negative values, which they changed to zero. [Bagust and Beale (2005)] found that negative values ‘renders direct comparisons with other scale measures difficult, and precludes analysis involving some transformations (e.g. logarithms)’, so they re-scaled the TTO scores to a closed interval similar to that of the ‘thermometer’ (from 0 to 100)[ix]. We adopted the same criterion than [Burström, Johannesson and Diderichsen (2003)], p. 641, for our negative data, assigning them a value equal to zero (death), just for the sake of comparability. We also carry out a sensitivity analysis where we relax this censure by allowing negative values.

To sum-up, the CHS allows to obtain health state scores in different ways: by using the subjective visual scale of the thermometer, by means of the subjective response to the question with 5 possibilities, and translating the responses to the health dimensions with the aid of one of the two ‘social’ tariffs (VAS or TTO). The health state scores obtained from one of the four sources can be adopted as the weights for the calculation of the ‘Quality Adjusted Years of Life’ (QALYs). The calculation of the health wealth or health capital of a population requires the discounted sum of those scores corrected by the probability of survival. Therefore, we need life tables, for which we have another two possibilities ([Cutler and Richardson (1997)], p. 231), the ‘period’ approach and the ‘cohort’ approach. The ‘period’ approach calculates the life expectancy from cross-section survival probabilities (derived from mortality rates). Then, these cross-sectional probabilities are assumed to hold in time, so the imputed survival probability for a person 20 years old within 30 years will be that of a 50 years old person today. This procedure does not take account of the differences in habits of life between both persons, or of the technological improvements in medical care during those 30 years. The ‘cohort’ approach estimates a survival probability for each cohort. The main problem of this approach is the need of *ex-post* data in long series, which regrettably we do not have. Besides, in predicting the survival probability of a live person this method does not avoid the problems just discussed in the ‘period’ approach. Therefore, we will use ‘period’ life tables based on the mortality data provided by the *Registre de Mortalitat de Catalunya, Servei d'Informació i estudis, Direcció General de Recursos Sanitaris, Departament de Salut* (see [Selvin (2004)], for a technical explanation on how these tables are built).

A discount rate must be applied in order to obtain the actualized expected QALYs of a person (or a collective). There exist arguments that support different discount rates, from 0 to much higher numbers (see [Cutler and Richardson (1997)], p. 233-234 for a brief discussion and some references). For preserving comparability with other studies, we will use a 3 per cent as our referential assumption, and we will repeat the calculations for 0 and 5 per cent discount rates in the sensitivity analysis.

The last step is to assign a monetary value to these discounted QALYs. Again, we have methodological alternatives. The first one consists in a measure of the 'value' of a QALY based on the *revealed preference for risk*, this is, how much we are willing to pay for reducing to zero the probability of a risk. These preferences, or implicit valuations, are "revealed" when an insurance contract is signed, or when a dangerous job is accepted in exchange of an extra wage, etc. (a classic reference is [Jones-Lee (1969)]; also see [Viscusi (1993)] and an extensive survey in [Viscusi and Aldy (2003)]). The second method, *contingent valuation*, consists in a simple hypothetical question posed to a person: how much are you willing to pay for an intervention that improves the health state? ([Cutler and Richardson (1997)], p. 232, provides a brief discussion and references). We will adopt a value of $100.000 for the sake of comparability–it is the value assumed in [Cutler and Richardson (1997)] and [Burström, Johannesson and Diderichsen (2003)]. In many references of the literature, $100.000 is the upper limit for the acceptance of an intervention that allows to gain an additional QALY, being $50.000 the median value below which the intervention is considered acceptable (see [Chapman, Stone, Sandberg, Bell and Newmann (2000)])[x].

Besides, we are interested in an explanation of the health wealth of the population and of the observed changes, for which we will estimate a regression model. The CHS offers many additional variables for one such estimation. These variables can be grouped as follows. We have socio-demographical variables, included gender, age, studies and others; risk indexes variables, as habits of life (including tobacco and alcohol consumption as well as feeding and physical exercise) and private medical insurance; and health state characterization variables, as several illnesses (respiratory problems, ulcer, vascular problems and so on) and handicaps (sight, hearing, speech, dependence) variables. The list of illness variables in the CHS of 2002 is lengthier than the CHS of 1994, including cancer, migraine, anaemia, cervical problems, lumbar problems, circulation problems, myocardial infarction and thyroid problems. The ordinary least-squares (OLS) and Tobit models are usually used in the literature for the estimations. However, our dependent variable is the health score of each person, which is a continuous variable bounded between 0 and 1 values with a strong concentration of values about one. No statistical distribution fits the shape of one such variable[xi]. Fortunately, there exist specially suited estimation methods adapted to the nature of our data, particularly the *symmetrically censored least squares* (SCLS) estimator, proposed by [Powell (1986)]. The implicit assumptions of each method are different. OLS and Tobit ask for homoskedasticity and normality, whereas SCLS only needs symmetry about zero (median and mean equal to zero) (see [Chesher and Irish (1987)]). In fact, an interesting way of testing what assumptions are violated and realizing the consequences of such violations, as suggested by [Chay and Powell (2001)], is to employ and compare all these estimation procedures[xii].

3 Results

3.1 Life expectancy

The life expectancy for the same ages reported by ([Burström, Johannesson and Diderichsen (2003)], Table 1, p. 642) are shown in our *Table 1*. We have included life expectancy and life expectancy discounted at 3% rate, and the change in life expectancy (with and without discount) between 1994 and 2000 (detailed data for 2001 was not disposable, but in any case the population of reference was that of Catalonia at January 1th of 2001).

TABLE 1

The mean age was 39.61 in the sample of 1994 and 39.80 in the sample for 2002. The proportion of women was around 51% in both samples. The mean age differs between men and women, being 38.05 and 41.03 respectively in 1994, and 38.85 and 40.71 in 2002. The life expectancy shows that women live more time, although men are converging to women. We can apply a monetary value to the 'years-of-life' (YOL) presented in the *Table 1*, which yields the simplest measure of health capital (see [Cutler and Richardson (1997)], p. 219).

3.2 Distribution of problems by EQ dimensions and health state scores

We have built two tables for the proportions of males and females reporting moderate or severe problems in the five dimensions of the EuroQol descriptive health state scores, by age groups. We have tried to facilitate the comparability with tables 2 and 3 from ([Burström, Johannesson and Diderichsen (2003)], p. 644 and 645). The same 10 years age groups have been adopted, although we have added cohorts for isolating the effect of the change in the structure of ages. The *Pain/Discomfort* dimension is the most reported by a large margin, although at old ages other dimensions become important as well. Several trends can be observed in the data. First, the dimensions at almost all ages show *a worsening between 1994 and 2002*, for males and females[xiii]. The second general trend is *a worsening at old ages* in every dimension. Nevertheless, we can observe some exceptions, again more frequent in males, at medium ages and in *Mobility*, *Self-Care* and *Anxiety/Depression* dimensions. Thirdly, *women report more problems than men*, especially at older ages. But even at younger ages women report more moderate or serious problems than men, especially in the *Pain/Discomfort* and *Anxiety/Depression* dimensions, where the differences are very notorious.

The average health state scores are reported at the bottom of the tables 2 and 3. These scores are provided by the tariffs that reduce the descriptive dimensions to a simple number. As we have explained, we have two alternatives, the VAS tariff and the TTO tariff. Both show the same declining trend, for men and women. Men have higher scores than women for all age groups. The declining trend is continuous for women, but men have a period of relatively stable health between 25 and 54 ages. The key result is that *the health scores are in general higher for men and women in 1994*–except in the youngest group of men. We observe a general worsening in the reported health state, as described by the EuroQol dimensions and by the scores, no matter how they have been calculated (VAS or TTO).

TABLE 2

TABLE 3

Our results points to a deterioration of the health state of men and women across all ages in Catalonia, between 1994 and 2002. However, it must be emphasized that these results, both for 1994 and 2002, are overall better than those obtained by [Burström et al. (2003)] for Sweden in 1996/97.

The results for the dimensions 1 and 2 of the EQ-5D (*Mobility* and *Self-care*) are slightly worse in Catalonia than in Sweden. Nevertheless, the results of the dimension 3 (*Usual activities*) are clearly better in Catalonia for any year and age considered. The results of the dimension 4 (*Pain/Discomfort*) are better in Catalonia for men and ambiguous for women (better results to early ages, worse results to elder ages). This ambiguous result also can be observed for both genders in the answers to the dimension 5 (*Anxiety/Depression*).

In summary, the aggregate results of the EQ-5D are better for the Catalonians that for the Swedish. This result must be considered with caution because the Swedish survey does not include the five dimensions of EQ-5D in a direct way and the tariffs used are the British ones. On the contrary, the CHS includes explicitly the EQ-5D and the tariffs were calculated specifically for the Spanish population.

3.3 QALYs

The life expectancy and the 'social weights' provided by the VAS and TTO tariffs allow us to calculate the 'expected QALYs' for men and females and the change experienced between 1994 and 2002. The calculation itself is quite simple, requiring the discounting of the tariffs throughout the expected life at a 3% rate. We present average health state scores for *specific ages* of males and females and for both tariffs. Notice that we have adopted the 2002 scores for those men and women of 1994 with ages comprised between 0 and 15 years. This is due to the low representativity of the health dimensions reports for the 0-15 age group in 1994. They are presented in the *Table 4*.

The absolute values obtained are greater than those shown by [Burström, Johannesson and Diderichsen (2003)], p. 647. Swedish men in 1996/97 have 66 expected quality-adjusted years of life (QALYs) when being born and 65 the women. However, men and women in Catalonia in 1994 have 71 and 73 QALYs respectively[xiv].

The changes between 1994 and 2002 can be seen in the fourth and seventh columns, and the main trend shown by both tariffs is consistent. The numbers are predominantly negative. This means a deterioration of the stock of health capital between 1994 and 2002. There are minor exceptions: only one change in discounted QALYs shows a positive value, and it is for males 75 years old (both TTO and VAS measures coincide here), whereas changes in undiscounted QALYs show positive values for men at 0 and 16 ages. Remarkably, all the values for women are negative. For men, the worsening in the health state is more intense at medium ages (35 and 45 years), whereas women show a greater deterioration spread among all the ages. Some of the discounted QALYs reported in [Burström, Johannesson and Diderichsen (2003)] also were negative, but these negative records were concentrated at younger ages–and it is interesting to note that these negative values arose only when the 1996/97 year was used as the year of reference for the calculations of the changes.

The loss of expected QALYs between 1994 and 2002 strongly contrasts with the net gains in life expectancy across all ages, which were reported in *Table 1*. It can be deduced that the life expectancy has increased but in exchange for worse quality of life.

TABLE 4

3.4 The monetary value of the change in health population

The calculation of the monetary value of the change in health from the reported results is straightforward. The monetary value of the changes in life expectancy and QALYs is obtained by multiplying the numbers reported in Tables 1 and 4 for the $100.000 per QALY adopted by us. This doesn't modify the pattern we have discussed. There are positive monetary gains due to the enlargement of the life expectancy (Table 1) and losses when we consider the quality of life according to Tables 2 and 3. The aggregate effect (as shown Table 4) is a worsening in the value of the individual stock of health capital for every age and gender considered (the only exception is the group of males of 75 years). Monetary values allow comparisons with public spending in medical care or pharmacy spending, but we will not do this kind of analysis. Therefore, a table of monetary values of changes in life expectancy and in QALYs–similar to the *Table 5* of [Burström, Johannesson and Diderichsen (2003)], p. 648–will not be presented here. It would be a mere duplication of our *Table 4*. Nevertheless, we have calculated the total health stock of capital for Catalonia in 1994 and 2002. The procedure was very simple. Each observation in the sample was multiplied by a corresponding factor provided by the survey itself. In this way, we obtained the total QALYs represented by each observation in the sample. These 'elevated' QALYs were added-up and then multiplied by $100.000 in order to obtain the total health stock in monetary terms, which was $12,519,095 millions in 1994 and $12,332,551 millions in 2002[xv]. Therefore, the health stock decreased between both years 1.5 per cent points, despite the 3.9 per cent increasing in the population and the improvement in life expectancy.

In the following section, we will test its robustness by means of a sensitivity complementary analysis. Besides, we will try to identify some key variables that explain the observed evolution of the 'quality-adjusted years of life' of the population of Catalonia.

3.5 Sensitivity analysis

The impact of a change in the monetary value of a year of life on the estimated stock is straightforward to see. It only is a change in the number we use for multiplying the results of Tables 1 and 4, so the trends will not be altered at all and no additional conclusions can be extracted from one such exercise.

The sensitivity analysis considers different alternatives to the original criteria adopted in our estimations, which compares the QALYs of the year 2002 with those of the year 1994 assuming a discount rate of 3% and censored tariffs (negative values replaced by zeros). The *SA1* re-estimates the value of the *change* in QALYs assuming that the life expectancy of the year 1994 had not changed in 2002. The *SA2* estimates the *change* in QALYs between 2002 and 1994 supposing that the quality of life scores of the year 1994 remain unchanged, but life expectancy changes. The other two sensitivity analysis, *SA3* y *SA4*, apply a different discount rate (5% instead of 3%) and allow for negative values of the VAS and TTO tariffs respectively. The *Table 5* summarizes the results of these exercises, which are presented in monetary terms.

TABLE 5

As expected, *SA1* reports a greater change in the QALYs for the considered period than the base case, since an improvement in life expectancy does not compensate the worsening in the quality of life. The *SA2* estimation keep fixed the quality of life, but allows for an improvement in the life expectancy. Therefore, the results are positive and much better than those of the base case. A higher discount rate makes the negative change in QALYs smaller, but still negative. Whether we allow for negative values, the changes become greater with the TTO tariff and mostly unchanged with the VAS tariff, which presents fewer of those negative values.

TABLE 5

3.5 Discussion of variables

We have tested a model that explains the individual health state scores by means of several binary variables that we have built for this purpose. Our aim was to detect some possible explanations to the changes observed. We had not a panel, so we were unable to apply a procedure for cancelling fixed effects, as suggested by [Honoré (1992)]. The complete list of variables is presented in the *Table 6*.

TABLE 6

We will try to explain the self-perceived health state of each person in the sample by means of a set of adequate variables that capture objective health status (chronic illnesses, recent accidents and hospitalizations and incapacities) and objective socioeconomic circumstances (age, gender, employment, education, etc.). We also have added a variable that takes care of the 'positional subjectivity' problem, by identifying extreme cases of biased self-valuation (excessive optimist or pessimist valuations of the own health status). An income variable was disposable only for the 1994 sample, but one third of it did not answer this question. Therefore, we have not used this variable. The question about caregivers is the contrary case, because the formulation of the question in the 1994 questionnaire doesn't allow identifying if the interviewed person takes care of the incapacitated and elderly. A similar problem happens with the occupation question, in this case due to a different formulation in 1994 and 2002, which makes the responses not comparable. A question about social class self-adscription is present in the questionnaires of 1994 and 2002, but the differences are excessively strong between both samples, so we have rejected the use of this variable. On the other hand, there are some potential problems of endogeneity that recommended us to exclude several variables. For instance, the use of the medical services determines the health state, but it is determined by the health state as well (see [Hernández-Vera (1999)]; also interesting is the case analysed in [Dwyer and Mitchell (1999)] and in [Benítez-Silva et al (2004)], on self-reported health status, disability and labour supply decisions). We ran the different models only including people older than 16, and the results are shown in *Tables 7* and *8*.

3.6 Econometric results

Different estimation procedures have been applied. The regressand was in any case the health score based on the VAS scale[xvi]. Two OLS estimations were carried out, the first with the complete sample (*OLS1*) and the second with a reduced sample in which the regressand excludes values equal to one (*OLS2*). Besides, we have applied a Tobit model based on maximum likelihood (bootstrapped standard errors also were calculated but not printed here, because they were quite similar). These parametric models require homoskedasticity and normality to hold. For this reason we have estimated a *semiparametric censored regression model* as well, particularly a *Symmetrically Censored Least Squares* (SCLS) model. The assumptions assumed by this model are less restrictive that those of the parametric models, as we have explained in the methodological notes of the second section. The SCLS provide bootstrapped estimates of the sampling variance. Statistical calculations were made using Stata 8 software. The program for the estimation of the SCLS model is the same used in [Chay and Powell (2001)][xvii].

TABLE 7

TABLE 8

In order to estimate the magnitude of the impact of these variables on the *aggregate* stock of capital, we need to identify the significant ones, to select the higher coefficients (and their changes) and the change in the number of cases in the total population (excluding people younger than 15 years old). For the significant character of the variables, we have adopted as a reference the results from the robust Tobit and, specially, those from the semi-parametric model (SCLS), because both models explicitly take account of the censored data. This is shown in the *Table 9*.

TABLE 9

Depression and illnesses narrowly related with pain–arthritis, rheumatism and lumbago–are strongly significant. The negative coefficients of these two variables are very high, compared with the coefficients of other significant ‘illness’ variables. The prevalence of these two diseases in the sample has increased from 1994 to 2002 (from 539,634 to 691,723 cases of depression, and from 1,557,613 to 2,175,298 cases of muscular/articulator diseases).

A diet prescribed by a doctor also is significant in both years for the two models, but diets not prescribed by a doctor (maybe 'aesthetic' diets) are not. The relevance of this kind of significant variables as possible explicative factors of the observed decrease in the stock of capital is secondary, due to the small size of the coefficients and the reduction in the number of cases observed in the population (from 754,677 to 598,022). Sedentary life has a negative, persistent and significant influence on the health state. The coefficient is appreciable and the problem has increased between 1994 and 2002. Tobacco and alcohol consumption have not significant influence, but it must be considered that we have not a panel data, so we have no information on *past habits*, which also determine the actual health state. Medical dependence on a treatment, diet or device is strongly significant in the two years considered, and the negative coefficient is remarkable (higher in 2002). This problem, however, has reduced its importance in the population. Age, as expected, has a significant negative impact on health state (the third age group goes from 45 to 64 years and the fourth group from 65 to the maximum age in the sample). The coefficient growths with age, and it is very high for the fourth age group. The aging of the population is exerting a powerful influence on the health stock. Men have better health than women, as we already know, but this cannot explain the change observed in the aggregate stock of health capital. To be 'employed' has a positive influence, and the economic climate was much better in 2002 (the unemployment rate in Catalonia was the 21.2 per cent of the active population in 1994 and the 9.5 per cent in 2002). However, the coefficient is relatively small, and even smaller in 2002. The 'sickleaver' variable has a significant negative impact on health, with a high coefficient, although the presence of sickleavers in the population is small, and reduced between 1994 and 2002. To be 'unemployed' only has a significant negative influence in 1994, and the problem has been strongly reduced in 2002. As a whole, these ‘employment’ variables cannot contribute substantially to the explanation of the observed reduction in the stock of health capital. To be Spanish but not born in Catalonia has a significant negative impact on the reported health status, which is a surprising result. However, the coefficient is small, and even smaller in 2002. The number of resident people not native-born is also smaller in 2002. Therefore, the variable is not of much importance for an explanation of our problem[xviii]. The education is an interesting proxy to many variables related with income levels and social class. The observed influence only is significant at 95% level for the 2002 sample, and the sign is positive, as expected. The access to the tertiary education was greatly improved in the 80s, thanks to the development of new universities in all the country, including Catalonia. Consequently, an increasing proportion of young people have tertiary education, and the significant influence observed for the sample of 2002 could be reflecting this trend (the number of cases with high education in the population is much greater in 2002). However, the coefficient for this variable is quite small and therefore the aggregate effect of these trends is negligible. Double insurance is another proxy to income and social class, however it is significant only at the 95% level in 1994, with a positive impact[xix]. The influence of the opinion on the public medical system neither is significant or important. Finally, the ‘positional objectivity’ variables are both significant. The optimism has a negative sign simply due to how the variable is constructed: optimist people are those that have at least a severe problem but consider its health as good, very good or excellent. Therefore, if this variable is equal to 1 for a particular person, at least a severe problem will exist. The reverse is the case of pessimist people, being the base group those which are ‘fair’ in the valuation of the health state.

3.7 Econometric tests

We have made several modifications to the original model in order to check the robustness of our results. The first exercise consisted of the using of age and age squared variables instead of dummies for age groups in order to catch non-linearities in the data. The age variables were significant, and the coefficients and significativity of the other variables did not change. Therefore, our modelling based on dummies for several age groups seems to be robust. A second exercise consisted of the use of cohort-based groups instead of age-based groups. This does not change the estimations for the 1994 sample, but the groups for 2002 are different. The lower and upper age of each group are moved 8 years, and a new group of people born after 1994 appear. The new cohort groups for 2002 include 0 to 7 years old people, 8 to 21, 22 to 51, 52 to 71 and people older than 72 years. We excluded people that belong to the first and last groups. The first group includes people that were not yet born in 1994, whereas the last group do not include an appreciable number of persons that died between 1994 and 2002. These groups introduce differences in the two samples and therefore we have dropped them. In this way, we have two samples of very similar people. It is not a true panel of data, but some degree of coherence is reintroduced. The ‘trimmed’ sample estimations yielded similar results to those presented in Tables 7 and 8. There were no appreciable differences in the size, sign or significativity of the coefficients. Consequently, our results are robust to the possible influence of new people eligible for being included in the sample and people unavoidably excluded (due to death).

We also built a pool of data, replacing ‘ages’ by ‘cohorts’. In this way, we can detect a ‘generational’ change in the self-perception of the own health. Slow changes in habits of life also could be captured by means of this ‘cohort’ variable, despite the inexistence of a true panel of data. We estimated weighted OLS and Tobit. All the cohort variables were significant, as expected, which can be considered an indication of the existence of one such ‘generational’ effect. The significativity and relative sizes of the coefficients of the other variables were quite similar to those observed in the differentiated samples.

Multicollinearity and *spurious correlation* are typical potential problems. We have made several tests aimed at reinforcing our confidence in the original results. The variable ‘age’ has a strong correlation on variables like muscular/articulator diseases (the correlation coefficient was 0.4318), factors of risk (cholesterol, diabetes or hypertension, 0.4392), comorbidity (0.4392), to be single (-0.6212) or to be a widow or widower (0.4032), among others. The significant character and size of the coefficients of these variables could be altered due to the overlapping with the ‘age’. We have calculated the *variance inflation factor* (*vif*), considering the whole sample and the trimmed sample that excludes values equal to one. The multicollinearity did not seem to be a problem. The maximum *vif* in 1994 was 3.41 (complete sample) and 3.42 (trimmed sample), whereas in 2002 the numbers were 3.65 and 3.30 respectively. These numbers are far from 10, the value from which collinearity could be present. The spurious or misleading correlation also could invalidate our findings, and hence we have substituted the strongly significant variables by non-sense variables found in the survey. For instance, the day in which the survey was carried out or the codes assigned to identify the interviewers and the supervisors of the survey. These arbitrary variables are expected not to be correlated with the regressand or the regressors and they should be non-significant. If the contrary had been the case, it would have been an evidence of spurious correlation in the original (reported) estimations. Nevertheless, no awful results were obtained with this test–the non-sense variables had not significant explicative power–, and we can trust in the robustness of the significant relations found in the estimation of the original model[xx].

4 Discussion

Our results apparently are quite different to those of [Cutler and Richardson (1997)] or [Burström, Johannesson and Diderichsen (2003)], which report an increase in the stock of health capital of the populations analyzed. This typical result match the initial hypothesis based on the observed improvement in life expectancy and medical services. However, our findings seem to reflect the opposite. Several reasons could explain it. The first one is related to some weaknesses in the methodology applied, already discussed in the vast literature on the subject. The second cause has to do with the difficulties in catching structural tendencies observing only two points in time.

A methodological problem cited in the literature is the application of tariff scales to the descriptive ‘dimensions’. These tariffs provide a common quantitative index taken from the preferences of the population. Neither subjective valuations nor objective valuations or ‘social averages’ based tariffs are free from flaws. The subjective valuations are under severe criticism due to the ‘positional objectivity’ problem. Procedures that are more objective based on ‘observed morbidity’ or ‘diagnosed morbidity’ also present problems, and the results obtained from ‘observed morbidity’ can contradict those derived from ‘self-perceived morbidity’ (see for more detail and additional references [Murray and Chen (1992)], p. 485 and followings, and [Sen (2002)]). The ‘social averages’ based tariffs try to isolate the valuation from the ‘positional objectivity’ problem. However, these ‘social averages’ find new problems. The first one has to do with how the different tariffs are related to each other, because they are not directly comparable–[Bleichrodt and Johannesson (1997)] and [Dolan and Sutton (1997)] have studied these relations. Secondly, the different methods for the calculation of tariffs also have been severely criticized in the literature[xxi]. Thirdly, the application of the tariffs could present practical problems. For instance, there was not a

Swedish TTO tariff, so [Burström, Johannesson and Diderichsen (2003)] were forced to apply the UK tariff ([Dolan, Shaw, Tsuchiya and Williams (2005)]) for this purpose, which is a usual practice in the literature. Therefore, to the problems derived from the use of a tariff dated in a different year from that to which the health states are referred to, [Burström, Johannesson and Diderichsen (2001)] and [Burström, Johannesson and Diderichsen (2003)] add a new bias related to the employment of a tariff calculated from a sample of a different country[xxii]. We have minimized the adverse consequences of these methodological problems by means of the sensitivity analysis and the use of two alternative tariffs in our calculations.

The analysis of the sections 3.5 and 3.6 allowed us to identify some key variables for the understanding of the observed changes in the health scores. The sensitivity analysis discards the aging and the change of the population as possible explicative variables of the decreasing in the health stock observed. The econometric analysis pointed to several variables, like the depression and the diseases related with pain, like arthritis, rheumatism and lumbago. The growing prevalence of these diseases between 1994 and 2002 is an important explicative factor. The positive influence of the improvement of the life expectancy is exceeded by the negative influence of this worsening in the health state and, consequently, the QALYs show a deterioration between 1994 and 2002. This negative effect is not compensated in the aggregate by the increasing of the population between both years.

However, a second type of problem arises here. The short length of the period considered does not allow us to differentiate between changes due to random shocks and true structural tendencies. The improved medical assistance and increased consciousness of the existence of these depression problems in the population, which in the past were stigmatizing illnesses, are a structural tendency. However, the increase in anxiety or depression problems also could be a consequence of the general economic climate or other exogenous factors affecting optimism through time and, therefore, the subjective valuation of the own health state, as [Burström, Johannesson and Diderichsen (2003)], p. 649-651, pointed to as a hypothesis. More data is necessary to determine if the drop in quality of life was due to an exogenous shock or to a structural tendency.

Table 1. Life expectancy in years and change in life expectancy, by period (1994/2000), by age and gender, CHS.

	Life expectancy		*Change in life expectancy*
Age	*1994*	*2000*	*1994/2000*
0 years			
Male	74.80 (29.68)	76.48 (29.86)	1.68 (0.18)
Female	82.00 (30.38)	83.22 (30.48)	1.22 (0.10)
16 years			
Male	59.41 (27.58)	60.97 (27.84)	1.56 (0.26)
Female	66.61 (28.68)	67.67 (28.82)	1.06 (0.14)
25 years			
Male	50.86 (25.92)	52.38 (26.25)	1.53 (0.33)
Female	57.76 (27.29)	58.85 (27.48)	1.09 (0.19)
35 years			
Male	41.90 (23.67)	42.93 (23.96)	1.02 (0.29)
Female	48.14 (25.30)	49.06 (25.52)	0.92 (0.22)
45 years			
Male	32.80 (20.69)	33.72 (21.03)	0.92 (0.34)
Female	38.52 (22.66)	39.43 (22.94)	0.90 (0.28)
55 years			
Male	24.15 (17.01)	25.00 (17.41)	0.85 (0.41)
Female	29.23 (19.28)	29.99 (19.60)	0.76 (0.31)
65 years			
Male	16.31 (12.75)	16.99 (13.16)	0.68 (0.41)
Female	20.25 (15.01)	20.88 (15.35)	0.63 (0.34)
75 years			
Male	9.95 (8.49)	10.27 (8.73)	0.33 (0.24)
Female	12.20 (10.09)	12.59 (10.36)	0.39 (0.26)

- *Discounted years in parentheses, discount rate 3%.*

Table 2. Percentage of *males* reporting moderate or severe problems in different dimensions (with standard error), and mean health state scores (with standard error), by period (1994, 2002), age group and cohorts, CHS*

Dimension	*16-24* *[23-31]*		*25-34* *[32-41]*		*35-44* *[42-51]*		*45-54* *[52-61]*		*55-64* *[62-71]*		*65-74* *[72-81]*		*75-84* *[82-91]*		*85+* *[92+]*	
Period	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*
Mobility																
1994	2.29	0.150	2.54	0.157	4.11	0.199	6.00	0.238	14.27	0.35	19.83	0.399	34.33	0.476	51.28	0.503
2002	0.66*	0.081	4.07	0.198	3.48	0.183	7.95	0.271	13.25	0.339	20.20	0.402	36.14	0.482	66.67	0.479
[2002]	[3.52]	[0.184]	[3.21]	[0.176]	[6.17]	[0.240]	[12.45]	[0.330]	[17.03]	[0.376]	[31.14]	[0.464]	[50.00]	[0.504]	[80.00]	[0.447]
Self-care																
1994	0.92	0.095	1.04	0.101	1.51	0.122	1.15	0.107	1.61	0.126	4.28	0.203	9.33	0.291	26.92	0.446
2002	0.66	0.081	1.31	0.114	0.70	0.083	1.85	0.135	2.35	0.152	4.63	0.210	13.37	0.341	33.33	0.479
[2002]	[1.34]	[0.115]	[0.51]	[0.071]	[1.27]	[0.112]	[2.62]	[0.160]	[3.42]	[0.182]	[10.62]	[0.309]	[23.44]	[0.427]	[20.00]	[0.447]
Usual activities																
1994	1.83	0.134	2.19	0.147	3.14	0.174	4.61	0.210	7.36	0.261	8.99	0.286	21.00	0.410	37.18	0.490
2002	1.16	0.107	3.58	0.186	4.35	0.204	5.74	0.233	10.30	0.304	13.11*	0.338	23.38	0.424	45.45	0.506
[2002]	[3.19]	[0.176]	[3.21]	[0.176]	[5.99]	[0.238]	[9.09]	[0.288]	[11.98]	[0.325]	[18.38]	[0.388]	[40.62]	[0.495]	[20.00]	[0.447]
Pain/discomfort																
1994	7.42	0.262	11.32	0.317	13.73	0.344	19.49	0.396	32.68	0.470	34.95	0.477	40.67	0.492	42.31	0.497
2002	6.29	0.243	13.87	0.346	20.03*	0.401	27.96*	0.449	38.46*	0.487	43.08*	0.496	54.23*	0.499	51.52	0.508
[2002]	[12.29]	[0.329]	[18.07]	[0.385]	[25.64]	[0.437]	[35.21]	[0.478]	[42.44]	[0.495]	[46.32]	[0.500]	[57.81]	[0.498]	[80.00]	[0.447]
Anxiety/depression																
1994	5.68	0.232	6.94	0.254	8.65	0.281	8.54	0.280	10.36	0.305	11.43	0.320	18.33	0.388	19.23	0.397
2002	3.65	0.188	9.77*	0.297	12.54*	0.332	13.86*	0.346	17.24*	0.378	17.48*	0.380	21.29	0.410	15.62	0.369
[2002]	[8.24]	[0.275]	[11.17]	[0.315]	[14.16]	[0.349]	[16.73]	[0.374]	[16.71]	[0.374]	[19.41]	[0.396]	[20.63]	[0.408]	[20.00]	[0.447]
Health state score (VAS)																
1994	0.964	0.105	0.953	0.123	0.942	0.136	0.924	0.152	0.884	0.170	0.857	0.198	0.795	0.235	0.679	0.313
2002	0.978*	0.080	0.940	0.141	0.923*	0.152	0.897*	0.169	0.85*	0.202	0.824*	0.225	0.763	0.241	0.663	0.261
[2002]	[0.948]	[0.134]	[0.931]	[0.144]	[0.903]	[0.165]	[0.862]	[0.196]	[0.835]	[0.213]	[0.794]	[0.241]	[0.696]	[0.253]	[0.719]	[0.181]
Health state score (TTO)																
1994	0.974	0.098	0.964	0.121	0.955	0.134	0.939	0.153	0.907	0.168	0.880	0.210	0.820	0.260	0.689	0.352
2002	0.985*	0.060	0.952	0.142	0.938*	0.154	0.915*	0.175	0.869*	0.221	0.845*	0.245	0.788	0.275	0.674	0.331
[2002]	[0.958]	[0.134]	[0.945]	[0.146]	[0.921]	[0.170]	[0.880]	[0.214]	[0.855]	[0.234]	[0.820]	[0.263]	[0.711]	[0.315]	[0.773]	[0.170]

The percentages have been calculated over the valid responses. Missing values are discarded.

Significant differences between 1994 and 2002 (p<0.05)

Table 3. Percentage of *females* reporting moderate or severe problems in different dimensions (with standard error), and mean health state scores (with standard error), by period (1994, 2002), age group and cohorts, CHS*

Dimension	*16-24* *[23-31]*		*25-34* *[32-41]*		*35-44* *[42-51]*		*45-54* *[52-61]*		*55-64* *[62-71]*		*65-74* *[72-81]*		*75-84* *[82-91]*		*85+* *[92+]*	
Period	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*	*%*	*SE*
Mobility																
1994	1.11	0.105	2.45	0.155	3.66	0.188	11.04	0.314	23.02	0.421	32.64	0.470	46.49	0.500	74.21	0.439
2002	1.18	0.108	2.30	0.150	4.55	0.208	9.17	0.289	23.21	0.423	32.03	0.467	48.31	0.500	68.24	0.468
[2002]	[2.00]	[0.140]	[4.14]	[0.199]	[7.25]	[0.260]	[19.17]	[0.394]	[27.04]	[0.445]	[45.21]	[0.498]	[58.78]	[0.494]	[84.62]	[0.376]
Self-care																
1994	0.28	0.053	0.53	0.073	1.03	0.101	2.03	0.141	4.71	0.212	6.34	0.244	12.02	0.326	35.85	0.481
2002	0.84	0.091	0.71	0.084	2.28*	0.149	2.08	0.143	5.12	0.221	8.95	0.286	19.10*	0.394	52.94*	0.502
[2002]	[0.73]	[0.085]	[2.08]	[0.143]	[2.02]	[0.141]	[4.36]	[0.204]	[6.78]	[0.252]	[15.27]	[0.360]	[38.93]	[0.489]	[76.92]	[0.439]
Usual activities																
1994	1.57	0.124	2.45	0.155	3.75	0.190	7.50	0.263	14.88	0.356	20.67	0.405	32.87	0.470	56.60	0.497
2002	1.68	0.129	3.54	0.185	5.18	0.222	8.93	0.285	17.45	0.380	24.51	0.431	42.32*	0.495	67.06	0.473
[2002]	[3.28]	[0.178]	[4.66]	[0.211]	[7.36]	[0.261]	[14.74]	[0.355]	[21.41]	[0.411]	[35.33]	[0.479]	[61.07]	[0.489]	[76.92]	[0.439]
Pain/discomfort																
1994	10.78	0.310	16.01	0.367	24.09	0.428	36.47	0.482	49.57	0.500	56.63	0.496	58.92	0.492	64.78	0.479
2002	13.64	0.343	17.64	0.381	24.80	0.432	39.83	0.490	55.78*	0.497	62.09	0.486	76.12*	0.427	80.00*	0.402
[2002]	[15.82]	[0.365]	[21.76]	[0.413]	[34.84]	[0.477]	[50.09]	[0.501]	[59.91]	[0.491]	[74.93]	[0.434]	[77.10]	[0.422]	[84.62]	[0.376]
Anxiety/depression																
1994	7.83	0.269	12.38	0.330	12.21	0.328	18.54	0.389	23.66	0.425	25.40	0.436	29.46	0.456	29.56	0.458
2002	7.74	0.268	12.35	0.329	19.48*	0.396	21.28	0.410	31.33*	0.464	31.37*	0.465	38.20*	0.487	52.38*	0.502
[2002]	[9.82]	[0.298]	[20.17]	[0.402]	[19.19]	[0.394]	[28.98]	[0.454]	[28.44]	[0.452]	[39.10]	[0.489]	[44.19]	[0.499]	[61.54]	[0.506]
Health state score (VAS)																
1994	0.958	0.106	0.934	0.136	0.915	0.152	0.865	0.192	0.800	0.217	0.755	0.232	0.697	0.256	0.543	0.294
2002	0.952	0.115	0.928	0.142	0.892*	0.182	0.849	0.203	0.770*	0.234	0.734	0.239	0.631*	0.251	0.460*	0.293
[2002]	[0.939]	[0.129]	[0.899]	[0.176]	[0.866]	[0.198]	[0.794]	[0.227]	[0.754]	[0.232	[0.650]	[0.244]	[0.558]	[0.282]	[0.242]	[0.294]
Health state score (TTO)																
1994	0.970	0.097	0.949	0.134	0.931	0.156	0.884	0.208	0.820	0.248	0.775	0.272	0.712	0.310	0.538	0.357
2002	0.965	0.107	0.943	0.143	0.907*	0.194	0.865	0.229	0.789	0.277	0.748*	0.284	0.637*	0.319	0.444	0.368
[2002]	[0.953]	[0.127]	[0.914]	[0.184]	[0.882]	[0.221]	[0.813]	[0.264]	[0.772]	[0.275]	[0.657]	[0.309]	[0.555]	[0.350]	[0.191]	[0.364]

The percentages have been calculated over the valid responses. Missing values are discarded.

** Significant differences between 1994 and 2002 (p<0.05)*

Table 4. Number of expected quality-adjusted years of life (QALYs) and change in QALYs by period (1994/2001), using TTO and VAS tariffs, by specific ages and gender, CHS*

	TTO Tariff			*VAS Tariff*		
Age	1994	2002	1994/2002	1994	2002	1994/2002
0 years						
Male	71.28157 (29.24707)	71.49604 (29.16692)	0.21447 (-0.08015)	70.27844 (28.97959)	70.45049 (28.8929)	0.17205 (-0.08669)
Female	73.5399 (29.30337)	72.53473 (29.03335)	-1.00517 (-0.27002)	72.34238 (28.967)	71.51293 (28.71595)	-0.82945 (-0.25105)
16 years						
Male	56.42389 (27.14579)	56.51793 (26.99272)	0.09404 (-0.15307)	55.45123 (26.75881)	55.51394 (26.59718)	0.06271 (-0.16163)
Female	58.43547 (26.99363)	57.25895 (26.53512)	-1.17652 (-0.45851)	57.29884 (26.53647)	56.31115 (26.11022)	-0.98769 (-0.42625)
25 years						
Male	48.03188 (25.30627)	47.98471 (24.97688)	-0.04717 (-0.32939)	47.13209 (24.89623)	47.0409 (24.53982)	-0.09119 (-0.35641)
Female	49.81384 (25.09353)	48.66971 (24.53324)	-1.14413 (-0.56029)	48.77777 (24.61469)	47.84018 (24.11419)	-0.93759 (-0.5005)
35 years						
Male	39.2535 (22.87254)	38.91154 (22.45341)	-0.34196 (-0.41913)	38.44566 (22.44613)	38.07999 (22.00827)	-0.36567 (-0.43786)
Female	40.58327 (22.56858)	39.37286 (21.8772)	-1.21041 (-0.69138)	39.6841 (22.0898)	38.6951 (21.48922)	-0.989 (-0.60058)
45 years						
Male	30.39474 (19.71096)	30.19247 (19.33963)	-0.20227 (-0.37133)	29.71065 (19.28967)	29.4806 (18.90022)	-0.23005 (-0.38945)
Female	31.54695 (19.39938)	30.47672 (18.74765)	-1.07023 (-0.65173)	30.804 (18.94345)	29.96699 (18.4068)	-0.83701 (-0.53665)
55 years						
Male	22.11478 (15.95119)	22.09069 (15.69719)	-0.02409 (-0.254)	21.5558 (15.54762)	21.53626 (15.31449)	-0.01954 (-0.23313)
Female	23.20124 (15.82995)	22.08288 (15.06814)	-1.11836 (-0.76181)	22.65062 (15.44795)	21.76617 (14.81515)	-0.88445 (-0.6328)
65 years						
Male	14.75765 (11.79258)	14.66671 (11.61918)	-0.09094 (-0.1734)	14.36199 (11.4786)	14.29333 (11.32321)	-0.06866 (-0.15539)
Female	15.59274 (11.87258)	14.6782 (11.20117)	-0.91454 (-0.67141)	15.24814 (11.60225)	14.54974 (11.08366)	-0.6984 (-0.51859)
75 years						
Male	8.949826 (7.767247)	8.821726 (7.639935)	-0.1281 (-0.127312)	8.672679 (7.530195)	8.536691 (7.393639)	-0.135988 (-0.136556)
Female	8.866387 (7.519803)	8.061563 (6.797747)	-0.804824 (-0.722056)	8.743302 (7.408407)	8.06248 (6.796658)	-0.680822 (-0.611749)

** Discounted years in parentheses, discount rate 3%.*

Table 5. Sensitivity Analysis of the change in QALYs by period (1994/2001), using *TTO* and *VAS* tariffs, by age and gender, CHS. Thousands of US dollars.

	Base Case		*SA1- Life Expectancy unvaried*		*SA2- Quality of Life unvaried*		*SA3- Discount rate 5%*		*SA4- Uncensored tariffs*	
Age	*TTO*	*VAS*	*TTO*	*VAS*	*TTO*	*VAS*	*TTO*	*VAS*	*TTO*	*VAS*
0 years										
Male	-8.015	-8.669	-22.971	-23.076	14.773	14.366	-4,399	-4.569	-8.901	-8.800
Female	-27.002	-25.105	-33.960	-31.915	7.272	7.142	-11,877	-11.661	-27.052	-25.020
16 years										
Male	-15.307	-16.163	-36.838	-37.147	21.423	20.895	-10,453	-10.762	-16.569	-16.353
Female	-45.851	-42.625	-54.492	-51.270	10.174	10.009	-26,649	-26.130	-46.215	-42.513
25 years										
Male	-32.939	-35.641	-59.601	-61.807	26.577	26.039	-29,568	-31.751	-34.711	-35.864
Female	-56.029	-50.050	-67.225	-61.340	13.729	13.515	-37,114	-34.316	-56.361	-49.915
35 years										
Male	-41.913	-43.786	-65.427	-66.688	22.337	22.004	-36,905	-38.661	-42.941	-43.901
Female	-69.138	-60.058	-80.983	-72.211	15.505	15.285	-51,123	-45.434	-70.193	-59.891
45 years										
Male	-37.133	-38.945	-65.241	-66.085	27.470	26.984	-37,455	-39.170	-37.982	-39.100
Female	-65.173	-53.665	-79.585	-68.875	19.064	18.882	-48,479	-40.619	-65.030	-53.440
55 years										
Male	-25.400	-23.313	-58.072	-54.971	32.185	30.874	-31,307	-28.859	-27.341	-23.549
Female	-76.181	-63.280	-90.727	-79.274	19.543	19.487	-60,863	-51.792	-77.284	-63.184
65 years										
Male	-17.340	-15.539	-43.761	-42.248	34.506	32.475	-20,324	-18.697	-21.820	-15.855
Female	-67.141	-51.859	-84.320	-68.817	17.975	18.352	-54,848	-42.469	-68.433	-51.836
75 years										
Male	-12.731	-13.656	-29.381	-29.477	15.746	16.011	-12,468	-13.484	-11.498	-13.393
Female	-72.206	-61.175	-83.361	-72.917	15.119	15.014	-67,421	-57.166	-77.536	-61.558

Table 6. Definitions of variables

	Endogenous variable
Personal score (VAS based)	Continuous variable with a upper bound at 1, meaning the health state score derived from the application of the social TTO or VAS tariff to the personal descriptive 5 dimensions health score.
	Exogenous variables
Chronic illnesses	
Respiratory	1 for those with respiratory diseases, 0 otherwise
Vascular	1 for those with vascular diseases (heart, circulatory problems), 0 otherwise
Muscular and articular	1 for those with pain diseases (arthritis, rheumatism, lumbago), 0 otherwise
Ulcer	1 for those with ulcer, 0 otherwise
Risks	1 for those with cholesterol, diabetes or hypertension, 0 otherwise
Anxiety or depression	1 for those with anxiety or depression, 0 otherwise
Other health problems	This variable includes other chronic diseases as prostate problems, skin problems, defecation problems and other problems not mentioned before. The list for 2002 is more detailed, and additional diseases are explicitly included, as headaches, haemorrhoid, tumours, osteoporosis, anaemia and thyroid problems.
Comorbidity	1 for those with more than 1 chronic illness, 0 otherwise
Accidents and hospitalizations	
Accident	1 for those who suffered an accident in the past 12 months, 0 otherwise
Hospitalization	1 for those who were hospitalized in the past 12 months, 0 otherwise
Life habits	
Medicaldiet	1 for those who follows a diet medically prescribed, 0 otherwise
Nomedicaldiet	1 for those who follows a diet not medically prescribed, 0 otherwise
Sedentary	1 for those who walk at least 20 minutes in the past week, 0 otherwise
Smoke	1 for those who smokes (dairy or occasionally), 0 otherwise
Risky drinker	1 for those who drank more than 35 alcohol units the past week, if male, or 25 alcohol units, if female, and 0 otherwise. One alcohol unit is equivalent to about 8-10 grams.
Incapacities	
Blindness	1 for those who have vision problems, 0 otherwise
Deafness	1 for those who have ear problems, 0 otherwise
Dumbness	1 for those who have speech problems, 0 otherwise
Medical dependence	1 for those who need a medical treatment, diet or device, 0 otherwise
Socioeconomic variables	
Age groups	Several age groups were created, adopting those recommended in the methodology of the survey for a correct representation of the population. The dummy variables are age1 (less than 15 years old), age2 (15 to 44), age3 (45 to 64), age4 (65 or more years old)
Gender	1 for males, 0 for females
Employment status	We have four possible categories: employed, unemployed, sickleavers (temporal or permanent) and inactives (retired, students, kids and housewives). The dummy variables are 'employed' (1 for those who are employed, 0 otherwise), 'unemployed' (1 for those who are unemployed for a maximum of 12 months, and 0 otherwise) and sickleavers (1 for those who are not actually working due to sickness, and 0 otherwise).

Long unemployment	1 for those who are unemployed for more than 1 year, 0 otherwise.
Marital state	We have four possible categories: single, married, separated/divorced or widow/er. The dummy variables are married (1 for those who are married, 0 otherwise), separated/divorced (1 for those who are separated or divorced, 0 otherwise) and widow/er (1 for those who are widow or widower, 0 otherwise).
Birthplace	We have three possible categories: Catalonian, Spanish but not Catalonian and Foreign. The dummy variables are noncatalonian (1 for those born in Spain, but not in Catalonia, 0 otherwise) and foreign (1 for those who born outside of Spain, 0 otherwise).
Education	We have four possible categories: no education, primary, secondary and tertiary. The dummy variable is 1 for those with secondary or tertiary education, 0 otherwise.
Duplicate coverage	This variable tells us if the person has a private insurance that provides medical assistance. The dummy variable is 1 for those with private (duplicate) insurance, and 0 otherwise.
Opinion about the national health system	We have three possible categories: the medical service works fine; the medical service has positive aspects, but reforms are needed; and the medical service works bad and a whole reform is needed. The dummy variables are goodopinion (1 for those with the first type of opinion, 0 otherwise) and badopinion (1 for those with the third type of opinion, 0 otherwise).
Positional Objectivity variables	
Season	1 whether the interview was carried out in the 6 months period between October and March, 0 otherwise. This variable is used only for the 1994 estimations, because all the interviews in the 2002 survey were carried out between October and March.
Positional variable	The dummy variables are optimism (1 if the euroqol shows at least one serious problem and the health state perception is good, very good or excellent or if there exist at least one moderate problem and the perception is excellent, and 0 otherwise) and pessimism (1 if the euroqol shows no problems and the health state perception is passable or bad, and 0 otherwise).

Table 7. Econometric results for OLS, robust Tobit by maximum likelihood and SCLS models, CHS, 1994.

	Mean and SE	OLS1	OLS2	Tobit	SCLS
respiratory	0.199376 (0.3995472)	-0.0390085 (0.0041881)*	-0.0245543 (0.0060683)*	-0,0664773 (0,0083842)*	-0.0616274 (0.0082352)*
vascular	0.2151433 (0.4109381)	-0.0440678 (0.0046763)*	-0.0301852 (0.005994)*	-0,062588 (0,0085061)*	-0.050136 (0.0084041)*
muscular and articular	0.3368269 (0.4726441)	-0.1124525 (0.004283)*	-0.051783 (0.0057679)*	-0,2261836 (0,0093619)*	-0.1742895 (0.0099531)*
ulcer	0.0601137 (0.2377068)	-0.0313046 (0.0075864)*	-0.0293764 (0.0094101)*	-0,0335361 (0,0131337)*	-0.0302663 (0.0140332)*
risks	0.2615459 (0.4394942)	-0.0229002 (0.0050033)*	-0.013526 (0.0068416)*	-0,025658 (0,0097147)*	-0.0337077 (0.0098374)*
anxiety/depression	0.1112445 (0.3144472)	-0.1075276 (0.0062682)*	-0.0664822 (0.0068532)*	-0,1664296 (0,0097007)*	-0.1232095 (0.0093302)*
others	0.4541237 (0.4979108)	-0.0334724 (0.0035921)*	-0.0264221 (0.0056569)*	-0,0738906 (0,0086241)*	-0.0355357 (0.0090658)*
comorbidity	0.4578034 (0.4982362)	0.0258042 (0.0056072)*	0.0257163 (0.0078608)*	-0,028561 (0,0127617)*	0.0059877 (0.0133177)
accident	0.149988 (0.3570739)	-0.026116 (0.004206)*	-0.0180548 (0.006996)*	-0,0550668 (0,009464)*	-0.0383412 (0.009848)*
hospitalization	0.08392 (0.2772789)	-0.0377164 (0.0060701)*	-0.0340094 (0.0083743)*	-0,0778712 (0,0116302)*	-0.0562276 (0.0116827)*
medicaldiet	0.1679947 (0.373877)	-0.0185604 (0.0054648)*	-0.0074097 (0.0070434)	-0,0322613 (0,0101139)*	-0.0169523 (0.0100143)
nomedicaldiet	0.0097087 (0.0980575)	-0.001776 (0.0160527)	0.004512 (0.02302)	-0,0018401 (0,0301869)	-0.0058567 (0.0353553)
sedentary	0.4524396 (0.4977533)	-0.0178438 (0.0028596)*	-0.0314175 (0.0051042)*	-0,0277 (0,0071707)*	-0.051086 (0.0081745)*
smoke	0.2980714 (0.4574298)	-0.0026044 (0.0029327)	-0.0013861 (0.0058605)	-0,0120628 (0,0092718)	-0.0065852 (0.0111519)
risky_drinker	0.0361571 (0.1866884)	0.0048918 (0.0069687)	0.0026371 (0.0136575)	0,0033526 (0,0218628)	0.0352889 (0.0288978)
blindness	0.037517 (0.1900325)	-0.0657514 (0.0107203)*	-0.0467083 (0.012226)*	-0,0884695 (0,0154068)*	-0.0775187 (0.0150481)*
deafness	0.0314375 (0.1745039)	-0.0217568 (0.0107221)*	-0.0050181 (0.012776)	-0,0338454 (0,0174187)**	-0.0322517 (0.0158273)*
dumbness	0.0075994 (0.0868461)	-0.0218568 (0.0472545)	0.0341844 (0.0476388)	-0,0267194 (0,071575)	0.0086764 (0.0338891)
medical dependence	0.0175186 (0.1311986)	-0.0812963 (0.0172332)*	-0.0614477 (0.0185408)*	-0,094229 (0,023195)*	-0.085202 (0.0244588)*
age_3	0.2925366 (0.4549456)	-0.0087761 (0.0036887)*	0.0029816 (0.0069823)	-0,0378893 (0,0104078)*	-0.0335002 (0.0134025)*
age_4	0.2080634 (0.4059386)	-0.0550305 (0.0058222)*	-0.0252725 (0.0091471)*	-0,1239676 (0,0132366)*	-0.0867007 (0.0152839)*
male	0.4670026 (0.4989299)	0.0167378 (0.0029953)*	0.0182187 (0.0057209)*	0,0408052 (0,0085672)*	0.0332671 (0.0096344)*
employed	0.4082352 (0.4915268)	0.008656 (0.0032986)*	0.0162442 (0.0064228)*	0,025017 (0,0098223)*	0.050639 (0.0111801)*
sickleave	0.0343667 (0.1821766)	-0.0952086 (0.0113277)*	-0.0481275 (0.0119184)*	-0,1492989 (0,0161574)*	-0.1036206 (0.0166245)*
unemployed	0.0479052 (0.2135741)	0.0011587 (0.0059114)	0.0222679 (0.0114834)**	-0,0079394 (0,0198576)	0.0682787 (0.0409725)
long_unemp	0.0302376 (0.1712472)	-0.0203368 (0.0079644)*	-0.009735 (0.0136411)	-0,063648 (0,0205662)*	-0.0423789 (0.0225472)**

married	0.6114803 (0.4874332)	0.0011195 (0.0033208)	0.0006172 (0.0076085)	-0,0283075 (0,0109728)*	0.0119963 (0.0148904)
separated or divorced	0.0176927 (0.1318374)	0.0038133 (0.0113805)	0.0079343 (0.0180855)	-0,0330277 (0,0284118)	0.0188618 (0.0634308)
widow/er	0.0855816 (0.2797564)	-0.0282542 (0.0079213)*	-0.0180729 (0.0111777)	-0,0663862 (0,0157097)*	-0.0219833 (0.0178314)
born in Spain but not in Catalonia	0.3025452 (0.4593784)	-0.0204434 (0.0033569)*	-0.0215446 (0.0053198)*	-0,0436667 (0,0076807)*	-0.038634 (0.0082234)*
foreign	0.0136866 (0.1161909)	-0.0017642 (0.0112674)	-0.0023045 (0.0235287)	0,0000225 (0,03014)	-0.0253058 (0.0327346)
high education	0.1714818 (0.376947)	0.0067968 (0.0031243)*	0.0107603 (0.0075061)	0,0182762 (0,0117514)	0.0232678 (0.0193894)
double insurance	0.1907163 (0.3928816)	0.0081135 (0.0035735)*	-0.0024492 (0.0067954)	0,019222 (0,0100872)**	0.0286241 (0.0124136)*
good opinion	0.4169767 (0.4930798)	0.0108094 (0.0029309)*	0.0083838 (0.0053774)	0,0211416 (0,0075449)*	0.0378041 (0.0083306)*
bad opinion	0.0681434 (0.2520025)	-0.0092943 (0.0054893)**	0.004669 (0.0090907)	-0,0334043 (0,0140722)*	-0.003701 (0.0152263)
season	0.50004 (0.50002)	-0.006864 (0.002758)*	-0.0073042 (0.0049503)	-0,020796 (0,0070301)*	-0.0103233 (0.0075458)
optimism	0.00944 (0.0967038)	-0.2339723 (0.0145569)*	-0.0930603 (0.0135918)*	-0,423527 (0,023441)*	-0.317857 (0.0222692)*
pessimism	0.07896 (0.2696871)	0.1408604 (0.0041841)*	0.1261521 (0.0092354)*	0,4656585 (0,0219046)*	0.4339821 (0.045109)*
_cons	-	0.9935483 (0.0040302)*	0.7945909 (0.0092088)*	1,349411 (0,014114)*	1.115943 (0.0214984)*

N=12,501 for the dependent variable, which is censored at 1. The SCLS sample is reduced by trimming (N= 4,076), which indicates the existence of outliers in the dataset. OLS and Tobit standard errors are robust to heteroskedasticity, and they were calculated by means of the asymptotic approximation. OLS1 employs the entire sample, and OLS2 uses only those values of the dependent variable different to one (N=4,306). The SCLS estimates of the standard errors are calculated by means of a bootstrap procedure based on 999 replications. * denotes the estimation is statistically significantly different from zero at a confidence level of 95%, and ** at a confidence level of 90%. Standard errors in parentheses.

Table 8. Econometric results for OLS, robust Tobit by maximum likelihood and SCLS models, CHS, 2002.

	Mean and SE	OLS1	OLS2	Tobit	SCLS
respiratory	0.1875353 (0.3903682)	-0.0181062 (0.0054649)*	-0.0106658 (0.0075839)	-0.0264401 (0.0107069)*	-0.0174111 (0.0117568)
vascular	0.280 (0.4490306)	-0.0293432 (0.0059325)*	-0.0177329 (0.0074039)*	-0.0315666 (0.0106987)*	-0.0292167 (0.010454)*
muscular and articular	0.4129944 (0.4924066)	-0.0914062 (0.0051535)*	-0.0405018 (0.0071672)*	-0.1985387 (0.0115822)*	-0.1337394 (0.0135417)*
ulcer	0.0511444 (0.2203077)	-0.0329975 (0.0104925)*	-0.0115126 (0.0109842)	-0.039096 (0.0167066)*	-0.0219769 (0.0165515)
risks	0.2700751 (0.4440298)	-0.0173641 (0.0060535)*	-0.014225 (0.0079661)**	-0.014464 (0.0111685)	-0.0237701 (0.011393)*
anxiety/depression	0.1259887 (0.3318601)	-0.1446143 (0.0083636)*	-0.0887943 (0.0084782)*	-0.2020486 (0.0117771)*	-0.1669732 (0.0119873)*
others	0.4040034 (0.4907327)	-0.0464087 (0.0049103)*	-0.0242134 (0.007196)*	-0.0938336 (0.0108589)*	-0.0716627 (0.0118645)*
comorbidity	0.472512 (0.499279)	0.0108735 (0.0073965)	0.0182853 (0.0099423)**	-0.0646006 (0.0160094)*	-0.0182873 (0.0222093)
accident	0.2310403 (0.4215279)	-0.0167649 (0.0047408)*	-0.0233575 (0.0075184)*	-0.0424843 (0.0105196)*	-0.0148702 (0.0112288)
hospitalization	0.0968335 (0.2957518)	-0.0321669 (0.0081843)*	-0.0379379 (0.0108406)*	-0.0575165 (0.0145136)*	-0.0303222 (0.0159828)**
medicaldiet	0.1197043 (0.3246385)	-0.0324662 (0.0075111)*	-0.0197903 (0.0092512)*	-0.059732 (0.013004)*	-0.0424347 (0.012432)*
nomedicaldiet	0.02914 (0.1682109)	0.0047391 (0.0105293)	0.0054363 (0.0168585)	-0.0148609 (0.0256742)	-0.0039023 (0.0358846)
sedentary	0.504088 (0.5000185)	-0.0318527 (0.0036133)*	-0.0551733 (0.0064181)*	-0.0602211 (0.0088934)*	-0.0712342 (0.0104912)*
smoke	0.3111433 (0.4629948)	0.0000466 (0.0036462)	-0.0009684 (0.0073223)	-0.0134207 (0.0104731)	-0.0037901 (0.0139947)
risky_drinker	0.0363688 (0.1872192)	-0.0131395 (0.0078937)**	0.0138651 (0.0106853)	-0.0496056 (0.0226327)*	-0.0079355 (0.0311919)
blindness	0.0525646 (0.2231785)	-0.0110915 (0.0108751)	-0.0240303 (0.0155062)	0.0009369 (0.0193865)	-0.0095134 (0.0169167)
deafness	0.0325088 (0.1773597)	-0.0166573 (0.0131532)	0.0110373 (0.0158793)	-0.0372665 (0.021042)**	-0.0315395 (0.0192)
dumbness	0.0094767 (0.0968926)	-0.0394738 (0.0350726)	-0.0057854 (0.0323514)	-0.0930165 (0.0486234)**	-0.0681054 (0.0543431)
medical dependence	0.0113379 (0.1058816)	-0.1564739 (0.0355772)*	-0.1449977 (0.0364584)*	-0.1506693 (0.0462719)*	-0.1500692 (0.040298)*
age_3	0.2850296 (0.4514604)	-0.0198907 (0.0047685)*	-0.0088934 (0.0085858)	-0.0616952 (0.0123623)*	-0.056285 (0.015334)*
age_4	0.200733 (0.4005769)	-0.071142 (0.0080653)*	-0.0457616 (0.0121122)*	-0.1466785 (0.0165768)*	-0.1117808 (0.0203816)*
male	0.4870313 (0.499867)	0.0074943 (0.0038335)**	0.011465 (0.0070544)	0.0172438 (0.0098683)**	0.01976 (0.0125758)
employed	0.4955464 (0.5000155)	0.0150094 (0.004336)*	0.0257532 (0.0090065)*	0.0314576 (0.0118699)*	0.0378817 (0.0136724)*
sickleaver	0.0303973 (0.17169)	-0.1626004 (0.0182438)*	-0.123644 (0.018586)*	-0.2195457 (0.0241619)*	-0.1773769 (0.0231895)*
unemployed	0.0282765 (0.1657735)	-0.0058499 (0.0112826)	-0.0023717 (0.0223212)	-0.021567 (0.030415)	0.0335035 (0.0419202)
long_unemp	0.0131097 (0.1137525)	-0.0034249 (0.0179105)	-0.0092935 (0.0248321)	-0.0205999 (0.0384993)	0.0397235 (0.0726717)

married	0.5977385 (0.4903888)	-0.0004674 (0.0040199)	-0.0154668 (0.0085615)**	-0.0165761 (0.0127482)	-0.023592 (0.0177283)
separated or divorced	0.0826855 (0.2754257)	-0.0265034 (0.009111)*	-0.0164572 (0.012586)	-0.0514665 (0.0181012)*	-0.0470354 (0.0219785)*
widow/er	0.0154064 (0.1231712)	-0.0069011 (0.0206204)	0.0072822 (0.0281095)	-0.0366841 (0.0403313)	-0.0136811 (0.0556878)
born in Spain but not in Catalonia	0.2649185 (0.4413211)	-0.0178157 (0.0048881)*	-0.0081211 (0.0071133)	-0.0413753 (0.0099844)*	-0.0215063 (0.0100481)*
Foreign	0.0345854 (0.1827402)	-0.0101281 (0.0080239)	-0.0162887 (0.0157197)	-0.0128189 (0.0231088)	-0.0484035 (0.0244994)*
high education	0.3725378 (0.483515)	0.0153535 (0.0036174)*	0.026491 (0.0076368)*	0.0350434 (0.0107842)*	0.0320122 (0.0132417)*
double insurance	0.2413988 (0.4279617)	0.0063648 (0.0041282)	-0.0088407 (0.0078539)	0.011804 (0.0110885)	0.0151999 (0.0132557)
good opinion	0.2850321 (0.4514634)	0.0069783 (0.0039135)**	0.0071182 (0.0070259)	0.0151001 (0.0097748)	0.0136967 (0.0107317)
bad opinion	0.0732726 (0.260603)	-0.0213309 (0.0072181)*	-0.0170609 (0.0108974)	-0.0537016 (0.0158782)*	-0.030744 (0.019378)
optimism	0.0118443 (0.1081929)	-0.2343104 (0.0169484)*	-0.1055652 (0.0156697)*	-0.3852534 (0.0261861)*	-0.2859431 (0.0246257)*
pessimism	0.0408911 (0.198052)	0.1465875 (0.0072723)*	0.1146458 (0.0184596)*	0.5000561 (0.042814)*	0.539655 (0.0411658)*
_cons	-	1.000709 (0.0050805)*	0.8105306 (0.0116171)*	1.366251 (0.0167818)*	1.167849 (0.0281636)*

N=7,094 for the dependent variable, which is censored at 1. The SCLS sample is reduced by trimming (N= 2,875). OLS and Tobit standard errors are robust to heteroskedasticity, and they were calculated by means of the asymptotic approximation. OLS1 employs the entire sample, and OLS2 uses only those values of the dependent variable different to one (N=2,283). The SCLS estimates of the standard errors are calculated by means of a bootstrap procedure based on 999 replications. * denotes the estimation is statistically significantly different from zero at a confidence level of 95%. ** at a confidence level of 90%. Standard errors in parentheses.

Table 9. Estimated cases in the total population in absolute values and as percentage of the total population 15 or more years old*.

	Cases in the 1994 population	Cases as percentage of the 1994 population	Cases in the 2002 population	Cases as percentage of the 2002 population
respiratory	1,015,063	19.6%	1,023,823	18.7%
vascular	1,018,536	19.7%	1,471,063	26.9%
muscular and articulator	1,557,613	30.2%	2,175,298	39.8%
ulcer	280,981	5.4%	272,801	5.0%
risks	1,201,726	23.3%	1,346,693	24.6%
depression	539,634	10.4%	691,723	12.7%
others	2,090,835	40.5%	2,116,682	38.7%
comorbidity	2,132,816	41.3%	2,483,585	45.4%
accident	703,360	13.6%	1,271,333	23.3%
hospitalization	421,527	8.2%	508,860	9.3%
medicaldiet	754,677	14.6%	598,022	10.9%
nomedicaldiet	42,487	0.8%	146,904	2.7%
sedentary	1,888,636	36.6%	2,562,059	46.9%
smoke	1,610,078	31.2%	1,614,027	29.5%
risky_drinker	149,193	2.9%	177,835	3.3%
blindness	163,262	3.2%	301,743	5.5%
deafness	135,452	2.6%	161,051	2.9%
dumbness	34,947	0.7%	52,233	1.0%
medical dependence	79,550	1.5%	60,477	1.1%
age_3	1,401,061	27.1%	1,414,160	25.9%
age_4	930,413	18.0%	991,249	18.1%
male	2,484,342	48.1%	2,513,525	46.0%
employed	2,148,846	41.6%	2,565,583	46.9%
sickleave	172,282	3.3%	171,707	3.1%
unemployed	275,540	5.3%	151,721	2.8%
long_unemp	185,009	3.6%	73,245	1.3%
married	3,029,179	58.6%	2,992,489	54.7%
separated or divorced	104,716	2.0%	435,381	8.0%
widow/er	384,672	7.4%	80,111	1.5%
born in Spain but not in Catalonia	1,707,776	33.1%	1,470,071	26.9%
foreign	86,129	1.7%	184,873	3.4%
high education	890,564	17.2%	2,027,700	37.1%
double insurance	1,083,168	21.0%	1,293,702	23.7%
good opinion	1,840,104	35.6%	1,335,607	24.4%
bad opinion	371,936	7.2%	366,941	6.7%
optimism	50,435	1.0%	63,732	1.2%
pessimism	388,207	7.5%	202,975	3.7%

* The total population of Catalonia 15 or more years old was 5,166,174 in 1994 and 5,467,149 in 2002.

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[i] The CHS has been used in previous studies on health economics (see, for instance, [Vera-Hernández (1999)]).

[ii] For a recent application of data based on the EQ-5D see [Kind, Hardman and Leese (2005)]. For a detailed explanation of the EuroQol system see [Brooks and EuroQol Group (1996)].

[iii] See [Gudex (1994a)] and [Gudex (1994b)], for a detailed description of the surveys based on these methods.

[iv] The TTO scale is the most frequently used, and often considered as the best alternative (see [Bleichrodt and Johannesson (1997)] and [Arnesen and Trommald (2005)]). See also [Bell et al (2001)] for an extensive catalogue of computed results.

[v] For this reason, [Dolan, Gudex, Kind and Williams (1996)], p. 153, guess that «in certain situations, it may be appropriate to weight more heavily the preferences of those most directly affected by an intervention or policy». However, in other contexts, as allocation of resources problems, the preferences of the general population could be the most adequate, because the perspective of the actual or past patients could be biased. A discussion of this topic can be found in [De Wit et al (2000)]. For instance, whether no problems are reported in the five dimensions of the EQ-5D the EuroQol number will be 11111. This number corresponds to a score of 1 using the two tariffs, meaning that the health status is the best possible. As has been said, this could not match the personal and subjective thermometer score or the health state self-valuation based on five possibilities.

[vi] We have discarded those cases in which contradictions have been detected. Firstly, those cases in which the value of the thermometer was equal to or near 100, or when the person answered that its state of health was excellent, and the VAS or TTO tariff indicates a negative value. Secondly, when the value of the thermometer was equal or near 0, or when the person answered that its state of health was very bad, and the VAS or TTO tariff indicates a value equal or close to one. When considering the VAS tariff, there are in the 2002 survey 9 observations with these characteristics (10 with tariff TTO) and in the survey of year 1994 there are 49 cases (51 with tariff TTO).

[vii] [Sen (1998)], p. 20, explains it briefly in this way: 'The morbidity information that is obtained from our own perceptions of illnesses and ailments is mediated through our positional understandings and interpretations'.

[viii] The EuroQol number 33233 is equivalent to -0.0161 and -0.48030 according to the VAS and the TTO tariffs respectively. Negative values shouldn't look so strange if we consider that pain and agony can be worse than dead–and Alighieri Dante would have agreed with this (see [Sen (1998)], p. 17). For an analysis on the negative utility of life, see [Sutherland et al (1982)].

[ix] This subject was analyzed in [Patrick et al (1994)], where other transformation was proposed, setting a lower bound of -1 (this solution was also applied by [Dolan et al (1996)], p. 146).

[x] Willingness to pay for a QALY depends of the particular resources of a person or country. The most commonly cited value for a QALY in Spain is 30,000 euros (see [(Sacristán, Oliva, del Llano, Prieto and Pinto (2002)]).

[xi] In many cases, OLS estimation is considered inadequate due to the censored nature of the data (see for example, [Dolan and Sutton (1997)] or [Clarke, Gray and Holman (2002)]), but other studies have shown that OLS estimations are quite robust even in those cases, despite the violation of the basic assumptions of the model, particularly the normality of the errors distribution (see [Bagust and Beale (2005)]). Tobit estimations are criticized as well, due to the same problem of violation of the normality assumption (see [Clarke, Gray and Holman (2002)], and [Vijverberg (1987)]). It is well known the sensitivity of the Tobit model to heteroskedasticity and non-normality ([Arabmazar and Schmidt (1981)], [Arabmazar and Schmidt (1982)], and [Vijverberg (1987)]), although heteroskedasticity appears to cause greater bias than non-normality (see the simulation of [Powell (1986)]). Tobit models robust to heteroskedasticity can be easily estimated.

[xii] This comparison has been made by [Austin (2002)] in the context of quality-of-life measures similar to those that we are employing. Additional estimation techniques were applied in that study, as the *median* regression and the *censored least absolute deviations* (CLAD) estimator, first proposed by [Powell (1984)]. The CLAD doesn't require homoskedasticity, normality or even symmetry (only needs zero median), which is an interesting property. The author finds that the median regression and CLAD have the highest predictive power between the models considered.

Nevertheless, the two methods–based on the minimization of the absolute deviations–yield strange results with our data, maybe due to the strong concentration of values equal to one in the dependent variable (more than 60% in 1994 and 2002). For this reason we have not used them.

[xiii] We observe an exception for males in all the dimensions at ages 16-24, while for females this only occurs in the *Anxiety/Depression* dimension. In the *Mobility* and *Self-Care* dimensions we see several exceptions as well, at 35-44 and 55-64 ages for males and at 45-55 and 65-74 ages for females.

[xiv] The comparison of subjective measures between different countries of periods of time must be considered with a grain of salt (see [Anh (2003)]). This question has to do with the 'positional objectivity' problem.

[xv] Those numbers were calculated for the TTO tariff and a discount rate of 3 per cent. For the VAS tariff the numbers are $12,288,451 millions for 1994 and $12,122,128 millions for 2002, which implies a little smaller decreasing. Whether we employ a 0 per cent discount rate the decreasing is greater, and smaller if the rate is 5 per cent. In any case, the stock of capital decreases between 1994 and 2002.

[xvi] The VAS scale only assigns negative values to four possible health states, compared with 91 health states with negative scores from the TTO scale. Besides, the TTO scale provides very low values for deteriorated health states–as low as -0.6533, which is a very low number for this variable– and very high scores for nearly perfect health states (as high as 0.9095). The VAS scores are more moderate, spread more uniformly in the 0 to 1 range, from -0.0757 (for the worse possible case, with severe problems in the 5 dimensions) to 0.7985 (for people with only moderate problems of anxiety or depression).

[xvii] The program for the SCLS command can be found at (http://elsa.berkeley.edu/~kenchay). When the null hypothesis is true, the number of replications can safely be small (see [Davidson and MacKinnon (2000)], p. 64). Put in another way, if the coefficient is not individually significant, additional replications will make it clearer. Therefore, we have compared the standard errors derived from the bootstrap procedure for 99, 199 and 499 replications, and the differences reported were negligible. Finally, we made 999 replications as a safe number. On the other hand, it is interesting to

note that Stata software surpasses the standard tests of accuracy, overcoming the problems of accuracy analyzed in [McCullough and Vinod (1999)].

[xviii] The Spanish residents in Catalonia not native-born show greater prevalence numbers for all of the diseases included in the model, the mean age is higher, the proportion of employed and unemployed people is smaller (but the proportion of sickleavers is greater), the proportion of people with high education is lower and the same can be said on people with double insurance. This holds for 1994 and 2002.

[xix] A recent study based on the Spanish *National Health Survey* shows that people with double insurance have a lower average age, better health state and higher levels of education. For additional details, see Rodríguez and Stoyanova (2004).

[xx] We have changed the position of the three false explicative variables three times, alternatively substituting three different strongly significant 'true' variables. We have estimated the two OLS models, the Tobit model and the SCLS, for 1994 and 2002. The detailed results of these variants of the original model are disposable from the authors by request.

[xxi] For instance, the TTO scale is the most frequently used, but [Bleichrodt and Johannesson (1997)], in an extensive survey on how these TTO scales are calculated in the literature, found problems and limitations. [Dolan, Gudex, Kind and Williams (1996)] present a more optimistic point of view, but they also recognize the existence of problems. There exist even more radical critiques to this tariff. For instance, [Arnesen and Norheim (2003)] conclude that «we find no justification for using the results of the TTO as quality of life weightings in the construction of QALYs». The visual analogue scale (VAS) is not free of critiques. [Nord (1991)] also concludes that «the VAS values should not be used directly as utility weights for life years».

[xxii] These problems were acknowledged by [Burström, Johannesson and Diderichsen (2003)], p. 652: «The estimations of the health state scores are crucial for the results. The validity of these results depends on the validity of the mapping of health questions in the ULF survey to the EQ-5D questions, and on the validity of the conversion of the health description to health state scores by the use of the UK EQ-5D index tariff». This doesn't necessarily invalidate the results of [Burström, Johannesson and Diderichsen (2003)]. For instance, [Bagust and Beale (2005)], p. 228, consider that

«replacing the UK model with a locally calibrated alternative will lead to changes to scores calculated for individuals, buy may have much less effect in aggregate».